Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

Conference synopsis: New technology in contact lens research

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Technological advances and modifications allow us to view the eye in fresh ways, leading to interesting and sometimes significant progress in our interpretation of ocular physiology and its interaction with contact lenses. We've combed through the 2013 archives of the meetings of the Association for Research in Vision and Ophthalmology (ARVO) and the American Association of Optometry (AAO) to share technology-related conference highlights with you.

Furthering our understanding of contact lens wear with the use of a Low-Humidity Environmental Exposure Chamber (ARVO, 2013)

Researchers at Inflammax Research Inc. and the Centre for Contact Lens Research at the University of Waterloo's School of Optometry and Vision Science collaborated to test the effects of contact lens wear on exposure to a Low Humidity Environmental Exposure Chamber (Inflamax Research Inc., Canada).

The chamber referenced in this work has been validated to maintain uniform low relative humidity (10±3%) and comfortable room temperatures that mimic natural arid outdoor/indoor environments, making it possible to accelerate the effects of lens wear, in effect simulating the conditions of a typical day of wear.

All three of the following descriptions reference a study in which ten symptomatic contact lens wearers spent 180 minutes in the chamber, wearing two different contact lenses (etafilcon A and narafilcon A), one on each eye. They were asked to prepare for the study by discontinuing lens wear and using lubricating drops two days before entering the study.

Fiona Soong and colleagues reported that spending time in the chamber worsened lens wettability significantly over time with both lenses, similar to values recorded after eight hours of lens wear in natural environments. Blink rate increased significantly from baseline for both lenses.

Piyush Patel and colleagues reported that corneal and conjunctival staining increased and tear break-up time decreased for both lenses.

Lyndon Jones and colleagues reported that upper and lower lid wiper epitheliopathy increased from baseline for both lenses and did not return to baseline levels 120 minutes after participants left the chamber, despite the use of lubricating eye drops.

All three of these abstracts reported that symptoms only escalated significantly with the narafilcon A lenses.

Use of confocal microscopy to investigate the effects of contact lens wear on the lid margin (AAO 2013)

Philip Morgan and colleagues from Eurolens Research at the University of Manchester used confocal microscopy (Heidelberg Retina Tomograph III Rostock with cornea module) to determine the impact of contact lens wear on the margin of the upper eyelid.

They examined the upper eyelid margin of ten non-lens wearers and ten contact lens wearers early in the morning (before lens wear) and late afternoon (after lens wear). At the afternoon exam, they noted small bright spots at the proximal edge of the lid margin, particularly in those wearing contact lenses with higher levels of surface friction.

Testing antimicrobial efficacy of lens care systems via confocal microscopy (ARVO 2013)

The presence of Achromobacter xylosoxidans (Ax) biofilms in contact lens cases can lead to microbial keratitis. David McCanna and colleagues at the Centre for Contact Lens Research, University of Waterloo School of Optometry and Vision Science used confocal microscopy to evaluate the efficacy of contact lens solutions against these bacteria by measuring damage to the membranes of Ax cells after exposure to cleaning regimens.

Ax biofilms were produced by incubating bacteria overnight before exposing them to various contact lens solutions for four hours. The team then stained the bacteria with dye, enabling them to count the number of damaged cell membranes. Results indicated that multiple solutions were able to cause some loss of membrane integrity, but a solution containing polyquaternium-1 and alexidine caused the greatest damage.

Use of confocal microscopy to investigate corneal epithelial changes resulting from contact lens wear (ARVO 2013)

Researchers at the University Hospitals Case Medical Center (Ohio) and Alcon Laboratories used confocal microscopy (ConfoScan 4, Nidek Technologies) to examine the microstructure of corneal epithelial cells in order to determine the effects of contact lens wear.

The team examined the central cornea of 218 patients wearing lotrafilcon A lenses on a daily wear basis, at baseline and after five months. Two masked observers analyzed basal cell density and morphological changes in the superficial epithelial cells.

Jessica Lee and colleagues reported that the use of a PHMB-preserved lens care system was associated with a significantly greater number of hyper-reflective cells at five months and corneal staining higher than grade 2. Subjects displaying solution-induced corneal staining in either eye were more likely to have at least one hyper-reflective cell in either eye.

Subjects who had substantial bioburden (on lenses, lids or case) did not have a significant number of hyper-reflective cells compared to those without bioburden, but the tests showed that the density of their basal epithelial cells decreased compared to baseline.

Christine Marchetti and colleagues reported that short tear break-up time was associated with a greater number of corneal immune cells, that a decrease in lid bioburden was associated with a decrease in peripheral total stromal reflectivity over five months, and that patients with substantial lens bioburden had a higher cell density at five months.

Examining in vitro tear film deposition via atomic force microscopy (AAO 2013)

Steven Cheung and colleagues from the Centre for Contact Lens Research at the University of Waterloo School of Optometry and Vision Science used atomic force microscopy to examine the in vitro deposition pattern of tear film constituents on silicone hydrogel contact lenses as well as the cleaning abilities of various lens care systems. They incubated lenses in an artificial tear solution before soaking them in a lens care system.

Atomic force microscopy revealed that the lenses attracted varying levels and patterns of surface deposits from the artificial tear solution: some had a height of 20nm while others grew to 130 nm; deposition on some lenses completely occluded the surface, while another lens yielded clusters of deposits as high as 80nm but left large regions with no deposits.

Care systems consistently cleaned the lens surface, leaving behind minimal traces of tear film constituents, although some solutions left behind distinct residues.

Slit lamp modification for image capture (AAO 2013)

To aid in investigating the fluorescein patterns of the post-lens tear film, Bo Tan and colleagues from the School of Optometry at the University of California Berkeley and Indiana University-Purdue University Indianapolis modified the optics of a slit lamp to eliminate corneal Purkinje image reflection and expand the illuminated area on the cornea.

This process involved instillation of 3μL of 7% fluorescein isothiocyanate-dextran onto the concave surface of contact lenses prior to insertion in the eyes of 12 subjects. Images were captured approximately every five minutes for one hour.

The intensity of the fluorescence was highest during the first five minutes and continued to decrease over time—at a relatively even rate with some lenses and at a decreasing rate over time with others. The decline in intensity was more gradual towards the centre of the lens, while the rate of decline was faster but more variable at the periphery.

A variation of fluorogram patterns was observed among the lenses suggesting different post-lens tear mixing rates.