10:00 AM 2 hours | Room 225 A-B
P-10 | **Papers: Contact Lens Basic Science**
Moderators: Noel A. Brennan, OD, PhD, FAAO, Nathan Efron, BScOptom, PhD, DSc, FAAO

10:00 AM. **OPTIMIZATION OF A NOVEL FLUORESCENT BASED LYSOZYME ACTIVITY ASSAY FOR CONTACT LENS STUDIES** (120052)
Alan Ng, BMSc, Miriam Heynen, MSc, Lakshman N. Subbaraman, MSc, PhD, FAAO, Lyndon W. Jones, PhD, FCOptom, FAAO, University of Waterloo, Centre for Contact Lens Research

RESULTS: A standard curve was generated by the Enzchek, ranging from 2ng-150ng and with a correlation coefficient (R2) of 0.99. The total active lysozyme quantified in the six lysozyme samples were not significantly different between the two assays ($p>0.05$). The coefficient of repeatability was calculated using the standard deviation of differences (SD) of the two assays, and was found to be 0.28. The sensitivity of the Enzchek was higher compared to the classical turbidity assay when quantifying 10ng or less active lysozyme. Following extraction and lyophilisation, the total active lysozyme recovered from each lens type was 95% or greater.
PURPOSE: To optimize a novel fluorescent based lysozyme activity assay to investigate the conformational state of lysozyme in solution and when extracted from contact lens materials.
METHODS: The fluorescent based lysozyme activity assay, Enzchek (Molecular Probes Inc, Eugene, OR) which utilizes fluorescently quenched Micrococcus lysodeikticus, was used to determine the total amount of active lysozyme in six differently concentrated lysozyme samples (2.0, 1.0, 0.5, 0.25, 0.125 and 0.01 mg/mL). The six differently concentrated lysozyme samples were further quantified using the Enzchek following extraction from different contact lens materials using 0.2% and 0.02% trifluroacetic acid/ acetonitrile (ACN/TFA) solvents and lyophilisation. All samples were also analyzed using the classical lysozyme turbidity assay to assess the accuracy of the Enzchek.
CONCLUSIONS: In comparison to the classical turbidity assay, the Enzchek is a very time efficient method, making it a favourable technique particularly when studying contact lens materials that deposit relatively low levels of lysozyme.

10:15 AM. **ASSOCIATIONS BETWEEN CORNEAL NERVE DENSITY, CORNEAL SENSITIVITY, AND TEAR SUBSTANCE P IN LENS WEARERS** (120722)
Isabelle Jalbert, OD, PhD, FAAO, Cecilia Chao, BOptom, MOptom, Fiona Stapleton, MCOptom, PhD, FAAO, Blanka Golebiowski, BOptom, PhD, University of New South Wales, School of Optometry and Vision Science

RESULTS: Twenty non-contact lens (7M:13F, age 31±5) and 22 contact lens wearers (7M:15F, age 30±5) completed this study. The mean OCI score was lower in NCL (28±5) than CL (33±2.5) ($p=0.03$) but was not associated with other indicators (all $p>0.05$). Central corneal nerve density correlated with the SP levels (r=0.36, $p=0.035$). Central corneal sensitivity correlated with central

nerve density (r=0.45, p=0.01) and SP levels (r=0.48, p=0.05) in contact lens wearers. Tear osmolarity was associated with NIBUT in non wearers (r=0.40,p=0.02). Central and mid temporal corneal nerve density, levels of SP and central corneal sensitivity showed no difference between groups (all p>0.05). Tear osmolarity was higher (298 ±5.5 vs 287 ±3.9mmol/L p=0.001) while NITBUT time was lower in contact lens wear compared with non-contact wear (9 ±1.7 vs 14±3s; p=0.01).
PURPOSE: To investigate the relationships between nerve density, corneal sensitivity, and tear neuropeptide, osmolarity and stability in contact lens and non lens wearers.
METHODS: A cross sectional, single visit investigator-masked pilot study was conducted. Assessments included the ocular comfort index (OCI), central and mid-peripheral corneal nerve density (HRT with Rostock Module), central corneal sensitivity (Cochet-Bonnet aesthesiometer), tear Substance P concentration (SP) (EIA kit), tear osmolarity (TearLab Corporation), and non-invasive tear breakup time (NITBUT, Keeler Tearscope). Statistics were conducted using Spearman correlations, T-test or Mann-Whitney U test.
CONCLUSIONS: This study demonstrated a relationship between nerve morphology (density), tear neuropeptide (SP), and corneal sensitivity in contact lens wearers but not in non wearers. The tear osmolarity was increased but NITBUT increased in non lens wearers. Taken together, these findings suggest that lens wear may induce sensory driven changes to the ocular surface.
ADDITIONAL COMMENTS: AOF Vistakon grant 2009

10:30 AM. **INCORPORATING HYDROXYPROPYL GUAR IN MODEL CONVENTIONAL AND SILICONE HYDROGEL CONTACT LENSES** (120449)
Lakshman N. Subbaraman, University of Waterloo, Centre for Contact Lens Research, Heather Sheardown, PhD, McMaster University Department of Chemical Engineering

RESULTS: Presence of HPG significantly decreased the CAs of both the HA- and non-HA containing materials (p<0.05). Materials with higher concentration of HPG (7% wt) showed significantly lower CAs than those with lower concentration (3% wt) (p<0.05). Incorporation of HPG did not have an effect on the OT when compared to the control. Presence of HPG did not significantly affect the lysozyme sorption on CH and SH lens materials (p>0.05). All the HA containing materials showed significantly lower CAs and reduced lysozyme sorption than non-HA containing materials (p<0.05).
PURPOSE: Hydroxypropyl Guar (HPG) is a non-ionic polymer that has been shown to be an effective component in artificial tear formulations (Ubels J, et al. J Toxicol Cutaneous Ocul Toxicol. 2002; 21(4)273-81). The purpose of this study was to incorporate HPG into model conventional hydrogel (CH) and silicone hydrogel (SH) contact lens materials and to determine the effect of HPG on surface characteristics and protein-sorption properties of these contact lenses.
METHODS: HPG solution was prepared by adding the polymer to water and the solution was allowed to hydrate for 2 h with mixing. The pH of the solution was adjusted to 7.4 and filtered. One model CH (poly(2-hydroxyethyl methacrylate) [pHEMA]) and two model SH (pHEMA,Methacryloxypropyltris(trimethylsiloxy)silane [pHEMA TRIS] and N,N-Dimethylacrylamide, TRIS [DMAA TRIS]) lens materials were prepared with

and without hyaluronic acid (HA) of molecular weight 35 or 132 kDa. HPG was incorporated into these materials at two different concentrations (3% and 7% by weight). Advancing water contact angle (CA), optical transparency (OT) and lysozyme sorption on these lens materials were investigated.
CONCLUSIONS: Incorporation of HPG improves the hydrophilicity in model contact lens materials without affecting the OT of the materials. SH materials that contain HPG and HA have tremendous potential as hydrophilic contact lens materials.
ADDITIONAL COMMENTS: Funding: NSERC 20/20 Network for the Development of Advanced Ophthalmic Materials

10:45 AM. **THE EFFECT OF TEAR GLYCANS ON ADHESION OF *PSEUDOMONAS AERUGINOSA*** (120136)
Mark Willcox, BSc(Hons), PhD, FAAO, Liisa Kautto, PhD, Terry Nguyen-Khuong, PhD, Zhenjun Zhao, PhD, University of New South Wales, School of Optometry and Vision Science, Nicki Packer, PhD, Macquarie University

RESULTS: 50 N-linked glycans and 9 O-linked glycans from human tear fluid glycoproteins were identified. Of the N-linked glycans, 67% were core-fucosylated, 33% were sialylated and 48% possessed a bisecting N-acetylglucosamine. The adhesion of the laboratory and cytotoxic strain, but not the invasive strain, was reduced after treatment of tears with neuraminidase and fucosidase ≥13% reduction). Incubation of all strains with mixed N-glycans released from tear glycoproteins reduced adhesion by 17-34% depending on the strain. Similarly, mixed O-glycans released from mucins inhibited adhesion by 19-46% depending on strain.
PURPOSE: The human tear film protects and lubricates the cornea and conjunctiva. The aim of this study was to investigate the role of the glycans from glycoproteins of the tear fluid on the adhesion of *P. aeruginosa*.
METHODS: The N- and O- linked glycans of the tear film glycoproteins from basal tears were characterised using PNGase F and beta-elimination to release the glycans, then separated and identified using porous graphitised carbon LC-ESI-MS/MS. Bacterial adhesion, and inhibition of adhesion, to tear fluid was measured by the binding of fluorescently labelled bacteria to PVDF-membrane micro-well plates coated with whole tears. Three different isolates of *P. aeruginosa* were used. The involvement of specific glycan ligands in the bacterial adherence was shown by a reduction in adherence to the tear fluid after treatment with different exo-glycosidases or by incubation in presence of released oligosaccharides.
CONCLUSIONS: There are many different glycan components in tears. *P. aeruginosa* can adhere to tear film glycoproteins via these glycan structures. These bacterial/glycan interactions may help defend the eye by acting as decoy receptors and prevent bacterial adhesion to epithelial cell surfaces.
ADDITIONAL COMMENTS: Supported by ARC grant DP1094624

11:00 AM. **REVISED ESTIMATE OF THE OXYGEN TRANSMISSIBILITY NEEDED TO PRODUCE SAME LEVEL OF OVERNIGHT CORNEAL SWELLING AS THAT WHICH OCCURS WHEN NO LENS IS WORN** (120676)

Brien A. Holden, PhD, DSc, FAAO, Brien Holden Vision Institute, Desmond Fonn, OD, MOptom, FAAO, University of Waterloo School of Optometry and Vision Science, Donna La Hood, BOptom, Brien Holden Vision Institute, Amir Moezzi, MSc, BOptom, Doris Richter, MASc, OD, University of Waterloo, Centre for Contact Lens Research

RESULTS: The weighted average overnight edema without lenses was 3.97% (peak to trough) and 3.2% when comparing the 22:00pm lens insertion timepoint and 7:00am readings. The relationship derived between ONCS and Dk/tav predicted that estimated Dk/tav values of 150 and 190 would produce 4.0% and 3.2% ONCS. A high correlation was found between lens induced ONCS and Dk/t average (R square = 0.87).
PURPOSE: To re-estimate the contact lens oxygen transmissibility (Dk/tav) that produces the same amount of overnight central corneal swelling (ONCS) as that which occurs when lenses are not worn.
METHODS: The results of 39 overnight corneal swelling studies involving 628 subjects conducted at the BHVI and the CCLR were pooled as the studies were conducted in the same manner with the same methods. Neophytes wore hydrogel and silicone hydrogel lens types overnight with oxygen transmissibilities (averaged over the central area of the lens, Dk/tav) ranging from 3 to 157barrer/cm. Fifty eight neophyte subjects in 2 studies had their ONCS measured without any lens wear. Both groups slept for approximately 8 hours. Central corneal thickness was measured using an optical pachometer in the evening (at lens insertion) and immediately on waking; and for the no lens wearing subjects, during the following day.
CONCLUSIONS: The availability of many more higher Dk lenses allows a better, and considerably higher, estimate of the Dk/tav required to produce the same level of ONCS as that occurring in non-lens wearing eyes than the 87 and 125 barrer/cm for 4.0% and 3.2% ONCS based on the work of Holden and Mertz in 1984.

11:15 AM. **OVERNIGHT CORNEAL SWELLING (ONCS) OF THE CONTRALATERAL NON-LENS WEARING EYE IS AFFECTED BY THE AMOUNT OF ONCS IN THE LENS WEARING EYE** (120732)
Desmond Fonn, OD, MOptom, FAAO, University of Waterloo, Centre for Contact Lens Research, Brien A Holden, PhD, DSc, FAAO, Brien Holden Vision Institute, Amir Moezzi, MSc, OD, University of Waterloo, Centre for Contact Lens Research, Percy Lazon de la Jara, BOptom, PhD, Donna La Hood, BOptom, Brien Holden Vision Institute

RESULTS: All lens wearing eyes swelled significantly more than the control eyes ($p<0.05$) regardless of Dk/t. A high correlation was found between the corneal swelling of the lens wearing eyes and the contralateral controls for ONCS values less than 9.0% (R2=0.9185). The ONCS results for 61 subjects wearing etafilcon lenses at 9.2% were uncharacteristically low at 2.6% in the non-lens wearing eye and when included reduced the R2 value to 0.4616.
PURPOSE: To determine if there is a relationship in contralateral studies between the corneal swelling of a non-wearing eye and that of the lens wearing eye.
METHODS: Data from all of the ONCS studies that were conducted at the CCLR in which neophyte subjects wore a lens on only one eye and the other eye was used as the control were used. The central Dk/t of the soft lenses varied from (16 - 215 barrer/cm).

Central corneal thickness was measured using an optical pachometer before lens insertion and immediately on waking following 8 hours of sleep. The control eyes were measured at the same time points.
CONCLUSIONS: The result of this analysis indicates that there is a yoked effect; with higher lens ONCS being associated with higher ONCS in the non lens wearing eye. Caution, therefore, must be exercised when conducting any contralateral ONCS study. Possible mechanisms for this contralateral effect include neurological, chemical or osmotic interactions. It does seem strange that some very high Dk/t lenses appear to be associated with a lower than normal (3.2%) contralateral non-lens ONCS.

11:30 AM. **ENTIRE THICKNESS PROFILES OF THE EPITHELIUM AND CONTACT LENS IMAGED WITH HIGH SPEED AND HIGH RESOLUTION OPTICAL COHERENCE TOMOGRAPHY** (120168)
Aizhu Tao, MD, Jianhua Wang, MD, PhD, FAAO, Yilei Shao, Bascom Palmer Eye Institute, Yufeng Ye, Bascom Palmer Eye Institute, Meixiao Shen, School of Ophthalmology and Optometry Wenzhou Medical College

RESULTS: The full range of epithelium, ocular surface and contact lens were clearly visualized. The epithelial thickness (ET) at the center zone of 0.3 mm was 51.9 ± 2.7 μm, it remained constant for about 7 mm range and then increased at both temporal and nasal periphery. The overall coefficient of repeatability (CoR) of ET was 7.9 ±5.8 μm. The total corneal thickness (CT) increased gradually for the center to the periphery. The CoR of CT at the center was 8.7 μm and at the periphery was 49.3 μm, respectively. The contact lens profile showed the thinnest point at the center with thickness of 115.3 ± 4.8 μm. The thickness increased towards to the mid-periphery then decreased at the edge. Overall CoR was 19.6 ± 16.5 μm.
PURPOSE: To test the feasibility of imaging the entire thickness profiles of the epithelium and contact lens in vivo, using high speed and high resolution spectral domain optical coherence tomography (SD-OCT).
METHODS: A custom-built SD-OCT was developed based on CMOS (Basler sprint spL4096-140k; Basler AG, Germany) based spectrometer and run at the speed of 70,000 A-lines per second. The light source was 840 nm with 50 nm bandwidth and axial resolution was about 7.0 μm in tissue. The scan width was up to 18 mm and scan depth was set to 5.2 mm. Five eyes of 5 subjects (age: 34.8 ± 8.9 years) were imaged twice across the horizontal meridian before and after wearing one contact lens (CL: PureVision, BC 8.3mm, -3.00D) for 5 minutes. Semi-automatical measurement was done to yield the entire thickness profiles of the epithelium, total cornea, and contact lens after correcting optical distortion.
CONCLUSIONS: This pilot study demonstrated the feasibility using high speed CMOS based OCT to evaluate the entire thickness profiles of the epithelium and contact lens, and their interaction in vivo. Further development will be needed to extend the scanning from 2D to 3D with robust automatic image process.
ADDITIONAL COMMENTS: Supported by NIH R21EY021012, NIH Center Grant P30 EY014801 and RPB.

11:45 AM. **CORNEAL SENSITIVITY AND NERVE MORPHOLOGY IN ORTHOKERATOLOGY** (120260)

Edward Lum, BOptom, The Australian Research Council Linkage Project Scheme, Blanka Golebiowski, BOptom, PhD, Helen A. Swarbrick, PhD, FAAO, University of New South Wales, School of Optometry and Vision Science

RESULTS: There was a significant difference in sensation thresholds between the two groups using the COBO instrument ($p<0.001$). Central threshold was significantly higher in OK (0.69 +/- 0.42 g/sq.mm) than NL (0.44 +/- 0.12 g/sq.mm; $p=0.04$). Mid-peripheral threshold was not different between the two groups (OK: 0.41 +/- 0.10 g/sq.mm, NL: 0.47 +/- 0.29 g/sq.mm; $p>0.05$). There was a significant difference in NFD between the two groups ($p=0.02$). Central NFD was significantly less in OK (17.895 +/- 4.422 mm/sq.mm) than NL (25.867 +/- 5.003 mm/sq.mm; $p=0.001$). Mid-peripheral NFD was not different between the two groups (OK: 22.972 +/- 5.025 mm/sq.mm, NL: 23.569 +/- 4.945 mm/sq.mm; $p>0.05$). There was no difference in sensation thresholds between the two groups using the NCCA instrument ($p>0.05$)

PURPOSE: To investigate changes in corneal sensitivity and nerve morphology in orthokeratology contact lens wear

METHODS: In a cross-sectional study, 36 subjects (aged 18-44 yrs) were grouped into two categories: overnight orthokeratology (OK, n=18) and non-lens wearers (NL, n=18). Corneal sensitivity was measured at the corneal apex and 2.5 mm temporal to the apex using the Cochet-Bonnet (COBO) and Non-Contact Corneal aesthesiometers (NCCA). Corneal nerve morphology was assessed by sampling a 1x1mm area of the sub-basal nerve plexus using the Heidelberg Retinal Tomograph with Rostock Corneal Module at the corneal apex and the temporal mid-periphery 2.5 mm from the apex. Nerve fiber density (NFD) was calculated by measuring the total length of nerve fibers per sq.mm using Image Pro Analyser. Comparisons between groups were made using mixed ANOVA and post hoc paired t-tests with Bonferroni correction, or the Kruskal-Wallis test and post hoc Mann-Whitney U tests as appropriate

CONCLUSIONS: The decrease in sub-basal corneal nerve fiber density in OK lens wear is associated with decreased central corneal sensitivity. The mechanism underlying refractive change during OK treatment appears to impact both corneal sensitivity and nerve morphology

ADDITIONAL COMMENTS: Funded through the Australian Research Council Linkage Scheme