10:00 AM 2 hours | Room 225 A-B
P-06 | **Papers: Contact Lenses & Dry Eye**
Moderators: Mark Willcox, BSc, PhD, FAAO, Jason J. Nichols, OD, MPH, PhD, FAAO, Diplomate, Cornea, Contact Lenses & Refractive Technologies and Public Health

10:00 AM. **IS TEAR FILM OSMOLARITY INFUENCED BY AGE, GENDER, ETHNICITY OR CONTACT LENS WEAR?** (120709)
Fiona Stapleton, MCOptom, PhD, FAAO, Blanka Golebiowski, Isabelle Jalbert, University of New South Wales, School of Optometry and Vision Science

RESULTS: Mean tear osmolarity for all subjects was 294.4±10.6 mOsmol/L (range 278-327). 10% of subjects had osmolarity above 308 mOsmol/L indicative of possible dry eye. There were no significant differences in osmolarity between CL wearers and non-wearers (CL wearers 293.2±10.1, non-wearers 295.3?10.9), between males and females (M 293.9±10.2, F 294.6±10.8), nor between Asian and non-Asian subjects (A 293.5±10.5, nA 294.4±10.3). No association was evident between age and osmolarity (r=-0.08). No difference was found between right and left eye osmolarity measurements. There was no significant association between osmolarity and ocular symptoms using the OCI (r=0.18) or OSDI (r=0.20).
PURPOSE: To investigate the influence of age, gender, ethnicity and contact lens wear on tear film osmolarity and examine the relationship with ocular symptoms in normal subjects.
METHODS: A pooled analysis of 221 normal subjects, including 98 contact lens wearers. Subject characteristics: age 18-94 years (39±21 yrs), 67% female, 42% Asian and 58% non-Asian. Osmolarity was measured on eye (TearLab Corporation) and subjective symptoms were assessed using Ocular Comfort Index (OCI) and Ocular Surface Disease Index (OSDI). Comparisons between groups made using Independent Samples and paired t-test, Mann-Whitney U test or Pearson Chi-square; Spearman's rho was used to examine associations. Significance determined at 95% confidence level.
CONCLUSIONS: Osmolarity is a robust and independent measure of tear film homeostasis, which is not influenced by age, gender, ethnicity or contact lens wear in a convenience sample. Osmolarity is not associated with dryness and discomfort symptoms in normal subjects.
ADDITIONAL COMMENTS: Acknowledgements: The authors would like to acknowledge the AOF ? Vistakon Research Grant, TearLab Corporation and Blackmores Ltd for funding and Moneisha Gokhale, Cecilia Chao, Jenny Cheng, Katrina Chim, Jennifer Ng, Mei Shao, Jennifer So and Daniel Wong for assistance with data collection.

10:15 AM. **QUANTIFICATION OF SOFT CONTACT LENS OPTICAL AND PARAMETER CHANGES DURING DEHYDRATION** (120497)
Pete S. Kollbaum, OD, PhD, FAAO, Indiana University School of Optometry, D. Robert Iskander, Institute of Biomedical Engineering and Instrumentation, Meredith E. Jansen, OD, MS, FAAO, Ryan McGiffen, BS, Indiana University School of Optometry

RESULTS: High-resolution retro-illumination and axial imaging demonstrate areas of lens dehydration and measureable lens surface shape, thickness, and diameter changes, which correlate with the observed optical path length changes. Although the changes vary with lens material, nominal thickness, and power (-9 D to +5 D in 2 D steps), optical path length changes of up to 12 microns may occur for some lenses for short-term air exposures of under 1-2 minutes, and these optical path length changes could significantly influence the optical properties of the eye-lens system.
PURPOSE: Soft contact lenses (SCL) now have the potential to increase or decrease the aberrations of the eye + lens system in a controlled design manner. However, how the lens conforms to the eye may impact the resultant optics and vision. Because a SCL dehydrates, the shape of the lens may continue to change further. The purpose of the study was to investigate the feasibility of a novel methodology to quantify dehydration-related SCL shape changes.
METHODS: High resolution, ex-vivo, Shack-Hartmann wavefront technology was utilized to capture the real-time relative changes in optical path length (6mm analysis diameter) which occur as SCLs dehydrated for periods up to 30 minutes. Lenses were positioned on both a plane glass plate and a model eye, which approximated the cornea shape. Optical path length data was used to develop a computational model of the underlying morphological changes in SCL shape and refractive index caused by lens bulk and surface dehydration.
CONCLUSIONS: The novel methodology described appears feasible in describing and quantifying SCL dehydration-related changes.
ADDITIONAL COMMENTS: Project partially funded by Bausch and Lomb.

10:30 AM. **LIMBAL CAPILLARY PERFUSION AND VELOCITY OF BLOOD FLOW UNDERNEATH SOFT CONTACT LENS** (120419)
Jianhua Wang, MD, PhD, FAAO, Yufeng Ye, Hong Jiang, Delia Cabrera DeBuc, Aizhu Tao, Bascom Palmer Eye Institute
RESULTS: The nCPMs showed capillaries in exquisite detail with and without CL in situ. The blood flow velocities in the temporal conjunctiva without and with CL were 0.86 ± 0.08 mm/s(mean &plusmn SD) and 0.99 ± 0.11 mm/s, respectively (p=0.09). No significant differences were found between conjunctival limbal and bulbar zones with and without CL.
PURPOSE: Conjunctival tissue compression and distortion at the limbal region due to contact lens wear have been documented. The goal was to develop sensitive biomarkers to quantitatively evaluate the interaction between the lens and ocular surface by imaging limbal capillary perfusion and velocity of blood flow.
METHODS: A retinal function imager (RFI, Optical Imaging Ltd, Rehovot, Israel) was adapted from the retinal imaging to anterior surface imaging. Hemoglobin in red blood cells was used as an intrinsic motion-contrast agent in the generation of detailed noninvasive capillary-perfusion maps (nCPMs) and the calculation of the velocity of blood blow. Five health subjects (3 males and 2 females, age 36.4 ± 8.4 years) were recruited. The temporal conjunctivas of right eye were imaged and repeated after wearing a contact lens (CL) for 5 minutes. The blood flow velocities were measured at about twenty vessel segments.
CONCLUSIONS: For the first time, this pilot study demonstrated that optical imaging

using RFI is feasible to image high resolution of nCPM and blood flow velocity on the limbus underneath soft contact lenses. Although significant differences in velocity were not found in the small sample size, the trend of increased velocity may indicate the compromise of microcirculation underneath CL, resulting from possible localized pressure underneath the lens. Future studies with a larger sample size and a variety of lenses for an extended wearing period may further validate the biomarkers for ocular integrity during lens wear. The method may shed light into CL-induced corneal neovascularization and conjunctival hyperemia.
ADDITIONAL COMMENTS: Supported by NIH R21EY021012, R01EY020607, R01EY020607S, P30 EY014801 and RPB.

10:45 AM. **IN-VIVO PRE-LENS TEAR FILM COVERAGE IN CONTACT LENS-RELATED DRY EYE** (120530)
Padmapriya Ramamoorthy, BSOptom, PhD, FAAO, Houston, TX, Jason J. Nichols, OD, PhD, FAAO, University of Houston, College of Optometry

RESULTS: Average pre-lens tear film coverage immediately post-blink, 5s post-blink, 10s post-blink were 97.1 ? 8.0, 83.8 ? 17.0 and 68.1 ? 23.9 in the normal group. Values in the CLDE group were 84.9 ? 19.0, 58.9 ? 28.5 and 41.1 ? 27.8. Repeated measures two way ANOVA was used to assess differences over time and by subject group revealing a significant effect ($p < 0.0001$); however, there was also a significant interaction between CLDE and pre-lens tear film coverage ($p = 0.001$). Pre-lens tear film coverage was found to be significantly lower in the CLDE group at all time points using t-test calculations (all $p<0.0001$).
PURPOSE: To quantify and assess differences in in-vivo pre-lens tear film coverage between normal soft contact lens wearers and those with contact lens dry eye (CLDE).
METHODS: This was a cross-sectional study including 100 experienced daily wear, soft contact lens wearers (50 normal and 50 with CLDE). Eligible subjects were classified into normal/ CLDE groups based on Contact Lens and Dry Eye Questionnaire (CLDEQ), tear break up time (TBUT, normal $\geq$ 7 seconds, CLDE < 7 seconds) and difference between total and comfortable daily lens wear hours (normal < 2, CLDE $\geq$ 2). Twenty second video recordings of the pre-lens tear film were obtained from both eyes using a custom-built imaging interferometer. Percentage in-vivo pre-lens tear film coverage was estimated at the following time points: immediately post blink, 5s post blink, 10s post blink and at the end of the recording (~18s post blink). Values were averaged between the two eyes for each subject. Repeated measures two way ANOVA and t-tests were used for statistical analysis.
CONCLUSIONS: In-vivo pre-lens tear film coverage is significantly reduced in CLDE. These findings concur with previous reports on rapid pre-lens tear film thinning in CLDE. The causes for poor pre-lens tear film coverage in CLDE are likely to be multifactorial and highlight the need for treatment measures to improve pre-lens tear film stability and impede evaporation/dewetting in CLDE patients.
ADDITIONAL COMMENTS: AOF Ezell Fellowship 2010-2011 (PR)

11:00 AM. **CHANGE IN THE 8-ITEM CONTACT LENS DRY EYE QUESTIONNAIRE (CLDEQ-8) BEFORE AND AFTER REFITTING WITH SILICONE HYDROGEL DAILY DISPOSABLE CONTACT LENSES** (120966)
Robin L. Chalmers, OD, FAAO, Atlanta, GA, Sheila B. Hickson-Curran, BSC, (Hons), MCOptom, FAAO, Vistakon, Lisa Keay, BOptom, PhD, MPH, The George Institute for International Health, William Gleason, OD, Roger Albright, MBA, Foresight Regulatory Strategies Inc.

RESULTS: Of the 436 registered wearers (67% female, mean age 34 (13) yrs, range 9 to 76 yrs), 34% entered the study wearing hydrogel DDs. Mean CLDEQ-8 score was 12.8 (SD 7.1) at baseline and 8.4 (SD 5.6) at 2 weeks, similar to Very Good/Good and Excellent/Very Good ratings in benchmark datasets. The largest effect occurred in intensity of discomfort at the end of the wearing time (-0.89 ? 1.44, p<0.0001), with 58% reporting improvement, 27% unchanged and 14% worsening. Frequency of discomfort improved for 57% and worsened for 10% (-0.73 ? 1.06, p<0.0001). Late-day intensity of dryness (-0.65 (SD 1.38), p<0.0001) and blurry, changeable vision (-0.65 (SD 1.62), p<0.0001) were the next most responsive symptoms.
PURPOSE: To describe soft contact lens (SCL) wearers? responses to the 8 item Contact Lens Dry Eye Questionnaire (CLDEQ-8) in a large registry of patients recently fit with daily disposable (DD) SCLs.
METHODS: Registered wearers who entered the 1-DAY ACUVUER TruEyeTM and 1-DAY ACUVUER MoistR Performance Overview (TEMPO) Registry (#NCT01467557) as habitual SCL wearers, had recently been fit with narafilcon B lenses (1-DAY ACUVUER TruEyeTM) and 2-week surveys were analyzed. Recall of symptoms with habitual SCLs and recently prescribed DD SCLs were captured via electronic administration of the validated CLDEQ-8 symptom questionnaire as part of a larger survey. Change in response was tested with Wilcoxon Signed Rank test with significance at p<0.01. Maximum CLDEQ-8 score is 35, and change per item is shown (scale 0 to 4 or 5).
CONCLUSIONS: Unselected habitual SCL wearers reported significant improvement in symptoms of discomfort, dryness, and blurry, changeable vision 2 weeks after being refit with narafilcon B lenses in this US post-market registry of DD SCLs. Reduction of SCL-related symptoms may be an important benefit of silicone hydrogel DD lenses.
ADDITIONAL COMMENTS: This study was designed by the study team and supported by Johnson & Johnson Vision Care, Inc.

11:15 AM. **DAILY DISPOSABLE CONTACT LENSES: A POTENTIAL OPTION FOR "PROBLEM" REUSABLE LENS WEARERS** (120371)
Michael Spyridon, Sheila B. Hickson-Curran, BSc, (Hons), MCOptom, FAAO, Vistakon, Graeme Young, MPhil, PhD, FAAO, Visioncare Research Ltd

RESULTS: Part I: 42% (154/364) of the reusable CL wearers were classified as "problem" patients, and 75% of them reported reduced CWT, 43.5% dryness and 10.7% irritation. Problematic conjunctival injection or corneal staining was observed in approximately 10% of patients. Part II: The prevalence of dryness and reduced CWT were decreased from 51.9% to 33.2% (P=0.001) and from 88.6% to 47.2% (P=0.041),

respectively, with DD-CLs, while no significant differences were noticed in irritation, conjunctival injection or corneal staining. Following refitting, higher proportions of patients reported symptoms with nelA than etA CLs: dryness (44.5% vs. 31.7%, P=0.052), irritation (21.9% vs. 11.7%, P=0.05), reduced CWT (55.4% vs. 37.3%, P=0.04). The prevalence of conjunctival injection was also significantly higher in the nelA group (10.9% vs.1.8%, P=0.003), while corneal staining although trended higher in nelA-fitted patients, the difference between the two materials did not reach significance (17.1% vs. 9.34, P>0.05).
PURPOSE: To estimate the prevalence of "problem" reusable contact lens (CL) wearers and examine the effect of fitting them with daily disposable (DD) lenses.
METHODS: Part I: 364 reusable CL wearers with no evidence of ocular abnormality were included in this analysis. Patients with frequent or constant dryness or irritation, reduced comfortable wearing time (CWT), ≥ grade 2 of conjunctival injection (0-4 scale), or ≥ grade 3 corneal staining (0-15), were regarded as "problem". Part II: 235 "problem" patients were fitted with etafilcon A (etaA) (n=107) or nelfilcon A (nelA) (n=128) DD-CLs and reassessed 1 week later. The "problem" population included 154 patients identified in Part I and 81 patients with objective signs of dry eye recruited in separate trials.
CONCLUSIONS: Symptoms experienced by reusable soft CL wearers could be alleviated with daily disposable CLs, while the lens material plays also a key role.
ADDITIONAL COMMENTS: The authors are grateful to Vistakon for funding this project.

11:30 AM. **WHY DO SOME CONTACT LENS WEARERS AVOID CONTACT LENS DRY EYE SYMPTOMS?** (120286)
Alan Tomlinson, MSc, PhD, FAAO, Raied Fagehi, BSc, Velitchko Manahilov, PhD, Glasgow Caledonian University, School of Health and Life Sciences

RESULTS: Tear evaporation rate was raised from normal levels in both groups (38.70 +/- 11.42 and 38.78 +/- 8.71 g/m2/h for symptomatic and asymptomatic patients respectively) and osmolarity showed no change (307.42 +/- 6.97 and 303.33 +/- 9.74 mOsmol/L). Tear turnover was normal in symptomatic but significantly higher in asymptomatic subjects (20.78 +/_ 6.86 and 33.83 +/- 8.81 %/min). Measures of lens wetting, namely OL, DD and PL were significantly higher in symptomatic than asymptomatic wearers (OL- 22.35 +/- 16.78 and 10.63 +/- 2.21 secs; DD - 36.05 +/- 19.74 and 25.23 +/-7.53 secs; PL - 30.08 +/- 25.45 and 14.86 +/- 4.34 secs) but MS was similar.
PURPOSE: To assess the differences in tear physiology and in-vivo lens wettability in patients who were symptomatic and asymptomatic in contact lens wear. This was an attempt to define the factors which lead to complaints of contact lens dry eye (CLDE).
METHODS: Seven symptomatic contact lens wearers were identified from 9 asymptomatic patients by the OSDI questionnaire, by a score of > 10. Tear turnover rate TTR (by scanning fluorophotometry) and evaporation rate (by vapor pressure evaporimetry) were measured together with osmolarity (by freezing point depression osmometry) following lens wear. The wettability of the lens surfaces in -vivo were assessed by thin film interferometry (Doane interferometer) by onset latency (OL-the

time until the first dry spot appeared), the drying duration (DD- time after OL until the lens surface became completely dry), maximum speed of drying (MS - the peak velocity of the increase in dry area), and peak latency (PL- time until maximum speed was achieved).
CONCLUSIONS: The increased tear turnover rate in asymptomatic contact lens wearers could account for the absence of symptoms in this group despite the increased evaporation which should predispose them to an evaporative dry eye state. The better wetting shown by lenses worn by the symptomatic patients did not appear to provide enough benefit to offset the loss of tear fluid through evaporation (in the presence of normal tear turnover).

11:45 AM. **CAN OMEGA 3 SUPPLEMENTS IMPROVE OCULAR COMFORT DURING CONTACT LENS WEAR?** (120703)
Percy Lazon de la Jara, PhD, Jennie Diec, BOptom(Hons), Brien Holden Vision Institute, Mark Duncan Perry Willcox, BSc(Hons), PhD, FAAO, University of New South Wales, School of Optometry and Vision Science, Brien A. Holden, BAppSc, PhD, FAAO, Brien Holden Vision Institute

RESULTS: Omega-3 significantly improved ($p<0.001$) ocular comfort with or without CLs at AM by 4.5?7.9 and 4.3?13.6, respectively and improved PM by 4.6?12.2 and 5.7?13.9, respectively. No differences in AM comfort ratings were found with and without CL wear irrespective of Omega-3 consumption ($p> 0.05$). CL wear significantly decreased ($p=0.001$) the ratings (9?13) at PM, compared to no CL wear (4?10), regardless of whether Omega-3 was taken. Symptomatic patients who showed a comfort rating decrease of ≥ 10 units without CL wear have significant improvement in diurnal variation of 10?9 units in comfort rating without CL wear after Omega-3 consumption, however no effect was found in the comfort change towards the end of the day during CL wear (2?13, $p=0.596$).
PURPOSE: To determine the effect of Omega-3 supplements on ocular comfort with and without contact lenses (CL).
METHODS: Forty five participants rated their ocular comfort (on a 1-100 visual analogue [VAS] scale) over 10 days of no CL wear and 10 days of CL wear, in the morning (AM) and evening (PM). Following this, omega 3 supplements were taken for 6 weeks and subjective ratings were repeated during no CL wear and CL wear (10 days each), whilst still taking supplements. Ratings during CL wear were taken prior to insertion and prior to removal. Comparisons between no CL wear and CL wear, with and without supplements were made using linear mixed models and summarised as mean ? SD.
CONCLUSIONS: The decline in ocular comfort was greatest in magnitude with CL wear. Omega-3 supplements aided in increasing the ratings at AM and PM, but did not have an effect in the magnitude of change from morning to evening.