



Free Paper Abstracts

## Free Papers; Speciality

### Ways to use image analysis software to evaluate the peripheral fitting of scleral contact lenses

Giancarlo Montani

The purpose of this pilot study was to evaluate the potential utility of an image analysis software to evaluate the peripheral fitting of a scleral contact lens.

Twelve eyes with healthy corneas were recruited for the study and a scleral lens design with the possibility to modify the landing zone (SLC Conica, Medlac, Avellino, IT) was used for the measurements. Three lenses with different peripheral design were fitted to obtain an apical clearance of 250  $\mu\text{m}$  with an OAD of 16,80 mm after their settling time. The differences of landing zone behaviour were obtained changing the peripheral angles to control the level of peripheral contact lens bearing/compression. The landing behaviour of the lenses fitted were acquired in different four sections (Nasal, Temporal, Superior and Inferior) with two-dimensional cross-sectional images obtained with an OCT system (Revo NX, Optopol Technology SA, Zawiercie, PL) and with digital slit lamp images. The slit lamp images were subsequently analysed using an image analysis software (AOS Anterior, London, UK) using the "bulbar redness" function in different areas of conjunctiva to evaluate possible blanching of the conjunctival vessels induced by compression of landing zone.

From our results we found a very high correlation between the areas ( $r = 0.914$ ) and depth ( $r = 0.981$ ) of compression induced by different peripheral design as evaluated using the OCT information and the blanching of the conjunctival vessels as evaluated using the image analysis.

In conclusion the objective evaluation of bulbar redness function obtained using an ocular surface and image enhancement software can be an effective support for a better and objective evaluation of the behavior of scleral contact lens periphery on conjunctival tissue without OCT uses.

Giancarlo Montani Optometrist FIACLE, FBCLA is Professor of Clinical Contact Lens Application at the University of Salento, Italy. Involved in Optometry education since 1988, he has been Department Head of the Contact Lens Division at the Santa Chiara University Medical Centre in Pisa, Italy until 2004. In 2007 Professor Giancarlo Montani has co-founded the Centre for contact lens research of the University of Salento. Giancarlo Montani also works in private practice. He has published numerous articles in optometric journals, and has been invited as lecturer to several national and international Optometry Congresses. BCLA



## Free Paper Abstracts

### **Scleral lenses reduce the need for corneal transplants after hydrops.**

Carina Koppen

To investigate the success and failure of scleral lens fitting for keratoconus with resolved hydrops. Retrospective case series of patients with keratoconus who attended the Ophthalmology Department at Antwerp University Hospital, Belgium and developed acute hydrops between January 1, 2015 and June 30, 2018. The exclusion criteria included amblyopia, mental retardation and insufficient follow-up.

: Of the 25 keratoconus patients with acute hydrops, 14 patients (16 eyes) were included in this study. Median age was 31 years (range 19-52). Prior to hydrops, median maximal keratometry values of affected eyes was 81.3D (range 66.3-108.3). The acute hydrops was managed medically in 5 eyes (31.3%), by observation in 5 (31.3%), with application of bandage contact lens in 1 (6.3%) and compression corneal sutures in 5 (31.3%). Contact lens fitting following hydrops was unnecessary for 2 patients (2 eyes; 12.5%) due to excellent vision in the fellow eye. Of the remaining patients, 11 (68.8%) were successfully fitted with mini-scleral lenses with a median visual acuity of 0.7 (0.5-0.9; decimal Snellen). Three patients (3 eyes; 18.8%) proceeded to graft surgery due to limited visual acuity with scleral lenses (n=2) or persistent edema (n=1).

Scleral contact lenses are effective at providing satisfactory visual acuity following corneal hydrops in keratoconus. Contact lens trial with scleral lenses is advised prior to listing patients for graft surgery. Ophthalmologist with subspecialty in cornea, ocular surface diseases and contact lenses working in a university hospital.



## Free Paper Abstracts

### **Anterior best fit sphere – Is it a better starting point to fit rigid gas permeable contact lens in penetrating keratoplasty eyes? – A clinical observation**

Faiza Bhombal

**Purpose:** Rigid gas permeable (RGP) contact lens fitting after penetrating keratoplasty (PK) is challenging due to significant irregular astigmatism. The aim of the study was to identify a corneal topography parameter for predicting the initial base curve (BC) of RGP contact lens in post PK eyes. **Methods:** The data of patients who had tricurve RGP contact lens fitting post PK were collected retrospectively. Following data were collected: Visual acuity (VA) with glasses and contact lenses; Final BC and diameter of the dispensed contact lens; corneal topography parameters which included steep keratometry value (K), flat-K, mean-K, corneal astigmatism and anterior Best Fit Sphere (BFS) measured using Scheimpflug imaging.

**Results:** The median age of the 40 subjects (46 eyes) who met the inclusion criteria was 37.5 years (IQR 26.7 - 45.5). The spherical equivalent was  $-3.00$  diopter (D) ( $-8.31$  to  $-1.56$ ). The median steep-K, flat-K and average K in them were 6.76 mm (6.28-7.07), 7.78 mm (7.37-8.14) and 7.26 mm (6.93-7.46), respectively. The median anterior BFS value of the transplanted cornea was 6.96 mm (6.60-7.37). The median corneal astigmatism from Scheimpflug imaging was  $-2.2$  D ( $-6.82$  to  $5.67$ ). The median BC of final RGP lens was 7.0 mm (6.70-7.23) and the median diameter was 9.80 mm (9.40-10.40). On comparison of final base curve with parameters of Scheimpflug imaging and corneal astigmatism BFS was showing the least difference with the final base curve.

**Conclusion:** The anterior BFS value can be used as a reference in selecting the initial base curve of tricurve RGP contact lens which may reduce chair time of patients after PK.

Ms. Faiza Bhombal completed her Bachelor's degree in Optometry from Aditya Jyot Institute of Optometry, Mumbai. After working as a Consultant Optometrist at Krishna Eye centre, Mumbai for one year, she did her 2 years residency program in Contact Lenses at LVPEI Hyderabad. Currently she is working as a Contact Lens Consultant at Bausch and Lomb Contact Lens Centre at LVPEI. Her areas of interest are - speciality contact lens fitting and contact lens related complications.



## Free Paper Abstracts

### **A topographical method to quantify scleral contact lens decentration**

Stephen Vincent

To describe a simple method to quantify scleral contact lens decentration using over-topography captured with a Placido ring videokeratoscope, and to measure its repeatability.

Scleral lens over-topography (E300 videokeratoscope, Medmont) was measured on 10 healthy participants following 15 minutes of lens settling (16.5 mm total diameter ICD miniscleral, Capricornia). Horizontal and vertical lens decentration was quantified from the translation of the front optic zone relative to the pupil centre, derived from ellipses manually fitted to tangential power over-topography maps, using both a standard and normalised dioptric scale. Intrasession (different maps captured within the same measurement session), intraobserver (identical maps analysed by the same observer), and intertechnique (standard or normalised tangential power scales) repeatability were calculated.

The mean lens decentration was  $0.62 \pm 0.18$  mm temporally and  $0.91 \pm 0.33$  mm inferiorly. Lens decentration derived from tangential topography maps with a standard power scale were more repeatable (95% limits of agreement for intraobserver repeatability  $\pm 0.07$  mm and intrasession repeatability  $\pm 0.15$  mm) than measurements derived from normalised maps (95% limits of agreement for intraobserver repeatability  $\pm 0.11$  mm and intrasession repeatability  $\pm 0.20$  mm). Scleral lens decentration can be reliably quantified using tangential power maps with a standard (fixed) scale captured during over-topography without the need for customised instrumentation or image analysis software. This method has a range of potential applications in research and clinical practice.

Associate Professor Steve Vincent is an academic in the School of Optometry and Vision Science at the Queensland University of Technology, Australia. He completed his undergraduate optometry degree in 2004 and PhD in 2011 and has since published over 60 scientific papers primarily related to scleral contact lenses, visual optics, and myopia. Steve is an Associate Editor for Contact Lens and Anterior Eye, and a fellow of the American Academy of Optometry, the British Contact Lens Association, the Scleral Lens Education Society, the Australian College of Optometry, and the Higher Education Academy.



## Free Paper Abstracts

### **Minimum oxygen permeability required for mini-scleral contact lens daily wear**

Sandeep Dhallu

To determine the minimum oxygen permeability required for mini-scleral contact lens daily wear. Mini-scleral contact lenses of identical design, but made of materials with different oxygen permeabilities (DK) were fitted to 9 participants for 8 hours of wear in a double masked, randomised trial, with a minimum washout period between lenses of 48 hours. Comparison to no lens wear and a soft silicone-hydrogel lens was also made at the same time of day. Corneal thickness over the entire cornea and central corneal lens clearance (Zeiss, Cirrus Optical Coherence Tomography), corneal curvature, objective bulbar and limbal redness (Oculus, Keratograph 5m), corneal biomechanics (Reichert, Ocular-Response-Analyzer) and comfort with a visual analogue scale were assessed after 8 hours of wear.

Corneal thickness did not significantly change during the waking day ( $p=0.284$ ) and baseline measures on each day were similar ( $F=1.582$ ,  $p=0.187$ ). Reducing the DK of the mini-scleral lenses to 65 increased corneal swelling ( $F=5.597$ ,  $p=0.005$ ) compared to higher DKs (100+), but all the mini-scleral lenses resulted in greater corneal thickness after 8 hours than at baseline and with soft contact lens wear ( $p<0.05$ ). Corneal clearance did not change with the DK of the mini-scleral contact lens, but decreased from  $255.4\pm 68.8\mu\text{m}$  following insertion to  $114.8\pm 73.0\mu\text{m}$  after 8 hours of wear. Neither corneal curvature ( $F=0.614$ ,  $p=0.689$ ) or corneal biomechanics (corneal hysteresis:  $F=1.539$ ,  $p=0.200$ ; corneal resistance factor:  $F=2.007$ ,  $p=0.098$ ) were affected by soft or mini-scleral lens wear. There was no difference in bulbar redness ( $p=0.684$ ) or limbal redness ( $p=0.874$ ) between the mini-sclerals. Comfort varied between lenses ( $p=0.001$ ) with the soft lens being more comfortable than the mini-scleral lenses ( $p<0.05$ ), and the 100DK lenses having the best comfort amongst the mini-sclerals.

A DK  $\geq 100$  is advised for safe mini-scleral contact lens daily wear.

After completing my Bachelor of Science in Optometry at Aston University in 2010, I returned to pursue a PhD investigating new ways of evaluating premium intraocular lenses. I then spent two and a half years working as a Research Optometrist at Moorfields Eye Hospital, London working on a NIHR funded, University College London (UCL) sponsored multi-centre clinical trial comparing femto-assisted cataract surgery with standard phacoemulsification within the NHS. In 2017, I returned to Aston University to take up a post as Research Fellow.



Free Paper Abstracts

## Free papers; Highlights of 2019 - International Perspectives

### **Is the Internet Era affecting the relations between Ametropes and Contact Lens Practitioners? An Italian Survey.**

Fabrizio Zeri

To assess if internet behaviour in terms of contact lens (CL) on-line purchasing and time spent on social media can affect the relationship between ametropes and CL practitioners (CLP).

A Computer-assisted Web-interviewing survey carried out on ametropes and CLPs. Ametropes (CL wearers and non-wearers) were interviewed by questionnaire in several domains: demographic variables, type of visual defect, relationship with CLPs, modality of CL purchasing (only CL wearers) and time spent on the main social media platforms (Facebook, YouTube, LinkedIn, Twitter, Instagram). The questionnaire used for CLPs included questions in three domains: demographic variables, perception of ametropes behaviour towards CLs in relation to his/her professional role and time spent on the main social media platforms.

One thousand questionnaires were collected from ametropes (50% females;  $38.7 \pm 10.3$  yrs; 70% CL wearers), and four hundred and sixty-one from CLPs (28% females;  $49.4 \pm 11.3$  yrs). Forty-three % of CL wearers purchased CLs online at least once. Notably, more males bought online than females, 49.1% versus 39.1% ( $p < 0.01$ ). Eighty % of CLPs, as opposed to 50% of CL wearers, think that the main reason for CL wearers buying CLs online, is that it saves money ( $p < 0.00$ ). The frequency of online CL purchasing, and the time spent on social media platforms results in being significantly correlated ( $p < 0.01$ ). Among non-CL wearers, the frequency of time spent online does not relate to the importance they attribute to CLPs, when a decision is made to fit CLs ( $p = 0.36$ ). CLPs believe that customers decide to start wearing CLs, on the push of social influence (relatives, friends and internet), yet CL wearers reiterated they started because of the recommendation by their CLP ( $p < 0.00$ ).

Although online purchasing of CLs is quite common and resulted correlated with the time spent on social platforms, CLPs remain a major reference, both for actual CL wearers and non-wearers.

Fabrizio Zeri is a researcher at the University of Milan "Bicocca" and a Visiting Research Fellow at Aston University. He did his Diploma in Optometry at the Istituto Superiore Scienze Optometriche, Rome. He graduated in Experimental Psychology at the "Sapienza University" of Rome, where he also did his PhD in Cognitive Neurosciences. He has been President of the Italian Optometric Association and secretary of the Italian Contact Lens Academy. He is FIACLE, FBCLA and FEAOO. In 2017 he was awarded with the Irving Fatt Memorial Lecture by the BCLA. He published over 50 papers and has given over 100 lectures.



## Free Paper Abstracts

### **Contact lens use and compliance in Greece**

Dimitra Makrynioti

To determine the types of contact lenses (CL) used in the Greek population and to evaluate compliance with CL by assessing the hygiene practices and behaviors of CL users in Greece. In a cross-sectional study, 240 CL users from around Greece answered a specially designed, self-administered, anonymous, on-line, 11 item questionnaire. Amongst others, demographic patterns of CL users, preferred CL types, source of CL supply, habitual use of CL and hygiene practices followed were investigated.

Out of the 240 participants, 67 (28%) were male and 173 (72%) female. The majority of the users were fitted with conventional hydrogel lenses (59%), while 33% of them were fitted with silicone hydrogels and 8% with rigid CL. The supplier for their CL was mainly their Optician-Optometrist (89.5%) while a 8.8% of them purchased their CL online. 86.6% of CL users clean their CL with branded solutions, while 13.4% of them admitted using tap water instead. The majority of CL users (83.3%) do clean their hands before touching their CL while 0.8% admitted no cleaning whatsoever. Surprisingly, 62.5% of wearers reporting sleeping with their CL on, while only 20.8% remove their lenses before going to bed. For swimming, 35.8% always swim with their CL on, and 17.5% rarely do that, while only 24.6% never do that. Additionally, 42% of CL users tend to wear their lenses 8-12 hours a day, 31% for more than 12 hours a day and only 27% less than 8 hours a day.

In this study, noncompliance with the CL protocol was common among users; encouragement to adopt a healthy CL wear and care habit is a priority. Inadequate lens care, poor hygiene and extended CL wear are behaviors that call for increased awareness programmes and targeted compliance education in order to avoid eye health complications.

Dr. Dimitra Makrynioti, Optician-Optometrist, BSc(Hons), MSc, PhD, is a Contact Lens Lecturer in the Optics & Optometry Department, T.E.I. of West Greece (Aegion subsidiary), Greece. A previous Research Assistant and Visiting Scientist within Eurolens Research, an Occasional Lecturer in the UoM Optometry department, a chief Optometrist-CL Practitioner-Optician in national Eye Clinics and Practices, and a volunteer at the Manchester Eye Hospital, the Ophthalmology Clinic of the University Hospital of Patras, the Special Olympics Eye Clinic & more. She is a BCLA, IACLE, EAEO, ARVO member and has presented her work in numerous national and international conferences. Her research interests are Contact Lenses & Optometry.



## Free Paper Abstracts

### **Contact lens complications among wearers in Ghana**

Emmanuel Kobia-Acquah

Contact lens (CL) practice is relatively new in Ghana; a country where the geographical location (warm climate) lends itself to harsh environmental conditions (high humidity) known to influence CL wear. Recent studies suggest an increase in CL wear (corrective and cosmetic), yet, there are no studies about CL-related complications. This study sought to determine the complications associated with CL wear in Ghana.

This was a retrospective study where medical records of 117 CL patients (aged 16 to 81) who reported to five selected eye clinics from 2013 to 2016 were reviewed. Four of these clinics dispensed soft CL only, thus there were more soft CL users (28) compared to rigid CL users (6). Patient demographics, CL type, duration of wear, complications, and causes of complication were recorded on a data collection form. Statistical analyses were performed using IBM SPSS (Version 20.0. Chicago: SPSS Inc), an alpha value of  $p \leq 0.05$  was considered statistically significant. Chi square test was used to evaluate the relationship between age and CL complications.

The mean  $\pm$  SD age of the 34 out of 117 patients who reported complications was  $35.2 \pm 14.7$ . The age-group with the highest reported complications was 20-29 years,  $\chi^2(6, N=34)=28.3, p=.02$ . 44.1% had complications 1-3 months after CL was prescribed. Refractive error (61.8%) was the commonest indication for CL prescription followed by keratoconus (14.7%). The common complications were giant papillary conjunctivitis (41.2%) and cornea infiltrates (29.4%). Patient negligence was the highest cause of complication (26.47%) with CL use followed by reaction to CL solution (14.7%) and dirty CL (14.7%).

About a third of CL wearers in Ghana report complications associated with CL wear. There is a high proportion of patient negligence leading to complications among CL wearers; emphasis on patient education during fitting procedures in Ghana may be beneficial to reduce CL complications.

Emmanuel Kobia-Acquah is an accomplished, Ghanaian trained optometrist. His research interests are public health optometry, anterior eye, and contact lens research. He currently lectures at the Kwame Nkrumah University of Science and Technology (KNUST). He graduated with a Doctor of Optometry degree at KNUST. He had a one-year Fellowship training in Clinical Optometry at the L.V. Prasad Eye Institute in India and subsequently obtained an MSc in Public Health for Eye Care at the London School of Hygiene and Tropical Medicine, United Kingdom. Dr. Kobia-Acquah is involved in several community outreach programs in Ghana and is a board member of the Volunteer Optometric Services to Humanity (VOSH-Ghana) as well as the liaison between Vision Aid Overseas (VAO) and KNUST Optometry Department.





## Free Paper Abstracts

### **Build your brand in Social Media**

Bridgitte Shen Lee

With the number of global internet users surpassing 4 billion and the number of social media users climbing to 3.2 billion, savvy social media knowledge and engagement are important to any business growth. This course will teach you how to utilize effective eyecare #hashtags and create engaging content to grow your practice and to build your professional brand. In addition, it will review different posting methods with the top five platforms: Facebook, Instagram, Twitter, LinkedIn, YouTube

Dr. Bridgitte Shen Lee earned her Doctor of Optometry degree magna cum laude from University of Houston College of Optometry. She is the co-founder and CEO of Vision Optique® and iTravelCE®. Dr. Shen Lee writes and lectures on the topics of Digital Eye Health®, Dry Eye Disease, Anti-Aging Eye Care, Health Care Social Media, and Ocular Aesthetics.

Dr. Shen Lee is the past editor of Optometric Management's Blue Light Bulletin, and the first editor of the Ocular Aesthetics for Eyecare Business. She serves as one of the TFOS (Tear Film & Ocular Surface Society) Global Ambassadors representing the United States. In 2019, Dr. Shen Lee has been selected to serve as a Spokesperson and Medical Adviser to the Vision Council.

Financial Disclosures: Alcon, Essilor, Eyevance Pharmaceuticals, Guardion Health Sciences, Johnson & Johnson Vision, Lumenis, OCuSOFT, Sun Pharmaceuticals



## Free Paper Abstracts

### **Opportunities and Threats to Contact Lens Practice**

Nilesh Thite

We conducted this study to explore what eye care practitioners (ECPs) perceive as opportunities and threats to contact lens (CL) practice.

The questionnaire was designed after discussions with ECPs and face validation by 5 experts. It covered demographic data, potential opportunities & threats and possible interventions to enhance CL practice. This self-administered, online questionnaire was distributed to Indian ECPs using social media platforms. Data were analysed using R software version 3.5.2. One-way ANOVA and T-test were used for statistical analysis.

A total of 490 complete, valid responses were received from 120 cities across India: 64% were males, 53% were qualified with Bachelor's degree in Optometry and 38% were from hospital-based practices. The majority of ECPs were hopeful or very hopeful (80%) about the future of their CL practice; 73% never discouraged their potential CL patients from considering CL wear. Daily disposable CL for occasional wear was considered the best opportunity (7.63 + 2.33) followed by cosmetic lenses (7.21 + 2.30). Lenses being available online without validating prescription (7.23 + 3.1) and lack of regulation (7.05 + 2.52) were perceived as major threats. ECPs with a master's degree in optometry were more concerned than those with Diploma or B. Optometry about the legal/administrative threats to CL practice such as- lack of regulation ( $p=0.0005$ ), lenses being available online without validating prescription ( $p=0.0048$ ), clinics without proper instrumentation ( $p=0.0003$ ) and commoditization of CL ( $p=0.0037$ ). Fellows of International Association of Contact Lens Educators (FIACLE) showed similar outlook towards the potential threats. FIACLE rated specialty lens practice ( $p=0.0001$ ) and multifocal contact lenses for presbyopes ( $p=0.0004$ ) higher than others as opportunities.

The Indian ECPs are hopeful about the future of CL practice with daily disposable lenses for occasional wear offering best opportunity. Regulation of CL practice could make the practitioners secured about the future.

Nilesh Thite is currently working as the Director of Educational Programs at the International Association of Contact Lens Educators. He is also a director and co-founder of a unique educational initiative – Masterclass Optometry. He is an associate professor and former in-charge of Bharati Vidyapeeth School of Optometry with teaching experience over 12 years. He has had a corporate stint with Bausch + Lomb India and continues to offer his consultation to this organization. Nilesh has presented scientific papers/posters in many international conferences and has published papers. He has keen interest in optometry education and scope of optometry practice.



Free Paper Abstracts

### **Perceptions about Daily Disposable Silicone Hydrogel Contact Lenses from ECPs in Three Countries**

Gary Orsborn

Global industry data show that daily disposable lenses (DDs) make up 52% of all contact lens (CL) revenue. Silicone hydrogel (SiH) DDs comprise 39% of the total DD revenue, and growth was 35% in 2018 compared to just 3% for hydrogel DDs. This research study sought to understand eye care professionals' (ECPs) perceptions regarding the benefits of SiH DDs for their patients compared to hydrogel DDs, and how these may be contributing to the market's growth of SiH DDs.

An online survey was conducted with 100 ECPs in each of three countries – United Kingdom, United States and Japan - during November 2017 by Cello Health Insight, an independent market research agency. A sample size of 100 per country was determined to be robust at a 95% confidence level with a +/- 10% margin of error. The survey contained 34 statements to which participants provided their level of agreement using a 6-point Likert scale. Categories of statements included Health, Comfort, Patient Experience, and Standard of Care. A minimum of 70% agreement was set to define majority agreement.

ECPs reported greater than 70% agreement to 33 of 34 statements across all categories. Three statements receiving the highest ratings overall were "If cost was equivalent, I would choose SiH over hydrogel for my DD patients" (95% agreement); "SiH DDs satisfy today's patients' demanding lifestyles" (93%); and "SiH DDs are the best choice to safeguard my patients' eye health related to CL wear" (92%).

This research study provides evidence that many ECPs in these three countries share strong beliefs and perceptions relating to the benefits of prescribing SiH CLs to their patients.

Dr. Gary Orsborn is Vice President, Global Professional & Clinical Affairs at CooperVision. He is responsible for the development and management of the company's professional and clinical affairs strategy worldwide. Dr. Orsborn received his Doctor of Optometry degree and a Master of Science in Physiological Optics from The Ohio State University College of Optometry. He is a fellow of both the American Academy of Optometry and of the British Contact Lens Association, and a member of the American Optometric Association and the Association of Research and Vision in Ophthalmology.



Free Paper Abstracts

## **Rapid Fire Papers; Comfort**

### **Ocular Comfort Observed with Three Marketed Solutions**

Meredith Jansen Bishop

This study evaluated comfort (Visual Analog Scale 0-100, 100=best comfort imaginable) of 2 multi-purpose solutions and 1 peroxide solution worn with 3 ACUVUE® brand contact lenses for 45 and 120 minutes.

This was a randomized, double-masked, contralateral, crossover, 5-visit study. Subjects were fit and dispensed 1-DAY ACUVUE® MOIST® as a washout lens. At subsequent visits, subjects were randomly fit with one of three study lenses (ACUVUE® 2(AV2), ACUVUE® OASYS®(AO), or ACUVUE® Vita®(AV)) pre-soaked for 16-28 hours in randomized study solution (RevitaLens®(RL), OPTI-FREE® Puremoist®(OF), and CLEAR CARE®(CC)). After 45 or 120 minutes of wear, study evaluations were performed. Washout lenses were worn 5-7 days between visits.

106 subjects completed, and 78 were included in Per-Protocol Population. RL had comfort scores of 92.4, 93.0, 93.5, and 94.7 at 1, 5, 45, and 120 minutes post fit, respectively. There were no significant differences for RL (95% credible intervals differences (CID) ranged -6.9 to 3.6, all contained 0) at any time points compared to OF or CC (92.0, 92.3, 93.5, 94.3 for OF and 92.4, 93.4, 93.7, 94.6 for CC, respectively). Additionally, no significant differences were found for comfort between RL and OF or CC when analyzed for the 3 lens types individually (CIDs: AV2: -9.5 to 6.2; AO: -8.0 to 7.4; AV: -8.4 to 4.6, all contained 0). The mean corneal staining area scores (0-10 scale) were similar between solutions at 45 minutes and 120 minutes (mean[SD]: RL 0.42[0.64], OF 0.31[0.51], CC 0.23[0.42] at 45 minutes; RL 0.39[0.65], OF 0.39[0.70], CC 0.18[0.32] at 120 minutes). The differences were not considered clinically relevant.

RL was not statistically significantly different than OF and CC for comfort scores at 1, 5, 45, and 120 minutes post fit. All solutions had low levels of ocular physiology findings and no clinically relevant corneal staining differences observed.

Dr. Meredith Jansen Bishop received her Doctorate of Optometry and her Masters in Vision Science from Indiana University School of Optometry. Upon graduating she took a faculty research position at the university where her research focused on contact lenses, tear film optics, and dry eye. Since 2013, Dr. Jansen Bishop has been a Principal Research Optometrist at Johnson & Johnson Vision. She is very passionate about patient care and developing new products to meet patient needs.



## Free Paper Abstracts

### **Design and development of a new questionnaire: contact lens discomfort index**

Cristina Arroyo-del Arroyo

To design a new questionnaire for detecting and grading contact lens (CL) discomfort (CLD) based on the currently established CLD definition considered in the latest Tear Film and Ocular Surface Workshop.

From the responses obtained from an initial survey, created to explore and characterized CLD symptoms, a questionnaire was developed. It was assessed using item response theory (Rasch model). The model was then adjusted using the Andersen likelihood ratio, and unidimensionality was checked applying principal components analysis. A cut-off score was calculated using Gower's general similarity coefficient, the partitioning around medoids algorithm, and the silhouette width. Because some people did not associate well with the two possible clusters (asymptomatic or symptomatic group), the questionnaire scores were evaluated following a decision tree. Finally, test-retest reliability of the questionnaire was assessed using the intraclass correlation coefficient (ICC) and Cohen's kappa (k) coefficient.

The initial 41-item survey was completed by 1104 volunteers, and resulted in a 9-item questionnaire, called Contact Lens Discomfort Index (CLDI). It showed mean square infit and outfit values within the 0.76 to 1.10 range and eigenvalues  $\leq 1.3$ . The score of the CLDI was calculated after performing the sum of all items, ranging from 0 to 18. Scores from 6 to 10 should undergo further sub-analysis to better detect CLD by using a subscale. Finally, a CLDI total score  $>8$  indicated presence of CLD. ICC was 0.87 (95% confidence interval, 0.75–0.94), and k value was 0.67 (95% confidence interval, 0.41–0.93).

The CLDI questionnaire is a well-structured instrument properly designed. It has acceptable psychometric properties, making it a valid and reliable tool to measure CL-related symptoms, helping clinicians and researchers to diagnose, grade and monitor CLD.

Cristina Arroyo is a PhD student in Vision Science at the University of Valladolid (UVA), Valladolid, Spain. She got her Degree in Optometry in 2012 at the UVA. Arroyo also completed a Master's degree in Clinical Optometry in 2013 at the Camilo José Cela University, Madrid, Spain. In 2014, she joined the Ocular Surface Group of the University Institute of Applied Ophthalmobiology (IOBA), when she got the Master's degree in Research in Vision Science. She is currently working at the UVA developing her PhD research in contact lens discomfort, where she published 4 papers in indexed journals.



## Free Paper Abstracts

### **Effect of Digital Zone Optics® design contact lenses in symptoms, vision and clinical variables**

Laura Valencia Nieto

Digital Zone Optics® (DZO) design has been developed to help contact lens (CL) wearers that suffer from Computer Vision Syndrome related to the use of electronic devices. The purpose is to compare symptoms, visual function and clinical signs while using a CL with DZO design (Biofinity Energys™, Cooper Vision) with the use of a CL with the same material but without DZO design (Biofinity®, Cooper Vision).

20 CL wearers were fitted with Biofinity® and Biofinity Energys™ CL for 4 weeks each, in a random order. Symptoms associated with the use of CL were analyzed through the CLDEQ-8, and symptoms associated with electronic devices use through the CVSS17 questionnaire. Visual Analog Scales (VAS) were used to evaluate ocular discomfort, blurred vision and photophobia. Visual function was evaluated through high and low contrast distance visual acuity (VA), near VA, amplitude of accommodation, lag of accommodation and flexibility of accommodation. Also, clinical features such as CL fitting, non-invasive break up time (NIBUT), conjunctival and limbal hyperemia, and corneal and conjunctival staining were analyzed.

6 men and 14 women ( $26.15 \pm 6.22$  years old) were included. There were no differences in CLDEQ-8, CVSS17 questionnaire or VAS between both CL. Visual function variables did not show significant differences, with the exception of the lag of accommodation that decreased with the use of Biofinity Energys™ CL ( $0.61 \pm 0.59$ ) with respect to Biofinity® CL ( $0.88 \pm 0.65$ ); ( $p=0.037$ ). Regarding clinical signs, there were no differences in NIBUT, ocular surface staining, conjunctival hyperemia or CL fitting between both CL.

The clinical behavior of Biofinity Energys™ is similar to Biofinity® CL regarding symptoms, visual function or clinical signs in young CL wearers. Further studies with subjects that suffer from Computer Vision Syndrome are warranted.

Laura Valencia got her Optometry Degree in 2018 at the University of Valladolid, Spain. She is currently completing her training with a Research in Vision Sciences Master's Degree at the University Institute of Applied Ophthalmobiology (IOBA), Valladolid, Spain; and with a part time research grant at the Ocular Surface Group, where she is collaborating with different research projects on the ocular surface and contact lens field. She has been awarded with the 2018 CooperVision FORCE Student of the Year.



## Free Paper Abstracts

### **The impact of contact lens wear on particulate clearance from the ocular surface**

Michael Read

Contact lens-related infection and inflammation is thought to be related to the aggregation of bacteria between the contact lens and the corneal surface during wear. In this clinical study, fluorescent polystyrene microspheres were utilised to compare the particulate clearance rate with and without contact lens wear.

A custom fluorescent imaging system was developed based on a digital camera and macro flash illumination. Ten subjects were recruited and at separate study visits applied 10 $\mu$ L of fluorescent green microsphere suspension (1% solids) to either (i) the bulbar conjunctiva of a non-lens wearing eye or (ii) the back surface of a contact lens (comfilcon A) immediately prior to application. A series of digital images were then captured over a 30-minute period (every minute for 10 minutes and then every 5 minutes). Image analysis was undertaken to quantify fluorescence.

The custom imaging system was able to capture high-resolution images of the microspheres on the ocular surface. Imaging underlined the highly dynamic nature of the tear film, with the microspheres rapidly cleared from the meniscus of the bare eye via a blink-driven process. A significantly slower rate of microsphere clearance was observed during contact lens wear ( $p < 0.0001$ ), with a clearance half-life of 10.3 minutes, compared with 0.9 minutes for the bare eye.

Microsphere particles instilled into the tear film of a bare eye were cleared extremely rapidly from the ocular surface. In contrast, when microspheres were applied to the posterior surface of a contact lens immediately prior to application, the rate of microsphere clearance was delayed significantly. Future work will look to use this methodology to investigate the impact of alterations to lens design and materials on the post-lens tear film exchange with the ultimate aim of making contact lens wear safer by reducing the rate of corneal infection and inflammation.

Dr Michael Read is the New Technologies Manager at Eurolens Research, The University of Manchester, United Kingdom. In this capacity he is responsible for liaising with the contact lens industry and managing clinical and laboratory research projects within the group. In 2010, He completed his PhD which investigated the influence of surface characteristics on the clinical performance of silicone hydrogel contact materials. He is a member of the College of Optometrist and worked for 5 years in primary care practice prior to his PhD studies. He is the author of several peer-reviewed papers and has lectured internationally.



## Free Paper Abstracts

### **Assessment of wheat germ agglutinin staining of the ocular surface in contact lens wearers and non-contact lens wearers**

Maria Navascues-Cornago

Fluorescein-labeled wheat germ agglutinin (F-WGA) can act as a clinical marker for the presence of the ocular surface glycocalyx. This study sought to investigate whether the degree of F-WGA fluorescence observed at the ocular surface differed between symptomatic contact lens wearers, asymptomatic contact lens wearers and non-contact lens wearers.

Twenty-five subjects attended a study visit having worn their habitual contact lenses for  $\geq 4$  hours (or been awake for  $\geq 4$  hours in the non-contact lens wearers). A 5 $\mu$ l droplet of F-WGA solution (5%) was applied directly to the ocular surface (approximately 15 minutes after contact lens removal in the contact lens wearers). Prior to and 30 min after F-WGA application, photographs of the cornea and bulbar conjunctiva were then captured using a high sensitivity custom imaging system. MATLAB image analysis software was developed to quantify the degree of fluorescence.

The imaging system was able to capture high-resolution images of F-WGA fluorescence at the ocular surface. The degree of fluorescence differed significantly between the ocular surface regions ( $p < 0.001$ ), with the bulbar conjunctiva showing greater fluorescence compared with the cornea. A significant difference in fluorescence was found between subjects groups for the cornea ( $p = 0.01$ ), with both the symptomatic and asymptomatic contact lens wearers showing lower fluorescence than the non-lens wearers. The difference in fluorescence between subject groups approached statistical significance for the temporal conjunctiva ( $p = 0.06$ ).

The use of F-WGA as a clinical marker for the glycocalyx allows an improved understanding of its distribution across the ocular surface. The concentration of glycocalyx appears greatest across the bulbar conjunctiva and lowest on the cornea. Contact lens wear appears to negatively impact the concentration of surface-bound glycocalyx across the ocular surface. No significant differences were found between symptomatic and asymptomatic contact lens wearers in this study.

Maria Navascues-Cornago is an Optometrist who graduated from the Complutense University of Madrid in 2008 and received her MSc in Clinical Optometry from the European University of Madrid in 2009. She completed her PhD at The University of Manchester in 2016, which investigated factors that may affect comfort in contact lens wear. Since receiving her PhD, she has been working as a Research Associate at Eurolens Research, The University of Manchester. Her main research interests relate to the clinical performance and comfort of contact lenses.





## Free Paper Abstracts

### **Analysis of the placebo effect in comfort during contact lens wear.**

Andrea Novo-Diez

To evaluate the change in contact lens (CL) comfort when a masked CL is fitted.

Symptomatic subjects, according to 'Contact Lens Dry Eye Questionnaire-8' (CLDEQ-8), wearing monthly CL were recruited. At first day of the study (V1), subjects scored their comfort 15 minutes after the insertion of their habitual CL (online assessment), using a 0-100 visual analogue scale (VAS). After 4 to 6 hours of wear (afternoon visit), they evaluated comfort again with the VAS and with the CLDEQ-8. Then, they were provided with a new pair of their habitual CL, although participants did not know they were the same CL (masked). One month later (V2), subjects evaluated comfort in the same way as in V1, and with a -50 to +50 global rating change scale (GRCS) comparing comfort to V1. VAS outcomes completed during the insertion and the afternoon, and CLDEQ-8 scores were compared between V1 and V2. Also, GRCS was evaluated in V2. Changes in comfort were estimated using T-student test for normal variables and Wilcoxon contrast for no-parametric variables. Fourteen women and three men participated (mean age:  $22.1 \pm 3.6$ ). Days of use of the CL in V1 were  $23.4 \pm 4.6$ , while in V2 were  $28.1 \pm 5.6$  ( $p=0.02$ ). VAS outcomes at insertion in V1 and V2 were  $59.5 \pm 22.5$  and  $69.1 \pm 22.8$  respectively ( $p=0.19$ ), while afternoon VAS values were  $51.2 \pm 17.1$  and  $57.5 \pm 18.9$  ( $p=0.32$ ). CLDEQ-8 scores for V1 and V2 were  $20.4 \pm 8.3$  and  $15.9 \pm 6.0$  ( $p=0.06$ ). At V2, participants showed higher CL comfort with the GRCS compared to V1:  $14.9 \pm 16.9$  ( $p=0.002$ ). It has been found a possible placebo effect in comfort when a new CL is provided, even though CL are the same as subjects have been wearing. This effect can be detected using a GRCS and considering a 3-point difference in CLDEQ-8, as it has been previously published.

Graduated in Optics and Optometry by the University of Valladolid in 2016, and master in Visual Science Research by the same university in 2017. PhD student of Visual Science Doctoral Program since 2018. Working at Instituto Universitario de Oftalmobiología Aplicada (IOBA) as pre-doctoral researcher in the Ocular Surface Group. She has been involved in research projects about contact lens discomfort, dry eye disease and chronic pain, and evaluation of meibomian gland dysfunction.



## Free Paper Abstracts

### **Introducing a novel in vivo method to access visual performance during dewetting process of contact lens surface**

Felix Zimmermann

To introduce a novel in vivo method to access visual performance (VP) during dewetting process (Visual Acuity Dry Up; VADU) and investigate the influence of drying up behavior of pre lens tear film (PLTF) on VP for various visual requirements for a daily disposable contact lens (CL) (Nelfilcon A). Thirty nine subjects were fitted with CL (Nelfilcon A). Dewetting characteristics of PLTF were recorded by using a modified multifunctional topographer (Keratograph 5M, OCULUS Optikgeräte GmbH, Wetzlar, GERMANY) combined with Non-Invasive Keratograph Dry Up Time (NIK-DUT) method during the assessment of participants VP and blink suppression. Recorded videos were analyzed regarding elapsed time in s (Visual Acuity Drying Up Time; VADUT) and dewetted area in mm<sup>2</sup> (Visual Acuity Drying Up Area; VADUA) at visual loss of one, two or three log units below maximal distance corrected visual acuity (DCVA).

After 13.1s±17.4s, 20.83s±21.81s, 34.67s±29.11s (VADUT mean) participants lost one (DCVA+0.1logMAR), two (DCVA+0.2logMAR) or three (DCVA+0.3logMAR) log units of DCVA that corresponds to a mean dewetting area of 4.82mm<sup>2</sup>±6.64mm<sup>2</sup>, 9.5mm<sup>2</sup>±8.26mm<sup>2</sup> and 13.0mm<sup>2</sup>±8.68mm<sup>2</sup> (VADUA) of CL surface. All differences of VADUT und VADUA regarding the visual requirements (one, two and three log units below DCVA) are statistically significant with an alpha level of 0.05 (VADUT: DCVA+0.1logMAR vs DCVA+0.2logMAR P = 0.006, DCVA+0.1logMAR vs DCVA+0.3logMAR P < 0.0001, DCVA+0.2logMAR vs DCVA+0.3logMAR P = 0.001; VADUA: DCVA+0.1logMAR vs DCVA+0.2logMAR P < 0.0001, DCVA+0.1logMAR vs DCVA+0.3logMAR P < 0.0001, DCVA+0.2logMAR vs DCVA+0.3logMAR P = 0.31).

The novel VADU method uses a quantified visual loss of a predefined visual requirement based on the threshold definition of the psychometric function to analyze the function of PLTF on VP. VP is impacted as a function of the amount of dewetted area of a CL surface and elapsed time. The whole front surface of the cornea may affect the VP.

2010-2013 Apprenticeship as Optician in Magdeburg, GERMANY 2013-2017 Bachelor of Science Augenoptik/ Optometrie Ernst-Abbe University of Applied Sciences Jena, GERMANY 2017-2019 Master of Science Optometry/ Vision Science Ernst-Abbe University of Applied Sciences Jena, GERMANY since 07/2018 Clinical Research Associate JenVis Research Jena, GERMANY

## **Dewetting of different soft lens materials before and after stress test with lipid containing rewetting eye drops using Non-Invasive Keratograph Drying Up Time (NIK-DUT)**

Sebastian Marx

The primary objective of the study was to determine differences between surface dewetting of SCL materials out of PBS before and after treatment with lipid containing rewetting drops in vitro using a modified corneal topographer K5M (Non-Invasive Keratograph – Drying-Up Time [NIK-DUT]). Fifteen lenses of different SCL material classes according to ISO18369 were tested (polymacon, nelfilcon A, oculifcon D, balafilcon A, somofilcon A, lotrafilcon B). Lenses were rinsed and stored in PBS to minimize the effect of the original blister solution. Single dewetting videos per lens were captured with K5M. Afterwards all lenses were soaked in phospholipid containing rewetting solution for 25 hours. Lenses were gently shaken by an orbital shaker with a frequency of 15 times per minutes, tilting up to 15°. After treatment all lenses were equilibrated again in PBS for at least 30 minutes. Dewetting videos were captured again. In vitro NIK-DUT was determined for a measurement time of 180 s, expressed by Area under Curve (AUC) data.

The AUC results before and after treatment were: polymacon ( $4870.85 \pm 942.74$  and  $6214.07 \pm 932.09$ ;  $t(14) = -3.959$ ,  $p = 0.001$ ), nelfilcon A ( $4688.03 \pm 1065.14$  and  $6959.76 \pm 1081.81$ ;  $t(14) = -6.444$ ,  $p < 0.001$ ), oculifcon D ( $3612.63 \pm 875.51$  and  $7041.97 \pm 714.26$ ;  $t(14) = -11.294$ ,  $p < 0.001$ ), balafilcon A ( $4170.37 \pm 927.19$  and  $7385.56 \pm 879.84$ ;  $t(14) = -10.798$ ,  $p < 0.001$ ), somofilcon A ( $4284.49 \pm 833.80$  and  $6762.17 \pm 1380.15$ ;  $t(13) = -7.546$ ,  $p < 0.001$ ) and lotrafilcon B, comfilcon A ( $4973.30 \pm 1249.25$  and  $7415.65 \pm 994.79$ ,  $t(14) = -12.565$ ,  $p < 0.001$ ). All differences were statistically significant at a significance level of 0.05.

Lipid containing solutions interact with various SCL materials and lead to increased in vitro dewetting. Accelerated dewetting of lens surfaces may contribute to both, reduced comfort and vision.

Sebastian Marx graduated in 2000 from the OSZ Havelland School of Ophthalmic Optics in Rathenow before he worked in practice. After a study of optometry at the University of Applied Sciences Jena he started to work at the JENVIS Research Institute in Jena. He is coordinating research projects and responsible for the clinical area. Parallel to his work, he is part time educator at the University of Applied Sciences Jena in the field of vision research and member of the German committee of standardisation. Since 2006 he is a fellow of the International Association of Contact lens educators.



Free Paper Abstracts

## Free Papers; Materials

### Changes of the curvature of modern daily disposable soft contact lenses during wear

Patryk Mlyniuk

The aim of this study is to evaluate the changes of the curvature of 3 different daily disposable soft contact lenses during wear.

Forty five eyes with myopia of -3,0 D were enrolled. All patients underwent general ophthalmic examination, autokeratometry and corneal topography/tomography (Placido/Scheimpflug instrument). Subsequently, all patients wore 3 types of daily soft contact lenses for 12-16 hours a day in the following order: nesofilcon A hydrogel lenses, delefilcon A silicone hydrogel lenses and stenfilcon A silicone hydrogel lenses. Contact lenses geometry was measured immediately after removal in two perpendicular planes in a wet cell with the use of a custom built swept source OCT prototype operating at the central wavelength of 1310 nm and at the speed of 50 000 scans per second. The results were compared with the ones achieved with the new contact lenses of the same design and power of -3.0 D.

We found a decrease in contact lenses' posterior central curvature by  $0.18 \pm 0.2$  and  $0.29 \pm 0.21$  mm for nesofilcon A,  $0.38 \pm 0.32$  and  $0.62 \pm 0.25$  mm for stenfilcon A,  $0.32 \pm 0.22$  and  $0.5 \pm 0.3$  mm for delefilcon A in two perpendicular planes. The differences for different lenses were statistically significant ( $p < 0.001$ ). The changes of the posterior curvature of the lenses correlated with the mean keratometry value of the cornea at the level of -0.54 and -0.42 for nesofilcon A, 0.13 and -0.19 for stenfilcon A, -0.42 and -0.45 for delefilcon A in two perpendicular planes ( $r$ ,  $p < 0.001$ ). The lenses made of stenfilcon A showed statistically significant lower correlation between the change of posterior curvature of the lenses and mean keratometry value.

The posterior curvature of all three types of daily disposable soft contact lenses for low myopia decrease during wear to imitate the geometry of the anterior surface of the cornea. There are differences between lenses in the extent of curvature decrease and the correlation of the decrease with the keratometry.

I am an optician (BSc). This year I will obtain a master's degree in optometry (OD). I am a member of the research team founded with support of Polish National Science Centre grant entitled "Ophthalmic applications of in vitro measurements with a prototype OCT tomograph". I am the author of scientific papers on optometry in the field of contactology and the anterior segment of the eye imaging. I am co-author of the scientific papers presented at national and international conferences on corneal epithelial thickness mapping and the use of optical coherence tomography to measure the total corneal power.



## Free Paper Abstracts

### **Life cycle analysis: end of life analysis of two contact lens replacement modalities**

Sarah L. Smith

There is growing evidence of an increase in microplastic pollution of the aquatic environment, and wider environmental concerns regarding use and disposal of resources. This study examines the annualised waste produced by two representative contact lens systems and the end of life disposal of contact lenses and packaging.

Waste audits for a representative daily disposable system (somofilcon A) versus a reusable monthly replacement system (somofilcon A with MPS) were conducted to quantify and characterise the materials that would enter household waste or recycling during normal use. Calculations for the reusable system included all lens care products; 12 solution bottles and 12 lens cases. Once weighed (after dehydration, where appropriate) and categorised, annualised figures were calculated assuming compliant, full-time use, with lenses worn in both eyes.

Four categories of material were identified: liquid; paper and cardboard; metal; plastics (high-density polyethylene, polypropylene and hydrogel plastic). The reusable system generated 0.8kg of material solid waste (MSW) over a year, the daily disposable system 1.1kg. Plastics accounted for the most significant proportion of MSW by mass for both systems. The annualised mass of somofilcon A was 0.3g and 10g for reusable and daily disposable lenses respectively. 89% by mass of MSW generated by the monthly replacement system could be recycled, compared to 35% of the daily disposable system. Polypropylene trays generated 700g of waste over a year for the daily disposable system; such material is not commonly accepted for household recycling.

In the UK, household waste generated per person is approximately 390kg per year. Contact lens use accounts for only a small percentage of household waste, 0.2-0.3% and a significant proportion of this can be recycled. Contact lens wearers should be encouraged to dispose of worn lenses in the bin, rather than the sink or lavatory to avoid microplastic contamination of the marine environment. Sarah Smith is a Research Optometrist with Eurolens Research at The University of Manchester. In this role, Sarah is closely involved in the planning and execution of clinical studies. Alongside her work at Eurolens Research, Sarah continues to work in private practice and is an Assessor with the College of Optometrists, which is the professional, scientific and examining body for optometry in the United Kingdom.



## Free Paper Abstracts

### **Influence of temperature on sagittal height of hydrogel contact lenses**

Christian Kempgens

It has been suggested that contact lens sagittal height (SAG) might be a useful additional parameter to fit CLs. According to ISO standard 18369-3 sagittal height is measured at 20°C. However, a temperature of approximately 34°C prevails at the ocular surface. Our study examined to what extent soft CL SAG changes with temperature.

Sagittal height of soft CLs immersed in temperature controlled ( $\pm 1^\circ\text{C}$ ) saline solution was measured within a wet cell (projection method). CL materials were Benz G3X, G5X and G72HW with parameters BC 8.6mm,  $\emptyset$  14.0mm, BOZD 10mm, SAG 3650 $\mu\text{m}$ . Per material, three CLs with BVP +6, +3, 0, -3 and -6D were measured three times at 20°C (T20), 27°C (T27) and 34°C (T34). Prior to measurement, all 45 CLs were equilibrated in standard saline solution.

Changes in SAG due to temperature increase ranged from -70 to +80 $\mu\text{m}$ . The average decrease in SAG T20 vs. T34 for G3X, G5X and G72HW was -12 (SD 17), -5 (SD 22) and -8 (SD 26)  $\mu\text{m}$ , respectively. The Friedman test revealed significant differences in SAG at different temperatures for materials G3X (Chi-square(2)=10.889,  $p=0,004$ ,  $n=15$ ) and G5X (Chi-square(2)=14.824,  $p=0,001$ ,  $n=15$ ), but not G72 HW (Chi-square(2)=5,091,  $p=0,078$ ,  $n=15$ ). Dunn-Bonferroni post hoc testing showed statistical differences in SAG only for -3D lenses of Benz G5X ( $n=3$ ), for T20 vs. T27 ( $z=2,475$   $p=0,040$ ) and T27 vs. T34 ( $z=-2,475$   $p=0,040$ ).

Changes in SAG of  $\geq 130\mu\text{m}$  are said to result in a change in contact lens fit. The maximum sagittal height changes due to temperature changes from 20°C to 27°C and 34°C in this paper are  $\leq 80\mu\text{m}$ . Thus, although ocular surface temperature is 34°C, measurement of CL SAG (Benz materials) at 20°C as defined in the ISO standard is acceptable, because the temperature increase from 20°C to 34°C does not result in any clinically relevant changes in SAG.

Christian Kempgens qualified as an optometrist in Germany in 2002, writing his final year thesis at Pacific University, Oregon. He worked at a specialty contact lens practice in Bremen, Germany, before obtaining a PhD in Vision Sciences at Glasgow Caledonian University, Scotland. From 2008 to 2016, he taught contact lens studies and diagnostic techniques within the course of optometry at the University of Applied Sciences, Luebeck, Germany. In September 2016 Christian was appointed Professor fuer Kontaktoptik und Optometrie at Beuth Hochschule fuer Technik Berlin, and teaches contact lens studies for the university's BSc and MSc courses of optometry.



## Free Paper Abstracts

### **One-month clinical comparison of silicone hydrogel monthly lenses in high-lipid depositors.**

Michel Guillon

To compare total lipid extracted ( $\mu\text{g}$ ) in lotrafilcon B packaged in blister solution containing EOBO (polyoxyethylene-polyoxybutylene) wetting agent (lotrafilcon B+EOBO) and senofilcon C lenses after 30 days of wear by high-lipid depositors.

76 subjects were randomized to receive lotrafilcon B+EOBO and senofilcon C lenses with habitual contact lens solution in this prospective, randomized (lens sequence), double-masked, crossover study. As a requirement for inclusion, a high-lipid depositor was defined as total lipid extracted of  $7.0 \mu\text{g}/\text{lens}$  with balafilcon A lenses (right lenses) that were dispensed on screening visit 2 and worn for 10 hours ( $\pm 30$  minutes). Lotrafilcon B+EOBO ( $n=59$ ) and senofilcon C ( $n=56$ ) right lenses were collected for assessment of total lipid extraction after 30 days (+3 days) of wear. Total lipids comprised of Wax Esters/Cholesterol Esters (WE/CE), Phospholipids/Triglycerides (PL/TG), Fatty Acids (FA), and Cholesterol (C). All data is presented as Mean (SD; 95% CI).

Lotrafilcon B+EOBO lenses had significantly lower total lipids extracted ( $78.14 (70.79; 59.69-96.59) \mu\text{g}/\text{lens}$ ) than senofilcon C lenses ( $307.68 (303.93; 226.29-389.07) \mu\text{g}/\text{lens}$ ) ( $p<0.0001$ ). This difference was mainly driven by non-polar lipid species WE/CE; lotrafilcon B+EOBO lenses extracted  $75.55 (70.61; 57.15-93.95) \mu\text{g}/\text{lens}$  vs. senofilcon C extracted  $301.63 (303.46; 220.36-382.90) \mu\text{g}/\text{lens}$ . Lotrafilcon B+EOBO lenses also extracted less C and PL/TG compared to senofilcon C (C:  $1.59 (1.38; 1.23-1.95)$  vs  $4.61 (2.55; 3.92-5.29)$ , PL/TG:  $0.39 (0.83; 0.17-0.61)$  vs.  $0.88 (1.25; 0.55-1.22)$ ). For FA lotrafilcon B+EOBO extracted  $0.62 (1.72; 0.17-1.06) \mu\text{g}/\text{lens}$  vs.  $0.56 (1.15; 0.26-0.87) \mu\text{g}/\text{lens}$  for senofilcon C.

Worn lotrafilcon B+EOBO lenses had significantly lower total lipids extracted compared with senofilcon C lenses at Day 30, this difference seems to be caused by the presence of less non-polar lipids on lotrafilcon B+EOBO lenses, non-polar lipids are most commonly associated with contact lens lipid deposits.

Professor Michel Guillon is the Managing Director of OCULAR TECHNOLOGY GROUP -International and MICHEL GUILLON SPORTS VISION, and Honorary Professor in The School of Life and Health Sciences at Aston University. He has presented over 165 papers or posters, published over 70 scientific papers, co-edited a major text book on contact lenses with Professor Montague Ruben and contributed to 19 chapters in text books. Professor Guillon is also a co-inventor on thirty-one patents worldwide. His research activities include vision correction and optical performance, clinical and biochemical analysis of dry eye and the tear film and vision strategy of elite athletes.



## Free Paper Abstracts

### **Influence of material, replacement interval and care system on the sub-clinical inflammatory response to soft contact lens wear**

Noor Haziq Saliman

To investigate the impact of different types of lens materials, replacement intervals and care systems on the sub-clinical inflammation of the ocular surface.

Phase 1: 20 subjects wore reusable Acuvue 2 (A2), reusable Acuvue Oasys (AO) and daily disposable AO (AODD) for one week each in random sequence, with one week washout periods. Lenses were worn in one eye only on a daily wear basis (the fellow eye acted as a control). Hydrogen peroxide Oxysept 1 Step (O1S) was used with both reusable lenses. Phase 2: 15 subjects wore A2 and AO lenses bilaterally for one week, and had no lens wear for one week, in random sequence, again with washout periods. O1S and Opti-Free Replenish (OFR) were used with right and left lenses, respectively. In both phases, in vivo confocal microscopy was carried out for the cornea, bulbar conjunctiva and eyelid margin to determine the density of the presumed dendritic cells (DCs) and hyperreflective white spots (WSs). Impression cytology evaluated the presence of hematopoietic progenitor cells in the bulbar conjunctiva and upper eyelid margin cells using the CD45 antibody marker.

Phase 1: DCs, WSs and conjunctival CD45+ cells were upregulated in both A2 and AO compared to AODD lens ( $p < 0.05$ ). There was no difference between A2 and AO lenses. Phase 2: the AO+OFR combination was the most, and A2+OFR the least, inflammatory combination for all parameters. No significant differences were found between A2 and AO when used with O1S ( $p > 0.05$ ).

The sub-clinical impact of lens materials, replacement intervals and care systems appears to be broadly consistent with the reported rate of corneal infiltrative events. To minimise ocular surface inflammation, this work suggests that daily disposables should be the first choice lens. For reusables, conventional hydrogels should be used with multipurpose solutions and silicone hydrogels with hydrogen peroxide.

Noor Haziq Saliman is an Optometrist who graduated from MARA University of Technology, Malaysia in 2011. He then gained an MHS (Optometry) from the National University of Malaysia in 2014, researching the visual performance of schoolchildren with nystagmus. Since then, he has worked as a junior lecturer and responsible for low vision teaching of undergraduate students. In 2015, Haziq came to the UK to study a PhD at The University of Manchester under the supervision of Professor Philip Morgan and Dr Carole Maldonado-Codina. Currently, his research focuses on the inflammatory response of the ocular surface to contact lens wear.





Free Paper Abstracts

## Free Papers; Optics and Design

### Between-eye asymmetry in corneal topography and its association with gender

Kristina Mihic

Variations in corneal curvature and astigmatism influence contact lens fit and acuity. The aim of this study was to investigate the asymmetry in corneal shape between eyes and its association with gender in a healthy student population.

The Aladdin topographer (Topcon, Tokyo, Japan) was used to obtain central corneal curvature, axis orientation and corneal astigmatism parameters from 152 volunteers (mean age  $20.8 \pm 2.3$  (SD) years), involving 31 (20%) males and 121 (80%) females without history of ocular disease. For both right eye (RE) and left eye (LE), keratometry (K) and axes (Ax) values were recorded for the flat (Kf) and steep (Ks) meridians of both eyes. Corneal astigmatism (CA) was taken as the difference in keratometry values in dioptres and was also classified as with the rule (WTR), against the rule (ATR), or oblique.

Flat and steep K-values were significantly different between eyes ( $Z=2.37$ ;  $P=0.018$  and  $Z=1.97$ ;  $P=0.049$ , respectively). There was also a significant difference between eyes for Ks Ax ( $Z=4.20$ ;  $P<0.0005$ ). Corneal astigmatism (CA) was not statistically significant between eyes ( $Z=0.67$ ;  $P=0.38$ ). Gender had no significant effect on the difference between eyes for any of the corneal topography parameters ( $P>0.05$ ). The percentage proportion of the classification of CA in the right eye was similar between genders: 81/16/3 compared to 77/20/3 respectively (WTR/oblique/ATR).

We found a small but significant difference in corneal topography parameters between eyes although this was not associated with gender. Our results showed a higher proportion of difference in CA classification between eyes (17%) compared to the published literature (2%). Oblique astigmatism was present in 15% of our study population; this is a higher proportion than reported by other studies (1 to 6%). Possible explanations for these differences include the study population and variation in classification boundaries.

Kristina Mihic worked as a dispensing optician in Croatia since 1999 and she completed her bachelor's degree in optometry in 2010. She worked as a lecturer in contact lenses and refraction at the University of Applied Sciences Velika Gorica for 7 years. In 2015 she completed her master's degree in Vision Science and Business (Optometry) at Aalen University where she obtained clinical experience in Germany and USA. Currently, she is a PhD candidate in Optometry and Visual Science at City, University of London. She investigates orthokeratology lens designs for myopia control. She is a member of the BCLA and IACLE.



## Free Paper Abstracts

### **A contralateral comparison of the effects of light scatter when using an activated photochromic vs. clear contact lens**

Lisa Renzi-Hammond

To assess the visual effects of wearing an activated photochromic contact lens with a direct comparison to a non-photochromic contact lens worn in the fellow eye. This study focused on the visual effects of scatter quantified as the minimum distance between two points of light, and the diameter of the halo and starbursts that surround a bright white point source.

Sixty subjects were measured in a crossover design where lens type was randomly assigned to each eye. All visual measures were made while each eye was illuminated by a violet activator. Two-point thresholds were determined by measuring the minimum distance between two points of white light. Glare geometry was measured using an aperture that created a bright point source of light 38 inches from the plane of the eye. Between the point source and subject, a centering precision caliper was used to measure lateral spread of halos and visual spokes. The head was stabilized using an adjustable head-rest assembly and the eye was aligned and monitored with a bore camera. Compared to the non-photochromic lens, the activated photochromic reduced the light spread based on two-point thresholds by 37.0% on average, the halos were reduced by 48.2% on average, and the spokes were narrowed by 41.8% on average. Based on 95% confidence interval testing, these effects were highly significant ( $p < 0.05$ ).

These data are consistent with previous data showing that soft contact lenses with photochromic additive can improve many aspects of visual function. Our past data focused on visual function under bright light conditions (e.g., glare disability, discomfort, and photostress recovery). Based on the small aperture size of the point source and the distance from the eye, however, these visual stimuli were not intense. This suggests that the photochromic lens improves the effects of light scatter even at lower luminance.

Dr. Lisa Renzi-Hammond earned her B.S., M.S. and doctorate degrees from the Psychology Department at the University of Georgia. While at the University of Georgia, Dr. Renzi-Hammond specialized in visual neuroscience and neurological development and studied the ways in which implementing behavioral changes influences vision system function, as well as risk for acquired ocular and neurological diseases.

Dr. Renzi-Hammond completed her postdoctoral fellowship at the University of Texas at Austin as a member of three different disciplinary groups: the Center for Perceptual Systems, the Institute for Neuroscience, and the Nutrition Sciences Department. She also served as a visiting scientist at the Jean Mayer USDA Human Nutrition Center on Aging at Tufts University in Boston, MA, where she was a member of the Carotenoids in Health Laboratory.

Following her graduate and post-graduate training, Dr. Renzi-Hammond returned to the University of Georgia as faculty, where she founded the Human Biofactors Laboratory and published numerous peer-reviewed articles and book chapters on the topic of carotenoids and visual and neurological function. She has presented this research in a wide variety of national and international venues. She is currently an Assistant Professor in the UGA Institute of Gerontology and Department of Health Promotion and Behavior and maintains adjunct faculty status in the Behavioral and Brain Sciences Program in the Department of Psychology.



## Free Paper Abstracts

### **Effects of different contact lens design on reading behaviour of pre presbyopic subjects subjects.**

Giancarlo Montani

To assess the effects of one daily hydrogel single vision (SV) CL and one daily hydrogel CL with an “extended depth of focus” (EDOF) on reading behavior through eye movement recordings in pre-presbyopic subjects.

Eighteen pre-presbyopic subjects (range age 35-42yrs) with distance high contrast VA  $\leq 0,00\log\text{Mar}$ , spherical refractive error between +3,00 and -5,00D and refractive astigmatism  $< 0,50\text{D}$  were selected. To record the reading behaviour was used the Clinical Eye Tracker system (Thomson Software Solutions Ltd.) with a sampling frequencies of 60Hz and an accuracy of  $0,5^\circ$ . Two different targets were used one with 20 rows with 15 simple words and the other one with two separated columns of 20 letters both presented at a viewing distance of 55cm. Measurements were carried out during wear of a daily hydrogel SV CL (Fusion 1Day, Safilens) and a daily hydrogel CL indicated for the management of eyestrain (Fusion 1Day Vista, Safilens). The power of SV CLs were determined based on subjective refraction (maximum amount of spherical plus power for best VA). The power of EDOF CLs were selected more positive or less negative by 0,50D compared to the SV one.

Between SV and EDOF design CLs were not found significant differences in far and near VA ( $p > 0,05$ ). The EDOF design in respect to SV one induced a significant increase (t-test  $p < 0,01$ ) of number of letter read in a minute both for words (respectively  $131 \pm 12\text{WPM}$  vs  $166 \pm 18\text{WPM}$ ) and for letters (respectively  $419 \pm 42\text{WPM}$  vs  $523 \pm 61\text{WPM}$ ). During the reading of the words EDOF design CLs reduced significantly the fixation duration while the number of fixations did not change significantly. The data obtained in this pilot study suggest that the CL for the management of eyestrain used in pre-presbyopic subjects may influence reading behavior, when an increase of positive power by 0,50D for distance vision is used.

Giancarlo Montani Optometrist FIACLE, FBCLA is Professor of Clinical Contact Lens Application at the University of Salento, Italy. Involved in Optometry education since 1988, he has been Department Head of the Contact Lens Division at the Santa Chiara University Medical Centre in Pisa, Italy until 2004. In 2007 Professor Giancarlo Montani has co-founded the Centre for contact lens research of the University of Salento. Giancarlo Montani also works in private practice. He has published numerous articles in optometric journals, and has been invited as lecturer to several national and international Optometry Congresses.



## Free Paper Abstracts

### **How Driving Performance is Impacted by Photochromic Contact Lenses**

John Buch

To evaluate the performance of the first of its kind photochromic soft contact lens on vision and driving performance in both daytime and nighttime lighting under real world driving conditions In a 4-visit bilateral 3x3 crossover study, 24 subjects were randomized to assess the performance of the photochromic soft contact lens (Test) on vision and driving performance by comparison to the non-photochromic soft contact lens worn without and with plano photochromic spectacles (Control 1 and Control 2 respectively). The subjects drove an actual car on a closed-circuit driving track, with three different routes administered in random order and under a range of challenging controlled conditions. Overall driving performance was a composite Z-score based on six objective metrics. Other vision measures included logMAR visual acuity and contrast sensitivity under various conditions.

Twenty-four subjects, age 21-46 years, completed the study. For daytime driving, the adjusted mean difference in Z-score (95% CI) between Test and Control 1 and between Test and Control 2 were 0.101 (-0.013, 0.216) and 0.044 (-0.070, 0.158) respectively. For nighttime driving, the differences were 0.069 (-0.045, 0.183) between Test and Control 1, and 0.117 (0.003, 0.231) between Test and Control 2. The results demonstrated the non-inferiority of Test relative to the control lenses with respect to both nighttime and daytime driving performance using a non-inferiority margin of -0.25 Z-score. Non-inferiority (margin 0.1 logMAR), or no statistical difference (proportion of letters correctly identified), of the Test to Control 1 and Control 2 was also demonstrated on all logMAR and contrast threshold testing.

Subjects wearing the photochromic soft contact lens during daytime driving, nighttime driving, logMAR and contrast sensitivity testing performed equal or better than when they wore a non-photochromic contact lens by itself and when worn in conjunction with plano photochromic spectacles.

Dr. John Buch is a Senior Principal Research Optometrist for Johnson & Johnson Vision Care and a Fellow of the American Academy of Optometry. John received his O.D. degree from The Ohio State University and his M.S. degree from the Indiana University. His thesis investigated the effect that contact lens designs have on ocular surface physiology. Since joining J&J in 1998, John has been the clinical project lead on several marketed products, most recently Acuvue Oasys with Transitions. He has a research interest in the psychophysical and neurobiological basis of visual perception and the clinical evaluation of contact lens performance.



Free Paper Abstracts

## Free Papers; Presbyopia

### The influence of power profiles on lens power of single vision and multifocal soft contact lenses

Klaus Ehrmann

To demonstrate influence of power profiles of the most commonly prescribed single vision and multifocal soft contact lenses on power shift across power range.

Power profiles of 7 single vision (SV) and 4 multifocal (MF) soft contact lenses were measured using the Nimo TR1504 (LambdaX, Belgium), each in all available powers between -6.00D and +4.00D. Spherical power readings were obtained for a 5mm aperture for SV lenses and for the peripheral, distance power ring zone for MF lenses. Power profiles across the power range were plotted for each lens type and visually assessed for spherical aberration patterns and compared against measured distance powers across the power range.

Distinct patterns in power distribution and power profiles across the power range were observed. Lenses like the PureVision2 or the AirOptix Aqua MF have consistent power profiles, leading to consistent distance power results across the power range with less than 0.1D drift from nominal powers. Conversely, 1-Day Acuvue Moist and Clarity MF have a high degree of spherical aberration varying from minus to plus across -6.00D to +4.00D power range, resulting in distance power variations from nominal by up to 1.75D over the 10.00D range. Other lens types, like the SofLens Daily maintain a consistent power profile, but shift the entire profile towards more minus for negative lenses and towards more plus for positive lenses. Combinations of these three design principles have also been noted, leading to various degrees of power offsets from nominal power. The measured power can differ significantly between lens types and lens powers, some falling outside ISO tolerance, particularly for higher minus or plus lenses. This power variation can largely be explained by, and correlated to, the design concepts on spherical aberrations. Detailed knowledge of power profiles and offsets would benefit practitioners when fitting and prescribing soft contact lenses.

Dr Ehrmann is Director of Technology at the Brien Holden Vision Institute. He has held engineering R&D positions in the USA, Israel, Germany and the UK. Prior to joining the University of New South Wales for his Doctoral degree, he worked for several years for the National Physical Laboratory, Germany. For the last 22 years he has been responsible for instrument development and metrology at BHVI. He has received numerous awards for his innovative ideas, has published over 45 peer-reviewed articles, and holds numerous patents. His research interests focus on developing innovative methods for contact-lens and vision related measurements.



Free Paper Abstracts

### **Comparison of Extended Depth-of-Focus Prototype Contact Lenses with a Commercially-available Center-near Multifocal**

Irene Martínez Alberquilla

Fourteen patients, mean age  $36.1 \pm 13.2$  years, were enrolled in the study and fitted with an EDOF prototype (Filcon V3) and a CN design (Filcon V3). Three different pupil apertures (3, 4 and 5 mm) after pupil dilation with cycloplegia and three different addition powers (0.75D, 1.50D and 2.25D) were randomly considered for each patient and CL. Monocular defocus curves were obtained with the best distance correction for all conditions.

The EDOF lens showed no significant differences in VA at OD defocus position (distance vision) as a function of the addition power for any aperture size. As a function of pupil size, statistically significant differences were found for 0.75D ( $p=0.042$ ), 1.50D ( $p=0.035$ ) and 2.25D addition ( $p=0.016$ ), being the results better for smaller apertures. Conversely, CN outcomes showed significant differences in VA at OD defocus position for all aperture sizes as a function of addition power ( $p<0.05$  in all cases), being the results better for lower addition powers. As a function of pupil size, no significant differences were showed for 0.75D addition ( $p=0.062$ ). For the higher additions, the best results were obtained for 3mm of aperture ( $p=0.018$  for 1.50D and  $p=0.023$  for 2.25D). The defocus curves showed more variability for the CN design in the great majority of the situations. Although the general results showed that both lenses performed better for smaller apertures and lower addition powers, the EDOF design presented significant more robust visual outcomes than the CN lens in all situations, showing the CN more pupil and addition dependence.

Irene received a degree in Optics and Optometry in 2017 at the Complutense University of Madrid and finished the Master's degree in Optometry and Vision at the Complutense University of Madrid in 2018, while she was participating in clinical research studies. Her research interests include multifocal contact lenses, orthokeratology, ocular surface changes during contact lens wear and their role in ocular discomfort. Co-author of 1 article published and has some papers submitted to publication. Also author and co-author of several communications in national and international scientific conferences.

Jessica Mathew (OD, PhD) is Associate Medical Director for North America Vision Care at Alcon, and is responsible for post-market medical and research activities for Alcon's contact lens and lens care portfolios. Prior to joining Alcon, Jessica was on Faculty at the University of Houston College of Optometry. She has over 10 years experience in direct patient care, clinical research and education in the areas of contact lenses and lens care solutions, dry eye, and keratoconus.



## Free Paper Abstracts

### **Implementing eye movement-based reading performance as a measure of functional vision in presbyopes**

Sotiris Plainis

Simple measures of acuity provide only a partial indication of functional vision of in presbyopia correction. Many complaints from presbyopes originate in reading difficulties, especially under low lighting levels. Here we present a new method, based on eye movement analysis, to evaluate sustained reading performance in a presbyopic population.

Eighteen volunteers (age  $64 \pm 4$  yrs) with normal vision participated in the study. Reading performance was evaluated binocularly and monocularly (dominant eye) using simple paragraphs of about 140 words each (0.4 logMAR print size at 40 cm distance) at two luminance levels (50 and 5 cd/m<sup>2</sup>). A reading comprehension questionnaire was performed to secure a high level of attention. Eye movements were monitored with an infrared eyetracker (Eye-Link II, SR Research Ltd). Data analysis included computation of reading speed (in wpm), fixation duration, number of fixations per word and percentage of regressions.

Average reading speed was  $198 \pm 44$  and  $183 \pm 43$  wpm binocularly and monocularly, respectively. The binocular advantage was statistically significant ( $p=0.04$ ) and was attributed to the faster average fixation duration with binocular ( $236 \pm 36$  ms) compared to monocular ( $251 \pm 40$  ms) viewing ( $p=0.011$ ). Number of fixations per word ( $0.9 \pm 0.2$  vs  $0.9 \pm 0.2$ ,  $p=0.41$ ) and percentage of regressions ( $14 \pm 5$  vs.  $13 \pm 5$ ,  $p=0.22$ ) did not differ between the two viewing conditions. Reading speed with binocular viewing was dramatically decreased in low luminance to  $128 \pm 57$  wpm ( $p < 0.001$ ). This was mainly due to an increase in average fixation duration by 145ms ( $381 \pm 88$  ms,  $p < 0.001$ ), while number of fixations increased to  $1.0 \pm 0.3$  fpw ( $p=0.02$ ). Percentage of regressions was not altered in low luminance ( $14 \pm 6$ ,  $p=0.94$ ).

The study shows that average fixation duration is the main eye movement parameter influenced when visuomotor processing is altered - fixations and regressions are mostly affected in retina disease and by cognitive factors. Evaluating reading performance using eye fixation analysis can result in a reliable outcome of functional vision in presbyopia correction.

Sotiris Plainis is a Senior Research Fellow at the Laboratory of Optics and Vision, University of Crete, leading a research group in visual psychophysics and electrophysiology. He is a Visiting Research Fellow at Aston University, UK. He forms a Faculty member of the Basic Optics course organised by the ESCRS and a past member of the Education Committee of the EAOO. He is a BCLA fellow and a member of ISCLR. He forms an International Vision Impairment Classifier. He has published 55 peer-reviewed manuscripts, edited a book and is a reviewer of Postgraduate Scholarships at the College of Optometrists.



## Free Paper Abstracts

### **Pupil Diameter Impact on MF Fitting and Performance**

Jessica Mathew

Pupil size is considered an important variable when fitting multifocal (MF) contact lenses. It has been shown that, with Alcon MF lenses, 98% of patients can be fit with two lenses or less per eye and that 80% can be fit with one lens per eye. The purpose of this study was to evaluate the association of pupil size and 1) the number of lenses required for fitting and 2) visual performance.

Presbyopes (n=84) successfully wearing a variety of soft MF lens designs were refitted with Alcon MF lenses, in lotrafilcon B, nelfilcon A, and delefilcon A materials. Pupil size was measured under photopic, intermediate, and mesopic lighting using ORC Eye-Dentify pupil card. The number of lenses required for the initial fitting were recorded. Following a successful fitting logMAR acuity and subjective visual quality (1-10 scale) were measured at 40cm, 80cm and 4m. Paired comparisons and linear correlation analyses assessed relationship between pupil size (right eye only) and clinical measures.

Mean (SD) photopic, intermediate and mesopic pupil sizes were 3.6 (0.84), 4.5 (1.06), and 5.4 (1.22)mm, with an overall range of 2.0-8.0mm. There was no significant difference in the number of lenses required over the photopic pupil size range on the initial fit (mean=1.36 lenses,  $p>0.05$ ).

Photopic Pearson linear correlation coefficient (near, intermediate, distance respectively) with VA was  $r=0.20$ ,  $r=0.046$ ,  $r=0.048$  and for subjective vision was  $r=-0.004$ ,  $r=-0.069$ ,  $r=-0.002$  ( $p>0.05$  in all instances). Mesopic Pearson linear correlation coefficient for VA was  $r=0.14$ ,  $r=0.03$ ,  $r=0.099$  and for subjective vision was  $r=-0.098$ ,  $r=-0.18$ ,  $r=-0.14$  ( $p>0.05$  in all instances).

Alcon MF contact lenses are pupil size independent and work successfully across a wide range of pupil sizes. Pupil diameter was not related to the number of lenses required for a successful fit and was not associated with subjective and objective visual outcomes.





Free Paper Abstracts

## Free Papers; Myopia Control

### The Montreal Experience On 469 Subjects: A Retrospective Study Of The Management Of Myopia And Axial Length Progression

Langis Michaud

To compare the efficacy of several myopia control strategies on a population of myopic patients This is a retrospective analysis of the chart of every young (< 20 y.o.) myopic (>-0.50D at baseline) patient seen between 2012 and 2017 for myopia management, and followed for at least 5 months. Management strategies include orthoK or soft MF in standard or customized designs, and low-dose atropine, stand -alone or combined with other methods.

The clinical population studied was Female (55%) and Asian (55%). Subjects' ages were at baseline 10.8 + 2.5 years old (males), and 11.4 + 2.3 years old (females). Caucasian males (CM) progressed near 0.25 D/year for each eye (OD -0.24 + 0.31; OS -0.26 + 0.33), not significantly different than Asian males (AM-OD -0.29 + 0.39; OS -0.31 + 0.43) or Caucasian (CF) (OD -0.35 + 0.39; OS -0.34 + 0.38) and Asian females (AF-OD -0.23 + 0.30; OS -0.26 + 0.34). Axial length (AL) progression was near 0.15 mm for all groups (CM OD and OS 0.14 +0.21; AM OD and OS 0.11+ 0.23 mm; CF OD and OS 0.15 + 0.19 and AF OD 0.15 + 0.18 OS 0.16 + 0.20). Based on literature, this represents 50% (D) and 25 to 50% (AL) of control. Looking at myopia control strategies (MCS), OK, offer a better outcome than soft MF, especially for AM , CF and CM. The same tendency is observed for AL, where low myopic CF and AM are showing higher progression in soft MF vs OK lenses. Stand-alone atropine was efficient to limit myopia progression (D) but less efficient to keep AL evolution under control.

It is possible to manage successfully myopia and AL up to 50% of natural evolution. Results vary considering refractive error at baseline, gender, ethnicity and MCS.

Dr Michaud graduated from Université de Montréal (OD-1986; M.Sc. 1998). Since 2001, he is working there as a full professor. He is a Diplomate of the American Academy of Optometry, Fellow of the British Contact Lens Association, of the Scleral Lens Education Society and of the European Academy of Optometry. He authored many articles in peer-reviewed journals and had been invited to speak around the world. He is an editorial board member of Journal of Contact Lens Research and Science, and of the Scleral Lens Education Society.



## Free Paper Abstracts

### **Further comparison of myopia progression in new and established myopia control treatment (MiSight®) groups**

Paul Chamberlain

To evaluate myopia progression in children new to MiSight 1 Day (M1D) contact lenses compared to an established M1D group.

Following completion of a 3-year trial (Part 1) to assess the efficacy of M1D, the control group, comprising wearers of Proclear 1 Day (P1D), were refitted to M1D (Previous P1D, n=52). The existing M1D wearer group continued with M1D (Continuing M1D, n=56) for Part 2 of the study. The age range of both groups was 11-15 years at Part 2 baseline. Cycloplegic spherical equivalent autorefraction (SERE) and axial length (AL) were measured at baseline and then at yearly intervals. Mixed model analyses were used to compare the adjusted change in SERE and AL between groups of Part 2.

There was no significant difference ( $P>0.05$ ) in fixed demographic factors between groups, however, Previous P1D group displayed more myopia (SERE: Previous P1D,  $-3.45\pm 1.14$ D vs Continuing M1D,  $-2.52\pm 0.98$ D) and longer AL (Previous P1D,  $25.07\pm 0.74$ mm vs Continuing M1D,  $24.76\pm 0.66$ mm) for Part 2 at baseline. After the 12-month visit, 100 subjects (51 Previous P1D and 49 Continuing M1D) were analysed. The mean change from Part 2 Baseline to the 12-month visit for SERE was  $-0.17$ D (95%CI  $-0.11$  to  $0.22$ ) and  $-0.12$ D (95%CI  $-0.06$  to  $-0.18$ ) for the Continuing M1D and Previous P1D wearers, respectively. Change in AL was  $0.07$ mm (95%CI  $0.05$  to  $0.10$ ) and  $0.06$ mm (95%CI  $0.03$  to  $0.08$ ), respectively. There were no significant differences between groups for change in SERE and AL over this 12-month period ( $P=0.25$  and  $P=0.35$  respectively).

Myopia progression rates were similar across two demographically matched populations in their first versus fourth year of MiSight lens wear, even though the Previous Proclear 1 Day group had more myopia and longer axial length at Part 2 baseline.

As myopia program lead, Paul Chamberlain is currently responsible for the strategic direction and execution of CooperVision's research in this area. From 2011 to 2016 he managed a team of optometrists who supported all clinical product development activities within R&D. Before joining CooperVision in 2011, Paul spent five years managing industry sponsored research studies at Eurolens Research at the University of Manchester. Prior to that, he was part of Michel Guillon's research team at Optometric Technology Group in London. Paul earned his bachelor's degree in optometry from City University in London.



## Free Paper Abstracts

### **Effects of different design of soft centre distance multifocal contact lenses on HOAs, accommodation and phoria in young adults myopic eyes.**

Giancarlo Montani

The purpose of this study was to investigate the changes induced by a centre distance soft multifocal contact lens using different additions and central distant optical zones (CDOZs), on high order aberrations (HOAs), accommodation and near phoria in young adults myopic eyes.

Sixteen young adults (range age 16–26yrs) with spherical refractive error of -0.50 to -5.00D similar in both eyes participated. With a single vision soft CLs were measured baseline high and low-contrast logMAR acuity at 5m, the pupillary diameter in high mesopic condition (4,00 lux) using a binocular infrared pupilometer and the ocular wavefront aberrations (RMS of coma, spherical aberration and HOAs) using a Hartmann-Shack aberrometer. We measured also at 33cm the binocular accommodative response using an open-field autorefractor and the near phoria using a modified Thorington card. The same set of measurements were repeated immediately after subjects were fitted with custom made soft CLs with different CDOZs (3.50/4.50/5.50mm) and different additions (+1.50/+2.50D) introduced by a peripheral polynomial progression.

The subjects had a pupillary diameter of  $4.88 \pm 0.28$ mm (ave $\pm$ SD). In respect to baseline CLs use induced an increase in RMS for HOAs, coma and positive SA with a higher effect for 3,5mm CDOZs and 2,5D add (this lens presented also the more significant reduction of VA) and lower for 5,5mm CDOZs and 1,5D add. A significant variation of accommodative response (with a reduction of LAG or increase of LEAD) and near phoria (with a shift in exo direction) was associated just with 2,50D with 3,5 and 4,5mm CDOZs.

To consider the possible use of this CL design for myopia control to obtain the best balance between visual quality, increase of positive SA, reduction of LAG of accommodation and shift of near phoria in exo direction we suggested the use of 2,50D integrated addition with 4,5mm CDOZs.

Giancarlo Montani Optometrist FIACLE, FBCLA is Professor of Clinical Contact Lens Application at the University of Salento, Italy. Involved in Optometry education since 1988, he has been Department Head of the Contact Lens Division at the Santa Chiara University Medical Centre in Pisa, Italy until 2004. In 2007 Professor Giancarlo Montani has co-founded the Centre for contact lens research of the University of Salento. Giancarlo Montani also works in private practice. He has published numerous articles in optometric journals, and has been invited as lecturer to several national and international Optometry Congresses.



## Free Paper Abstracts

### **Subjective wearing experience and discontinuation rates with novel, extended depth of focus (EDOF), myopia management lenses**

Fabian Conrad

To report on subjective experience and discontinuation rates of children wearing novel extended depth of focus contact lenses (EDOF CL). These lenses were found to slow myopia progression by approximately 30% over 12 months (1). (1) Sankaridurg et al, Novel contact lenses designed to slow progress of myopia: 12 month results. Invest. Ophthalmol. Vis. Sci. 2017;58(8):2391.

Children (n=508, 8 to 13 years old) with cycloplegic spherical equivalent -0.75D to -3.50D were enrolled in a prospective, double-blind clinical trial. Contact lenses were worn as daily disposables and the children filled in questionnaires at 3-monthly intervals. Out of the sample (5 groups), a subset (3 groups, 304 children) wearing two novel extended depth of focus designs (Etafilcon A, PegaVision Corporation, Taiwan), and the single vision (SV) control lens (somofilcon A, Coopervision [Sauflon Pharmaceuticals Ltd], United Kingdom) was analysed for discontinuation rates and subjective wearing experience.

The discontinuation rate from 1 to 24 months was 21% in the SV group which was not significantly different to the EDOF CL groups (21.6% to 24.7%,  $p>0.05$ ). On a subjective scale of 1-10, vision clarity at distance was high for all groups with ratings ranging from 8.8 to 9.5 for EDOF CL and 9.2 to 9.9 for SV controls over 24 months. Similarly, vision clarity at intermediate and near was high and ranged from 9.2 to 9.9 for EDOF CL and 9.6 to 9.9 for SV controls. There was no significant difference between study groups for vision clarity at distance, intermediate and near (all  $p>0.05$ ). Ocular comfort with EDOF CL was rated high (8.7 to 9.2) and similar to SV controls (8.6 to 9.4,  $p>0.05$ ). Subjective vision and comfort ratings with two novel EDOF CL designs was similar to that observed with a single vision contact lens. Discontinuation rates with these CL were also not different to single vision CL. EDOF CL offer a viable optical strategy to reduce levels of myopia of progressing myopic children.

Dr. Fabian Conrad has worked in the areas of technology development and myopia research for over 10 years. Fabian's research has led to numerous patents and publications in those areas. Originally from Germany, he graduated from the University of Applied Sciences in Berlin as an Optometrist in 2005. He then went on to pursue his doctorate degree at the University of New South Wales in Sydney. Apart from his research in interest in myopia control and algorithm development, he is responsible for the transfer of licensed technology at the Brien Holden Vision Institute and a conjoint associate lecturer at UNSW.



Free Paper Abstracts

## Free Papers; Myopia Control/OrthoK

### CLINICAL EVALUATION OF CUSTOMIZED ORTHO-K DESIGN ON MYOPIA CONTROL AND AXIAL LENGTH ELONGATION

Patrick Simard

To evaluate the efficacy of customized orthokeratology lens design on a population of myopic patients

This is a retrospective analysis of patients consulting at Clinique Universitaire de la Vision, Université de Montréal and for whom a myopia control strategy was initiated. The chart of every young (< 20 y.o.) myopic (>-0.50D at baseline) patient seen between 2012 and 2018, and followed for at least 5 months, was reviewed. The subjects analyzed had been managed by customized orthokeratology lens design using the RGP Designer platform. This means that the lens parameters were fully adapted to patient's ocular parameters, including pupil size. Treatment zone parameters were determined based on corneal curvatures, eccentricity, and pupil area. A double-reservoir type of orthokeratology lens was designed to generate between 75 and 90 microns in the first reservoir.

The study was made on at least 98 subjects, 45 boys (18 Caucasian and 27 Asian) and 53 girls (20 Caucasian and 33 Asian), aged  $11.4 \pm 2.3$  years old. Lenses were worn for 7 days a week, at least 8 h00 overnight, and subjects had been followed for  $5.6 \pm 0.7$  months. Baseline refractive error was  $-3.66 \pm 0.17$  D for OD and  $-3.56 \pm 0.18$  D OS. Axial length was  $25.13 \pm 0.33$  mm OD and  $25.09 \pm 0.38$  mm OS. Pupil size was  $5.37 \pm 0.01$  and  $5.31 \pm 0.07$  mm OD respectively. Myopic evolution was OD  $-0.06 \pm 0.12$  D for the right eye and  $-0.07 \pm 0.17$  D for OS. Axial length elongation was  $-0.03 \pm 0.09$  mm OD and  $-0.02 \pm 0.10$  mm OS.

Customizing Orthokeratology design seems to be more effective, compared with known data, for myopia and axial length management, at least on a short term (near 6 months follow-up). Further studies are needed to confirm this tendency.

Dr. Simard is mainly in private practice at Clinique d'Optométrie Bélanger and is also a clinical instructor and lecturer at Université de Montréal. He completed a master degree on keratoconus and a master degree in business. Current research is focusing on myopia control and he owns a patent for a soft contact device to control myopia progression and axial length.



## Free Paper Abstracts

### **Measurement of factors related to corneal edema after overnight orthokeratology**

Yue Evelyn Zhang

To investigate the occurrence of corneal edema with overnight wear of orthokeratology (OK) lenses in myopes, as indicated by changes in the corneal volume, corneal densitometry and pachymetry. The medical records of 41 myopes (81 eyes) wearing OK lenses between 2013 and 2018 were reviewed retrospectively. Visual acuity (VA), at baseline and the most recent visit, and the baseline refractive error were recorded. Corneal volume, densitometry and pachymetry were collected from the Pentacam at baseline, after one night of lens wear, and at latest visit.

The average age was  $14.0 \pm 6.8$  years at the time of OK lens fitting. The baseline refractive error was  $-3.09 \pm 1.43$  DS and  $-0.62 \pm 0.34$  DC of astigmatism. The final VA after OK wear was reduced from baseline by  $-0.07$  logMAR ( $p < 0.0001$ ). The corneal volume increased significantly between baseline and day 1 ( $p < 0.001$ ), and baseline and latest visit ( $p < 0.01$ ), but not between day 1 and latest visit ( $p > 0.05$ ). Densitometry and pachymetry changed significantly among the three visits and varied with corneal location ( $p = 0.0047$  and  $p < 0.0001$ , respectively). Pachymetry in the central 2mm cornea did not change significantly across all visits ( $p > 0.05$ ), despite expected thinning. Pachymetry changed significantly in both the nasal and temporal regions of the cornea:  $1.17 \pm 0.30\%$  ( $p < 0.0001$ ) and  $1.22 \pm 0.39\%$  ( $p = 0.013$ ) between baseline and day 1, and  $2.25 \pm 0.29\%$  ( $p < 0.0001$ ) and  $2.21 \pm 0.65\%$  ( $p < 0.001$ ) between baseline and latest visit, respectively. Corneal volume, densitometry and vision were all correlated (average  $R^2 = 0.23$ ,  $p < 0.05$ ). No significant difference was found in the corneal pachymetry, final visual acuity, corneal volume and densitometry between subjects with baseline refraction  $> -3.00$  DS and those with  $\leq -3.00$  DS ( $p > 0.05$ ).

Corneal edema from overnight wear of OK lenses in myopes was demonstrated by the increased corneal volume after one night and maintained with continuous lens wear. The degree of corneal edema was not affected by the baseline refraction.

Dr. Yue Evelyn Zhang completed her BSc and OD degree in 2018 at the University of Waterloo School of Optometry and Vision Science. She is currently completing her residency in Cornea and Contact Lens at the University of Waterloo School of Optometry and Vision Science. She is a tutor of the basic and advanced contact lens laboratories. Her research and clinical interests are in orthokeratology, keratoconus and specialty lens fitting.



Free Paper Abstracts

**The impact of changing optic zone diameter on treatment zone parameters during orthokeratology**

Vinod Maseedupally

To investigate the effect of reducing back optic zone diameter (BOZD) of orthokeratology (OK) lenses on treatment zone (TZ) parameters.

Seventeen subjects (mean age  $24 \pm 1$  years) with myopia  $<6.00D$  and astigmatism  $<1.50D$  were enrolled in this prospective study. Subjects wore 'standard' design OK lenses with approximately 6mm BOZD for one week and OK lenses of a 'modified' lens design with BOZD 0.50 mm smaller than the standard lenses for another week in both eyes. The modified lenses were designed to have same overall sagittal height as standard lenses. All lenses were fabricated by Capricornia Contact Lenses, Australia. The order of lens wear was randomised and a one-week washout period of no lens wear was given between the two lens designs. Right eye raw topographic data (Medmont E300), obtained at before and after 7 nights of lens wear of both the lens designs were exported to a customised MATLAB program to determine TZ parameters including horizontal (HTZD) and vertical TZ diameters (VTZD), and polar TZ decentration relative to pupil centre. A two-tailed paired t-test was performed to detect any significant changes in the TZ parameters between the lens designs. A critical p value of  $<0.05$  used for statistical significance.

After 1 week of lens wear, the HTZD and VTZD were significantly lower with the modified (HTZD:  $4.75 \pm 0.94mm$ , VTZD:  $5.18 \pm 1.15mm$ ) compared to the standard design OK lenses (HTZD:  $5.75 \pm 0.76mm$ , VTZD:  $6.07 \pm 1.16mm$ ) (both  $p < 0.05$ ). However, no significant difference was noted in polar TZ decentration between the standard ( $0.85 \pm 0.47mm$ ) and modified ( $0.89 \pm 0.46mm$ ) lens designs ( $p = 0.40$ ).

TZ diameter can be lowered by reducing the BOZD of OK lenses without compromising TZ centration during short-term OK. The outcomes of this study may be useful in optimising peripheral refraction during myopia control with OK where smaller TZs are likely to generate desirable peripheral refraction profiles.

Dr Vinod Maseedupally is a lecturer at the School of Optometry and Vision Science, University of New South Wales. He obtained his basic optometry qualifications from the L V Prasad Eye Institute (LVPEI) and the Bausch and Lomb School of Optometry, India. He was awarded a PhD from UNSW in orthokeratology and treatment zone centration in 2013 and he is currently investigating the effects of peripheral corneal shape on orthokeratology lens centration. Dr Maseedupally is a fellow of American Academy of Optometry and is also the founder and past vice-president of the Alumni of LVPEI Optometrists.



## Free Paper Abstracts

### **First month preliminary results of orthokeratology lens wear with increased compression factor**

Kin Wan

To investigate and compare safety, lens performance, and refractive responses between subjects fitted with orthokeratology (ortho-k) lenses of different compression factors.

Children aged between 6 and 10 years were recruited in a 2-year longitudinal, double masked, randomised study. Each subject was randomly assigned wear ortho-k lenses of either conventional compression factor (CCF, 0.75 D) or increased compression factor (ICF, 1.75 D). All subjects had to attend four follow-up visits within the first month of the study period. The four visits were scheduled in the morning after the first overnight, first week, second week, and one month after lens delivery. Thirty-four subjects and 35 subjects were randomly assigned into the CCF and ICF groups, respectively. Mean (SD) age of the subjects was 9.2 (1.0). The first fit success rates were comparable between two groups at week 4 (CCF: 97%; ICF: 100%). A higher percentage of ICF subjects could achieve full correction at the 1-month visit (CCF: 90.7%; ICF: 97.1%). No significant between-group differences in daytime vision at the 1-month visit and in the coverage and depth of corneal staining between the two ortho-k groups ( $p > 0.05$ ) were observed at any visit.

Increased compression factor induced a faster rate in myopia reduction without compromising the corneal integrity and the ortho-k lens performance. These results suggest that the increased compression factor of 1D was safe to be utilized in a longitudinal study investigating the potential of increasing compression factor to increase efficacy of myopia control in ortho-k.

Mr Ken Wan obtained his Bachelor of Science (Honours) in Optometry from The Hong Kong Polytechnic University (PolyU). He now serves as a research resident and a supervisor of clinical trainings at the School of Optometry in PolyU. He is currently enrolled in a PhD programme, under the joint supervision of Prof Pauline Cho, Prof James Wolffsohn, and Dr Janis Orr. His area of interest is in myopic control and anterior segment changes in orthokeratology treatment.





Free Paper Abstracts

## Free Papers; Pathology

### **The susceptibility of bacterial isolate from corneal infiltrative events of Melimine Antimicrobial Contact Lens (MACL) wear clinical trial**

Parthasarathi Kalaiselvan

#### **Da Vinci Award**

The Melimine Antimicrobial Contact Lens (MACL) clinical trial was conducted to assess its efficacy in reducing corneal infiltrative events (CIEs) during extended wear. The current study investigated the susceptibility of bacteria isolated from contact lenses (CL) of subjects with CIEs during the trial to the Mel4 (Melimine) antimicrobial peptide and the impact of Mel4 on bacterial adhesion to CLs in vitro. A prospective, randomised, double-masked, contralateral, extended CL wear clinical trial was conducted at L V Prasad Eye Institute, Hyderabad, India with 176 subjects. Ethics approval (HREC#15436) was received and the trial was registered with Australia and New Zealand Clinical Trial Registry (ACTRN1261500072556). Antimicrobial contact lenses were produced by coating with Mel4 (Melimine) peptide as previously reported. The CLs were removed and replaced at 14-day intervals over a period of three months. Any Gram-negative bacteria that were isolated at the time of CIEs or during asymptomatic lens wear from CLs were analysed for their susceptibility to Mel4 peptide, and the ability of the Mel4-coated lenses to inhibit their adhesion.

A total of three CIEs with Mel4-coated lens wear and six with control lens wear were observed. *Acinetobacter haemolyticus* was isolated from control lens, and *Citrobacter diversus* from Mel4 lens during the CIEs. *Acinetobacter lwoffii*, *Pasteurella canis*, *Pseudomonas stutzeri*, *Pseudomonas oleovorans*, *Enterobacter asburiae*, *Roseomonas gilardii* and *Ochrobactrum anthropi* were isolated from lenses during asymptomatic lens wear. All the bacteria were susceptible to Mel4 peptide with minimum inhibitory concentration ranging between 15.6 and 125 µg/mL. When tested for the ability of Mel4 CLs to prevent adhesion, all strains showed greater or equal to 2.1 log inhibition of adhesion.

All Gram-negative bacteria that were isolated from lenses were susceptible to Mel4 peptide and Mel4 coated CLs inhibited Gram negative bacterial adhesion.

Parthasarathi Kalaiselvan is a PhD Scholar at School of Optometry and Vision Science, University of New South Wales in Sydney, Australia. He completed his Bachelors (2007) and a Masters (2014) in Optometry training in India. He joined the contact lens department at L V Prasad Eye Institute, Hyderabad in 2011 and took up teaching responsibilities within the Institute, along with a number of other roles including consultant optometrist and research optometrist. His current PhD thesis aims to evaluate the ability of antimicrobial contact lenses to reduce the incidence of corneal infiltrative events during extended wear.



## Free Paper Abstracts

### **The effect of “no water” stickers on water contact-behaviour of contact lens wearers**

Memoona Arshad

Water exposure during contact lens (CL) wear is associated with complications including sight-threatening corneal infections. Despite the documented risks due to water exposure, water-related habits are common amongst CL wearers. The purpose of this study was to determine the effect of “no water” stickers on CL wearers’ water-contact behaviour.

A prospective, masked, randomised controlled trial was conducted and 186 daily CL wearers were randomised to either receive a storage case with a “no water” sticker (test group) or without (control group). Participants completed a self-administered CL hygiene questionnaire at baseline and after 6 weeks. A water-contact behaviour score (0: excellent, 7: poor) estimated the overall water-contact behaviour, including showering, swimming, use of wet hands and use of tap water during CL care. A one-way ANCOVA was conducted to determine the difference between overall water-contact behaviour score for the test and control groups over time when controlling for the baseline score. Each group consisted of 93 participants with an average age of  $27 \pm 11$  years (test) and  $31 \pm 14$  years (control) and male to female ratio of 1:2 in each group. At the baseline visit, the median (IQR) water-contact score was 1(3) and 2(2) in the test and control group respectively and there were no differences between groups for overall water-contact behaviour score or individual behaviours. At the follow-up visit, the median (IQR) water-contact score was 0(1) and 1(2) in the test and control group respectively and both groups differed significantly ( $p=0.01$ ). No significant differences were found for individual water-contact behaviours in both groups.

The inclusion of “no water” stickers in the CL packaging improved the overall water-contact behaviour score of CL wearers. Refining the messaging on the “no water” stickers may help to reinforce water avoidance for individual water-contact behaviours.

Ms. Arshad is a PhD candidate at School of Optometry & Vision Science, University of New South Wales, Australia to investigate the risk factors in contact lens related disease. She is working on the impact of water education on contact lens wearers’ behaviours and case contamination. After graduating with a BSc(h) Optom in 2011 from Pakistan, Ms. Arshad completed her M.Phil thesis on “The effects of long term contact lens wear on corneal pathophysiology” in 2015. Ms. Arshad is also a casual academic and teaching fellow in University of New South Wales and involved in teaching of undergraduate optometry students.



## Free Paper Abstracts

### **Global Multi-Centre study of Potential Benefits of Ultra-Violet Light blocking Contact Lenses**

James Wolffsohn

Although there is strong evidence that shielding the skin from ultra-violet light (UV) is beneficial, there is less evidence for the eyes. Following a pilot study, this multi-site study examined the retrospective effects of wearing UV-blocking contact lenses on eye health, ocular accommodation and macular pigment across 5 developed countries.

Forty two pre-presbyopic patients were recruited who had worn contact lenses for at least 5 years at each site (n=210 in total). Twenty one reported wearing UV-blocking contact lenses for the previous 5 years and the 21 controls had worn a contact lens material with minimal UV-blocking properties for the same period. Ocular health was assessed using slit lamp biomicroscopy and the Efron grading scale. Ocular accommodation was assessed subjectively with a push-up test and defocus curves. Objective stimulus response and dynamic measures of the accommodative response were quantified with an open-field aberrometer. Macular pigment optical density (MPOD) was determined (MPS II). The cohorts of subjects who had worn UV-blocking or non UV-blocking contact lenses were matched for age, sex, race, body-mass-index, diet, lifestyle, UV exposure, refractive error and visual acuity. Ocular health ( $p>0.05$ ), range of clear focus ( $p=0.152$ ) and macular pigment ( $p=0.627$ ) were statistically similar in eyes that had worn UV-blocking contact lenses compared to the controls. However, the amplitude of accommodation was significantly greater ( $p=0.021$ ) in eyes that had worn UV-blocking contact lenses ( $8.0\pm 3.7D$ ) compared to eyes that had worn contact lenses with minimal UV blocking properties ( $7.3\pm 3.3D$ ).

Blocking the transmission of UV through a contact lens is beneficial in maintaining the eye's ability to focus, suggesting that presbyopia may be delayed in individuals who wear UV blocking contact lenses long-term.

Following a 1st class Optometry degree from Manchester, a pre-registration year at Moorfield's Eye Hospital, London, a PhD at Cardiff University and a clinical/research fellowship at the University of Melbourne, Australia, Professor Wolffsohn was appointed by Aston University in 2000, where he was Head of Optometry 2004-9 and Deputy Executive Dean for Life and Health Sciences 2009-16, being awarded a personal Chair in 2007. He is now associate Pro-Vice Chancellor. James has published over 200 peer reviewed academic papers and given numerous international presentations. He is the academic Chair of the British Contact Lens Association, having been a past president.



## Free Paper Abstracts

### **Comparison Of Organic Soil Formulations On The Efficacy Of Contact Lens Disinfection**

Simon Kilvington

ISO14729 is the international standard for determining the efficacy of contact lens disinfection systems against bacteria and fungi. Although not a requirement, most solutions are also tested using organic soil (O/S) comprising the yeast *Saccharomyces cerevisiae* and bovine serum. There is not set regulation for the O/S test concentration, resulting in the tendency to titrate the mixture until the result matches that found with the ISO14729 findings for a given product. Here we propose an alternative O/S, Test Organic Soil:TOS and test method.

Test organisms were the ISO14729 reference strains of *P. aeruginosa*, *S. aureus*, *S. marcescens*, *C. albicans*, *F. solani*. In addition, clinical isolates of *P. aeruginosa*, *S. marcescens* and *A. xylooxidans* were also tested. A variety of disinfectant solutions were tested, based on PHMB (MPS-1), Alexidine + PQ1 (MPS-2), aldox + PQ1 (MPS-3), PHMB + PQ1 (MPS-4), hydrogen peroxide (Per-1) and povidone iodine (PI-1). TOS was a formulation of lysozyme, albumin, mucin, oleic acid, triolein, squalene, cholesterol & paraffin. O/S and TOS were added in each solution respectively at 0.3% final concentration.

Microorganism were inoculated to the tube (final organism concentration of  $10^5 \sim 10^6$ cfu/mL). After the manufacture's recommendation disinfection time, 1mL of the solution was added to D/E neutralizing broth and the viable count was measured by agar plate counts. All tests were performed in triplicate.

The results varied by solution and test organism. 0.3% O/S had little affect on solution performances. However, with TOS notable differences were observed depending on the test solution and organism. For example, significant reduction in microbial kill was observed for *F. solani* (ATCC 36031) with MPS-1, MPS-2, MPS-3 and MPS-4, large reductions were also seen with *C. albicans* (ATCC 10231) against MPS-1, MPS-2, MPS-3 and MPS-4. Similarly MPS-1, MPS-2, MPS-3 and MPS-4 against other microbes. *A. xylooxidans* kill was reduced in kill with MPS-1, MPS-2 and MPS-4. Only with Per-1 and PI-1 were no reduction in antimicrobial efficacy obtained.

The finding of this study indicate that current use of O/S show limited value in assessing more robust testing of contact lens disinfection efficacy. In contrast, TOS showed greater depth of variation and might be considered for further evaluation in the adoption of an ISO standard.



## Free Paper Abstracts

### **Copper and Silver nanoparticle loaded antimicrobial contact lenses**

Debarun Dutta, Davood Kharaghani

To develop antimicrobial contact lenses by loading copper and silver nanoparticles on commercial contact lenses.

Nelfilcon A (PVA added; Focus® DAILIES®) contact lenses were used for copper and silver nanoparticle loading. Briefly, 10 mg/mL copper sulphate or silver nitrate solution was prepared in 0.01 M sodium hydroxide solution. Following this, 100 µl of copper sulphate or silver nitrate solution was added to 20 mL de-ionised (DE) water. Nelfilcon A contact lenses were washed in phosphate buffered saline (PBS; pH 7.2) three times, and immersed in the copper sulphate or silver nitrate solution in DE water for 6 hours with shaking at 120 rpm. Contact lenses containing the metallic ions then were immersed in the sodium hydroxide solution for 10 minutes, washed for three times with PBS, and stored at 4°C in the dark until use. The morphology of metallic nanoparticles loaded into the lenses was characterised by Transmission Electron Microscope (TEM). The antimicrobial activity of the lenses was determined against *Pseudomonas aeruginosa* 6294 and *Staphylococcus aureus* 31 by viable plate count. The cytotoxicity of lenses was studied following the guidelines of ISO 10993-5 with Human Corneal Epithelial (HCE) cells.

TEM showed that nanoparticles of copper and silver were uniformly dispersed in the lens matrix. Copper and silver loaded cells were able to produce  $7.39 \pm 0.0$  and  $7.38 \pm 0.01$  log inhibition against *P. aeruginosa* and  $7.39 \pm 0.0$  and  $7.39 \pm 2.44$  log inhibition against *S. aureus* respectively. Copper nanoparticle loaded lenses showed no cytotoxicity, but silver nanoparticle loaded lenses showed grade-3 response indicating a toxic effect on HCE.

Metallic nanoparticle loaded lenses, especially copper-based nanoparticles, have high potential for development as effective antimicrobial lenses to help reduce the incidence of contact lens-related infection and inflammation. Silver nanoparticle loaded lenses require further refinement to reduce toxicity prior to in vivo investigations.

Debarun Dutta is a lecturer at the Optometry School, Life and Health Sciences Aston University, Birmingham, UK. Prior to this, he worked as a Research and Senior Research Fellow at the School of Optometry and Vision Science at the University of New South Wales for four and half years. Debarun completed his PhD from Brien Holden Vision Institute, and University of New South Wales, Sydney in 2014. Debarun completed his Bachelor of Optometry from West Bengal University of Technology in 2007, followed by one-year clinical fellowship at the L V Prasad Eye Institute, India in 2008. Debarun worked as a clinician and contact lens consultant at the L V Prasad Eye Institute for two years.

Debarun's research interest includes contact lens and dry eye: Anterior ocular surface and tear film, tear lipid layer, effect of preservatives and surfactants on ocular comfort. Debarun is also interested in contact lens-related adverse events: Particularly infiltrative events, development of novel antimicrobial agents, antimicrobial peptides, mechanism and activity of antimicrobial peptides, and aetiology of development of keratitis.



## Free Paper Abstracts

### **Morphological changes of the corneal endothelium between the central and the peripheral areas.**

Federica Cozza

To evaluate centre-periphery differences in endothelium cell density, polymorphism, and polymegathism, using a new method of morphometric analysis applied to a slit-lamp biomicroscope. In vivo central, temporal, and nasal endothelium cell density (ECD), hexagonality (HEX), and polymegathism, expressed as the coefficient of variation (CoV) of cell areas, were determined in the right eyes of 25 healthy subjects (20-35 yrs) utilising a Takagi 700GL slit lamp, equipped with a facility for the acquisition of endothelium and its morphometric analysis.

The mean central ECD ( $2636 \pm 178 \text{ mm}^{-2}$ ) resulted significantly lower than the peripheral ECDs (nasal:  $2828 \pm 217 \text{ mm}^{-2}$ ,  $p < 0.01$ ; temporal:  $2796 \pm 214 \text{ mm}^{-2}$ ,  $p < 0.001$ ). Also, the mean central HEX ( $47.8 \pm 4.0 \%$ ) resulted significantly lower than the peripheral HEXs (nasal:  $56.0 \pm 6.0 \%$ ,  $p < 0.001$ ; temporal:  $55.5 \pm 5.3 \%$ ,  $p < 0.001$ ). Conversely, the mean central CoV ( $28.7 \pm 2.6 \%$ ) resulted higher than the peripheral CoVs (nasal:  $26.3 \pm 2.7 \%$ ,  $p < 0.001$ ; temporal  $27.0 \pm 2.7 \%$ ,  $p < 0.01$ ). Pearson's coefficients between corresponding central and peripheral data varied between 0.16 and 0.55.

A new method of morphometric analysis of the corneal endothelium enabled the comparison of central, nasal, and temporal regions, acquiring images using a slit-lamp. The periphery appeared more homogenous with less degree of polymegathism (6-8% lower mean CoV in the periphery), less polymorphism (17-18% higher mean HEX in the periphery) and 6-8% higher mean cell density. Not only was the central data different from the peripheral one, but negligible correlation was also observed between the two. This further indicated that an assessment both in the centre, and in the periphery, is recommended. A centre-periphery difference in the morphology of the corneal endothelium could have implications in studying the hypothesis of regeneration of the endothelial cells, corneal physiology, and the associated influence of contact lenses.

Federica Cozza graduated with a BSc in Optics and Optometry at University of Milano Bicocca. She currently works at Neuromuscular Omincentre (NEMO) Fondazione Serena Onlus in Milan, as an optometrist, collecting ocular data about patients affected by neuromuscular diseases. Her research interests focus on corneal endothelium and optical systems; she has recently acquired expertise in optometric assessment in people with motor disabilities. She has worked as a teaching assistant in the Degree Course in Optics and Optometry at University Milano Bicocca, in particular in the laboratories of "Principles and Practice of optometry" and " Optical instruments".



## Free Paper Abstracts

### **To investigate reliability of crystal violet (CV) staining to determine the presence of biofilm in lens cases**

Maureen Boost

To investigate reliability of crystal violet (CV) staining to determine the presence of biofilm in lens cases.

1mL aliquots of 10<sup>6</sup> CFU/mL cultures of *Staphylococcus aureus* ATCC6538 and ATCC29523, and *Pseudomonas aeruginosa* ATCC9027 were introduced into lens cases of various designs and left for 12 hours before exposure to rigid lens disinfecting solutions. Cases were left for 24, 48, or 168 hours before washing to remove free organisms and staining with CV. Cases were photographed before stain uptake and determining Optical Density (OD) 580nm. Stain was also added to cases without organisms to determine if it could be removed by rinsing before uptake. Finally, biofilm survival was assessed using tetrazolium-dye reduction (MTT).

ODs of biofilms varied considerably using the recommended cases for solutions (staphylococci 30-74% of control ( $p < 0.001$ ); 57-73% *Pseudomonas* ( $p = 0.03$ )), with surprisingly high readings for povidone-iodine (P-I). However, same solution in different cases also resulted in great variation (0.04-0.19 for *S. aureus*, 0.19-0.31 for *P. aeruginosa*) in OD measurements, which occurred even with uncontaminated cases (0.007 -0.188), the highest reading being for the P-I cylindrical case. MTT assay revealed P-I and chlorhexidine-based solutions could kill virtually all organisms, although the biofilm itself remained relatively intact and could be stained with CV. The two PHMB-containing solutions did reduce viability, but left considerable numbers alive ((31 – 51% of control,  $p < 0.001$ ). CV staining can provide misleading results if used to indicate bactericidal activity against biofilm as dead cells will still stain. Case design strongly effects CV readings even in the absence of organisms. However, even if solutions can kill biofilm, as demonstrated by MTT assay, dead material can act as an easy anchor point and food source for further bacteria. Therefore, even after use of an effective solution, it is advisable to tissue dry lens cases to remove remaining biofilm.

Dr Maureen Boost is registered as a Medical Laboratory Scientist with HCE (UK) since 1975. She has published many papers with Dr Pauline Cho on contact lens-related studies, including non-compliance and contamination, effectiveness and cytotoxicity of contact lens solutions. She is currently a part-time Principal Research Fellow at the School of Optometry, The Hong Kong Polytechnic University.



## Free Paper Abstracts

### **Transient effects of smoking on the eye**

Shehzad Naroo

**Purpose:** To investigate the effects on tear break up time and accommodative ability immediately after smoking.

**Methods:** Three different methods of tear break-up time (TBUT) were used; using fluorescein, a non-invasive TBUT using a tearscope and a video captured method (Oculus Keratograph 5M). Pupil size was measured objectively by using the Keratograph 5M. Accommodative ability was checked with a 'push up test' to measure amplitudes of accommodation (AoA) and also with defocus curves. Participants were examined before and again within 5 minutes of smoking one cigarette.

**Results:** Forty-five smoker participants were enrolled in this study (mean age  $22.0 \pm 4.4$  years). TBUT was significantly reduced after smoking a cigarette in all three methods of TBUT assessment (K5 before  $11.7 \pm 6.1$  seconds & after  $8.7 \pm 6.2$  seconds; Tearscope before  $9.8 \pm 4.0$  seconds & after  $7.0 \pm 2.3$  seconds; Fluorescein TBUT before  $6.7 \pm 3.2$  seconds & after  $4.6 \pm 2.6$  seconds,  $p < 0.001$  for all three methods). A significant reduction in pupil size (before  $5.6 \pm 1.1$ mm & after  $5.4 \pm 1.0$ mm,  $p < 0.01$ ) and in AoA (before  $10.6 \pm 1.8$  dioptres & after  $10.0 \pm 1.6$  dioptres,  $p < 0.001$ ) was observed after an exposure to smoking one cigarette.

**Conclusion:** The study shows that there is a reduction in TBUT immediately after smoking one cigarette and a reduction in amplitudes of accommodation. Smoking has an immediate stimulatory effect followed by a sedentary effect which can be seen when investigating heart rate after smoking. It is possible that this relaxation occurs temporarily in the eyes' accommodative mechanism too.

Shehzad is a Reader at Aston University. Shehzad's research interests include contact lenses, dry eye, corneal biomechanics, laser refractive surgery, cataract and lens surgery, intraocular lenses, sports vision and business aspects of UK eye health care. He has authored and co-authored around 150 publications (including peer-reviewed, editorials, textbook chapters, non-peer-reviewed etc.). In 2015 he was given the 'International Optometrist Award' by the World Council of Optometry. He is Global President of the International Association of Contact Lens Educators (IACLE). He is an Honorary Fellow of the British Contact Lens Association (BCLA) and Editor-in-Chief of the journal 'Contact Lens and Anterior Eye'.





## Free Paper Abstracts

### **Influence of lens deposits on bacterial adhesion to rigid gas-permeable contact lens**

Takahiro Hiraoka

**Purpose :** To investigate the influence of lens deposits such as proteins and lipids on bacterial adhesion and biofilm formation in rigid gas-permeable contact lens (RGPCl) materials.

**Method :** Three brands of orthokeratology RGPCl were soaked in a mixture of proteins and lipids for 24 h, and then the deposition amount of lysozyme and total lipids in each lens was measured. The amount of active lysozyme was also evaluated. Next, RGPCls with artificial deposits of proteins and lipids were soaked in a suspension with *P. aeruginosa* for 4 h, and then the amount of adherent *P. aeruginosa* was calculated and the amount of biofilm was assessed by concanavalin-A staining. The ability of four care solutions, MPS A (containing chlorhexidine and PHMB), MPS B (poly-lysine), Catalase-hydrogen peroxide system (H<sub>2</sub>O<sub>2</sub>) and Povidone-iodine based solution (PVP-I), to remove native and denatured proteins and lipids was evaluated, and disinfectant efficacy of care solutions against biofilms of *P. aeruginosa* and *S. aureus* was also assessed.

**Results :** The amount of lysozyme and lipids deposited on lenses varied between RGPCl brands, ranging from 4 to 300µg/lens for lysozyme and from 40 to 150µg/lens for lipids. The amount of adherent *P. aeruginosa* was 2.8 times higher after soaking RGPCl in proteins and lipids compared to unsoaked RGPCls. Proteins and lipid deposits on RGPCl increased the amount of biofilm formed. PVP-I has the greatest cleaning efficacy among four care solutions tested, and showed high disinfectant efficacy and removal of both bacterial biofilms.

**Conclusion :** Deposits of proteins and lipids enhanced the adhesion of bacteria to RGPCl and increase biofilm formation. In addition, PVP-I showed a high cleaning and disinfectant efficacy against deposits and bacteria. Daily cleaning by PVP-I which contains protease and anionic surfactant may help reduce the likelihood of RGPCl-related infections.

Takahiro Hiraoka completed his M.D. and Ph.D. at the University of Tsukuba, Japan. He was the Director of the Department of Ophthalmology, Ibaraki Seinan Medical Center from 1999-2002, a Fellow and Lecturer in the Faculty of Medicine at the University of Tsukuba, and is the current Assistant Professor in the Department of Ophthalmology. He received the Young Researcher's Awards in 2009 from Japan Cornea Society and in 2011 from Japan Contact Lens Society, and the Best Scientific Paper Award in 2015 from the Japanese Society of Ophthalmological Optics. He is also a board member of International Academy of Orthokeratology Asia.



Free Paper Abstracts

**Comparison of a povidone-iodine containing multi-purpose solution with other MPS for rigid lenses against bacterial biofilm**

Pauline Cho

**Purpose:** To investigate effectiveness of four disinfecting solutions for rigid contact lenses to disrupt and kill established biofilms

**Methods:** 1mL aliquots of 10<sup>6</sup> CFU/mL cultures of *Staphylococcus aureus* ATCC 6538, *S. aureus* ATCC25923, and *Pseudomonas aeruginosa* ATCC 9027 were introduced into lens cases provided by the manufacturers. The cases were allowed to stand for 24 and 72h for biofilm formation before exposure to disinfection (two multipurpose solutions (MPS) containing PHMBs, one MPS containing chlorhexidine, and one povidone-iodine (P-I) solution with slow release neutralizer) for the manufacturers' recommended disinfection time. The cases were washed gently with PBS to remove detached bacteria, before assessing the amount of biofilm present by staining with crystal violet (CV) followed by uptake of stain in ethanol and OD measurement at 580nm. All procedures were repeated replacing CV staining with viability determination using MTT. After incubation, the MTT was removed and the formazan crystals dissolved in dimethyl sulfoxide before measuring absorbance at 550nm.

**Results:** CV staining indicated all solutions had poor ability to remove staphylococcal biofilm. Pseudomonal biofilm was disrupted more efficiently by chlorhexidine ( $0.041 < p < 0.001$ ) and P-I ( $p < 0.001$ ). However, MTT viability determination revealed there were very few surviving bacteria following exposure to either chlorhexidine or P-I. Their efficacy was significantly different from the activity of PHMB-containing solutions ( $p < 0.001$ ). PHMB solutions did reduce viability with prolonged incubation, but did still not achieve the almost complete killing observed for the chlorhexidine and P-I solutions.

**Conclusion:** The newly-introduced formulation of P-I for rigid lenses could effectively kill organisms in an established biofilm. P-I offers a good alternative for contact lens disinfection, as it is stable for at least three months, with no loss of activity, and can effectively kill a wide range of bacterial and fungal pathogens, as well as *Acanthamoeba*. In addition, no resistance to P-I has been reported.

Prof. Pauline Cho obtained her Bachelor and PhD degrees from the University of New South Wales, Australia and University of Bradford, UK, respectively. She speaks extensively both locally and overseas and has published numerous papers. She is a Fellow of the American Academy of Optometry and British Contact Lens Association, and the Founding member and Immediate Past President of The Hong Kong Academy of Orthokeratology. She is currently an Honorary Professor of the School of Life & Health Sciences of Aston University, Birmingham, UK. She is one of the Associate Editors of the Journal "Contact Lens and Anterior Eye".



Free Paper Abstracts

## Free Papers; Dry Eye

### Let's face Demodex on the lids and the face

Sarah Aumond

To evaluate facial Demodex densities in participants with varying severities of blepharitis secondary to Demodex folliculorum.

Fifty-eight participants were divided into control, mild/moderate and severe Demodex blepharitis groups, according to the highest count of cylindrical dandruff on one lid. A standardized skin-surface biopsy and a lash epilation on each lid was performed to obtain the forehead Demodex densities and the overall lash mite count, respectively. Also, facial photographs were taken to evaluate facial erythema and dermatological conditions. The Ocular Surface Disease Index (OSDI), non-invasive break-up time (NIBUT), tear meniscus height (TMH), bulbar conjunctival redness as well as additional questions on watery eyes, ocular itching and itching along the lids were assessed.

Both mild/moderate and severe Demodex blepharitis groups were over the cut-off value [ $\geq 5$  mites/cm<sup>2</sup>] that confirms a facial demodicosis [mild/moderate:  $4.8 \pm 0.6$ ; severe:  $5.5 \pm 0.7$ ] while the control group was below it [ $2.4 \pm 0.6$ ]. The severity of Demodex blepharitis was positively associated with forehead mite densities ( $p = 0.002$ ) and lash mite count ( $p < 0.001$ ). The degree of facial erythema was also positively correlated with forehead mite densities ( $p = 0.02$ ). When compared to the controls, the mild/moderate group had more watery eyes ( $p = 0.02$ ), a lower TMH ( $p = 0.006$ ) and the severe group had more itching along the lids ( $p = 0.04$ ). The other ocular signs and symptoms (NIBUT, bulbar conjunctival redness, OSDI) were not affected by the severity of Demodex blepharitis ( $p > 0.05$ ).

Palpebral and facial Demodex infestation can co-exist, as the presence of blepharitis secondary to Demodex is associated with increased facial mite densities. Therefore, a collaborative model between eyecare professionals and dermatologists should be established for the management of Demodex infestations.

Sarah Aumond has completed a Master degree in vision science, in the field of dry eye disease, at the Université de Montreal.



## Free Paper Abstracts

### **Agreement and repeatability of four different devices to measure non-invasive tear breakup time (NIBUT)**

Stefan Bandlitz

Since tear film stability can be affected by fluorescein, the International Dry Eye Workshop (DEWSII) recommended a non-invasive measurement of tear breakup time (NIBUT). The aim of this study was to investigate the agreement and repeatability of four different instruments in the measurement of NIBUT.

72 subjects (mean  $24.2 \pm 3.62$  years) were recruited as subjects in this multi-centre, cross-sectional study. NIBUT was measured three times in randomized order on two separate sessions during a day, separated by at least 2 hours. NIBUT was performed at three sites (Switzerland, Germany and UK) by the use of Tearscope Plus (Keeler, Windsor, UK) (TS), Polaris (bon Optic, Lübeck, Germany) (POL), EasyTear Viewplus (Easytear, Rovereto, Italy) (ET) and Keratograph 5M (Oculus Optikgeräte GmbH, Wetzlar, Germany) (KER). Correlations between the instruments were analysed using the Pearson- or Spearman-coefficient in non-parametric data. Differences between the instruments were analysed using Friedman-test, differences between the sessions by Wilcoxon signed-rank test. NIBUT measurements between the four instruments were not statistically significant different: TS ( $15.2 \pm 16.2$ s), POL ( $14.5 \pm 14.0$ s), ET ( $15.0 \pm 15.5$ s) and KER ( $12.9 \pm 6.8$ s) ( $p=0.583$ ). Strong positive linear relationships were found between the subjective instruments (TS vs POL:  $r=0.890$ ), (ET vs POL:  $r=0.786$ ), (ET vs TS:  $r=0.782$ ), ( $p<0.0001$ ). Weaker linear relationships were observed between the objectively assessed KER measurements and the subjective instruments TS ( $r=0.662$ ), ET ( $r=0.611$ ), POL ( $r=0.609$ ), ( $p<0.0001$ ). Repeated measurements from session 1 and session 2 were not significantly different for TS ( $p=0.584$ ; 95% CI:  $-0.59$  to  $1.21$ s), POL ( $p=0.549$ ;  $-0.59$  to  $0.95$ s), ET ( $p=0.701$ ;  $-0.64$  to  $0.97$ s) or KER ( $p=0.261$ ;  $-0.32$  to  $1.14$ s).

NIBUT data of this study suggests that the four instruments for tear stability measurement give repeatable values and can be used interchangeably.

Dr. Stefan Bandlitz is a senior lecturer at the Cologne School of Optometry, Germany and a member of the Ophthalmic Research Group, Aston University, UK. He received his Master of Science in Clinical Optometry from Salus University in Philadelphia, USA and his PhD from Cardiff University, UK. Dr. Bandlitz is a Fellow of BCLA, the College of Optometrists (FCOptom) and the International Association of Contact Lens Educators (FIACLE). He is a known speaker at national and international meetings and author of several publications. His current research areas include contact lenses, anterior eye imaging, the ocular surface and the tear film.

### **The differing affinity of a purple powder eyeshadow for hydrogel and silicone-hydrogel contact lenses**

Silvia Tavazzi

To compare the affinity of an eyeshadow for different contact lens (CL) materials.

Six Hydrogels (H: hilafilconB, nelfilconA, omafilconA, etafilconA, filconIV, polymacon) and six silicone-hydrogels (SH: narafilconA, enfilconA, comfilconA, filconV, delefilconA, stenfilconA) were compared. A powder eyeshadow (containing talc, mica, C<sub>56</sub>H<sub>110</sub>O<sub>4</sub>, SiO<sub>2</sub>, borosilicates, (C<sub>10</sub>H<sub>8</sub>O<sub>4</sub>)<sub>n</sub>, KMg<sub>3</sub>(AlSi<sub>3</sub>O<sub>10</sub>)(F,OH)<sub>2</sub>, acrylates, C<sub>8</sub>H<sub>16</sub>O<sub>2</sub>, C<sub>8</sub>H<sub>10</sub>O<sub>2</sub>, C<sub>8</sub>H<sub>7</sub>NaO<sub>4</sub>, C<sub>28</sub>H<sub>44</sub>O<sub>7</sub>, SnO<sub>2</sub>, Mn dye) was dissolved (1 mg/mL) in saline solution. Before and after 24h exposure to this solution, the mass and the optical transmittance of -3.00D CL were measured by a microbalance and a spectrophotometer respectively. Total absorbed eyeshadow mass per CL (M<sub>tot</sub>), and absorbed dye (M<sub>dye</sub>, calculated as percentage compared to initially available dye in solution) were determined by the difference between pre and post-exposition measures. A confocal micrograph was also performed on CLs by a scanning fluorescence microscope: before and after 24h exposure to the powder eyeshadow solution, and limited to delefilconA and filconV, in vivo on three women made up with the eyeshadow after 8h of CL wear.

Mean M<sub>tot</sub> ( $\pm$ SD) was 227 $\pm$ 154  $\mu$ g for Hs and 667 $\pm$ 151  $\mu$ g for SHs (p=0.0005). Mean M<sub>dye</sub> was 28 $\pm$ 24 and 84 $\pm$ 20 %, respectively (p=0.0015). Excluding one H outlier (hilafilconB), and one SH outlier (narafilconA), the mean M<sub>dye</sub> became 19 $\pm$ 5 and 91 $\pm$ 10 %, respectively (p<0.0001). Notably, three SHs (enfilconA, delefilconA, stenfilconA) absorbed 100 $\pm$ 2 % of the dye. Whilst showing differences in intensity between different materials, fluorescence confocal micrographs showed homogeneous dye absorption throughout the entire thickness after both in-vitro exposure, and CL and eyeshadow wear.

The investigated eyeshadow contaminated more SHs than Hs. Concerning the dye component only, hilafilconB (H) and narafilconA (SH) showed unexpected high and low dye affinity, respectively, while total eyeshadow absorbed mass is in line with the typical values of their group. For the investigated samples, the dye absorption is evident throughout the entire CL thickness.

Dr Silvia Tavazzi is associate professor of experimental physics at the Materials Science Department of the University of Milano Bicocca (Milan, Italy). She teaches geometric and physical optics for the Degree Course in Optics and Optometry. Her research activity led to the publication of 94 peer-review scientific articles and 1 patent (source: Scopus, December 2018).



Free Paper Abstracts

**Randomised double-masked trial of the cumulative treatment profile of intense regulated pulsed light therapy for meibomian gland dysfunction**

Ally L Xue

**Purpose:** To assess the long-term cumulative treatment effects of intense regulated pulsed light (IRPL) therapy in patients with meibomian gland dysfunction (MGD).

**Methods:** Eighty-seven participants (58 females, 29 males; mean±SD age, 53±15 years) with clinical signs of MGD were enrolled in a prospective, double-masked, parallel-group, randomised controlled trial. Participants were randomised to three treatment groups, and underwent IRPL (E-Eye, E-Swin, France) therapy with four or five homogeneously sequenced light pulses or placebo treatment to the eyes. Visual acuity, ocular surface characteristics, and tear film parameters were assessed immediately before treatment on days 0, 15, 45, 75, and one-month following the completion of the treatment course on day 105. Expression of markers of ocular surface inflammation and goblet cell function, and eyelid swab microbiology cultures were evaluated at baseline and day 105.

**Results:** Baseline measurements did not differ between groups (all  $p > 0.05$ ). Significant decreases in OSDI, SPEED, and SANDE symptomology scores, and meibomian gland capping, accompanied by augmentation of tear film lipid layer thickness, and inhibition of *Corynebacterium macginleyi* growth were observed in both treatment groups (all  $p < 0.05$ ). Sustained clinical improvements were observed in the two treatment groups from day 75 onwards, although significant changes in lipid layer quality, meibomian gland capping, OSDI and SANDE symptomology were limited to the five-flash IPL group on day 45 (all  $p < 0.05$ ).

**Conclusions:** IPL therapy effected significant improvements in dry eye symptomology, tear film lipid layer thickness, and meibomian gland capping in MGD patients. The findings also demonstrated superior clinical efficacy of five-flash than four-flash IRPL application, and would suggest that an initial course of four treatments would be required to allow for sustained cumulative therapeutic effects to be established prior to the evaluation of overall treatment efficacy.

Ally Xue is a therapeutic optometrist and a final year PhD student in the Department of Ophthalmology at the University of Auckland in New Zealand. Her area of research interest is dry eye disease, with a focus on exploring novel management strategies. Her research is published in the scientific press and she has delivered continuing education lectures and research presentations both nationally and internationally.



Free Paper Abstracts

**Randomised masked trial of the clinical efficacy of MGO Manuka Honey microemulsion eye cream for the treatment of blepharitis**

Jennifer P Craig

To assess the clinical efficacy of a novel MGO Manuka Honey microemulsion (MHME) eye cream in the management of blepharitis.

Fifty-three participants (32 females, 21 males; mean±SD age, 60±12 years) with clinical signs of blepharitis were enrolled in a prospective, investigator-masked, randomised, paired-eye trial. The MHME eye cream (Manuka Health New Zealand) was applied to the closed eyelids of one eye (randomised) overnight for 3 months. Visual acuity, ocular surface characteristics, tear film parameters, and blepharitis symptomology were assessed at baseline, day 30, and day 90. Baseline measurements did not differ between treated and control eyes (all  $p>0.05$ ). Significant reductions in the SANDE and SPEED symptomology scores were detected in treated eyes on days 30 and 90 (all  $p<0.05$ ), while clinical improvements in non-invasive tear film breakup time, lipid layer thickness, and inferior lid wiper epitheliopathy were observed on day 90, relative to control (all  $p<0.05$ ). Following the 3-month treatment period, ocular Demodex count per eyelash decreased significantly in treated eyes ( $p=0.001$ ). There were no changes in visual acuity during the 90-day period (all  $p>0.05$ ), and no major adverse events were reported.

Topical overnight application of the MHME eye cream effected significant improvements in blepharitis symptomology, tear film stability, and lipid layer thickness, as well as reductions in lid margin staining and ocular Demodex load. The favourable clinical efficacy and tolerability profile would suggest that the MHME eye cream demonstrates promise as a novel treatment for the management of blepharitis patients.

Therapeutic optometrist, Jennifer P. Craig is an Associate Professor in Ophthalmology at the University of Auckland in New Zealand, where she heads the Ocular Surface Laboratory. Her main research interest is dry eye and tear film dysfunction. Jennifer regularly delivers continuing education and research lectures internationally and publishes widely in both the scientific and clinical press. She has contributed to the TFOS International Workshops on Meibomian Gland Dysfunction and Contact Lens Discomfort. She is a member of the TFOS Board of Directors and has recently served as Vice-Chair for the second Dry Eye Workshop (TFOS DEWS II).



## Free Paper Abstracts

### **Epiphora and chronic tarsal conjunctivitis associated with make up remover wipes**

Harry Roberts

To report a hypothesis of an association between the use of make up remover wipes (MURWs) and a distinct clinical entity of chronic bilateral epiphora with chronic tarsal conjunctivitis.

Retrospective review of case records.

A total of 25 adult patients, all females with an average age of 53, presented with bilateral epiphora. Average duration of symptoms was 24 months. Clinical examination showed bilateral conjunctival reaction in 92% (papillary predominant 64%, follicular predominant 8%, not specified 20%), without corneal or eyelid changes. None of the patients reported pruritis as a symptom, 80% did not have any atopic associations. The clinical history in all cases included prolonged use of eye make-up remover wipes. 48% of patients were given a course of topical steroids which partially improved symptoms in 36% and no benefit in 12%. 40% were lost to or did not attend follow up but the remaining 56% of patients returning to clinic reported improvement on cessation of make up remover wipes (one lady declined to stop using the wipes).

The presentation and appearances are consistent with a contact allergen-driven chronic conjunctivitis. Isothiazolinone is a common preservative used in make up remover wipes and is known to be a skin irritant, but there is a paucity of literature on its ocular surface effects. Steroid treatment provided partial relief of symptoms, but cessation of the make up remover wipes seemed the most efficacious management.

Harry is an experienced ophthalmologist currently working at Norfolk and Norwich Hospital. He graduated as a Fellow of the Royal College of Ophthalmologists(2016) and won the prestigious Harcourt medal for the highest score awarded. He has also won another 8 national or international prizes, including most recently best papers presented at ESCRS(2017) and UKISCRS(2018) and the Catherine Heatley Memorial Prize(2018). He has 13 publications as first author in important peer reviewed ophthalmic journals and has authored an ophthalmology textbook. He has a subspecialty interest in cataract and anterior segment surgery with experience in both full thickness and lamellar corneal transplantation.





## Free Paper Abstracts

### **Influence of eye gaze position on the inferior tear meniscus as measured by OCT**

Etty Bitton

**Purpose:** Evaluating tear volume, as measured by the inferior central tear meniscus height (TMH), is a valuable clinical measure in the assessment of tear deficient dry eye (DE). A previous study (Bitton, Wittich 2014) found that an inferior gaze position increased the Schirmer score over that of superior gaze. Due to the invasive nature of the Schirmer strip coupled with the enhanced resolution of imaging techniques such as optical coherence tomography (OCT), it would be of clinical value to reassess if gaze position has an influence on the tear meniscus using an anterior segment OCT.

**Methods:** The tear meniscus of the right eye was measured using an OCT (RTVue-100, Optovue) in 7 randomised eye positions; primary (0°), superior (+5, +10°), and inferior (-5,-10,-15,-20°). Inclusion criteria included OSDI <33, no systemic medication or affliction that can affect the tear film, no ocular medication or CL wear for 48 hrs prior to testing. Characteristics of the meniscus such as height (TMH), area (TMA) and depth (TMD), were calculated off-line.

**Results:** Volunteer participants (n=36, 17M:19F, avg age 24.31 ± 2.61 yrs) with ocular surface disease index (OSDI) scores varying between 0-29.5 (avg 9.23) had no difference in TMH (p=0.453) with eye gaze position. This was also the case with TMA (p=0.146). TMD however, revealed higher values with inferior gaze (p=0.016), with the -20° position being different.

**Conclusion:** The central TMH does not seem to be affected by eye gaze position when measured by OCT. TMA and TMD, additional parameters provided by the OCT, may be considered in future studies of the tear meniscus. The TMD seemed to be more sensitive to eye gaze than the TMH in this study.

Dr. Bitton completed her Optometry degree at the University of Waterloo (1988), followed by a Master's in Physiological Optics (1994) from the Université de Montréal both in Canada. She presently holds the rank of Associate professor, and is the Director of the Externship Program as well as the Director of the Dry Eye Clinic. Dr. Bitton is a Fellow of the American Academy of Optometry and the British Contact Lens Association as well as a member of several professional organizations. Her research interests include tear film evaluation, demodex, dry eye and its effect on contact lens wear.



## Free Paper Abstracts

### **The Relationship Between Dry Eye symptoms and Self-Rated Pain Perception.**

Emma Gibson

Dry eye is highly prevalent, however the poor association between symptoms and objective signs of the disease hinders investigation and management of dry eye. Pain perception may help to explain this lack of association. The Ocular Pain Assessment Survey assesses eye pain and general body pain. The Pain Sensitivity Questionnaire (PSQ) assesses self-rated pain perception based on imagined pain scenarios in daily life and correlates with experimentally obtained pain intensity ratings in healthy individuals. Our objective was to investigate whether higher symptoms of dry eye were associated with higher symptoms of general body pain, ocular pain and self-rated pain perception.

This cross-sectional, observational, single visit study recruited 56 postmenopausal women (mean age  $64.1 \pm 7.9$  years). Questionnaires were administered to assess systemic and ocular pain symptoms (PSQ, OPAS) and ocular surface symptoms (Ocular Surface Disease Index [OSDI]). Spearman's bivariate correlations were used to examine associations between questionnaire scores. Higher OSDI scores were moderately associated with higher OPAS scores (non-eye pain  $r=0.37$ ,  $p=0.005$ , eye pain  $r=0.39$ ,  $p=0.003$ ). The PSQ had moderate positive association with OPAS eye pain ( $r=0.42$ ,  $p=0.001$ ). There was no significant association between PSQ and OSDI; PSQ and OPAS-non-eye; or OPAS-eye and OPAS-non-eye.

Self-rated pain perception, measured with the PSQ, was not associated with symptoms of dry eye, measured with the OSDI, in contrast to previous associations between dry eye symptoms and pain tolerance/sensitivity measured with heat stimuli. However, self-rated pain perception was associated with eye pain measured with the OPAS. Increased symptoms of dry eye, measured with the OSDI, were significantly associated with increased eye pain and general body pain in this population. Management of dry eye is complex, and consideration of pain management may be important in addition to treatment of ocular signs.

Dr Emma Gibson is a UK trained Optometrist whose clinical work focuses on the Primary Eyecare Acute Referral Scheme (PEARS) and Eye Health Examination Wales (EHEW). Dr Gibson has spent four years at the University of New South Wales (UNSW) in Sydney researching dry eye and MGD in post-menopausal women. Key outcomes of this recent research include the development of an MGD grading scale for use in clinical practise, taking less than 2 minutes to perform and investigation of the effect of Aromatase Inhibitors, used for breast cancer treatment, on the ocular surface and pain sensitivity.

### **A New Method for Measuring the Pre-Lens Non-Invasive Tear Break Up Time (PLNIBUT)**

Ahmed Sherry

Developing a new method for measuring in-vitro and in-vivo contact lens wettability based on PLNIBUT and detecting the changes in it under different conditions.

A newly developed optical setup used for the assessment of the tear film stability based on the corneal reflex image degradation due to break ups happening on the anterior surface of the cornea was adopted for the PLNIBUT measurement in contact lenses. The method was applied in vitro for three contact lens materials (Delefilcon A (CL1), Omafilcon B (CL2), and Comfilcon A (CL3)) under normal environmental condition and when exposed to hot dry air. PLNIBUT was considered as the appearance of the first degradation in the reflex image. In vivo PLNIBUT was also measured in two materials (Delefilcon A and Omafilcon A (CL4)).



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The three tested materials showed reduced in vitro PLNIBUT when exposed to hot dry air (CL1  $13.33 \pm 7.64$ , CL2  $21.33 \pm 7.09$ , and CL3  $8.00 \pm 3.61$ ) compared to normal condition (CL1  $45.33 \pm 13.05$ , CL2  $49.67 \pm 9.50$ , and CL3  $46.33 \pm 11.59$ ). Materials of higher water content (CL2 62%) showed higher PLNIBUT compared to the lower water content materials (CL3 48%, and CL1 33%). The in vivo PLNIBUT measurements showed longer values for CL1  $8.33 \pm 3.06$  compared to CL4  $3.50 \pm 0.50$ . A new method for in vitro and in vivo assessment of contact lens wettability by measuring the PLNIBUT was presented. A demonstration of PLNIBUT measurements showed that the method can detect the difference in BUT results for different contact lens materials surface under different conditions. The results are in good agreement with previously reported data, showing the potential of the method as a tool to determine the contact lens wettability.

Ahmed Sherry has a BSc Optics and Optometry from the American University of Science and Technology (AUST), Lebanon, and MSc Biophotonics from Cardiff University, UK. Now, Ahmed is a PhD candidate at the Polytechnic University of Catalonia (UPC), Terrassa, Spain. Ahmed has more than 5 years of experience in retail and clinical practice, and 2 years in academia. Ahmed is a member in the International Association of Contact Lens Educators (IACLE), and a winner of the IACLE travel award 2018.