



2019 Clinical Conference Poster Abstracts

1 The access to and usage of medically necessary contact lenses in Ireland

Sean Keady

o Purpose The purpose of this research was to review the Irish government funding of medically necessary contact lenses and access to fitting services for these lenses.

o Methods Medically necessary contact lenses (MN CL) are lenses that a patient requires either because they cannot get adequate vision through spectacles or because they need contact lenses for a purpose other than vision i.e. therapeutic contact lenses. In Ireland no/low income patients are entitled to a medical card. Card holders may claim €42.36 or €64.78 towards a pair of contact lenses once every two years, irrespective of whether the lenses are required for medical reasons or for cosmetic purposes. Working patients who make PRSI (pay related social insurance) contributions may also claim a government contribution towards contact lenses, but a distinction is made for those who require MN CL. Those who require MN CLs may claim half the cost of the contact lenses up to a maximum of €500, under the PRSI scheme.

o Results In 2017 there were approximately 260 approved claims for contact lenses via the medical card system. The data is not broken down into cosmetic lenses and MN CL. In 2017 a total of 207 MN CL were claimed for via the PRSI system. There are only three optometrists working in Irish hospitals and only two of those do any contact lens work (exclusively on children). There is a further single contact lens optician supplying some contract work for hospital contact lens fitting.

o Conclusions Adult patients in Ireland requiring MN CL have great difficulty sourcing these lenses directly from hospitals and must be fitted by private practitioners. While the government will cover half the cost of these lenses for working patients, contributions towards MN CL for no/low income medical card holders is massively inadequate. The cost of fitting these lenses is not normally covered by the government

Sean Keady is an Optometrist based in the west of Ireland. He had his own independent practice for 15 years and recently sold it. In June 2018 he started an MPhil reviewing the current useage and access to medically needed contact lenses. He works as a locum optometrist.

2 Review of a digital contact lens fitting support tool for Eye Care Professionals.

Amanda Bogers

Purpose: Since the digital revolution, several apps have been developed to support Eye Care Professionals (ECP) during contact lens (CL) practice. A multifunctional app and website tool, available since 2014 (OptiExpert, CooperVision), is one example, available in 79 countries and 15 languages worldwide, and provides multifocal and toric calculators to support their prescribing and fitting. The purpose of this study was to understand how ECPs use the tool.

Method: Two months of data (November and December 2018) on usage of the app were collated on country, duration of visit, use of fitting calculators and other educational tools.

Results: There were a total of 72,355 sessions by 36,542 users which was 1.98 sessions per user with an average session duration of 3 minutes. 61.1% of ECPs were returning users. The UK has the most sessions (16,384) and users (7,877) followed by Germany (9,701 sessions and 4,920 users) and the recently launched USA (6,982 sessions and 4,902 users). The app is accessed predominantly by desktop (53.6%) and mobile (40.0%). ECPs used both the toric calculators (60.3% by session, 68.2% by user) and multifocal (36.0% by session and 46.8% by user) for fitting advice in addition to sourcing product information. Considering European prescribing trend data by CL design, the use of the multifocal calculator in comparison to that for torics is over indexed since toric CLs are prescribed around three times more than multifocals.

Conclusions: This novel analysis highlights that ECPs utilise the digital tool to support fitting of toric and multifocal CLs. Repeated use suggests that the app benefits their success in practice and that more support is needed when fitting multifocal compared to toric CLs. Further analysis of ECP satisfaction in using the OptiExpert tool is desired to understand how this can further help their needs.

Amanda Bogers BOptom MCOptom MBA is a Professional Services Manager, CooperVision EMEA. Amanda gained a thorough understanding of the optical industry in the Netherlands, South Africa and the UK. Amanda uses her extensive experience to develop and build strategic training programs to support ECPs and front of house staff and has an intimate understanding of their specific needs. Prior to joining CooperVision, Amanda developed her clinical skills and obtained customer and consumer insight as an optometrist and manager in optometric practices. Since completing an MBA, Amanda has further enhanced her business skills through different roles within the optical industry.

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3 Validation of an online lens fitting app for two daily disposable toric lenses

Doerte Luensmann

With recent increases in online tools to aid lens fitting, it was of interest to compare the prescriptions provided to wearers of two daily disposable silicone hydrogel (DDSH) toric lenses using traditional fitting guides to the prescriptions recommended by the OptiExpert online lens fitting app.

Investigators determined the optimal toric lens prescription (Rx) for two DDSH toric lenses; stenfilcon A and somofilcon A using subjective refraction data (sph/cyl/axis), following the manufacturer's fitting guide. The final lens prescription (Investigator-Rx) was determined based on the over-refraction and lens rotation. Subjects wore the lenses for one week. Retrospectively, the subjects' refraction data were entered into the fitting app, which calculated the recommended Rx (App-Rx). Pearson correlation analysis was conducted between the Investigator-Rx and the App-Rx for each lens type. A success matrix for each lens type was further created to show how closely the results matched, using different criteria for sph (± 0.25 , ± 0.50 D), cyl (± 0.00 DC) and axis (± 10 , ± 20 degrees).

Data of 54 and 37 subjects were analyzed for stenfilcon A and somofilcon A, respectively. Both lens types showed high correlation for sph, cyl and axis between Investigator-Rx and the App-Rx (stenfilcon A $r > 0.92$, somofilcon A $r > 0.97$). Compared to Investigator-Rx the matrix success rate for the app was 82% and 75% for criteria sph ± 0.25 D, cyl ± 0.00 DC, axis ± 10 for stenfilcon A and somofilcon A respectively, and the success rate reached 91% and 92% for criteria sph ± 0.50 D, cyl ± 0.00 DC, axis ± 20 .

The OptiExpert app showed close agreement to the investigator prescribed lens in 9 out of 10 eyes for both toric DDSH lens types. Today's toric lenses are generally stable and predictable in performance and this modern app-based approach can help to make toric lens fitting easy.

After finishing an Optician apprenticeship, Doerte attended the University of Applied Sciences in Aalen, Germany to study Ophthalmic Optics. In 2000 she completed her diploma thesis at the Queensland University of Technology in Australia. After four years in practice, Doerte entered the PhD program at the Centre for Ocular Research & Education (CORE formerly CCLR), University of Waterloo, under the supervision of Dr. Lyndon Jones. She studied the protein deposition profile on contact lenses and intraocular lenses using confocal laser scanning microscopy. Since 2011, Doerte is a clinical scientist at CORE, conducting clinical and laboratory-based contact lens and vision research.

4 How can modern analytical techniques aid the understanding of patient-lens incompatibilities?

Paul Topham

The combination of analytical techniques not normally used in contact lens testing offers the opportunity to identify patient-specific lens incompatibilities resulting from particular tear/materials chemistries. These techniques combine complex instrumentation and experimental expertise that can identify unusual patterns of (e.g.) surface protein and lipid immobilisation, anterior-posterior differences, and lower levels of key antibodies that create a propensity for lens sensitivities. In many cases these problems, once diagnosed, are overcome by a judicious change in lens selection.

Environmental Scanning Electron Microscopy (ESEM) and "wet" Transmission SEM enable sub-micron imaging of lenses. Taken together with zeta potential (ZP) measurements, physicochemical characterisation and detailed biochemical analyses of protein/lipid patterns of normal, abnormal behaviour can be identified.

ESEM images show distinct varied morphological regions with SiHys (absent in conventional hydrogels (CHs)) which are reflected in subject-dependent lipoidal surface domain behaviour (more film-like in CHs). ZP measures surface charge at the interface between sorped-layer and "shear-plane" of overlying fluid –relevant to "in-eye" behaviour. Unworn HEMA-based CHs (omafilcon, vifilcon, etafilcon) show quite similar ZP values (-3 to -6 mV) whereas nitrogenous groups common to current SiHys are much lower and structure-sensitive (balafilcon, -12mV, delefilcon, -30mV). Similarly, protein on worn lenses markedly reduces ZP values of CHs (worn omafilcon, -13mV). One diagnostic assay on extracted lenses measures sIgA levels – conveniently represented by lysozyme:sIgA ratios. "Normal" electropherogram values lie between $\sim 1.2:1-3:1$. Subjects with diminished levels ($< 4:1$) show enhanced protein and care-solution sensitivity and are found to be less successful with lenses that induce high protein deposition. ZP provides excellent additional information.

Appropriate combinations of analytical techniques provide excellent insights into patient-lens incompatibilities. Do you have any unusual or problem patients? For a ~ 2 year period Aston BRU is offering FREE analytical service of such cases. For information contact Val Franklin (biostuff@aston.ac.uk) heading the email BRU LENS ANALYSIS.

Paul achieved his PhD on molecular machines from the University of Sheffield in 2006 and is now Full Professor of Polymer Science at Aston University, Director of Aston Institute of Materials Research (AIMR) and Visiting Professor at South China University of Technology, Guangzhou, China. After post-doctoral work on polymer-peptide conjugates, he was appointed as a Lecturer at Aston in 2008. His current research interests focus on block copolymer self-assembly and triggerable polymer systems. He was the MacroGroup UK Young Researchers Medal 2014 and was hydrogen in the Periodic Table of Younger Chemists for the celebration of IUPAC100 and IYPT.

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5 Characterization of Computer Vision Syndrome in a university population

Pablo Arlanzón-Lope

To characterize Computer Vision Syndrome (CVS) in a university population and to evaluate the factors associated with it.

A survey was created to evaluate the demographic and visual characteristics and the electronic devices (ED) use in the University of Valladolid (Valladolid, Spain). The survey was administered online along with the Computer Vision Syndrome Scale (CVSS) 17 questionnaire. This questionnaire was validated to classify subjects into six groups, from those who suffer less to more symptoms of CVS. Then, groups were divided into asymptomatic (groups one to three) and symptomatic (groups four to six) subjects. Demographic and visual characteristics and ED use were statistically compared between asymptomatic and symptomatic groups using the Mann-Whitney U test, the t-test or the Chi-square test.

2227 valid responses (782 men, 1445 women; 28.9±13.1 years) were obtained. Twenty-four percent (n=432) of the subjects were classified as symptomatic. This group showed a higher presence of women ($p<0.016$), higher prevalence of illnesses related to the eye ($p<0.001$), and a higher intake of medicines with possible ocular affectation ($p<0.001$). The symptomatic group compared to the asymptomatic was also formed by a higher number of spectacles or contact lenses wearers ($p<0.001$), and of subjects who reported not seeing properly with their visual correction ($p<0.001$). Regarding ED use, symptomatic group referred using ED more hours per day ($p<0.001$) and spending longer time periods using ED without resting ($p=0.003$). Additionally, the asymptomatic group changed the activity to rest from ED use more frequently ($p=0.005$).

Approximately one in four subjects of the sample presented symptomatology associated with CVS. Among the main factors related to CVS are being a woman, the presence of eye related illnesses or uncorrected refractive errors. A reduction in the ED using time and resting of this use by changing the activity may help to reduce the symptoms of CVS.

Pablo Arlanzón got his Optometry Degree in 2018 at the University of Valladolid, Spain. He is currently completing his training with a Research in Vision Sciences Master's Degree at the University Institute of Applied Ophthalmobiology (IOBA), Valladolid, Spain. He has been awarded by a research grant from the Spanish Ministry of Education in which he could cooperate with the Ocular Surface Group, where he is collaborating with different research projects on the ocular surface and contact lens field. He has been awarded with the 2018 CooperVision FORCE Student of the Year.

6 Subjective assessment of contact lens handling: what can we learn from the past?

Lyndon Jones , Stephanie Wong

This study examines correlations between clinician-assessed subjective ease of handling of soft contact lenses, and laboratory-assessed physicochemical characteristics. High CL dropout rates caused by handling problems and difficulties in objectively measuring handling performance underline the clinical importance of such studies. The first stage involved assessment of conventional hydrogel lenses widely available in the 1980s, some currently available and some not. This is a platform for assessment of SiHy lenses in which effects of inherently lower coefficients of friction need to be assessed in parallel.

The prospective, single-masked study involved participants (no previous long-term CL wear history) each asked to rate the ease of handling of 23 different types of soft CLs on a 10-point continuous scale. Primary physicochemical data (e.g. EWC, lens thickness and mass, tensile modulus) were collected and additionally transposed into derived quantities (e.g. stiffness factor, plasticising factor).

The data for the conventional hydrogels revealed: • The early conventional hydrogels Hydrocurve II and SofLens 38 had lowest mean ± SD handling scores of 6.08 ± 1.56 and 6.08 ± 1.98 , respectively. • Excelens had the highest mean handling score of 8.67 ± 1.78 . • No significant correlation was found between handling and the equilibrium water content (Spearman's $r = -0.34$, $p = 0.11$) or centre thickness (Spearman's $r = 0.33$, $p = 0.13$) • Handling of hydrogel CLs was strongly correlated with the stated modulus (Spearman's $r = 0.70$, $p = 0.02$), the equilibrium water content (Spearman's $r = 0.64$, $p = 0.04$) and centre thickness (Spearman's $r = 0.76$, $p = 0.01$).

The poster will discuss detailed lens data including graphical presentation of "derived" factors combining thickness and modulus together with the observations that SiHy CLs had higher mean handling scores than hydrogel CLs. All current CLs had mean handling scores of > 6.0 .

Stephanie Wong completed a BA in Biology at the University of Texas at Austin in 2000. She also received an Optometry degree from City University, UK, in 2004 and qualified in 2005. She has worked as a hospital optometrist, in private practice and as the clinic manager at an independent research company. She is currently pursuing a PhD degree at the University of Waterloo investigating evaporimetry under the supervision of Dr. Lyndon Jones and Dr. Paul Murphy.



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10 Hyaluronic Acid (HA) Release of HA-Containing Lens Care Solutions with Silicone Hydrogel Lenses Melanie George

Purpose: Hyaluronic acid (HA) is a natural polysaccharide with hygroscopic properties used in ophthalmic and lens care products to enhance lens wettability and comfort. In vitro release of HA over time from silicone hydrogel (SiH) lenses soaked in HA-containing multi-purpose disinfecting solutions (MPDS) was evaluated using a solid-phase sandwich ELISA (enzyme-linked immunosorbent assay).

Methods: Comfilcon A, fanfilcon A, lotrafilcon B, and senofilcon A SiH lenses were soaked for 16 hours under overnight storage conditions in two MPDS (Hy-Care, CooperVision and Biotrue, B+L). Lenses were then transferred to 24-well plates containing 500 µL phosphate buffered saline rinse solution (PBS). At various time points up to 24 hours, 100 µL aliquots were removed, transferred to 96-well plates, and stored at 4°C pending analysis. Rinse solution was replaced with an equivalent amount of fresh PBS upon aliquot removal. HA lens release was quantified via a sandwich ELISA, wherein HA is initially bound by HA-specific immobilized recombinant aggrecan, then by enzyme-labelled colour detection aggrecan, and quantitated versus a standard curve. Differences in measurements were appraised (Student's t-test, p-value < 0.05 significant).

Results: All lenses demonstrated in vitro HA release over 24 hours from both MPDS (average 119 ± 14 to 487 ± 235 ng/lens), with no significant differences observed at 24 hours between solutions for any lenses ($p=0.2$ to 0.5). A burst release of HA was observed within the first 3 hours for all lenses (1029 ± 305 to 2069 ± 48 ng/lens), with no significant differences between solutions or materials ($p=0.05$ to 0.82).

Conclusions: The in vitro model showed both HA-containing MPDS were able to load lenses for potential on-eye HA release. After initial burst, release was sustained for 24 hours, suggesting availability during typical wear if release rates translate in vivo. Continued investigation of HA's role in contact lens comfort is warranted.

Dr. Melanie George, FBCLA is currently Research Fellow, CooperVision, Inc. She is a microbiologist with several years of experience in contact lens and lens care research and development, as well as, the cosmetics and personal care industry. Her areas of interest include new technologies, novel antimicrobial applications, bacterial adhesion, biofilm formation, and microbial pathogenesis.

11 Evidence for benefits of a water gradient spherical and multifocal lens (delefilcon A) for dryness symptomatic contact lens wearers Erich Bauman

Conduct review of clinical data on delefilcon A contact lenses to evaluate benefits of water gradient technology in symptomatic contact lens wearers.

Water gradient technology provides high oxygen transmissibility and lasting lubricity. Combined with phospholipid tear film stabilizer (DPMC), this technology contributes to improved comfort. Clinical review of published peer-review articles and clinical data was conducted to determine effect of water gradient technology on daily wear time and end-of-day comfort among subjects reporting contact lens discomfort.

DPMC release from delefilcon A was measured in-vitro and presence of phosphatidylcholine in tear film was reported by Rantamaki et al (2017) that contributes to tear film stability. Langis-Michaud et al (2015) measured 22% increase (+3.1 hrs, $p=0.031$) in comfortable daily wear time and improved CLDEQ-8 score (-8.9, $p<0.001$) on 76 subjects with contact lens discomfort. Perez-Gomez et al (2014) reported on 280 subjects across 16 EU nations and observed greater proportion of subjects reporting all day comfort with water gradient technology (93.2%) vs habitual lens wear (58.2%, $p<0.01$). There was a 78.9% reduction in proportion of subjects reporting end-of-day dryness following 2-week wear of water gradient CLs ($p<0.001$). An Alcon sponsored study, presented at the Contact Lens Association of Ophthalmologists Symposium, Toronto, June 2014 and at the American Academy of Optometry Meeting, Denver, Nov 2014 found that subjective comfort ratings were significantly better with delefilcon A than with control lenses ($p<0.0001$). Investigator-rated dry/non-wetting areas were twofold lower, and proportion of lenses without surface deposits about twofold higher, for delefilcon A, suggesting that higher subject comfort is associated with higher surface wettability and better lens surface attributes.

Water gradient technology in delefilcon A contact lenses provides reduction in contact lens related dryness symptoms and longer comfortable wearing time among contact lens wearers who experience discomfort or symptoms related to dryness during lens wear.

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Global planning, conduct and reporting of all clinical trials of Alcon Programs or Projects. Special Training • Good Clinical Practice • Clinical Data Management • Project Management in Monitoring of International Clinical Trials • Good Biostatistical Practice • Monitoring Workshop • Clinical Investigations of Medical Devices

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12 A clinical investigation of the short-term clinical performance to a range of contact lenses and care system combinations **Aftab Mirza**

Some studies have reported compatibility issues (with solution induced corneal staining SICS) with some silicone hydrogel (SiH) contact lens (CL) and multipurpose disinfecting solution (MPDS) combinations, with a peak in SICS 2-hours post-insertion. This study investigated the short-term responses to combinations of two CLs and two care systems.

This was a randomised, double-masked, contralateral, cross-over study in which subjects wore fanfilcon A and comfilcon A SiH CLs (CooperVision), with each lens having been soaked overnight in one of two multi-purpose disinfecting solutions (PHMB, Lite or Hy-Care, CooperVision). Evaluations of biomicroscopy, subjective scores (comfort, vision, burning/stinging, dryness, grittiness, overall), visual acuity, lens fit and lens surface were conducted two hours after lens application.

Twenty-eight subjects, (16 females and 12 males) with a mean age of 38.9 ± 16.2 years completed the study. No differences were seen between CLs and solutions for fit or visual acuity. Lens wettability was good and visible deposition was low for all lens/solution combinations. Most biomicroscopy scores at follow-up were generally similar and within accepted limits. Differences observed were not considered clinically significant: there was more conjunctival staining with Lite ($p = 0.02$) which was also associated with less tarsal conjunctival change ($p = 0.05$). Corneal staining was low (less than 7% corneal area) with all lens/solution combinations and was lowest (3.1% of corneal area) with the Lite/fanfilcon A combination and highest (6.3%) with Lite/comfilcon A. No statistically significant differences were found for subjective scores or reported symptoms.

All measures found in this work indicated good clinical short-term performance of both CLs with solution combinations. The magnitude of both the absolute staining levels and the differences between products were modest and well below the threshold which would be considered as clinically significant.

Aftab Mirza has been a Research Optometrist with Eurolens Research at the University of Manchester for 12 years. Prior to this he worked in private practice for 10 years. He has supervised 6 pre-registration graduates to successful registration. He was the Dollond & Aitchison Tutor Practitioner at University of Bradford for 4 years. He has been involved with teaching and clinical supervision at the University of Manchester for the last 14 years.

13 Protein permeation through silicone hydrogel contact lenses **Aisling Mann**

The importance to corneal health of the oxygen permeability of silicone hydrogels is widely established and more recently water and electrolyte transport has been investigated. Studies of the permeation of larger tear components such as proteins are, however, lacking. The purpose of this study was to investigate protein permeation with a selection of commercially available silicone hydrogel lens materials (SiHys).

kinetic profiles, end-point receiver concentration and permeation coefficients of eight SiHy materials with three protein (initial donor:1 mg/ml) species of differing molecular weight (kDa) and charge (pI) were monitored (UV, 280 nm) over 336 hours using donor-receiver Franz-cells. Water-structuring characteristics of the materials were measured, pre-and post-permeation, using differential scanning calorimetry.

Different protein transport rates through each SiHy material were observed, e.g. lysozyme (14.6 kDa, pI 11.4), lactoferrin (87 kDa, pI 8.7) and myoglobin (17.8 kDa, pI ~7) permeation coefficients (all values $\pm 10\%$) for balafilcon A were: 60×10^{-11} , 100×10^{-11} , 158×10^{-11} cm²/s, reflected in the rising percentage of ice-like water contents at 13.9 ± 1.3 , 14.4 ± 1.4 and 15.7 ± 0.9 respectively. This compares with the low permeating senofilcon A material with permeation coefficients at 0.7×10^{-11} , 10×10^{-11} , 43×10^{-11} cm²/s and ice-like water contents at 6.4 ± 0.2 , 9.7 ± 0.6 and 9.3 ± 0.8 respectively. Free-water content plays an important role in SiHy functionality; a threshold of ~8% ice-like water was found to be critical for protein permeation. Size and charge of the protein influenced their movement through these complex biomaterial structures.

As contact lens technology has evolved the need to maintain a pre-and post-lens tear film that mimics the tear film has become the dominating goal. SiHys intrinsic micro and nanostructure leads to areas of low and high water content, consequently different phases with different hydrophilicities and sizes develop which can allow tear components to move at different rates through the polymer structure - demonstrated by the distinct protein permeation profiles observed in this study.

I am a Research Fellow with the Biomaterials Research Unit at Aston University, Birmingham, UK. My research mainly focuses on biomaterial/host interactions and biocompatibility testing of existing and new biomaterials including the assessment of contact lenses, wound dressings and new hydrogel-based polymers. This post followed on from my PhD on which I obtained Aston University. Prior to my PhD I was a Clinical Scientist in tissue typing with the National Blood Service. I also worked in a rheumatic diseases diagnostic laboratory based in Birmingham University for my MSc in Immunology. I received a BSc in Microbiology from the NUIG, Ireland.

14 Assessment of contact lens dehydration using an in vivo and ex vivo methodology **Gillian Howarth**

Hydrophilic contact lenses are known to be prone to dehydration during wear. In this clinical study we compared a gravimetric approach (ex vivo) and a refractometer approach (in vivo) to assess changes in contact lens material water content with wear.

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Twenty subjects were recruited for a randomised, double-masked dispensing study. Each subject was fitted with four study lenses (somofilcon, etafilcon, stenfilcon and delefilcon) and wore a non-matching pair of study lenses to the two follow-up visits (≥ 6 hours lens wear). In vivo analysis involved placing a refractometer prism (customised Atago CL-1) in contact with the contact lens on eye, with the water content measured directly from the eyepiece graticule. The lens was then removed and weighed prior to and following dehydration, to calculate the gravimetric material water content. These results were then compared with laboratory measures of water content on unworn lenses with the same gravimetric and refractometer techniques.

Gravimetric analysis was successful for all measures, whereas refractometer measurement success varied between 26% (delefilcon) and 84% (somofilcon). Using the gravimetric methodology, the reduction in water content following wear (stenfilcon 0.3%, somofilcon 1.2%, etafilcon 3.2% and delefilcon 5.0%) differed significantly between lens types ($p < 0.0001$). For the refractometry methodology, the reduction in water content following wear (stenfilcon 1.3%, somofilcon 1.9%, etafilcon 3.7% and delefilcon 4.9%) differed significantly between lens types ($p < 0.0001$).

Following wear, all lens types showed a mean reduction in water content with both techniques, with a similar rank order between lens types. Gravimetric analysis provided a reliable measure of bulk water content, but is a destructive methodology, whereas refractometry, although more clinically challenging, provided water content measures at the lens surface in a non-destructive manner. As such, both techniques are complementary and are useful tools in the development of lens materials which are more resistant to dehydration during wear.

Gillian studied at The University of Bradford and was awarded a First Class BSc (Hons) in Optometry. In 2005 she joined Eurolens Research at The University of Manchester. As a Research Optometrist Gillian has been involved in a wide range of contact lens related clinical studies. Eurolens Research is an independent research and consultancy unit for the global contact lens industry.

15 Self-assembly in silicone hydrogels: effects of morphology and microstructure on electrolyte permeation.

Sian Layton

Commercial silicone hydrogels display transport properties which cannot simply be explained by their water content; studies of NaCl permeation through silicone hydrogel lenses, for example, yields results that do not correlate with EWC. This phenomenon is currently attributed to differences in material microstructure. The purpose of this study was to systematically vary simple silicone hydrogel structures to produce a series of silicone hydrogels in which concentration and self-assembly of the siloxy monomer could be compared with microstructural differences.

A series of membranes was synthesised based on TRIS silicone monomer copolymerised with hydrophilic NVP and NNDMA monomers. The concentration of TRIS in the membrane was kept constant (40%) throughout the series while NVP (60, 50, 40, 30, 20, 10 and 0%) and NNDMA (0, 10, 20, 30, 40, 50 and 60%) were varied. The "freezing water" content of the materials was studied using differential scanning calorimetry. Small angle x-ray scattering (SAXS) was used to probe distances between domains of these materials. Atomic force microscopy of this series produced images displaying microphase separated domains.

"Freezing water" content was found to increase (6.9% to 47.7%) with increasing NVP. NaCl permeation coefficients (all values $\pm 20\%$) were observed to rise from 5.8×10^{-8} to 11.3×10^{-8} cm 2 s $^{-1}$ but did not correlate with the water content data. SAXS experiments exhibited domain spacing values ranging from 2.4nm to 5.7nm. Taken together, the results clearly demonstrate the onset of microstructural effects that begin to over-ride water content and structure in controlling electrolyte transport properties.

Although the importance of microstructural effects on transport properties is recognised, it has been minimally investigated. Techniques described here assist in understanding effects of silicone monomer self-assembly on membrane microstructure and permeation. Greater understanding of these phenomena will assist in the understanding of corneal homeostasis in lens wear and the design of improved silicone hydrogel lenses.

Sian Layton is a final year PhD student working in the Biomaterials Research Unit at Aston University, UK. She obtained a degree in Applied Chemistry in 2016. In her current research she is studying the compositional and morphological effects on the water content and ion transport in purpose made silicone hydrogels. She is interested in the use of small angle x-ray scattering (SAXS) to probe the distances between separate domains in these materials on the nanometre scale. Using information obtained from SAXS correlated with permeability data she is working on finding the ideal composition of these gels for various application.

16 The development of synthetic analogues of glycosaminoglycans for the cost-effective modification of contact lens surfaces.

Helena Hutchins

Medical devices benefit from increasingly sophisticated mimics of bodily tissues; contact lenses are no exception and additionally rely on cost-effective process technology. Bodily hydration is often regulated by sulfated glycosaminoglycans (GAGs, e.g. chondroitin sulfate). Hydration is particularly important in dermal, ocular and orthopaedic (cartilage and intervertebral disc) applications. This poster describes synthetic approaches to harness synthetic GAG analogues in the cost-effective modification of contact lens surfaces.

Two families were investigated. (I): block (A-B) copolymers with (A) blocks containing surface attachment groups and (B) blocks containing analogues of GAG sulfate groups. (II): statistical copolymers containing an array of GAG functional groups (e.g. sulfate, hydroxyl, amide,

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carboxyl) together with double bond functionality as a means of immobilizing the copolymer at the lens surface. The families were designed to enable ease and effectiveness of attachment at lens surfaces using “in package coating” during autoclave. Commercial SiHys (e.g. senofilcon, galyfilcon, comfilcon) which already possess clinically acceptable wettability, were used to judge if improvements were possible.

Typical reductions in dynamic advancing contact angle (DACA – all values +/- 2 degrees) achieved with family (I) ranged from 8 degrees to 25 degrees as the proportion (20 -80%) and hydrophilic nature (Methoxy PEG to sulphonate anion) of block B and the pKa of block A relative to the pH of packing solution were varied. For family (II) the reductions in DACA ranged from 5 degrees to 10 degrees as the sulphonate content (inherently lower in this family) was raised from 20% to 40%

Synthetic sulphated glycosaminoglycans analogues can be used to synthesise versatile and cost-effective ways of modifying synthetic hydrogel surfaces with opportunity for structural variation. This contrasts with use of extracted natural mucins which has been reported to be expensive and non-reproducible. These studies are relevant both for contact lens modification and for the development of other implantable biomimetic devices.

Helena Hutchins is currently a first year PhD student working in the Biomaterials Research Unit at Aston University, UK. She obtained a degree in Applied Chemistry at Aston in 2016 followed by a PGCE (Chemistry) at the University of Wolverhampton in 2017. In her current research she is investigating the use of halogenated chain transfer agents (CTA's) in controlled radical polymerisations. Her interests include the synthesis of hydrophilic macromers as precursors for the production of amphiphilic block copolymers. Helena's current focus is determining the effects of varying halogenated CTA concentration on the rate of polymerisation.

17 Whither SiHys? Structures and surfaces in current silicone hydrogel contact lenses

Brian Tighe, Frank Molock

It is some years since a completely new silicone hydrogel concept was launched; existing families have “solidified”. Patterns of emerging clinical information are potentially relevant to problems such as end of day discomfort and intermittent CIEs. In this study we have examined factors that influence self-assembly (domain formation) in SiHys and the effectiveness of techniques consequently required to modulate lens comfort. The structural history of SiHys has often been influenced by IP imperatives and this history has, for the most part, persisted in the current generation of SiHys.

Three key variants found in lens process technology are silicone structure (monomer vs macromer), process diluent and lens comfort technology (coatings, wetting agents etc.). Current silicone hydrogel lens materials have been grouped to allow assessment of potential influences on (e.g.) water structure, ion permeation, domain structure (Environmental SEM and small-angle X-ray scattering) and dynamic surface wettability and lubricity.

Tabulation (not show here) of silicone structure, diluent characteristics and surface comfort technology reveals marked effects of historical structural evolution. This is illustrated by the transition in the same manufacturer's “stable” from balafilcon which to achieve ocular compatibility requires plasma oxidation, to samfilcon, in which manufacturing process and mixtures of lower and higher molecular weight monomers obviate the need for secondary surface treatment. In the case of another manufacturer, similar matrix chemistry has been transformed by a change from a thin “dry” plasma coating (lotrafilcon) to a wet substantial (>5micron) hydrogel layer (delefilcon). Additionally, trademarked terms such as Hydraglyde, Hydramax, Hydralux, Aquaform, and Moistureseal can be grouped under a limited number of molecular routes.

Tables of modulus, Dk and EWC are no longer adequate to inform clinical comparison of SiHys. This project provides a more comprehensive overview and analysis of key characteristics capable of influencing ocular interactions of SiHys.

Frank Molock is currently studying for a PhD within the multidisciplinary Biomaterials Research Unit at Aston University following 30 years industrial experience in contact lens research/development with over 100 issued US and EP patents. His specialist areas are Surfactant structure property relationships as applied to contact lenses; novel hydrogel materials; additives (UV absorption, dyes and photochromics) for contact lenses; experience in taking materials from the bench to prototypes for clinical evaluation; years of experience in getting materials approved through regulatory bodies (FDA and CE mark); troubleshooting production floor yield problems and Chemical modification of contact lens surfaces.

18 Correlation Between Ocular Comfort and Vision Quality of Three Daily Disposable Soft Toric Contact Lenses with Different Moduli of Elasticity

Gary Orsborn

Studies have shown that when vision quality is low, ocular comfort decreases. In addition, silicone hydrogel (SiHy) contact lenses typically have a higher modulus of elasticity than their hydrogel counterparts which can also affect comfort. Therefore, it is of interest to investigate if comfort is correlated to vision quality irrespective of modulus. This study investigated the relationship between comfort and vision quality with three daily disposable (DD) soft toric CLs (two hydrogel and one SiHy) with a range of modulus values.

Habitual soft toric contact lens wearers wore three study lenses (etafilcon A, nelfilcon A, somofilcon A) on a DD basis in a 1-week crossover, randomized, single-masked dispensing study. Subjective comfort and vision quality ratings were collected at the 1-week visit using a 0 - 10 scale. Subjective scores were compared for the three lenses using a linear regression model. Pearson's correlation was used to assess the strength and direction of association between comfort and vision quality variables.



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Thirty-six subjects aged 20 to 65, (mean 35.4 ± 14.1 years), were dispensed lenses and completed the study. At lens dispensing, a statistically significant difference in comfort was seen between the SiHy and hydrogel toric lenses, ($F=3.1$, $p=0.05$). At the 1-week visit, no significant difference was found between lenses for comfort, ($F=0.4$, $p=0.71$). A moderate positive correlation was found between vision quality and comfort at the dispensing visit, ($r=0.52$, $p<0.001$, $R\text{-sq}=27\%$), while a strong positive correlation was found at the 1-week follow-up visit ($r=0.79$, $p<0.001$, $R\text{-sq}=62\%$).

Subjective comfort with the hydrogel and SiHy DD toric contact lenses evaluated was very good and similar irrespective of lens material and modulus. In addition, vision quality was shown to be correlated with ocular comfort for the lenses evaluated.

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.

19 Aqueous Gel Adhesion Angela Pitenis

There are very few models and contact mechanics studies against mucous layers. For problems of soft thin layers, the deformations of the substrate can generally be neglected. Modeling these layers as a bed of springs can provide closed form solutions for contact problems including adhesion.

There are a number of theories regarding the origin of muco-adhesion, and here we assume that differences in the osmotic pressures can drive an adhesive interaction by trying to equilibrate through swelling.

During loading the contact is assumed to have no tensile zone. This is reasonable given that the contact is submerged in an aqueous fluid and is therefore screened from interactions. During loading the relationship between force and contact width is given by the simplified equation. The maximum adhesive force is estimated to be between 5 and 500 μN depending on the osmotic pressure difference between aqueous gel layers, which is consistent with experimental findings.

The closed form solutions reveal that mucoadhesion may be the result of dehydrated gels surfaces in contact.

Angela A. Pitenis is an Assistant Professor in the Materials Department at the University of California at Santa Barbara. Angela has published over 25 journal papers, and has over 400 citations. Her research interests have focused on lubrication mechanisms of soft aqueous gels, from synthetic hydrogels to mucinated corneal cell monolayers.

20 Quantification of Accommodative Response and Visual Performance in Non-Presbyopes Wearing Low-add Contact Lenses Shizuka Koh

Digital eye strain encompasses a range of ocular and visual symptoms across all age groups. Recently, symptoms associated with accommodative or binocular vision stress has become a major problem especially in young individuals. The purpose of this prospective, single-blinded study was to objectively quantify the accommodation response and visual performance of low-add soft contact lenses (CLs) in young non-presbyopic individuals.

Tested lens was a daily disposable low-add bifocal design lens (low-add CL), which employed a centre-distance optical zone and peripheral zone with the addition power of +0.50 D to support near vision. Sixteen subjects aged 20-39 years were enrolled in the study. Refractive state and accommodation (static and dynamic) were measured using an open-field autorefractor with three target vergences, namely, -0.20 D, -2.5 D, and -4.0 D. Binocular high (100%) and low contrast sensitivity (40%, 20%) and reading ability were assessed. Monofocal soft CLs were used as controls.

Accommodative response with low-add CLs was significantly smaller than those with two monofocal CL wearing conditions, i.e., at 40 cm (2.5 D of stimulus) and 25 cm (4.0 D of stimulus) (all $p < 0.05$). The 20% contrast sensitivity at distance was significantly better with low-add CLs and second-time monofocal CLs, compared with first-time monofocal CLs (all $p < 0.05$). The reading ability was not significantly different.

Quantification of accommodative response and visual performance demonstrated that using low-add CLs alleviated the accommodation under the near-vision condition, without sacrificing distance vision, in non-presbyopes.

Shizuka Koh, MD, PhD is an Endowed Associate Professor of the Department of Innovative Visual Science, at Osaka University Graduate School of Medicine. She received her MD from Osaka University Medical School in 1999. After her research fellowship at Osaka University and at University of Rochester (Rochester, NY), Dr Koh has pursued quality of vision in corneal or ocular surface diseases and has research interests in tear film dynamics, dry eye, corneal diseases, keratoconus or corneal ectatic diseases, and contact lens.

21 Myopia Management with NaturalVue (etafilcon A) Multifocal 1 Day Contact Lenses: Continuing Evidence from Clinical Practice. Thomas Aller

To determine the amount of myopic progression over time with the NaturalVue Multifocal 1 Day Contact Lenses (NVMF), an extended depth of focus design, in clinical practice based on change in refractive error (RE) and axial length (AL) progression over time.



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In a retrospective evaluation, clinical data from 141 children (48 male, 93 female, age range 5 to 22.7, with a mean of 12.38 ± 3.18 years), were followed for 6-48 months (M). Nine practice sites fitted the NVMF within the indicated use. Patients had at least $-0.50D$ of RE change per year at baseline. RE was measured at each visit (approximately 6-month intervals), and RE change from baseline was determined at each timepoint. In a subset of children at one site, AL was measured at baseline and each visit.

Baseline RE change ranged from $+0.25D$ to $-5.88D$ per year, with a mean of $-1.07 \pm 0.83 D$ myopic progression per year. There was approximately $1.00D$ reduction in RE change compared to baseline at all timepoints ($0.90D$ (84.1%) 12-17M; $0.97D$ (90.7%) 24-29M; $1.04D$ (97.2%) 36-41M; $0.99D$ (92.5%) 48M). All timepoints were statistically significantly different from baseline ($p < 0.00001$). Baseline AL change ranged from 0.03 to 1.03 mm per year (Mean $0.42 + 0.33$ mm). AL change from baseline averaged $0.19 + 0.17$ mm at 12-17M ($p < 0.005$, 0.23 mm (55%) reduction).

Children fitted with NVMF exhibited a statistically significant reduction in the progression of RE change at all timepoints out to 48M, and a statistically significant reduction in AL change as compared to baseline at 12-17M. These data suggest that this design can slow the progression of myopia and continued study will further explore these effects.

Thomas Aller, OD, FBCLA graduated from UC Berkeley School of Optometry and for 25 years has been researching the use of multifocal contacts for the control of myopia. After receiving the world's earliest patents for a method of myopia control, he began collaborating with the Vision CRC. He is currently conducting several clinical trials on myopia control and hyperopia reduction. He is a Visiting Scholar at UC Berkeley, editor of managemyopia.org, a member of the IMI, and advisor to several companies in the field of myopia control. Dr. Aller is also a recipient of the 2018 GSLS Award of Excellence.

22 Myopia Control: Why each dioptre matters

Mark Bullimore

There is a growing interest in slowing the progression of myopia. This arises from its increasing prevalence, the sight-threatening consequences of higher levels, and the growing evidence-based literature supporting a variety of therapies for its control. Nonetheless, some may say, "Why should we worry about slowing it?" This presentation quantifies the risk of myopic maculopathy associated with each dioptre of myopia.

Data were combined from five recent large population-based studies of the prevalence of myopic maculopathy (Vongphanit et al., 2002; Liu et al., 2010; Gao et al., 2011; Asakuma et al., 2012; Choudhury et al., 2017). Collectively, these studies across four countries report data on 21,000 adults. Each paper presented data for various ranges of myopia, so the midpoint of each range was used.

Prevalence was plotted on a logarithmic scale as a function of degree of myopia. Remarkably, all five studies were well fit by a line with a slope of $1.67x$ per dioptre. In other words, each one-dioptre increase in myopia is associated with a 67% increase in the prevalence of myopic maculopathy. Restated, slowing myopia such that a patient's refractive error is lower by one dioptre should reduce the likelihood of myopic maculopathy by 40%.

Preventing one dioptre of myopia should lower the risk of myopic maculopathy by 40%. Furthermore, this treatment benefit is independent the level of myopia. Thus, while the overall risk of myopic maculopathy is higher in a $-6 D$ myope than in a $-3 D$ myope, slowing their myopic progression by $1 D$ during childhood should lower the risk by 40% in both. In contrast, five years of daily soft contact lens wear, carries a 0.02% risk of visual acuity loss (Stapleton et al., 2008). In summary, the long-term benefits to a patient's visual health outweigh the low risk of daily contact lens wear during childhood to slow myopia progression.

Mark A. Bullimore received his Optometry degree and PhD in Vision Science from Aston University in Birmingham, England. He was a Professor at The Ohio State University College of Optometry for 15 years and previously spent 8 years at the University of California at Berkeley. He is an Adjunct Professor at the University of Houston College of Optometry, and recently served as Dean of the Southern California College of Optometry. He is Associate Editor of *Ophthalmic and Physiological Optics* and the former Editor of *Optometry and Vision Science*.

23 Clinical evaluation of higher add bifocal soft contact lens to control axial length growth in myopic children

Remy Marcotte-Collard

To evaluate the efficacy of a high add power soft multifocal contact lens prototype to control axial length growth on a young myopic population.

This is a prospective, randomized, clinical cross-over study. 24 subjects (aged 8-12) were recruited. Refractive astigmatism was $<0.75D$. Clinical assessment includes cycloplegic refraction, contrast visual acuity, binocular vision assessment, corneal topography, aberrometry, axial length, pupil measurement, fundus examination and slit lamp evaluation. Participants were randomly fitted on one eye with a soft bifocal lens, designed with a $+5.00D$ add power. Transition and central distance zone size were customized for every patient. The second eye was fitted with a spherical lens as a control. After six months, lenses were crossed-over.

The clinical population is made of 14 girls and ten boys, average age of $10.5 + 1.2$ y.o. Seven participants were excluded for the final analysis (3 drop-outs, 4 for compliance issues). Baseline refraction was $-3.44 + 1.40 D$ evolving to $-3.61 + 1.43 D$ after 6 months for the test eye compared with $-3.29 + 1.26$ evolving to $-3.62 + 1.19 D$ for the control. Axial length went from $24.75 + 0.61$ to $24.88 + 0.72$ on the test eye and from $24.70 + 0.69$ to $24.86 + 0.72$ mm on the control. There is a significant difference between test and control based on myopia

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evolution. For axial length, there is a significant difference for those who were fitted with the control first and the test lens in the following 6 months, AL limiting its elongation when wearing multifocal lenses. Reported on an annual basis, the efficacy was established at 60% vs control.

It is possible to fit soft bifocal lens with high add power and be effective to control myopia progression, without impacting vision at distance. This prototype may be considered as a valuable device for myopia management in the future.

Dr. Marcotte-Collard is in private practice at Clinique d'optométrie Bélanger and is a clinical instructor in the contact lens clinic at Université de Montréal. He is now a Phd candidate at Université de Montréal. Dr. Simard is in private practice at Clinique d'Optométrie Bélanger and is a clinical instructor and lecturer at Université de Montréal. Dr. Michaud is a full professor and chief of the contact lens department at École d'optométrie de l'Université de Montréal.

30 Study of Blink Dynamics: Involuntary vs Voluntary Blinks Santiago García-Lázaro

The aim is to analyze blink dynamics and establish the similarities between involuntary and voluntary blinks.

Thirty young adults (22.4 ± 3.5 years) were recruited for the study. Participants had no ocular or systemic pathology or were under any pharmacological treatment. The right eye of all participants was recorded through a high-velocity infrared camera. Involuntary blinks were recorded first, followed by voluntary blinks, stimulated every 6 seconds through an auditory signal. A Maltese cross, displayed in a monitor at a distance of 1 m from the chin rest, was used in order to maintain fixation. On each frame, upper and lower eyelid height along with interpalpebral distance, measured at the center, was recorded using an algorithm created by the authors, offering a detailed description of eyelid movement on the vertical axis. Through this information, the following parameters were obtained in a non-invasive manner: number of blinks, incomplete or complete blink classification, blink duration, contact time between eyelids, interblink interval and velocity and acceleration of eye lid closing and opening.

The percentage of incomplete blinks was lower during the voluntary blink sequence (29%) than during the involuntary sequence (69%). No statistical differences were obtained between voluntary and involuntary blinks for blink duration ($p=0.13$). However, lower contact time between eyelids was found for involuntary blinks ($p=0.02$). Mean closing and opening velocities and closing and accelerations were greater for voluntary blinks compared to involuntary blinks. ($p<0.05$).

Although blink duration is the same, blink dynamic differs between involuntary and voluntary blinks, mainly for contact time. The second significant difference is that the percentage of complete blinks increases when the subject is aware that he has to blink. Thus, it is important to pay attention to these differences when evaluating blink frequency, blink type or any other related parameter.

PhD in Optometría Avanzada y Ciencias de la Visión (University of Valencia) in 2011. Lecturer in different contactology subjects (Degree and MSc). Author of 70 indexed papers in peer-reviewed journals and more than 100 oral and poster presentations in international congress.

31 Prelens Tear Film Metric Derived from Twyman-Green Interferometry of Prelens Tear Films John Buch , Greg Hoffman

An in-vivo tear surface interferometer has been developed to measure the dynamic tear surface shape (TSS). A corresponding prelens tear film (PLTF) metric has been developed. The purpose of this work was to examine whether the metric could distinguish PLTFs by different lens types.

Four clinical trials were examined. In one (42 subjects), the TSS was measured with bare eye, with Acuvue® Oasys with HydraLuxe™ lenses (AO1D), and with habitual lenses. In three different non-crossover studies (41 subjects) the TSS was measured at baseline and 2-week follow-up (FU); four senofilcon investigational lenses (IL) were dispensed. One non-crossover trial also dispensed Acuvue® Oasys® (AO) lenses. The TSS metric was defined by converting the tear shapes to a weighted modulation transfer function (WMTF) and averaging the WMTF (MWMTF) over the 10 second measurement. Differences (DMWMTF) between the prelens and bare-eye MWMTFs, by lens type, were compared.

Results of the first trial are presented in Table 1. They show the AO1D and habitual DMWMTFs were significant ($p < 5\%$) and negative; indicating the bare eye has a higher optical quality tear film as compared to either PLTF. The difference in the habitual and AO1D MWMTFs was also significant ($p < 5\%$) and negative. Table 1: DMWMTF and 95% confidence intervals Comparison Mean DMWMTF (95% CI) AO1D – Bare Eye -713 (-984, -416) Habitual – Bare Eye -1193 (-1500, -868) Habitual – AO1D -480 (-808, -151) Results of the non-crossover studies are presented in Table 2. The bare eye has a higher quality tear film and differences (lens type) may exist among the PLTFs. Table 2: Differences between Baseline and 2-week FU Lens Mean DMWMTF (Standard Deviation) AO -1539 (532) IL 1, -858 (940) IL 2, -591 (1150) IL 3, -246 (1463) IL 4, -778 (929).

The tear film metric could distinguish PLTFs by different lens types.

Greg Hofmann has worked in contact lens research and development for nearly 20 years. He has been involved in a variety of activities ranging from process development to in vitro tribology. His current focus is in clinical metrology and finding connections between in vivo objective measures and subjective responses using machine learning methods.

32 Inflammatory mediators and Substance P in tears during contact lens discomfort Alberto López-de la Rosa

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To analyze whether the concentration of inflammatory mediators and substance P in tears of symptomatic contact lens (CL) wearers (CLW) is associated with the appearance of CL discomfort (CLD) and compare them with asymptomatic CLW.

Thirty symptomatic CLW (8 males, 22 females, mean age 24.7 ± 5.6 years) and 30 asymptomatic CLW (10 males, 20 females, mean age 26.9 ± 5.4 years) were included as classified by the Contact Lens Dry Eye Questionnaire (CLDEQ) short form. Subjects attended 4 study visits: 2 visits (morning and afternoon) in 2 randomized days (CL wearing day and non-CL wearing day). The CL wearing time was paired one-by-one between the symptomatic and asymptomatic CLW. Ocular comfort was measured using a visual analog scale and tear collection was performed with capillary glass in each visit. The levels of 23 inflammatory molecules and substance P were measured in tear samples using an immunobead-based array and an ELISA assay, respectively. The effects of CL wear (wearing/non-wearing), day time (morning/afternoon), and study group (symptomatic/asymptomatic) on tear molecule levels were statistically analyzed.

Ocular comfort and tear MMP-9 levels were lower and EGF higher ($p \leq 0.015$) in the CL wearing day compared to the non-CL wearing day. Ocular comfort, IL-8/CXCL8 and VEGF were lower and EGF, IP-10/CXCL10 and MCP-1/CCL2 higher ($p \leq 0.047$) in afternoon compared to morning. Ocular comfort was lower and substance P higher ($p \leq 0.006$) in symptomatic CLW compared to asymptomatic CLW.

The differences in substance P tear levels between subjects who suffer from CLD and those who are asymptomatic CL wearers suggest that this molecule may be implicated in CLD etiology. Whereas the tear levels of the rest of measured inflammatory molecules appear not to be related to CLD. The role of substance P and its potential application as a biomarker in CLD should be studied in depth.

Alberto graduated in Optometry from the University of Valladolid in 2010. He worked as an optometrist until 2012 when he joined the Ocular Surface Group of the Institute of Applied Ophthalmobiology (IOBA). He obtained a Master in Research in Vision Science in 2013 and, since 2014, he is working on his PhD studying the ocular surface inflammation as a possible cause of contact lens discomfort which, up to date, has given rise to several conference communications and three scientific articles.

33 Tear proteins influence growth and motility in keratitis-causing *Pseudomonas aeruginosa* isolates: towards optimised bacterial phenotype modelling at the ocular surface **Victoria Rimmer**

Pseudomonas aeruginosa is a common cause of bacterial keratitis and is particularly associated with contact lens use. Antimicrobial proteins in the tear film play an important defensive role against such bacteria at the ocular surface. In this work, we assessed the effect of tear proteins on the growth and motility of *P. aeruginosa* isolates from both contact lens and non-contact lens wearers.

P. aeruginosa isolates from contact lens wearing ($n = 2$) and non-contact lens wearing ($n = 3$) patients with keratitis were grown overnight with and without the addition of tear proteins (lysozyme, lactoferrin, mucin, IgG and albumin). All tear proteins were added at concentrations normally found in human tears. Bacterial motility was then assessed using a swim plate method and diameter of swim zones was recorded after overnight incubation at 37°C .

In the presence of tear proteins, exponential growth rate increased for all isolates by up to 26.2%. Swim zone diameters were reduced for all isolates when grown in the presence of tear proteins. For isolates taken from contact lens wearers, swim zone diameter was reduced by 1.2 ± 0.15 and 1.3 ± 0.12 -fold respectively (mean \pm SEM). For the non-wearer isolates, swim zone diameter was reduced by 1.6 ± 0.20 , 1.5 ± 0.22 and 1.2 ± 0.02 -fold respectively.

Tear proteins increased exponential growth rate but decreased motility in *P. aeruginosa* isolates to varying extents depending on bacterial origin and resistance profiles. These data will inform the development of a tear protein array for use in bacterial phenotype modelling at the ocular surface.

Victoria is a 3rd year PhD student at The University of Manchester. She originally graduated with a 1st Class BSc(Hons) in Pharmacology and Physiology from The University of Manchester in 2016, before moving on to study for a PhD in Optometry. Her work focuses on developing an in vitro model of the cornea and tear film to further understand how the phenotype of *Pseudomonas aeruginosa* is altered at the ocular surface during keratitis.

34 Characterisation of Porcine Ocular Tissue for Anterior Eye Research Applications **Francesco Menduni**

The role of ex vivo models is becoming increasingly important in the ophthalmic research applied to contact lenses and intraocular lenses development. Porcine eyes represent a useful and cost effective model of the anterior segment due to their similar morphology to the human eye. However, the "translation" of the scientific findings is very dependent on the conditions to which the eye is exposed prior to and post enucleation. This study aimed to understand the influence of pre-enucleation conditions and optimise the preservation technique of porcine eyes to maximise corneal

Ten porcine eyes were freshly enucleated at a local abattoir, stored at 4°C and dissected within 24 hours. Either air or supplemented Dulbecco's Modified Eagle's Medium (DMEM) were used as preservation solutions. Central Corneal Thickness (CCT) was obtained using ultrasound pachymetry, while corneal and crystalline lens transparency were quantified using spectrophotometry. Anterior Chamber Depth (ACD) and Endothelial Cell Density (ECD) were measured using OCT and confocal microscopy, respectively.

Corneal thickness and transparency were influenced by the freshness of the eye, scalding process and the storage conditions. Post enucleation CCT was $833 \pm 68 \mu\text{m}$ for unscalded eyes and $1003 \pm 45 \mu\text{m}$ for scalded eyes, while ACD was $2.40 \pm 0.01 \text{ mm}$ and $1.77 \pm 0.27 \text{ mm}$, respectively. Due to transparency loss, ECD was only measurable in unscalded eyes and it was $3172.6 \pm 194.7 \text{ cell/mm}^2$. Using

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supplemented DMEM reduced corneal turgidity thereby maintaining corneal thickness and transparency (transmission ~80%) during storage.

This study provides baseline information on porcine tissue and influence of any heat exposure prior to enucleation and storage conditions. Understanding these factors may help increase the reproducibility of published values derived from ex vivo eye models, especially those for dry eye disease. Additionally, the use of porcine eyes contributes to reducing slaughterhouse waste in powerful alternative assays in line with animal experimentation rules.

Mr Francesco Menduni is a project officer at Aston University, where he is currently developing an in-vitro animal model to evaluate novel pharmaceutical approaches to Dry Eye Disease management. His academic background and passion is Bioengineering, at the interphase between the biology of repair and biomedical technologies. In particular, after graduating summa cum laude in Biomedical Engineering at Università degli Studi di Napoli "Federico II", he moved to Aston University for doctoral studies, gaining solid background knowledge in rapid prototyping, image processing, and in subject areas related to biomaterials and tissue engineering.

35 The Lipid-Aqueous Interface: Influence of Contact Lens Wear **Val Franklin**

Stability of lipid-aqueous interfaces is enhanced by increasing surface pressure. This study examines the surface pressures of tear lipids and the influence of contact lens wear modalities (DW and CW) on these using dynamic surface pressure (SP) measurements.

A Langmuir trough (LT) was used to study surface behaviour of extracted lipids at the aqueous interface. Pressure-area isotherms (π -A) and adsorption profiles (π -T) were measured (multiple subjects: balafilcon A, lotrafilcon A, delefilcon and narafilcon-A lenses). Lenses were extracted and trans-methylated prior to GCMS analysis which gave fatty acid profiles for single lens extracts. Unworn lenses were also extracted to determine the surface behaviour of extractable material. Isotherms of subject tear lipids (no lens) showed "baseline" surface pressures of ~25-40mN/m under compression; GCMS showed the expected characteristic distribution of fatty acid derivatives. Significant differences were observed between the GCMS fatty acid profiles of DW and CW modality (balafilcon A and lotrafilcon A lenses) – the fatty acids associated with CW showed a marked reduction in unsaturated structures. Significantly, the π -A isotherms of extracted lipids from DW (~46mN/m) showed marked differences from CW (~34mN/m). Interesting behaviour (DW) was observed with narafilcon A. Extracted lipids showed consistent values of the SP (ca 35mN/m) whilst GCMS confirmed the presence of decanoic acid (SP, 35mN/m), identified in patents as a process additive. In contrast, hydrogel-coated delefilcon yielded no lipid extracts (DW, 8 hrs).

Langmuir trough studies- augmented by GCMS analyses - yield interesting insights into the interactive behaviour of lipids and lenses. The observations include: the overnight degradation (undoubtedly induced by free radicals) of fatty acid component of lipid structures, the unintended augmentation and stabilisation of lipid layers by extractable processing aids and the effectiveness of coherent hydrophilic lens coatings in inhibiting lipid sorption from the tear film.

Val studied Biological Sciences and graduated from Wolverhampton Polytechnic in 1986. She then joined the Biomaterials Research Unit at Aston University and attained her PhD 'Lipoidal Species in Ocular Spoilation Processes' in 1990. Won the Professor Jeffreys Prize for Research in her final year and the first two BCLA poster prizes. Awarded the BCLA Dallos Award in 1995. Val has continued to work within the Biomaterials Research Unit as a Research Fellow on various aspects of biochemical analysis of spoilation processes of biomedical polymers including contact lenses, intra ocular lenses and the development of biomimetic polymers for prosthetic applications

36 Low levels of ex vivo total cholesterol extraction and the maintenance pre-lens tear film stability and comfort with EOBO regimen throughout 30 days of lens wear **Christopher Lievens**

To investigate the total extracted ex vivo cholesterol, daily comfort, and pre-lens tear film stability over a period of 30 days with lotrafilcon B lenses packaged in blister solution containing EOBO (polyoxyethylene-polyoxybutylene) wetting agent, cared for with H2O2 lens care solution containing EOBO (Regimen1) or MPS solution containing EOBO (Regimen2).

122 subjects were randomized to either Regimen1 (n=59) or Regimen2 (n=63) in this multi-center, prospective, randomized, observer-masked study. A subset of right lenses were assessed for ex vivo total cholesterol extraction (n=23 Regimen1; n=25 Regimen2) at Day30. Overall daily comfort ratings (10-point scale; 1=poor, 10=excellent) were collected every day on Day1/6h to Day30/6h by answering text messages. Pre-lens tear film stability was determined by time (seconds) to first distortion (TFD) analyzed from 25 seconds by non-invasive keratography break-up time (NIK BUT) (Keratograph5, Oculus, Germany) videos over the right lens at Day1/8h and Day30/8h. All data is presented as Mean (SD; 95% CI).

Total ex vivo cholesterol extracted from lenses with Regimen1 was 0.28 μ g/lens (0.18; 0.20-0.36) and 0.28 μ g/lens (0.48; 0.08-0.48) for Regimen2. Overall daily comfort for Regimen1 was rated 8.0 (1.7; 7.5-8.5) on Day1/6h and 7.9 (1.6; 7.5-8.4) on Day30/6h vs. 8.2 (1.6; 7.8-8.6) and 8.1 (1.3; 7.7-8.4) for Regimen2, respectively. TFD for Regimen1 was 6.71 sec (3.76; 5.73-7.69) at Day1/8h, and 7.96 sec (4.58; 6.71-9.22) at Day30/8h vs. 6.46 sec (3.97; 5.46-7.46), and 6.79 sec (3.77; 5.83-7.76) for Regimen2, respectively.

Low levels of ex vivo total cholesterol extraction were observed from worn lotrafilcon B packaged with EOBO, cared for with EOBO lens care solutions. These low cholesterol levels may contribute to the maintenance of pre-lens tear film stability, and this may contribute to



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the maintenance of stable comfort, suggesting that the EOBO regimens maintain long lasting lens surface wettability throughout the wearing period of 30 days.

Chris Lievens is a Professor at Southern College of Optometry. He is a fellow of the American Academy of Optometry and is a Region Chair of the Academy's Admittance Committee. Dr. Lievens is the co-creator of the funduscopy grading card and currently conducts research in glaucoma, dry eye, uveitis and contact lens care. Dr. Lievens has a Master's degree in Healthcare Administration and is currently enrolled in a PhD program at Anglia Ruskin University. Dr. Lievens is also a member of the American Optometric Association, the British Contact Lens Association and the Association for Vision and Research in Ophthalmology.

37 Development of a mass cytometry protocol to assess the inflammatory status of the ocular surface

Rachel Cant

Discomfort is leading factor resulting in discontinued contact lens wear, however the inflammatory mechanisms potentially underpinning discomfort are not well defined. Characterisation of the inflammatory status of epithelial cells and immune cells removed from the ocular surface represents a powerful tool to investigate the coordination of these processes by different cell types. We have developed a mass cytometry method, which enables simultaneous assessment of up to 40 surface or intracellular proteins, to identify the immune cell infiltrate and inflammatory status of epithelial cells in contact lens wearers and validated this using primary corneal epithelial cells.

Primary corneal epithelial cells were incubated with heat killed *Pseudomonas aeruginosa* (HKPA), heat killed *Staphylococcus aureus* (HKSA) and IL-1B for 6 hours (n=3). Cells were then stained using a mass cytometry panel comprising of EpCam, CK3, CK13 and twelve inflammatory cytokines and samples were analysed by mass cytometry. The expression of inflammatory cytokines within the epithelial cell population was determined and compared to untreated cells.

Untreated corneal epithelial cells produced detectable levels of IL-12p35, IL-18, MCP, MDC and MMP-9. An 2.67-6.1 increase in IL-6 and IL-8 production was observed in corneal epithelial cells in response to HKPA, HKSA. Additionally, IL-1B stimulation of one of the epithelial cell samples also induced the increased production of IL-1B, IL-6, IL-8 and IL-18 (2.53-8.9 fold increases were detected).

Using a mass cytometry panel, inflammatory cytokines were shown to be produced by primary corneal epithelial cells in response to bacterial and immunological challenge. The response to bacterial challenge was more consistent, perhaps reflecting synergistic stimulation of multiple inflammatory pathways. This technique can now be applied to determine the inflammatory status of epithelial cells and immune cells taken from the ocular surface of asymptomatic and symptomatic contact lens wearers.

Rachel Cant is a postdoctoral research associate for the Medical Device Biology Group at the University of Manchester. Prior to this, she completed her PhD in regulation of innate immune receptors at St George's, University of London and a BSc in Medical Microbiology and Immunology at Newcastle University. Rachel's current research focus is on ocular surface immunity.

38 The impact of soft contact lens surface and optics on symptoms associated with digital eye fatigue in symptomatic soft contact lens wearers

Dawn Meyer, Pete Kollbaum

Near work, often on digital devices, now permeates the daily life of individuals of all ages at both work and play. Sustained near work on digital devices has been found to increase symptoms of eye strain. A contact lens which reduces the accommodative demand may help reduce symptoms. The current study compared subjectively reported eye strain, dryness, overall fatigue, and quality of vision of symptomatic subjects while binocularly wearing soft, daily disposable spherical and multifocal contact lenses.

Forty-three subjects with self-reported eye fatigue (>1x per month) while using digital devices >4 hours per day binocularly wore in a randomized order spherical and center near, low add multifocal contact lenses (both delefilcon A) for 7±3 days. During subject's normal activities, subjective ratings of eye strain, dryness, overall fatigue, and quality of vision were captured via an electronic survey at lens insertion, lens removal, and every 2 hours in between (14 hours total).

Collapsed across all time points, the average±standard deviation reported eye strain (where 100 indicated no eye strain) was significantly worse (p=0.02) with the single vision (71.1±4.9) compared to the multifocal (75.1±6.9) contact lens. Non-parametric comparisons yielded similar results (p=0.02). A linear regression across all time points indicated a significant worsening of symptoms (p=0.02) for the single vision lens, but not a significant worsening of symptoms (p=0.12) in the multifocal lens. Also, symptoms of dryness also worsened throughout the day, but were not significantly different between lenses. There were no reported differences in dryness, overall fatigue, or quality of vision between the lenses.

In digital device users with self-reported symptoms of eye fatigue, low add multifocal optics which reduce the accommodative demand of the wearer are capable of reducing the subjective-reported symptoms of eye fatigue relative to a lens with spherical optics of the same material.

Pete Kollbaum, OD, PhD, FAAO, FBCLA, is an Associate Professor, Associate Dean for Research, and Director of the Borish Center for Ophthalmic Research and the Clinical Optics Research lab at the Indiana University (IU) School of Optometry, where he teaches and performs research in the areas of contact lenses and optics. His specific interests include myopia, presbyopia, eye fatigue, keratoconus, metrology, and biometry. Dr. Kollbaum holds membership in several organizations including the American Academy of Optometry, ARVO, ISCLR, and BCLA.

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39 Variations in surface lint levels and pH amongst commercial lid cleansing wipes for anterior blepharitis **Christine Purslow**

An increasing range of lid cleansing wipes for managing anterior blepharitis, including that associated with Demodex, has become commercially available in recent years, but patients report wide variability in tolerance upon application. This study explored whether differences exist in pH or surface characteristics amongst commonly available commercial lid wipes that might explain variability in reported comfort by patients.

A total of 33 individual wipes, consisting of 9 different commercially available wipes (n=4 of each, for all but two products) were imaged with a 500x digital USB microscope to assess surface quality immediately on removal from their individual pouch, and following manipulation of the wipe (squeezing) to mimic the status of a wipe post-application. The solution extracted from each wipe on squeezing was tested for pH with pH Perfect Test Strips (Invigorated Living Ltd, UK).

Surface quality was observed to vary amongst wipes in terms of visible lint level, with medical grade products generally demonstrating a more homogenous surface with less loose fibres post-manipulation than products subject to less rigorous regulatory control. pH levels were found to vary significantly ($p < 0.05$) amongst the samples tested with lowest pH of 4.5 ± 0.0 exhibited by the Cliradex cleansing wipes (Cliradex, USA) and the highest pH levels of between 6.5 and 7.0 exhibited by Blink Lid Clean Eye wipes (AMO, USA) and Blephademodex wipes (Théa, France).

Sweat, containing lactic and amino acids, contributes to skin's slightly acidic physiological pH of around 5.5, but is recognised to irritate the ocular surface with a physiological tear pH of around 7.4. Variations noted in product surface quality, in terms of visible lint, and in pH, which was below the physiological pH of both skin and tears in a third of the products tested, may influence patient-reported product tolerability during application.

Professor Christine Purslow has worked in hospital optometry, private practice, academia, and specialist contact lens practice. Her PhD was awarded by Aston University and she has held roles as Senior Lecturer and Director of the Contact Lens & Anterior Eye Research Unit at Cardiff University, and Professor and Head of Optometry at Plymouth University. Chris is currently Head of Medical Affairs for Thea Pharmaceuticals (UK & Ireland), and maintains active research affiliations at Plymouth, Cardiff and Aston. Chris has authored numerous scientific papers and professional articles, and presents regularly on dry eye, tear film, ocular surface and contact lenses.

40 Is there any difference in the ocular surface between subjects with and without contact lens discomfort? **Maria J. Gonzalez-Garcia**

To evaluate whether the ocular comfort and clinical signs are affected by CL wear, day time and presence of symptoms in CLW wearers.

30 symptomatic and 30 asymptomatic CLW classified by means of the Contact Lens Dry Eye Questionnaire (CLDEQ)-short form, attended 4 visits: 2 visits (morning and afternoon) in 2 days (non-CL wearing day and CL wearing day). In the CL wearing day, symptomatic subjects were evaluated after the onset of the symptoms while wearing their CL. Ocular comfort, tear meniscus area, non-invasive tear break-up time (NIBUT), tear collection, and bulbar and limbal hyperemia were performed in all visits. Lid parallel conjunctival folds; corneal, conjunctival and lid wiper fluorescein staining; and corneal and conjunctival sensitivity were evaluated in the afternoon visits. The effects of CL wear (non-CL wearing day and CL wearing day), day time (morning and afternoon), and study group (symptomatic and asymptomatic) on the ocular comfort and clinical signs were statistically analyzed.

Ocular comfort, tear meniscus area, and NIBUT, were lower and conjunctival fluorescein staining higher ($p < 0.001$) in the CL wearing day compared to the non-CL wearing day. Ocular comfort was lower in afternoon compared to morning ($p < 0.001$), and in symptomatic CLW compared to asymptomatic CLW ($p = 0.006$). No statistical differences ($p > 0.05$) in clinical signs evaluated were found between the morning/afternoon visits or symptomatic/ asymptomatic groups.

The presence of a CL on the ocular surface is able to reduce tear volume and stability, and to increase conjunctival damage, reducing ocular comfort; however clinical signs are not associated with CLD.

She accomplished her degree in Optometry in 1992, and PhD in Vision Sciences in 2008. She is a staff member of the Instituto Universitario de Oftalmobiología Aplicada (IOBA), University of Valladolid (Spain) since 1994 and full-time professor since 1997, where she has been teaching contact lenses at the School of Optometry (University of Valladolid). In the Clinical Area at IOBA, she is the director of the Contact Lens Unit. She is an associate researcher at the Ocular Surface Group at IOBA, being focused on contact lens tolerance, specifically in altered environmental conditions or pre-existent diseases.

41 Is contact lens discomfort related to the morphology and function of the Meibomian glands? **Marta Blanco-Vázquez**

To analyse the relation between contact lens discomfort (CLD) and Meibomian Glands (MG) morphology and function. The hypothesis is that CLD is related to changes in the morphology and function of MG.

Patients were included in three groups according to contact lens wear and presence or absence of CLD. A value of 12 or higher in the Contact Lens Dry Eye Questionnaire-8 was considered as CLD. Patients with MG dysfunction (presence of alterations of the MG function and inflammatory signs in the eyelids) were excluded. To analyse the function of the MG, expression, quality of the secretion and number

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of obstructed MG were evaluated. To evaluate the MG morphology, images of the upper and lower eyelids were taken using an infrared camera. The following parameters were analysed in each image with the ImageJ program in the central 2/3 of the eyelid: total number of MG, number of complete and partial MG, percentage of MG loss and percentage of MG tortuosity. Concerning statistical analysis, one-way ANOVA and Kruskal-Wallis H test were used for quantitative variables; Chi-square test and Kruskal-Wallis H test were used for nominal and ordinal variables respectively.

40 patients were included (26 women and 14 men; mean age: 22.65±3.65): 15 contact lens wearers with CLD, 10 contact lens wearers without CLD, and 15 non-contact lens wearers. No significant differences were found in the MG function among the groups. Regarding morphology, significant differences were found in the total number of lower eyelid MG: contact lens wearers with CLD showed a lower number of MG in the lower eyelid than contact lens wearers without CLD (9.53±1.60, 12.0±2.31; p-value<0.01).

Individuals with CLD have shown changes in MG morphology; however, alterations in the MG function do not appear to be related to CLD.

Ms Marta Blanco accomplished her degree in Optometry in 2016. She is currently a PhD student with a contract funded by the Ministry of Spain. She is a member of the Ocular Surface Group of the Instituto de Oftalmobiología Aplicada (IOBA). At IOBA she has participated in two research projects related to discomfort with contact lens and is currently participating in one related to dry eye. She has published a scientific article and has presented four posters and one oral communication in international scientific congresses. She has also participated in the publication of an electronic book and an informative blog.

50 Are patients “bothered” by light?

Simone Schneider

To understand, identify and quantify the prevalence of consumers` being light sensitive or bothered by light when exposed to different everyday lighting conditions and environments.

Two online surveys (targeting consumers and ECPs), were conducted within the US in 2018. 1. The quarterly online omnibus survey (Ledger) asked four questions to 1000 representative adults (18+ years); results were balanced to reflect US population (age, gender, region, race and household size). The questions were designed to better understand consumers self-perspective on experiencing and dealing with different lighting conditions. 2. Within Sermo`s panel of US practicing optometrists (n=250), three questions were asked to assess how ECPs identify and handle potential light sensitivity with their patients.

34% of consumers self-identified as having light sensitive eyes. In comparison, ECPs estimated that only 25% of their patients are sensitive to light. Yet, when consumers were asked if they are bothered by bright or harsh lighting conditions daily, 64 % of consumers agreed and 94% of those agreeing reported using compensating behaviours, such as shading their eyes (76%), squinting (73%), turning lights off or down (56%) and turning down screen brightness (55%). However, only 34% of consumers who experience bothersome light or have eyes that are sensitive to light have told their ECP. In addition to this, only 38% of ECPs asked their patients if they are bothered by or sensitive to light, main reasons are that patients do not initiate a discussion themselves (60%) and that it is not part of the standard eye exam protocol (30%).

Nearly two-in-three consumers are bothered by bright and harsh lighting conditions daily. Asking the right questions will help to reveal this un-met need and will open the conversation to address this issue and for the first time offer a solution potentially involving contact lenses.

Simone Schneider, PhD MSc Dipl. Ing. (FH) Augenoptik Associate Director, Global Medical Affairs EMA, Vision Care Johnson & Johnson Vision

51 Mixed-methods study of behaviours and attitudes to vision correction of spectacle and contact lens wearers

Mark Draper

While contact lens (CL) innovation has evolved, its penetration has not increased significantly. This study explored attitudes of consumers requiring refractive error (spectacles or CLs) to identify their behaviours, motivations and perceived benefits of CLs.

A mixed-methods study was conducted in two phases in the UK: sequentially conducted, in-depth ethnographic interviews (qualitative) followed by a quantitative online survey. Survey questions included associations with their correction, impact on lifestyles and practitioner expectations.

Findings from qualitative work (n=16 aged 20-60 years) informed the survey (n=104 spectacle, n=175 CL-wearers; aged 16-54 years). While most expected practitioners to advise about CL suitability (80.0% CLs, 63.5% spectacles), practitioners only suggested CLs to 31.4% wearers versus 69.2% for spectacles. CL-wearers reported more improved (much/little better, p<0.05) quality of experiences post-correction in “freedom without restrictions” (61.5% vs 32.9%), “self-confidence” (68.5% vs 35.4%) and meeting friends (57.9% vs 25.5%). CL-wearers reported more positive experiences when first wearing their correction: freedom (46.9% vs 6.7%), confidence (44.0% vs 11.5%), happy (45.7% vs 17.3%); “sense of amazing amount of detail seen” had similar ratings (36.0% vs 29.8%). Significantly more CL-wearers stated they loved their correction (78.9% vs 27.9%) and that it`s transformed their life (79.4% vs 45.2%). CL-wearers were more likely to think highly of their practitioner who told them they were suitable for CLs (72.6% vs 44.2%) and then more likely to recommend their practitioner (63.4% vs 30.8%).

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This study highlights behaviours, motivations and attitudes of vision corrected consumers, and that important lifestyle factors such as confidence and freedom are more likely to be improved with CLs compared to spectacles. CL-wearers highlighted the emotional and lifestyle benefits of their correction compared to the functional benefits of spectacles. Consumers expect practitioners to advise them of vision correction options; this is linked to their opinion of and loyalty to their practitioner.

Mark Draper qualified as an Optometrist at UNSW before working in practice in both Australia and the UK. Following completion of an MBA he moved into industry including various roles across professional services, sales management and marketing. He is currently Head of Marketing & Professional Services for CooperVision UK & Ireland.

52 A clinical investigation into visual and ocular effects of an augmented reality headset compared to a tablet device. **Neil Chatterjee**

To compare acute visual and ocular effects of using Microsoft HoloLens and an iPad in near-emmetropic or contact lens wearing teenagers.

Ten subjects attended two study visits, where they used either the iPad or the HoloLens in a random order. Subjects read part of a novel with both devices and also watched a movie (iPad) or viewed a 3D scene (HoloLens). For both tasks, the iPad was held at a distance of 35cm and the HoloLens image was projected to 2m. For the last two minutes of reading and viewing, pupil size and pupillary distance (PD) were measured using a high speed infrared camera. Standard optometric tests of high contrast visual acuity, stereo-acuity, fixation disparity, oculomotor balance and accommodation were measured before and after using each device. After using each device, the subjective sickness questionnaire SSQ was used to elicit any symptoms.

No differences were found in the standard optometric tests between the iPad and HoloLens. Responses to the SSQ were similar after using both devices, although the higher score reported with the HoloLens in the oculomotor domain neared statistical significance ($p = 0.10$). Pupil size was larger during use of the iPad compared to the HoloLens by about 0.3mm and 0.7mm when reading and viewing the movie/3D scene respectively ($p=0.004$ and $p=0.0002$). Variability in pupil size was greater with the iPad whilst watching the movie (0.39mm, vs. 0.30mm, $p=0.01$), but not when reading the novel. PD was greater when watching the movie with the HoloLens than the iPad ($p=0.003$), but not when reading the novel.

No differences using standard optometric measures were observed. The differences found in pupil size, variation in pupil size and PD when using these two devices were unexpected and may warrant further exploration, given the potential wide scale use of augmented reality systems.

Neil Chatterjee is a research optometrist at EuroLens Research, The University of Manchester, where he has been an investigator on over 200 contact lens related clinical studies. Neil graduated in Optometry in 1998 and gained a Master's degree in Investigative Ophthalmology and Vision Science at the University of Manchester in 2005. Neil has a wide range of optometric experience ranging from community practice to the supervision of optometry students in the University of Manchester contact lens clinics and in 2018 was granted Fellowship of the BCLA.

53 A bilateral dispensing evaluation of two different toric lens geometries **Sarah Guthrie**

To evaluate the subjective acceptance of two different types of prism ballast toric lens geometries, when worn on a daily wear modality over 1 month.

The study was a prospective, double-masked, bilateral, randomized, cross-over, 1-month wear, dispensing study where 45 astigmats wore two different soft toric lenses: comfilcon A toric which utilises a uniform horizontal iso-thickness design and samfilcon A toric which utilises a thin-edge design. Assessments were completed at 1-month. Ratings (0-10 scale) were completed at 2-weeks and 1-month.

At 1-month, investigator-rated lens fit acceptance was high for both lens designs (3.65 vs 3.58, $p=0.29$), as was logMAR visual acuity for high contrast, high illumination (-0.12 vs -0.12, $p=0.63$) and low illumination (-0.10 vs -0.09, $p=0.71$). Subjective ratings for 'overall visual quality' were significantly higher for comfilcon A at 1-month (8.1 vs 7.4, $p=0.04$), but not different at 2-weeks (8.2 vs 7.6, $p=0.05$). 'Vision stability' ratings were significantly higher for comfilcon A at 2-weeks (8.2 vs 7.3, $p=0.01$) and 1-month (8.0 vs 7.2, $p=0.03$). 'Overall comfort' was rated significantly better with comfilcon A at 2-weeks (8.1 vs 7.4, $p=0.04$) and 1-month (8.1 vs 7.4, $p=0.03$). 'End of day comfort' ratings were similar after 1-month but significantly better with comfilcon A at 2-weeks (7.2 vs 6.5, $p=0.03$). 'Overall satisfaction' was statistically higher for comfilcon A after 2-weeks (8.0 vs 7.0, $p<0.01$) and 1-month (7.8 versus 7.0, $p=0.02$). Comfortable wearing time was not different at 2-weeks (9.2 vs 8.8, $p=0.12$), but was significantly longer with comfilcon A at 1-month (8.9h vs 8.0h, $p=0.03$).

Although both comfilcon A and samfilcon A use a prism ballast stabilisation principle and both provide excellent acuity and lens fit results, comfilcon A provided better subjective results for vision, vision stability, comfort, comfortable wear time and overall satisfaction.

Sarah Guthrie is a Research Associate at the Centre for Ocular Research & Education (CORE) at the University of Waterloo. She has a PhD in physics with a specialization in biophysics and is involved in a broad range of CORE's work. She conducts survey-based research projects, including practitioner and/or patient-focused surveys; lab-based projects including myopia control animal models, metrology, lubricity and fluid dynamics; and is responsible for data management and analysis of many clinical research projects. She also has a graduate-level certification as a Clinical Research Associate and is responsible for many aspects of CORE's regulatory compliance.

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54 Evaluation of the dynamic mechanical property changes in porcine crystalline lenses during induced cataract formation.

Fiona Lydon

Porcine crystalline lenses represent a useful and cost-effective model for the human eye because of the similarities in their morphology. The aim of this study was to optimise a reliable method to induce cataract formation and to assess mechanical property changes associated with lens ageing.

Porcine eyes were enucleated at a local abattoir within 4 hours of death, stored at 4°C and dissected within 24 hours for subsequent testing. Conditions for inducing cataract formation using a heat shock model were optimised by modification of temperatures and heat exposure times. The level of opacity associated with cataract formation was assessed. Dynamic mechanical measurements of the crystalline lens (Bohlin rheometer, 10mm parallel plates, 37°C) were made using a normal force of 10g and frequency sweep from 0.2-5 Hz. Porcine crystalline lenses were tested immediately after dissection and post heat shock.

Heat shock at 50°C for 24 hours was found to give consistent lens stiffening; shorter times and lower temperatures gave more varied results. Lens stiffness reached a plateau at 24 hours with longer treatment times producing no further stiffness increase. The elastic modulus at 0.47Hz increased from 7±1KPa when fresh (n=29), to 13.1±2KPa post heat shock (n=12) whilst the viscous modulus changed from 2.1±0.5KPa to 2.7±1KPa. The opacity of the lens after exposure to heat was further indication of cataract formation.

This study demonstrated the significant impact of heat ageing on cataract formation within the porcine crystalline lens. The dynamic mechanical measurements of the lens monitor and reflect the increase in stiffening which is typically associated with lens ageing. This modified heat shock model has significant potential value in further in vitro studies on the nature, inhibition and reversal of cataract formation—an area of considerable current interest.

Fiona Lydon is currently a post-doctoral researcher within the multidisciplinary Biomaterials Research Unit at Aston University. Her research focuses on biomaterial synthesis and characterisation studies including the assessment of soft contact lenses, skin adhesives and an array of new hydrogel based polymers. This post followed on after her PhD with the Biomaterials Research Unit which was entitled 'Novel hydrogel copolymers and semi-interpenetrating polymer networks'. She has authored and co-authored a number of scientific publications, and has taken part in many international conferences.

55 Subjective functional quality of vision and ease of fit rating of three multifocal contact lenses with similar optical design using two different fitting guides

Carolina Kunnen, Mohinder Merchea.

To assess subjective functional quality of vision rated by participants and evaluate ease of fit by eye care practitioners (ECPs) using the modified vs. standard multifocal fitting guides (FG) of three multifocal (MF) contact lenses (lotrafilcon B, nelfilcon A, and delefilcon A) fitted in presbyopic contact lens wearers.

20 sites in this subject-masked, prospective, randomized, stratified parallel-group study in three countries were randomized to the standard (in market pre-2017) (n=83) or modified FG (n=99) for three MF contact lenses. The FG procedures were identical except, for the modified FG, +0.25D was added binocularly to the spherical equivalent distance Rx for initial lens selection. Subjects rated their functional quality of vision (1-10 scale; 1=poor, 10=excellent) while driving, computer and tablet/phone use at Day10. ECPs rated ease of fitting with the modified and standard MF FG on a 1-10 scale (1=difficult; 10=easy) at Day10. All data is presented as Mean (SD; 95% CI).

Functional quality of vision while driving, using a computer, and using a tablet/mobile phone for the modified MF FG was rated as 8.3 (1.6; 7.9-8.6), 8.2 (1.7; 7.8-8.5), and 8.0 (2.0; 7.5-8.4), respectively, and rated 8.3 (1.5; 8.0-8.6), 8.0 (1.6; 7.6-8.4), 7.7 (1.8; 7.3-8.1) for the standard FG at Day10. Ease of fitting was rated either a 9 or 10 by 73.2% of ECPs for the modified FG and 56.4% for the standard FG. The addition of +0.25D binocularly to the spherical equivalent distance Rx in selection of the initial MF lens shows numerically higher quality of vision when performing functional tasks such as computer and tablet/phone use, while quality of vision for driving was not impacted. ECPs rated the ease of fit higher with the modified FG when fitting lotrafilcon B, nelfilcon A, and delefilcon A MF lenses on their presbyopic patients.

Mohinder Merchea is Head of the Medical Affairs Director Organization, Surgical/Vision Care, North America, at Alcon. Dr. Merchea earned his Doctor of Optometry and completed a combined Advanced Practice Fellowship in Cornea and Contact Lenses and a Master of Science degree in Physiological Optics and a Doctorate in Vision Science and a Master of Business Administration at Ohio State University. Dr. Merchea is a Diplomate in the Cornea, Contact Lens, and Refractive Technologies Section of the American Academy of Optometry, and a Fellow of the British Contact Lens Association.

56 Visual performance with a daily disposable silicone hydrogel center-near progressive design multifocal lens with two independent intermediate zones

Jill Woods, Jalaiah Varikooty

Multifocal contact lens visual performance can vary with add-power and lens design. This study compared logMAR acuity (VA) and subjective ratings in habitual multifocal lens (HabMF) wearers refitted with a daily disposable multifocal lens (DDMF) of center-near progressive design, with two intermediate zones.

VA with HABMF was measured at four working distances (WDs) - distance (DV), long-intermediate (LI=1.5m), short-intermediate (SI=0.75m), and near (NV=0.4m). Subjects were refit with a DDMF (somofilcon A) and after 2 weeks, VA and vision clarity rating (VC-

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rating) at these four WDs were measured; VC-rating options were 'Exceeded expectations', 'Met expectations' or 'Fell-Short of expectations'. For each WD, changes in VA were analysed for the whole group and also for subjects grouped according to their VC-rating. For the 48 subjects who completed the study, VA was better at every WD with DDMF compared to HabMF (all $p < 0.032$): mean logMAR VA improvement was DV=0.03, LI=0.06, SI=0.04 and NV=0.07. VC-ratings were significantly better for DDMF at LI ($p=0.013$), SI ($p=0.042$), NV ($p=0.001$), but not different at DV ($p=0.068$). When grouped by subjective VC-ratings into Exceeded and Met expectations, VA was also better at every WD with DDMF: mean logMAR VA improvement was DV=0.05 ($n=42$), LI=0.07 ($n=44$), SI=0.05 ($n=41$) and NV=0.08 ($n=40$). Subjects reporting VC-ratings of Fell Short of expectations showed mean logMAR VA improvement with DDMF at SI=0.02 ($n=7$) and NV=0.05 ($n=8$) but showed reduction in mean logMAR VA with DDMF at DV=0.03 ($n=6$) and LI=0.04 ($n=4$).

While positive subjective responses for all WDs were always associated with improved VA, the negative subjective responses were not always associated with reduced VA. This supports the importance of allowing the wearer to experience the lens in order to determine acceptance, rather than rely solely on VA measures.

Jalaiah trained as an ophthalmologist in India. His research interests focus on tear film, the ocular surface, image analysis of the anterior segment of the eye and LWE. He is currently exploring various methods of measurements of ocular discomfort, attempting to bridge the gaps between qualitative and quantitative methods of measuring ocular discomfort.

57 The effects of a photochromic contact lens on glare geometry when tested indoors

Lisa Renzi-Hammond

Photochromic contact lenses were designed to darken when exposed to outdoor sunlight. Like sunglasses, the filtering that results improves vision under bright light conditions. Some bright light exposures, however, do not occur outside per se. In this study we tested whether a photochromic contact lens could reduce symptoms of bright light (positive dysphotopsia) under conditions where the lens was minimally activated (i.e., no more than it normally would be in an indoor environment).

A subject-masked contralateral design was used comparing a photochromic contact lens in one eye to a non-photochromic contact in the other eye of the same subject in random order. Sixty subjects (18-39, 40-65 years) were tested. A Xenon source (simulating noonday sunlight) was used to produce light to measure both two-point light thresholds (minimum separation of light from two small apertures), halos (the diffuse light surrounding a small point source) and peripheral spoking or starbursts (radiants extending from a central bright point). The halos and starbursts were measured as circumferential spread using high-precision centering calipers. The two light points were created with small (2 mm) apertures in a light shield with an occluding center (threshold was defined as the minimum distance where light diffusion did not overlap).

The non-activated photochromic contact reduced light scatter (two-point light spread function) by 18.4% on average, and the diameter of halos (17.9% on average) and starbursts (21.7% on average) when compared to a non-photochromic contact lens. These effects (based on 95% confidence interval testing) were uniformly significant ($p < 0.05$).

These results suggest that even under conditions of exiguous activation (e.g., as would be expected indoors or while driving at night), a photochromic contact will improve many of the more deleterious aspects of bright light (reducing the effects, for example, of positive dysphotopsia).

Dr. Lisa Renzi-Hammond earned her B.S., M.S. and doctorate degrees at the University of Georgia. While at UGA, Dr. Renzi-Hammond specialized in neuroscience and vision science and studied the ways in which implementing behavioral changes influenced visual function. Dr. Renzi-Hammond completed her postdoctoral fellowship at the University of Texas at Austin in the Center for Perceptual Systems and the Institute for Neuroscience. In 2010, Dr. Renzi-Hammond returned to the University of Georgia as faculty, where she founded the Human Biofactors Laboratory. She is currently an Assistant Professor in the UGA College of Public Health.

58 Comparing the visual effects of a photochromic contact lens under simulated outdoor vs indoor conditions

Billy Hammond

Although most photochromic lenses activate under broadband outdoor conditions, some activation may also occur in normal indoor environments (from windows, artificial light sources, etc.). In a two-part study, we tested two common visual functions (glare disability, GD, chromatic contrast, CC) measured under conditions simulating normal outdoor and indoor exposures.

A randomized subject-masked contralateral design was used. A photochromic contact lens (Test) was worn in one eye, and a non-photochromic contact lens in the other. Sixty-one subjects were tested in the first part of the study (simulated outdoor) and 60 subjects in the second simulating indoor conditions (both used age ranges, 13-39, 40-65 years). A two-channel Maxwellian view optical system was setup at a single clinical site. For the outdoor condition, a violet (400 nm) activator was used across measurement conditions. For the indoor condition, no activator was used (any activation of the photochromic was simply a result of the lights used in the experiment). GD was evaluated as the energy in a surrounding xenon white annulus necessary to veil a central grating target. CC was measured as thresholds for a yellow grating target superposed on a 460-nm (blue-sky) background.

Under outdoor conditions, the photochromic lens reduced GD log energy 27% on average and CC by 32% on average compared to the Control. Under indoor conditions, the effect was less but still significant: GD was reduced 17% on average and CC was reduced also by 17% on average with the photochromic contact lens.

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When the photochromic contact was partially activated under simulated outdoor conditions, the improvement in GD and CC was significant. The visual benefit was reduced, but still significant under indoor conditions. These results suggest that a photochromic contact lens could improve visual function across a diversity of visual environments.

Dr. Hammond is a full Professor in the Brain and Behavioral Sciences program at the University of Georgia (UGA) and Principal Investigator of the Visual Sciences Laboratory. His B.S. was obtained at the University of Oregon and his Ph.D. was received at the University of New Hampshire. He was a postdoctoral fellow at Harvard Medical School and a professor for several years at Arizona State University before coming to UGA in 1999. He has published over 100 empirical papers and numerous chapters, reviews, and theoretical papers on the biology (e.g., retinal carotenoids) and optics of the visual system and brain.

60 The prevalence and seasonal variation of Acanthamoeba in domestic tap-water in greater Sydney region, Australia

Nicole Carnt

To assess the prevalence of free-living Acanthamoeba in domestic tap-water in the greater Sydney region in NSW, Australia, and determine any seasonal variation in prevalence. We hypothesized that higher temperatures in summer would generate a higher abundance of food for the amoeba, and therefore a greater prevalence of Acanthamoeba would be found in summer compared to winter. A total of 54 participants were enrolled to keep significance at 5% with 90% power and 20% drop out rate. Approval was received from university ethics committee (HC180048). The participants self-collected bathroom tap-water samples from their homes using an instructional kit. The samples were cultured and morphologically examined for the presence of free-living Acanthamoeba using an inverted light microscope. Each participant collected two samples, once in summer and once in winter. The association between sampling seasons was analysed with chi-square test.

A total of 98 samples were collected over the two seasons, with 28.57% of samples morphologically classified as Acanthamoeba. The summer period yielded 16 of 54 (29.63%) samples classified as Acanthamoeba, while the winter period yielded 12 of 44 (27.27%) samples classified as Acanthamoeba. There was no statistically significant difference ($p=0.7$) between the prevalence of free-living Acanthamoeba in summer compared to winter.

The prevalence of free-living Acanthamoeba characterized morphologically in domestic tap-water of the greater Sydney region was higher than expected, especially considering the low incidence of Acanthamoeba keratitis in Australia. We did not however find variation between seasons. Expanding this study to other regions in Australia and New Zealand where tank water is commonly used will be important. Further studies are needed to molecularly characterize the isolates and determine if the Australian tap-water isolates are phylogenetically related to virulent strains in parts of the world where Acanthamoeba keratitis is more prevalent, such as the UK.

Nicole Carnt graduated from Optometry at UNSW, Sydney in 1989 and worked in private practice for 10 years in Australia and the UK before taking a position with the Brien Holden Vision Institute in 1999. She completed a PhD on Epidemiology of Contact Lens Related Infection and Inflammation 2008-12 and has been the recipient of many research awards including two BCLA Dallos Awards. She was awarded a NHMRC Research Fellowship in 2012 and spent the first 2.5 years at Moorfields Eye Hospital, London. She now works as a Scientia Fellow and Senior Lecturer at UNSW.

61 Selective topical anaesthesia of the ocular surface

Carole Maldonado-Codina

To develop a method to selectively anaesthetise isolated regions of the ocular surface to aid in future systematic investigations of contact lens discomfort.

Five subjects had one of four anaesthesia 'treatments' (T1-T4) using proxymetacaine hydrochloride (0.5%) performed on each eye (randomly) over two visits to; the upper eyelid margin via cotton bud application (with a PureVision 2 lens shielding the cornea) (T1), the lower eyelid margin in the same way (T2), the cornea using a 3 μ l drop dispensed directly with the subject supine (T3) and to the cornea using 10 μ l of drug via a PureVision 2 lens 'carrier' with the subject face-down (T4). The eyelids were held apart during all treatments. Pre- and post-treatment, sensitivity thresholds in all three treatment areas (upper and lower eyelid margins and cornea) were measured in random sequence with a Cochet Bonnet esthesiometer (0.12mm filament). Sensitivity was measured in two locations (central and temporal) for each treatment area. Anaesthesia was deemed to be successful if threshold sensitivity was reduced to at least 1cm and an area was deemed unaffected if the change from baseline was reduced by no more than 1cm.

T1 and T2 were successful in anaesthetising upper and lower eyelid margins (in four and three subjects, respectively) whilst the other areas remained largely unaffected. Corneal anaesthesia using the drop method (T3) did not anaesthetise the temporal cornea in any subjects and only anaesthetised the central cornea in two subjects. However, corneal anaesthesia using the contact lens (T4) successfully anaesthetised four corneas centrally and three corneas temporally whilst the upper and lower eyelid margins remaining unaffected in all subjects.

This work has successfully identified a method to selectively anaesthetise three areas of interest on the ocular surface. The contact lens method was better than the drop method for anaesthetising the entire cornea.

Carole Maldonado-Codina is Senior Lecturer and Associate Director of Eurolens Research at The University of Manchester. She is responsible for contact lens teaching, holds the positions of Contact Lens Clinic Lead and Lead for Internationalisation, supervises postgraduate students and acts as Principal Investigator on a number of industry and grant-funded projects. Carole is a Fellow of the BCLA and AAO, a member of IACLE and BUCCLE, a council member of the ISCLR, past recipient of the BCLA Irving Fatt Memorial Award and examines for the College of Optometrists. Her research interests focus on the ocular response to contact lens wear.

62 SV as an atypical presentation of scleritis in a 21 year old female

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Case Study

Renee Reeder

Dr. Renee Reeder is a professor at the Kentucky College of Optometry at the University of Pikeville. She recently joined the faculty at UPIKE after over 20 years at Illinois College of Optometry where she was chief of contact lenses for 14 years and the disease curriculum coordinator for 2 years. Dr. Reeder holds fellowships in the BCLA, AAO, SLS, and IACLE. She is also a diplomate in the CL section of the Academy. Dr. Reeder is an active lecturer and researcher. She was the 2018 GPLI Practitioner of the Year and the 2018 AOACLS Achievement Award Winner.

63 Development of a mouse keratitis model for testing antimicrobial efficacy Sanjay Marasini

The study aimed to develop a keratitis model for testing therapeutic antimicrobial efficacy. The ideal model should reflect the low number of bacteria typical of a clinical infection but reproduce the full spectrum of disease at the cellular level, over a time course consistent with disease progression rates in patients.

The central corneal epithelium of the C57BL/6 mouse was debrided under isoflurane anaesthesia with an Algerbrush (0.5 mm burr) to create a 1 mm diameter defect. Likelihood of bacterial colonisation was compared between two defect creation techniques; by intermittent contact (Multiple-isolated Defects; MD) or continuous contact with the epithelium (Continuous Defect; CD). Both wound types were challenged with an overnight culture (5 µl) of Bioluminescent *P. aeruginosa* Xen05 (n = 6, each) in colony forming units (cfu) ranging from 10⁵ to 10⁸. Based on initial findings and to test reproducibility with the lower dose, a further four animals with CD were challenged with 10⁵ cfu. Disease progression was monitored in all animals by measuring bacterial bioluminescence and scoring corneal pathology (0 to IV) at 18 and 24 h post-inoculation.

Bacterial bioluminescence correlated closely with cfu (R² = 0.99). Irrespective of bacterial inoculum size, 100% CD wounds developed marked keratitis (grade II) at 18 h in the initial phase. The MD wounds showed more mild and inconsistent infection for all bacterial concentrations (grade 0 and I), with a bacterial clearance (recovery) rate of 67%. The reproducibility study confirmed the development of grade II Keratitis in 75% of animals with a 1 mm CD wound, infected with 10⁵ cfu.

A clinically relevant keratitis model deemed suitable for studying the effectiveness of antimicrobial treatments was created reproducibly by challenging a 1 mm continuous corneal wound with 10⁵ cfu *P. aeruginosa* in lightly sedated animals.

Sanjay is trained as an Optometrist. He has collaborated with several ophthalmic research groups, which have resulted in over 15 peer-reviewed publications. His previous research involved identifying and reporting burden of ophthalmic diseases, often combined with aspects of neurological conditions such as cerebral palsy and systemic drug poisoning. Sanjay's current research focus is on translational medicine involving ocular surface diseases, in particular, light-based therapies.

64 The effect of water exposure on contact lens storage case contamination. Fiona Stapleton

Microbial contamination of contact lens storage cases is associated with corneal disease ranging from sterile keratitis to sight threatening infections including bacterial and *Acanthamoeba* keratitis. Given the increasing association between water contact and contact lens-related disease, this study aimed to explore the effect of water contact and storage case contamination in habitual daily wear contact lens users.

One hundred and ninety-eight daily wear reusable CL wearers completed a self-administered questionnaire to determine demographics, lens wear history, compliance and frequency of water exposure. Contact lens storage cases were collected, and microbial analysis was conducted using a validated bacterial ATP assay to determine overall microbial bioburden. A water contact behaviour scoring system (0: excellent, 10: poor) was devised to determine the overall water exposure during CL wear. Logistic regression was used to determine the association between water contact behaviours and CL storage case contamination. Of the 198 participants, 67% were female. The average age was 29 years (range, 18-78 years). Mean microbial contamination level of CL storage cases was 3.16 (± 0.85) Log CFU/mL (range, 1.40 to 5.94 Log CFU/mL). Water contact behaviours included swimming while wearing CLs (89/198) without swimming goggles (58/89) and showering (80/198). One third of the participants used wet hands to handle CLs and 32/198 used tap water to rinse their CL storage cases. Using tap water to rinse (10/198) and store (2/198) CLs were the least prevalent practices. Overall water contact behaviour was significantly associated with CL storage case contamination (p < 0.01). Multiple regression showed that showering while wearing CL was independently associated with CL storage case contamination (p < 0.001).

Water contact behaviour such as showering while wearing CLs is prevalent among CL wearers and is independently associated CL storage case contamination. Minimizing water contact behaviour may lead to reduced storage case contamination and may reduce the risk of CL-related adverse events.

Fiona was awarded her PhD from City University and Moorfields Eye Hospital for her research on contact lens-related disease. Fiona is a clinical scientist with expertise in epidemiology and clinical research in the fields of corneal infection, dry eye and lens related disease. She is President-Elect of the International Society for Contact Lens Research and the 2015 recipient of the BCLA medal. She is a regular reviewer for a range of journals, belongs to the international editorial board of four journals, has more than 240 peer-reviewed publications, 20 book chapters and has published one book.

65 Synthesis and characterisation of silver-polyquaternium nanoparticles: an interesting new family of antimicrobials Evita Chundoo

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Polyquaternium (PQ) antibacterials, particularly PQ-1, are common components of ophthalmic care solutions. Similarly, the antimicrobial applications of silver in medical devices are well-known. The observation that silver nanoparticles (AgNPs) complexed with PHMB show synergistically enhanced activity led us to investigate the families of novel nanostructures formed through complexation of AgNPs with (initially non-antimicrobial) PQs. Interest centres on synergistic activity and potential ophthalmic applications.

Silver nanoparticles were synthesised from silver nitrate with sodium borohydride reducing agent and one of the following polyquaterniums: polyquaternium-4 (PQ-4), polyquaternium-10 (PQ-10) and polyquaternium-46 (PQ-46). The filtered nanoparticles were then characterised using dynamic light scattering (DLS) and UV-Visible spectroscopy. Initial studies of antimicrobial activity were carried out with *Staphylococcus Aureus*, a common ocular pathogen.

Successful synthesis of silver-PQ nanoparticles was confirmed by UV-Visible spectroscopy, which indicated a surface plasmon resonance (SPR) band of $402 \text{ nm} \pm 1 \text{ nm}$ for silver-PQ-10 nanoparticles, a SPR band of $406 \text{ nm} \pm 3 \text{ nm}$ for silver-PQ-4 nanoparticles and a SPR band of $447 \text{ nm} \pm 24 \text{ nm}$ for silver-PQ-46 nanoparticles. Antimicrobial activity was assessed with zone of inhibition (ZOI) measurements. Silver-PQ-46 nanoparticles displayed a level of antimicrobial activity ($12 \text{ mm} \pm 0.5 \text{ mm}$) higher than that of silver nanoparticles synthesised without any polyquaternium ($9 \text{ mm} \pm 1 \text{ mm}$) and silver nanoparticles made with PQ-4 and PQ-10 ($8 \text{ mm} \pm 1 \text{ mm}$ and $7 \text{ mm} \pm 1 \text{ mm}$ respectively) exhibited a slightly lower level of activity. None of the polyquaterniums displayed antimicrobial activity alone.

Novel hybrid antimicrobials, in the form of silver-PQ46 nanoparticles, demonstrated an enhanced level of activity when compared with the unmodified polyquaterniums. This provided an interesting new platform to improve the efficacy of current ocular antimicrobials. These complexes -especially those based on PQs with inherent antimicrobial activity - may have potential for use in ophthalmic devices.

Dr Evita Chundoo completed her PhD on 'Synthesis and evaluation of nanoparticle-polymer composites', and has since taken up a post-doctoral research position within the multidisciplinary Biomaterials Research Unit at Aston University. Her research focusses on nanostructures for both ocular and dermal applications. She has co-authored a number of scientific publications.

66 Silver-PHMB nanostructures: novel antimicrobials of potential ophthalmic interest **Jakub Sacharczuk**

Polyhexamethylene biguanide (PHMB) and silver, often in the form of nanoparticles (AgNPs) are widely used antimicrobials in contact lens care (e.g. care solutions and lens cases). The proposition that AgNPs stabilised with PHMB shows synergistically enhanced activity has prompted this study. Enhanced activity of two well-known antimicrobial materials has potential interest for ophthalmic applications.

Silver nanoparticles were synthesised from silver nitrate using a chemical reduction procedure with sodium borohydride in presence of a stabiliser, PHMB. Resultant PHMB-AgNPs were characterised using UV-Vis spectroscopy and dynamic light scattering (DLS). The spectroscopic techniques were of particular importance as they allowed for characterisation of PHMB-AgNPs without intrusive sample preparation. Initial assessment of antimicrobial properties involved *Escherichia coli* (*E. Coli*) and *Staphylococcus aureus* (*S. Aureus*) using zone of inhibition measurements.

AgNPs stabilised with PHMB ($10 - 200 \mu\text{g/ml}$) were initially characterised by shifts in Surface Plasmon Resonance (SPR) bands (typically 399 nm for Bare-AgNPs to 420 nm for complexes). Nanostructure diameters (ca $43 - 200 \text{ nm}$) varied with PHMB concentration and degree of aggregation. Zones of inhibitions for PHMB-AgNP complexes with varying PHMB concentration ($11.6 - 15.1 \text{ mm}$, *E. Coli*; $11.6 - 13.6 \text{ mm}$, *S. Aureus*) matched or exceeded reference material values - e.g. silver nitrate (11.8 mm , *E. Coli*; 12 mm , *S. Aureus*), PHMB@ $200 \mu\text{g/ml}$ (9.4 mm , *E. Coli*; 8.7 mm , *S. Aureus*). The results confirmed the desired synergistic effect.

PHMB-AgNP complexes were successfully synthesised in a simple two step reaction and characterised spectroscopically. Initial studies of antimicrobial behaviour showed sufficient promise to generate current studies of scale-up, detailed structural characterisation, aggregation and stability and extended microbial challenge testing. This study has highlighted the significance of synergistic PHMB-AgNPs as novel antimicrobial agents.

Jakub Sacharczuk is a PhD student on a full scholarship at Aston University in Birmingham. Jakub is currently conducting research as a part of Biomaterials Research Unit looking into the behaviour and applications for polymer stabilised silver nanoparticles as a novel antimicrobial agent by incorporating them into hydrogels. In his free time, which is greatly reduced by two small lively boys, Jakub ponders how to translate CL leaflets into Polish so that patients can enjoy it.

70 Clinical outcomes of newly developed pinhole contact lens for presbyopia **Changseon Lee**

To investigate the clinical efficacy of pinhole systems based soft contact lens for presbyopia correction.

Twenty nine participants with presbyopia were enrolled between October 2018 and December 2018. Newly developed pinhole system based soft contact lens (EyeLike II, Koryoeyetech Co. Ltd., Seoul, South Korea) was applied in the nondominant eye of the subjects. Binocular and unioocular uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), uncorrected near visual acuity (UNVA), and distance-corrected near visual acuity (DCNVA) were measured before and 1 week after wearing a contact lens. Binocular defocus curve, and contrast sensitivity under photopic and mesopic conditions were also examined.

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The mean logMAR DCNVA of treated eye improved from 0.34 ± 0.12 to 0.16 ± 0.15 after contact lens fitting ($P < 0.001$). The mean binocular logMAR DCNVA also improved from 0.31 ± 0.13 to 0.11 ± 0.09 after wearing contact lens ($P < 0.001$). Although the mean logMAR CDVA of treated eye decreased from -0.04 ± 0.05 to 0.02 ± 0.11 ($P = 0.02$), the mean binocular logMAR CDVA did not change after wearing contact lens (-0.05 ± 0.05 , and -0.05 ± 0.04 in before and 1 week after contact lens wearing, respectively; $P = 0.78$). Binocular defocus curve improved after wearing the contact lens, and there were no significant differences in binocular contrast sensitivities in photopic and mesopic conditions between pre-, and post- contact lens wear.

This newly developed pinhole contact lens provide good near visual acuity and does not interfere binocular distance visual acuity. The pinhole contact lens can be a good option for treating presbyopia.

Ikhyun Jun graduated Yonsei University college of medicine for medical doctor and finished residency in ophthalmology in Severance Hospital. He finished Ph.D. in pharmacology in Yonsei University Graduate School. He is now a Fellow in ophthalmology in Severance hospital.

71 Patient Attitudes to Presbyopia and its Correction **Brooke Hutchins**

To investigate (pre-) presbyopes' attitudes and beliefs towards presbyopia with a secondary emphasis on preferred modes of near refractive correction and attitudes towards multifocal contact lenses.

This qualitative study involved data collection from 20 participants using a short online pre-questionnaires and structured, recorded focus groups. Participants were aged from 36-48, representing a pre-presbyopic and a presbyopic population. The topic guide included questions about presbyopia and its significance, where information about presbyopia can be found, and opinions about current refractive correction including multifocal contact lenses. Participants' opinions and attitudes were transcribed manually, and coded using content analysis for overarching themes and patterns.

The mean age of the participants was 41.6 ± 4.0 years. Six participants (30%) were already wearing a near correction while 14 (70%) were not. Only 35% of those currently not using a near correction ($n=5$) specified that they would consider multifocal contact lenses if it became visually necessary. Of those 5 participants, 3 already wore contact lenses for distance. Five key primary themes with clear inter-participant similarities were identified as 'age-related' (85%), 'acceptance' (55%), clear lack of 'familiarity with the word presbyopia' (55%), '(multifocal) contact lenses' (50%), and 'comfort and convenience' (65%) whereby cost is of less importance.

The need for a reading correction was perceived as a sign of age and the onset of presbyopia was expected to occur with age. Spectacles were the preferred mode of near vision correction while there were mixed opinions towards multifocal contact lenses, mostly driven by the participants' previous contact lens history. Almost all participants felt that information about presbyopia should be provided by an optometrist in comparison to other health care professionals (e.g. General Practitioner). However, it was suggested that presbyopia and its correction could become part of the NHS Health Check in England for adults over 40.

Brooke Hutchins is a final year BSc Optometry student at City, University of London. Throughout her degree, she has acted as a student representative for the College of Optometrists, and in 2018 she successfully obtained a Step® Educational Project grant from the Johnson and Johnson Vision Care Institute. In addition to her studies, Brooke volunteers regularly at Moorfields Eye Hospital.

72 A new approach to presenting presbyopes the option of multifocal contact lenses **Philip Morgan, Andrew Plowright**

To assess the outcome when a proactive, low-key, recommendation of multifocal contact lenses is made to prospective presbyopic patients.

Healthy presbyopic patients attending six optometric practices were randomly assigned to either (a) receive a proactive offer of nelfilcon A multifocal contact lenses to assist with spectacle frame selection or (b) not receive a proactive offer but managed according to practice norms (including contact lens fitting if requested by the patient). The details of any contact lens fitting were recorded and contact lens use three months after the visit was determined.

196 eligible subjects (115 females and 81 males) were recruited. Of 110 eligible test subjects, 42 (38%) subjects agreed to try contact lenses. Four subjects were considered not suitable after a white light evaluation, so 38 lens fits were undertaken. In all 38 cases, the lenses were applied satisfactorily and the fit was acceptable. Three months after fitting, 19 of the test subjects (17% of those offered contact lenses initially) had purchased lenses. Of the 86 control subjects, eight (9%) were fitted with contact lenses on the day of examination and seven (8%) had purchased contact lenses three months later. For uptake of the fitting offer, three factors were demonstrated to be significant at the $p = 0.05$ level: subject group (4X more fits in the proactive group), investigator (great variation between practices) and sex (3X more in females). At three months, the same factors were significant: subject group (2X more in proactive group), investigator (great variation between practices) and sex (3X more in females).

A proactive manner for contact lens prescribing was successful and could be used more generally in contact lens practice. Over half of the females accepted the initial lens offer, suggesting that this group is particularly interested in trying contact lenses.

Andy Plowright is Operations Manager at Eurolens Research, The University of Manchester. He is responsible for the management and coordination of clinical studies within the group. Prior to joining Eurolens Research he worked within the pharmaceutical industry, monitoring and coordinating clinical research in oncology and virology.

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73 Validation of a multifocal contact lens online fitting app **Jill Woods**

Online tools to assist complex contact lens fittings are becoming more commonplace, replacing traditional fitting guides. Data from a daily disposable multifocal lens refit study were used to conduct a post-study comparison of the multifocal lens power recommendations of one such online tool, the OptiExpert app, with those powers determined by investigators who used the traditional fitting guide.

For 48 habitual multifocal lens wearers, subjective refraction data (sph, cyl, add, ocular-dominance) were determined by investigators who refit them with a somofilcon A lens, using the fitting guide. At an 'optimization visit' 3-10 days later, lens power was re-assessed and new powers dispensed if necessary. Subsequent to study completion, subjects' refraction data was input to the online app, and the recommended power for each eye (App-Rx) was compared to the power dispensed at the optimization visit (Optimized-Rx). Bland-Altman and correlation analyses were conducted to measure agreement between methods.

The 48 presbyopes (38F:10M) had a mean (\pm SD) age of 55.6 (\pm 7.3SD, range 41-67) years. Subjective refraction range across all 96 eyes was +5.25 to -6.75DS, all with cylinder \leq -1.00D. Reading add ranged between +1.25 to +2.50D. At the optimization visit, 10% of eyes (10 eyes across 10 subjects) required change in lens power, meaning 100% of eyes were successfully fit with just 1 additional lens. The App-Rx was significantly correlated with Optimized-Rx ($r=0.996$ and $p<0.0001$). Bland Altman analysis showed a mean difference (and 95% limits of agreement) between App-Rx and Optimized-Rx of 0.08D (-0.58 to +0.42). The app predicted powers were within 0.25D of the investigator-optimized lens powers in 82% of eyes, within 0.50D in 96% eyes.

The OptiExpert app recommended CL powers were in close agreement with those determined by investigators. Therefore, OptiExpert multifocal app is a useful tool to aid somofilcon A multifocal fitting success.

Jill is Clinical Research Manager and Senior Clinical Scientist at CORE, Centre for Ocular Research & Education, which she joined in 2005. Her role involves overseeing clinical research trials from concept to final report, managing the workload of research investigators and oversight of administrative and regulatory processes. Jill's work mainly involves the fields of contact lenses & aspects of dry eye disease with particular interest in presbyopic contact lenses, contact lens comfort & controlling myopia progression. Jill completed her Optometry degree in London, UK and has experience in her own private practice, low-vision hospital work, clinical teaching and continuing education.

80 Central corneal clearance during longer-term scleral contact lens wear **Elise Kramer**

To examine the variation in central corneal clearance (CCC) during the initial months of scleral contact lens wear.

Retrospective analysis of recent patients fitted with scleral lenses in private practice. CCC data was extracted from anterior segment OCT images obtained during the initial lens fitting and subsequent review appointment after commencing lens wear. Pearson's correlation analysis and linear regression were used to examine variables of interest using the data from right eyes only. Paired t-tests were used to examine data from fellow eyes.

50 eyes from 37 patients were included (mean age 49 ± 14 years, 65% male), with keratoconus the predominant indication for scleral lens correction (60% of eyes). Mean CCC at the initial fitting was $249 \pm 9 \mu\text{m}$ which reduced to $232 \pm 12 \mu\text{m}$ at review 88 ± 15 days later. 57% of eyes displayed a reduction in CCC (mean reduction of $60 \pm 8 \mu\text{m}$ or $22 \pm 3 \%$, maximum reduction $150 \mu\text{m}$ or 56%). The change in CCC from the initial fitting was associated with lens wearing time on the day of review ($r = -0.43$, $p < 0.01$), with an additional $9 \mu\text{m}$ reduction in CCC per additional hour of lens wear. A trend was also observed between greater CCC at the initial fitting and a greater reduction in CCC at review ($r = -0.32$, $p = 0.05$). A high degree of variability in CCC was observed between fellow eyes fitted with similar lens designs (mean interocular difference of $62 \pm 11 \mu\text{m}$ at review, $p = 0.02$).

The change in CCC during the initial 3 month lens wear period was not substantially greater than previous reports of changes in CCC over the course of the day in neophyte scleral lens wearers.

Dr. Elise Kramer is a residency-trained optometrist in Miami, Florida who specializes ocular surface disease and regular and specialty contact lens fitting. Her Doctorate degree was awarded in Optometry from the Université de Montréal in 2012. She then completed her residency at the Miami VA Medical Center. Her time there included training at the Bascom Palmer Eye Institute, the nation's top eye hospital. Dr. Kramer is a fellow of the Scleral Lens Education Society and of the American Academy of Optometry as well as a member of the American Optometric Association.

81 Prosthetic replacement of the ocular surface ecosystem for corneal irregularity: visual improvement and optical device characteristics **Preetam Kumar**

Purpose: To describe patterns of prescribing Prosthetic Replacement of Ocular Surface Ecosystem (PROSE) in irregular corneas and compare various components of lens design.

Method: Design: Retrospective, observational case series. 244 eyes of 173 patients with keratoconus ($n=178$), pellucid marginal degeneration ($n=21$), keratoglobus ($n=6$), following refractive surgery ($n=19$) and following keratoplasty ($n=20$) fitted with the PROSE device were retrospectively analyzed. Simulated keratometry value along the steep meridian (Steep-K) and anterior chamber depth (ACD)



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were measured using Scheimpflug imaging. Improvement in visual acuity and parameters of lens design such as vault, front surface eccentricity (FSE) and toricity at the haptic were analyzed and compared across all conditions.

Results: PROSE improved visual acuity, both uncorrected (median, 1.30 logMAR) and spectacle-corrected (median, 0.60 logMAR), to a median of 0.22 logMAR. Positive correlation was observed between Steep-K and ACD with lens vault, especially in keratoconus ($p < 0.0001$). Multiple regression analysis established ACD as the most reliable factor while choosing vault. FSE value of 0.6 was the most common across diagnostic subgroups. The distribution of FSE values did not differ between keratoconus patients with Steep keratometry of $< 60D$ or those $> 60D$. In every diagnostic subgroup, at least 20% of eyes required a lens design of with-the-rule toricity of haptic.

Conclusions: The PROSE device resulted in significant improvement in vision in this population. A trend of prescribing higher lens vault with increased keratometry value was evident especially in keratoconus. ACD appeared to be more important than Steep K in vault selection. An FSE of 0.6 and vertical peripheral lens toricity were used most frequently in this subset of patients.

Preetam Kumar, B Opt, received Bachelor in Optometry from Techno India College, Kolkata, India. An active clinician and researcher at L V Prasad Eye Institute, Hyderabad, India, he serves Contact Lens Services, Tej Kohli Cornea Institute and Visual Optics Laboratory, Brien Holden Institute of Optometry and Vision Sciences. He has presented his research works in several national and international conferences and has received award for best presentation and travel grants.

82 Efficacy of the standardized asymmetric soft contact lens with a decentered optic zone design for correcting visual performance in patients with keratoconus

Asaki Suzaki

It was previously reported that a newly-developed standardized asymmetric soft contact lens that has asymmetric diopters in the posterior surface can correct vertical coma in patients with keratoconus. (Suzaki, et al. IOVS 2017) However, decentration of the lens resting position remained an issue that was associated with a reduction of the correction. This case-control study investigated the efficacy of the modified design of this lens in improving optical quality and visual performance in keratoconic eyes.

Thirty-four eyes of 26 patients with mild to moderate keratoconus who were using rigid gas-permeable contact lenses were included in the study. The lens with the modified design had a 0.7-mm superiorly decentered optical zone. The suitable lens type for each eye was chosen based on the asymmetry data from corneal tomography and coma data from the wavefront sensor. The on-eye lens performance was evaluated using coma (4 mm pupil), measured with a wavefront sensor in three conditions: without lens, with conventional design lens, and with decentered optic zone lens.

Both lenses significantly decreased coma. ($0.68 \pm 0.27 \mu\text{m}$ without lens; $0.37 \pm 0.28 \mu\text{m}$ with conventional design lens; $0.19 \pm 0.15 \mu\text{m}$ with decentered optic zone lens, $p < 0.001$) Coma correction was significantly greater with the decentered optic zone lens than with the conventional lens. ($p = 0.009$) The mean optical center position with respect to the center of the pupil was vertically shifted by 0.42 ± 0.23 mm in the inferior direction with the conventional lens and 0.24 ± 0.28 mm in the superior direction with the decentered optic zone lens. The decentered optic zone lens had significantly better centration. ($p < 0.001$)

Optimization of the optical zone location of a standardized asymmetric soft contact lens provided better optical quality correction and visual performance in patients with keratoconus.

Mr. Asaki Suzaki, Master of Engineering Project Leader, Clinical Research & Development Center, Menicon Co., Ltd.

83 Scleral lens fitting in a Sjogren's syndrome Patient with post LASIK cornea and surgical induced scleral irregularity: A case report

Jimmy Sung-Hei Tse

Mr Jimmy Tse graduated from The Hong Kong Polytechnic University with a Bachelor of Science degree in Optometry in 2007. After completing a two-year residency program, specializing in contact lens and anterior segment in the Hong Kong Polytechnic University, he joined the Hong Kong Polytechnic University as a full-time Clinical Optometrist in 2011. He later obtained his Master of Science degree in Optometry in 2015 and was appointed as a Senior Optometrist in the School of Optometry in 2015. Mr. Tse is a Fellow of the American Academy of Optometry and the British Contact Lens Association.

84 Different cornea profile? Keep calm and fit specialty lens

A Case Report

Maria Giulia Muzzi

Muzzi Maria Giulia is the principal author of the poster; she studied economy at the university in Ferrara but her passion were eyes. For this reason ,after ending economics studies, she became optic and optometrist. Now she works as technical support manager for Occhio x Occhio based in Italy and she helps fitters in choosing the best contact lens. She ia also the public speaking for Occhio x Occhio teaching how to fit lenses RGP, hybrid and soft to the optics in Italy.



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85 Peripheral corneal characterization for large diameter corneal contact lenses fitting in a patient with keratoconus

Joan Gispets

To describe a case in which large diameter corneal contact lenses (CL) were fit to a patient with asymmetric stage IV (RE) and stage I (LE) keratoconus (Amsler-Krumeich scale) to improve visual quality and comfort. Contact lens geometry was spherical-progressive, with four concentric radii obtained by a novel corneal characterization method based on Scheimpflug images (Oculus Pentacam HR®)

Total CL diameter was 0.9 times the value of the horizontal visible corneal diameter, whereupon the width of each concentric zone corresponded to a predefined percentage of the total, with a minimum optical zone diameter of 6 mm. The radii of each zone was obtained from the mean sagittal height at the corresponding corneal diameter, as measured on Scheimpflug images at meridians 0°-180°, 45°-225° and 135°-315°. Five different trials with CLs of different geometries and parameters were conducted. Final CL selection was RE: KA4 REVERSE (Conoptica S.L.); LE: KAKC-I (Conoptica S.L.).

Corneal sagittal height data analysis led to a successful CL fit, with an inverse geometry LC in the RE and a keratoconus specific geometry (albeit of large diameter) in the LE. Contact lens fitting resulted in an improvement in corrected distance visual acuity of 0.35 (from 0.1 to 0.45 Dec) in RE and of 0.3 (from 0.5 to 0.8 Dec) in LE over the previous CL design used by the patient. Subjective comfort was graded at 5/5 for both eyes, as compared with 3/5 with the previous fit.

The new method of corneal characterization based on sagittal height measurements on Scheimpflug images has improved data understanding and availability to allow for the determination of large diameter corneal CL parameters. Besides, large diameter CL, either of inverse geometry or keratoconus specific geometry, notably improved both visual acuity and subjective comfort, as compared with the previous CL design.

Joan Gispets was awarded a degree in Optometry at the Technical University of Catalonia (UPC) in 1992, a Master degree in Optometry and Vision Science at the University of Manchester in 1993 and a PhD at the UPC in 2009. He has been a Faculty member of the Optics and Optometry Department at UPC since 1995 and Director of the Centre Universitari de la Visió from 1999 to 2014. He is currently Dean of the Faculty. His research interests are related to contact lenses, keratoconus, non-invasive diagnostic techniques implementation and myopia.

86 AS-OCT imaging of conjunctival prolapse and pseudo-conjunctival edema under the scleral lens

Sarah Ferreira

Contactless with the cornea, scleral contact lenses offer the best solution for improving the visual acuity in case of irregular astigmatism. Conjunctival prolapse is a known complication of scleral contact lenses due to the tear reservoir that creates a negative pressure. This poster describe 4 cases of patients presenting a conjunctival prolapse associated with pseudo-conjunctival edema showed with AS-OCT.

Four scleral contact lens wearers had an AS-OCT in 4 quadrants at the contact zone of the lens then a new AS-OCT on the same location 5 minutes after removing the contact lens.

In the presence of the lens, one can observe, the existence of transparent microcysts, a sign of a subconjunctival edema. There is also sometimes a conjunctival prolapse covering the cornea. After the lens removal, the conjunctiva is smooth, the transparent microcysts and conjunctival prolapse have disappeared, but a loose conjunctiva aspect remains visible at the slit lamp.

It appears that the scleral lens induces a negative pressure force which draws the conjunctiva toward the center, giving it a pseudo-edema appearance which spontaneously resolves itself a few minutes after the lens removal.

Sarah Ferreira studied Optometry in FHNW in Olten in Switzerland: She was graduate in 2014 as B. Sc in Optometry and EurOptom. Immediately she has start to work in a contact lens center where she fit a lot of scleral lenses. In the same time she collaborate with cornea ophtalmologist specialist in an Ophtalmic Hospital (Hôpital ophtalmique Jules Gonin in Lausanne). She was very concerned regarding continuous training in Optometry and created in 2016 the AOR (Association des Optométristes Romands) with 4 other optometrists. She contribute in the association as president.

87 Our Experience with ROSE K2 Contact Lens for visual rehabilitation in Keratoconic Corneas following Collagen Crosslinking

Sneha Aggarwal

To evaluate the multicurve contact Lens (ROSE K2 CL) fitting for visual rehabilitation of Keratoconic corneas following collagen crosslinking (C3R) and analyze the modifications used to achieve optimal fitting.

A retrospective evaluation and analysis of keratoconic post C3R corneas on ROSE K2 CL wear was done. Those using other contact lens systems, or other ocular morbidities were excluded. Study data noted stage of Keratoconus, Uncorrected Visual Acuity (UCVA), Best

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Spectacle Corrected Visual Acuity (BCVA with spectacles) and the Best Contact Lens Corrected Visual Acuity (BCVA with Contact Lenses), type of ROSE K2 CL, base curve (BC), overall diameter (OD), edge fit and modifications, Asymmetric Corneal Technology (ACT) & Toric Periphery (TP) design, lens exchanges, and follow ups. All details were noted onto predesigned proforma for analysis. Data was analyzed based on the fitting guidelines of ROSE K2 CL [BC mean K of ≤ 5.99 mm (group 1), 6.0mm to 6.99mm (group 2), >7.0 mm (group 3)] and in accordance to the keratoconus staging (Amsler Krumeich classification).

In the 105 eyes of 71 patients of mean age 22 ± 6.07 years [(range 11 to 36 years) (males 53, females 18)], mean logMAR UCVA was 1.02 ± 0.41 , mean logMAR BCVA with spectacles was 0.51 ± 0.32 and mean logMAR BCVA with ROSE K2 contact lenses was 0.12 ± 0.09 . The difference between the recommended and prescribed CL BC was 0.33 ± 0.34 mm in group 1, 0.19 ± 0.17 mm in group 2 and 0.18 ± 0.16 in group 3. Edge modification was required in 90%, 58.7% and 45.5% in group 1, 2 & 3 respectively. Stages 3 and 4 of Amsler Krumeich of KC classification required more changes in BC from recommended trial (0.26 ± 0.24 mm), change in overall lens diameter (0.21 ± 0.14 mm).

Advanced corneal ectasia corneas of keratoconus staging IV and with mean K base curve values of < 6 mm require more fitting modifications from recommended manufacturer's guidelines in order to achieve an optimal CL fitting. ROSE K2 multicurve lenses provide a tailored fit to the irregular corneal contours providing successful visual rehabilitation. Our experience provides guidance on the fitting modifications in parameters required for achieving better customization of ROSE K2 CL in post C3R keratoconic corneas with advanced ectasia.

I am an optometrist currently working as an Optometrist at Dr. R.P. Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi since September 2014. I am managing Low Vision and Rehabilitation services with Contact Lens Services. I am a Fellow of 4th Young Leader's Program by IVI in association with LVPEI, an IACLE Educator, Awarded IACLE Membership on August, 10 2015 and Certified by Duke Reading Centre for Visual Field, Fundus Photography, OCT and ETDRS Visual Acuity. I have 4 papers to my credit and presented my work in more than 15 conferences.

88 Analysis of corneal sublayers densitometry during long-term orthokeratology treatment

Mauro Frisani

Analyze densitometry of corneal sublayers (epithelium-Bowman, stroma, endothelium) in eyes in orthokeratology treatment for myopia control with no refractive changes over two years.

sample: 70 eyes of 36 subjects (21 females and 15 males; age by mean \pm SD of 11.9 ± 1.9 , range from min 9 to max 15 years; myopia by mean \pm SD -2.9 ± 1.1 , range from min -0.75 to max -5.25 dioptres) in orthokeratology treatment for myopia control, with no refractive changes over two years; tomographic images (Sirius, CSO, Italy) were processed through MATLAB® scripts to identify central vertex of cornea, corneal sublayers and to measure optical density over the central area of 3 mm for each sublayer. Shapiro-Wilk test, and paired samples T-test (Wilcoxon signed-rank test) were performed for statistical significance.

Right eye data have been statistically analysed. Densitometric values at baseline and after two years of orthokeratology treatment showed a Gray Scale Units (GSU) change for epithelium-Bowman complex from 18.4 ± 2.1 to 18.7 ± 1.4 (CI 95%, $p=0.04$), for stroma from 10.7 ± 0.8 and 11.2 ± 0.8 (CI 95%, Wilcoxon test $p<0.001$), and for endothelium from 5.1 ± 0.6 to 5.0 ± 0.6 (CI 95%, Wilcoxon test $p=0.80$).

Densitometric values for healthy cornea of primary sublayers were measured before and after two years of orthokeratology treatment for myopia control in young cohort with no refractive progress of myopia. Data analysis showed minimal variations of GSU for long-term orthokeratology treatment.

Optometrist, Professor at University of Turin, Italy.

89 Orthokeratology in eyes with photorefractive surgery myopic regression: long term results

Mauro Frisani

investigate refractive and corneal variations in subjects with photorefractive surgery myopic regression, after five years using orthokeratology lenses for myopia and astigmatism correction

sixteen eyes of eight subjects, (5 females and 3 males; age by mean \pm SD of 38.50 ± 3.4 , range from min 35 to max 43 years; myopia by mean \pm SD of 2.71 ± 0.94 , range from min -0.75 to max -3.75 diopters; astigmatism by mean \pm SD of 0.98 ± 0.89 , range from min of 0.25 to max of 1.00 diopters; distance Uncorrected Visual Acuity UCVA by mean \pm SD of 0.67 ± 0.21 from min 0.90 to max 0.34 LogMAR), with photorefractive surgery myopic regression, every eyes with successful surgery with no complications but with physiological return to myopia after many years, wearing overnight orthokeratology lenses for five consecutive years, were analysed with ocular tomography (Sirius, CSO, Italy) and ocular aberrometry (Keratron Onda, Optikon, Italy). Data from baseline, before (t_0) and after five years (t_5) of orthokeratology lenses use, have been compared for anterior and posterior curvature, total and minimum corneal thickness, objective ocular refraction from ocular aberrometry and UCVA.

After five years of orthokeratology lenses use, has been observed a statistical significance difference compared to baseline, with clinical significance in some measured parameters and ocular aberrations: UCVA (Student's T-test: $p<0,001$; t_0 $0,67 \pm 0,21$ vs t_5 $0,05 \pm 0,03$ logMAR); sphere (Student's T-test: $p<0,001$; t_0 $-2,71 \pm 0,94$ vs t_5 $-0,41 \pm 0,33$ diopters); anterior keratometric average 3mm (Student's T-test: $p<0,001$; t_0 $8,45 \pm 0,35$ vs t_5 $8,81 \pm 0,41$ mm); keratometric mean pupil power (Student's T-test: $p<0,001$; t_0 $39,06 \pm 1,71$ vs t_5 $37,75 \pm 1,95$ diopters). In some parameters has been observed a statistical significance difference, with no clinical significance: Central Corneal Thickness (CCT) (Student's T-test: $p<0,001$; t_0 $475,10 \pm 40,63$ vs t_5 $467,70 \pm 39,00$ μ m); Thinnest Corneal Thickness (TCT) (Student's T-test: $p<0,001$; t_0 $474,17 \pm 40,69$ vs t_5 $466,29 \pm 39,19$ μ m), while in only one parameter has been observed no statistical significance difference: posterior keratometric average 3mm (Student's T-test $p=0,09$, t_0 $6,40 \pm 0,22$ vs t_5 $6,44 \pm 0,20$ mm).

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Long-term overnight orthokeratology lenses use in eyes with photorefractive surgery myopic regression is able to improve natural vision and effectively correct myopia by flattening the cornea. Corneal thickness and posterior curvature of the cornea are not involved in the treatment.

Optometrist, Professor at University of Turin, Italy

90 Evaluation of the Effect of the Sagittal Height of Soft Contact Lenses on Corneal Topography After 4h and 8h of Wear. **Langis Michaud**

To evaluate modifications of corneal topography following four and eight hours wear of high DK lenses.

This is a prospective, randomized, single-blind study where subjects are asked to wear lotrafilcon A lenses, on 2 consecutive days. On day 1, one eye is randomly fitted with a 8.4 BC and the other one with a 8.6 BC lens (L2). One lens (L1), again randomly selected, was removed after 4h00 for I testing, then reinserted, while the other one (L2) was kept for 8h00. On day 2, this scenario was reversed. Corneal epithelial thickness and Sim K were evaluated in 4 quadrants. Topographic indices (SRI, SAI) were estimated from topography. All results were compared from baseline to 4 and 8h00 post insertion.

Population was composed with 16 subjects, 12 females and 4 males. Average age was 23.5 + 1.6 years old. Nine of them were regular daily disposable soft lens wearers but they were asked to remove their lenses 72h00 prior testing session. Average sagittal height of their ocular surface was 3562 $\mu\text{m} \pm 238.5\mu\text{m}$ OD and 3562 $\pm 228.6\mu\text{m}$ OS with a minimum of 3097 μm and a maximum of 3980 μm , measured for 15 mm chord. Corneal epithelial thickness and Sim K values varied slightly but not significantly during the study, in all 4 corneal quadrants. Corneal indices (SRI, SAI, SimK) derived from topography did not vary significantly either, after 4h00 or 8h00 of wear, for both L1 and L2 lenses. When asked about comfort, subjects identified the lens with the higher sag (8.4) as their preferred. This difference cannot be explained by corneal topographic modifications.

The flat lens sag (felt uncomfortable) being approximately 3679 μm this means that sagittal depth of the lens should exceed by more than 110 μm the ocular surface height to reach a comfortable wear.

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 Diplôme 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.

91 Are all customized contact lenses created equally? **Irene Lozano Sierra**

This study aims to verify that a customized contact lens design behaves in the same way in standard and non-standard patients and to evaluate the symptomatology and the integrity of the ocular surface.

A total of 16 participants (12 women, 4 men; mean age 23.6+/-1.6 years) wore Filcon V3 soft monthly disposable contact lenses for a four-week longitudinal study. Conjunctival indentation was captured on the temporal edge of the contact lens using Optical Coherence Tomography (OCT). Objective Non-Invasive Keratograph Break-Up Time (NIK BUT), NIK BUT average, Tear Meniscus Height (TMH) and bulbar and limbal ocular redness (BR and LR respectively) were evaluated (Keratograph 5M) after 1 day, 1 week, 2 weeks and 1 month of 8 hours wear. Symptoms were assessed using the Contact Lens Dry Eye Questionnaire (CLDEQ-8) and conjunctival staining was graded at every visit.

No statistically significant differences were found for TMH ($p=0.21$), NIK BUT ($p=0.19$), NIK BUT average ($p=0.06$), BR ($p=0.38$) and LR ($p=0.50$), which remained stable over time. Values of conjunctival indentation do not vary over time ($p=0.60$). Significant differences were found in upper bulbar and total bulbar conjunctival staining ($p=0.03$ both) between the first week and the rest of the visits. The comfort assessed with CLDEQ increased significantly in the 4th week ($p=0.03$).

The outcomes show that customized contact lenses with a knife edge design respect the integrity of the ocular surface, maintain user comfort levels and even improve the symptomatology associated with their use and are as suitable for patients with standard ocular parameters as for those outside the norm.

Firstly graduated as translator, the author discovered then her passion for optometry and contact lenses and decided to graduate also as such. Before graduating, she worked as an intern for the Deanery of the Faculty for six months. After graduating, she got an internship at the University Clinic for a year. When this period was over, she decided to go for something different and started working at mark'ennovy (a contact lens laboratory), first at Customer Care and then at Marketing and Professional Affairs departments, but always in touch with the university and always training and educating herself.

92 Binocular supra-threshold performance with contact lens-induced monovision: a reaction time and visual evoked potential study **Eleni Papadatou**

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To investigate how contact lens-induced monovision affects binocular performance using supra-threshold techniques, such as visual reaction time (RT) and pattern visual evoked potentials (pVEPs), compared to standard visual acuity (VA).

Conventional monovision and cross monovision were achieved by monocular fitting of positive powered contact lenses up to 3.00D (0.50D step). Binocular defocus was also induced. pVEP, RT and VA were measured at 1m viewing distance on 12 volunteers (age 29±7 years) with best spectacle spherocylindrical correction and natural pupils. pVEPs were elicited using reversing 10 arcmin checks with 100% contrast. RTs were measured to the onset of a horizontal sinusoidal grating with a 4 c/deg spatial frequency and a 10% contrast. Display luminance was 30 cd/m². VA was measured using ETDRS charts.

Average pVEPs P100 latency and RT were always shorter under monovision compared to binocular defocus. Conventional and cross monovision yielded similar results on pVEP (p=0.80), RT (p=0.82) and VA (p=0.11). Compared to the best in-focus condition, conventional and cross monovision increased for example P100 latency at 2.0D by 4±3 ms and 4±4 ms, respectively. The P100 latency with binocular defocus at 2.0D was slower by 16±7 ms. Similarly, conventional and cross monovision increased RT at 2.0D by 29±22 ms and 30±16 ms, respectively, while RT was slower by 141±72 ms with binocular defocus. VA decreased at 2.0D by 0.05±0.04 logMAR in conventional monovision, 0.07±0.06 logMAR in cross monovision and 0.55±0.29 logMAR in binocular defocus. A high covariance with defocus was observed between RT and pVEPs, both being more susceptible to monovision compared to VA.

Current findings highlight the potential of supra-threshold measures, such as pVEPs and RT, over conventional VA when evaluating visual performance with monovision. Their high covariance with blur indicates the existence of a common variability source in the underlying neural responses.

Dr Eleni Papadatou is a post-doctoral research fellow at the University of Plymouth School of Health Professions. She received a bachelor's degree in Optics and Optometry from Western Greece Technological Institution and a master's degree in Optics and Vision Sciences from University of Crete in Greece. She was awarded the degree of Doctor of Philosophy (PhD) from University of Valencia in Spain after completing her three years Marie Curie fellowship. She is interested in presbyopia and cataract surgery, intraocular and contact lens design and visual perception.

93 Changes in Corneal Thickness Associated With Variation of Central Corneal Clearance of Scleral Lenses

Kirsten Carter

Modern scleral lenses (ScCLs) promote little tear exchange, limiting oxygen delivery to the cornea, possibly resulting in corneal edema. Recent studies have investigated the hypoxic effects of varying central corneal clearance (CCC) in short-term ScCL wear, and theoretical models have been proposed. The purpose of this study was to observe if there were hypothesized changes in corneal thickness associated with low levels of corneal hypoxia in healthy participants wearing ScCLs of different (CCC) over a longer term of wear.

This was a prospective, dispensing study design involving 10 healthy eyes. Participants wore two randomly allocated ScCL designs; low (LC, 350 µm) and high clearance (HC, 450 µm). Pentacam HR[®] was performed at baseline (BL), and after six hours of lens wear following two weeks of lens wear.

BL pachymetry across the horizontal and vertical meridians was compared in LC versus HC ScCLs. Centrally, comparing BL with LC there was no significant difference in CT (p=0.423), but when compared to HC, there was a significant difference (p=0.000699); and also when comparing LC and HC ScCLs (p=0.017). Comparisons were made across 20 locations horizontally and vertically, where there were significant differences comparing BL to LC and HC ScCLs (p=0.0266). Horizontally, significant differences were found between BL and LC, BL and HC, and LC versus HC (all p<0.008). Similar results were found in the vertical meridian (p<0.028).

When fitting ScCLs with HC, compared to both baseline and LC ScCLs after 2 weeks of wear, the cornea responds with an increase in thickness. There was also a significant increase in thickness with LC lenses compared to BL. Excessive CCC should be avoided, and attention should be paid to a more chronic hypoxic response with long-term ScCL wear.

Kirsten Carter is a Doctor of Optometry Student at the University of Waterloo School of Optometry and Vision Science. She is concurrently pursuing her Master's Degree in Vision Science at the University of Waterloo, under the supervision of Dr. Luigina Sorbara, Head of the Contact Lens Clinic, and Professor of the Basic and Advanced Contact Lens courses. As an OD student, as well as through Undergraduate Research Assistantships in Physics, Kirsten has carried out and assisted with research projects involving many forms of ocular imaging, including high-resolution research-grade OCT and Pentacam HR[®] topographical imaging of the keratoconic and non-keratoconic population.

94 Predicting success in orthokeratology for myopia control for corneal shape and objective refraction changes

Mauro Frisani

to identify clinical factors contributing to predicting success in orthokeratology for myopia control and to investigate relationship between corneal topographical changes and objective myopic reduction, before and after two years of orthokeratology treatment

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retrospective study. Clinical records over two years of 119 subjects in orthokeratology treatment for myopia control were reviewed. The objective refraction from ocular aberrometry (Keratron ONDA, Optikon, Italy) and anterior corneal shape (Sirius, CSO, Italy) data at baseline and after two years of 59 subjects who fulfilled the inclusion criteria were retrieved and analyzed. The age of the subjects was between 7 and 18 years (mean \pm SD 12,0 \pm 1,7), myopia was between -1,00 and -7,50 diopters (D) (mean \pm SD -3,45 \pm 1,37 D), max value of astigmatism of -2,75D (mean \pm SD 0,79 \pm 0,69 D). Statistical analysis was performed using R (R Core Team 2015, Vienna, Austria).

Significant difference ($p < 0,01$) between the change in objective refraction (ΔRx) and changes in corneal shape were found. The linear regression analysis of the relationship between objective refractive change relative to mean Maloney's best-fit index (ΔBF_{flat}) and to mean simulated keratometry ($\Delta SimK_{flat}$) readings of the flat meridians, shows a poor correlations $r^2 = 0,14$ with $\Delta Rx = -0,38 \Delta BF_{flat} + 0,06$ (D) ($p < 0,004$) and $r^2 = 0,15$ with $\Delta Rx = -0,39 \Delta SimK_{flat} + 0,008$ (D) ($p < 0,002$) respectively.

Change in anterior corneal shape, for simulated keratometry and Maloney's best-fit index, underestimate the achieved myopic reduction in objective refraction and the results showed that these corneal parameters are not close estimation of the success of treatment. This study suggest that myopia reduction could be better predicted if the two parameters are considered together in a multiple factors model. Summary conventional index of corneal refraction used for keratometric values instead of specific index of refraction of epithelium, corneal substrate involved in orthokeratology treatment, could be an efficient method to predict results of orthokeratology treatment for changes in corneal shape in relation to objective ocular refraction.

Optometrist, Professor at University of Turin Italy

95 Keratoconic contact lens management in Autosomal dominant polycystic kidney disease at an optometric practice: A case report Ganeshbabu Mahalingam

Autosomal dominant poly cystic kidney disease (ADPKD) caused by mutations in a single gene is a common form of inherited kidney disease presenting with fluid-filled cyst formation in kidneys. Uncontrolled disease leads to kidney fibrosis and eventually kidney failure. One of the treatments for delaying the end-stage disease is by controlling the serum sodium level using V2-receptor inhibitor, Tolvaptan. This treatment increases solute-free fluid excretion (aquaresis) from the body. Patients administered with this medication over 90mg seem to demonstrate various systemic adverse effects relating to fluid excretion. In a patient suffering keratoconus, coexistence of ADPKD under pharmacological management can be a challenge in their contact lens wear. Excessive fluid excretion from the body due to the medication appears to drain the aqueous volume in the tear film. This could, within a month introduce ocular dryness signs and symptoms, and corresponding contact lens discomfort irrespective of the contact lens type used. The contact lens dependent keratoconic sufferers who are anxious about discontinuing the contact lens wear rather tends to limit their use and mentally accept the discomfort during their wearing time. In these patients, clinicians should consider refitting the contact lenses to allow extra fluid exchange behind the lenses. In addition, regular application of ocular lubricants irrespective of contact lens use, and increasing its frequency with contact lens use becomes mandatory. Other options like full-scleral contact lenses or punctal-plugs could be offered. Clinicians are recommended to consider discussing aquaresis symptoms and initiate tear film analysis should a kidney disease be reported during contact lens aftercares. A case of a 50years old gentleman suffering ADPKD and using contact lenses to achieve a better quality of vision from keratoconus highlights these findings in his ongoing clinical management.

The author has special interest in fitting contact lenses for challenging cornea and managing Glaucoma. Presently, works at an independent community optometric practice offering advanced contact lens service to Pinderfields eye hospital, Wakefield. Prior to his higher qualifications in Glaucoma, and his career in the U.K, the author originally qualified at a tertiary eye hospital in India. He had intense exposure to various hospital optometry services and gained experience of working under the ophthalmology consultants for Glaucoma, Uvea, Neuro-ophthalmology and cornea.

96 Predicting the Rotation of Back-Surface Toric Scleral Lenses with Corneo-Scleral Profilometry Javier Rojas-Viñuela

To compare the location of the meridian with the lowest sagittal height obtained from corneo-scleral profilometry to the position of the flattest meridian of toric scleral lenses.

10 eyes with irregular corneas from 6 patients were measured with the Eye Surface Profiler (ESP, Eaglet Eye, The Netherlands). The location in degrees of the lowest sagittal height (min sag) meridian was obtained for three different diameters: 14, 14.5 and 15 mm. These eyes were fitted and prescribed with toric scleral lenses (ICD, Paragon Vision Sciences) labeled with marks at the flattest meridian. The location of the flattest meridian in degrees (rotation) was measured and recorded with trial lenses and with the prescribed lens. Statistical analysis was performed to determine if there was correlation between the min sag meridian obtained with the ESP and the rotation with the prescribed lens.

The mean difference between the rotation with diagnostic lenses and with the prescribed lens was $14,0 \pm 16,81$ degrees. A statistically significant correlation was found between the min sag meridian and the rotation. Correlation coefficients were $r_1 = 0,75$, $r_2 = 0,84$ and $r_3 = 0,90$ for the diameters 14, 14.5 and 15 mm respectively ($p < 0,01$). A stronger correlation was found at the 15 mm diameter ($p < 0,001$).

Overall, the ESP showed good reliability on predicting the final on-eye rotation of the lens for these fittings. It seems to be more accurate when the min sag meridian is obtained from a larger diameter. These results suggest that the ESP could be used to estimate the lens toricity by measuring the sagittal height at the lowest meridian and the meridian located 90 degrees apart.



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Founder and Chief (Business Manager) of Natural Optics Balaguer. It is private practice providing primary eye carer and specialty contact lenses fittings. Founder of the Contact Lens Center. An institution focused on researching, teaching and providing Continuing Education (CE). Fellow of the American Academy of Optometry and Diplomate, Cornea, Contact Lenses and Refractive Technologies.

97 Cleaning effectiveness of a povidone-iodine based disinfecting solution for orthokeratology lenses

Sin-Wan Cheung

A recently introduced povidone-iodine (PI) based disinfecting solution for rigid gas permeable contact lenses incorporates anionic surfactant, sodium sulphite, and proteolytic enzyme claimed to be able to loosen deposits on the lens surface, thus providing cleaning action. This study investigated the effectiveness of solution's cleaning of orthokeratology (ortho-k) lenses after one-month of lens wear.

80 myopic subjects (6 to 11 years) participating in ortho-k studies were recruited and randomized to four groups: no rubbing (G1), daily rubbing with the PI-based solution (G2), daily rubbing with cleaner (G3), and daily rubbing with cleaner plus bi-weekly protein removal (G4). The lens surface was inspected and photographed using slit-lamp biomicroscopy, after one month of lens wear. Surface deposit and scratches were graded as none (0), mild (1), moderate (2) and severe (3).

Two subjects withdrew from the study before lens dispensing. At the time of writing, 68 (G1: 16; G2: 18; G3: 16; G4: 18) had completed the one-month examination, with 10 awaiting examination. There were no significant differences between groups in age ($p=0.674$, Mean \pm SD 9.0 \pm 1.2 years) and gender ($p=0.921$, overall 60% female). Back optic curve (BOC) and reverse curve (RC) were mild to moderately coated, whereas the alignment curve (AC) was only mildly coated after one month of lens wear. However, there were no significant differences in the level of deposits in BOC ($p=0.815$), RC ($p=0.282$), AC ($p=0.270$), or in the level of surface scratches ($p=0.188$) among the study groups.

Current results indicated that additional lens rubbing and intensive cleaning did not alter cleaning effectiveness over the first month of wear. However, it may be advisable to clean thoroughly weekly, to reduce chance of build-up of deposit or other contaminants.

Dr Cheung received her bachelor degree in Optometry in 1996 and her PhD degree in 2018 from the Hong Kong Polytechnic University. She is a Fellow of the American Academy of Optometry. She is currently a Project Fellow at The Hong Kong Polytechnic University and her research interests are related to soft contact lens and the care systems.

98 Peripheral refraction changes post short-term OrthoK contact lens wear

Pancham Kulkarni

This study investigated peripheral refraction changes induced by short-term use of reverse-geometry contact lenses (OrthoK) worn in open eye condition.

A total of 25 eyes of 15 young subjects with mean age 20.45 years (SD \pm 1.45 years) and with myopia between 1.00D to 4.00D wore OrthoK contact lenses (Fargo, USA) for 30 minutes and 2 hours in open eye condition on separate occasions. Peripheral refraction (PR) changes were recorded monocularly using the open field autorefractometer WAM-5500 (Grand Seiko Co. Ltd, Japan) from 30° nasal to 30° temporal at 5° steps in the horizontal visual field. Data was analysed by paired t-test before and after lens wear.

Mean baseline central spherical equivalent refractive error (M) was -2.39D (SD \pm 1.23D) that reduced to mean -2.00D (SD \pm 1.15D; $p < 0.001$) after 30 minutes of OrthoK lens wear and which further reduced to mean -1.68D (SD \pm 1.25D; $p < 0.001$) post 2 hours of lens wear. At 25° temporally and nasally PR displayed an increase in myopia of mean (M) -1.01D (SD \pm 0.92D; $p < 0.001$) and mean -0.57D (SD \pm 1.03D; $p = 0.011$) respectively from baseline post 30 mins of lens wear. Post 2 hours lens wear PR further increased at 25° from baseline values with mean (M) -1.28D (SD \pm 1.03D; $p < 0.001$) temporally and mean -0.82D (SD \pm 0.95D; $p < 0.001$) nasally. A similar myopic shift from baseline was also observed at 30° on both sides of visual field for both duration of lens wear ($p < 0.001$).

The central and PR responds rapidly to the application of OrthoK lenses with significant central myopia reduction and increase in peripheral myopia beyond 25° post 30 minutes of lens wear with continuous increase in effect for 2 hours lens wear.

Mr Pancham Kulkarni, M.Optomety (UNSW, Australia), Area of research: Orthokeratology, Moderator: Dr Helen Swarbrick F.I.A.C.L.E., Senior lecturer, Chitkara School of Health Sciences, India. Visiting faculty, Lotus College of Optometry, India. Contact lens consultant at Kulkarni Brothers Clinic, Mumbai, India. (14 years experience)