

## Oral abstract presentation

### OP-1 ANALYSIS AND REPORTING OF SURGICALLY INDUCED KERATOMETRIC EFFECT (SIKE)

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**Purpose** To investigate the surgically induced keratometric effect (SIKE) associated with cataract surgery.

**Methods** Consecutive patients undergoing cataract operation by four surgeons were prospectively included. Two surgeons made an incision at 110 with one side port at 50 (location 1). Two surgeons made a temporal incision at 200 and 20 for right eyes and left eyes respectively, with two side ports (location 2). Biometry was acquired preoperatively and at 6-weeks postoperatively using an IOL Master 500 (Carl Zeiss Meditec, Jena, Germany) on the operated and unoperated fellow eye. Keratometric change was analysed after being transformed into Long's formalism. Coupling was defined as a change between the mean pre to post K that was less than the change in the unoperated eye.

**Results** Two hundred patients were included, (132 in location 1 and 68 in location 2). There were significant differences in pre- to postoperative keratometry: location 1: preoperative and postoperative mean K were 43.65 (95%CI:40.27 to 47.04), 43.64 (95%CI:40.20 to 47.09) respectively, mean absolute difference 0.19 (SD:0.19;p<0.01), location 2: preoperative and postoperative mean K were 43.29 (95%CI:39.89 to 46.70), 43.21 (95%CI:39.91 to 46.51) respectively, mean absolute difference 0.21 (SD:0.21;p<0.01). For location 1, the mean SIKE was -0.23 @ 111/+0.21 @ 21 (95%CI:-1.43@122/+0.04 @ 32 to +1.04 @ 135/+0.30 @ 45). For location 2, the mean SIKE was -0.29 @ 104/+0.13 @ 14 (95%CI:-1.75@122/-0.19 @ 32 to +0.30 @ 47/+1.32 @ 137). Keratometric changes were not coupled in 69/132 (52%) for location 1 and in 42/68 (62%) for location 2, no significant difference between the coupling rate of location 1 and location 2 (p=0.51).

**Conclusion** The SIKE is relatively predictable for incision location and was surgeon independent. Coupling occurs in less than 50% of cases with a change in the mean keratometry.

### OP-2 ASSESSMENT OF CORNEAL ANGIOGRAPHY FILLING PATTERNS IN CORNEAL NEOVASCULARIZATION

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**Purpose** To describe vascular filling patterns in corneal neovascularization (CoNV) and evaluate the effect of corneal lesion location, CoNV surface area and multi-quadrant CoNV involvement on the filling pattern.

**Methods** Retrospective study of patients who had been investigated for CoNV using fluorescein angiography (FA) or

indocyanine green angiography (ICGA) between January 2010 and July 2020. Angiography images were graded and analysed multiple independent corneal specialists. Corneal surface was divided into 4 quadrants and patient information was obtained through electronic records.

**Results** 133 eyes were analysed. Corneal lesions were located on the peripheral (72%) or central (28%) cornea. Central lesions were associated with multi-quadrant CoNV more frequently than peripheral lesions (p=0.15). CoNV located within the same quadrant of the corneal lesion was often first to fill (88.4%). In multi-quadrant CoNV, the physiological inferior-superior-nasal-temporal order of filling was usually respected (61.7%). Central lesions resulted in larger CoNV surface area than to peripheral lesions (p=0.09). In multi-quadrant CoNV, the largest area of neovascularization was also the first to fill in (peripheral lesion 74%, central lesion 65%).

**Conclusion** Fillings patterns in healthy corneas have previously been reported. Despite CoNV development, these patterns are usually respected. Several factors that may influence filling patterns have been identified, including corneal lesion location, CoNV surface area and aetiology of CoNV. Understanding filling patterns of neovascularization allows identification of areas at higher risk of developing CoNV, aiding in earlier detection and intervention of CoNV.

### OP-3 THE EFFECTIVENESS OF ARTIFICIAL INTELLIGENCE IN ANNOTATING AND MEASURING CORNEAL PATHOLOGY ON OCT

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**Objective** To determine if corneal OCT images can be characterised and measured using artificial intelligence (AI) and how this compares to manual subjective assessment.

**Methods** Phase one. Casia OCT images of patients with corneal disease were included from Birmingham and Liverpool. Individual images were annotated by expert clinicians after concordance training sessions. Two annotations were made: high and low confidence lesion borders. Images were split into training and testing sets. Training data were used to train a DeepLabV3 deep learning model. Testing sets were used to evaluate performance. Lesions were independently evaluated by three masked experts. Phase two. OCT images from patients with microbial keratitis (MK) on days 0, 3, 7 and 28 were annotated by AI after training on normal corneal OCTs. Nonparametric analysis was undertaken using SPSS v25.

**Results** Phase one. 456 images from patients with primary cornea disease were used to train the AI model and 43 were used for testing the model. Comparing manual and automated annotation, there was a significant difference between expert clinicians (p=0.03, p=0.001) in deciding whether the AI or subjective annotation was a better representation. This may reflect the variety of lesions included. Phase two. Images of 102 patients with MK were selected from days 0, 3, 7 and 28 and subjected to automated annotation. Data analysis on AI annotation of improvement in MK is due March 2022.

**Conclusion** The usefulness of AI for annotating corneal OCT lesions depends on the homogeneity and quality of the image. OCT systems which provide higher resolution images enable better automated annotation.

#### OP-4 DEVELOPMENT OF NOVEL HUMAN-DERIVED HYBRID HOST DEFENSE PEPTIDES FOR INFECTIOUS KERATITIS

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**Background/Aim** Infectious keratitis (IK) is a major cause of corneal blindness worldwide. This study aimed to develop potent human-derived hybrid host defense peptides (HyHDPs) with broad-spectrum antimicrobial activities for IK.

**Methods** HyHDPs were rationally designed through combination of human cathelicidin (LL-37) and human-beta-defensins (HBDs), and with guidance from molecular dynamics (MD) simulations. Efficacy of HyHDPs was determined against a range of bacteria, fungi and Acanthamoeba. Risk of antimicrobial resistance (AMR) was evaluated using multipassage AMR assay. Pre-clinical murine studies were performed to examine the in vivo efficacy and safety of HyHDPs in methicillin-resistant *S. aureus* (MRSA)-related keratitis.

**Results** Hybridisation of LL-37 and HBD-2 led to the development of HDP23, which demonstrated good efficacy against *S. aureus* and MRSA [minimum inhibitory concentration (MIC)=12.5–25.0 µm/ml], but not against fungi or Acanthamoeba. MD simulations provided atomistic insights into the key membrane-active residues and accelerated the discovery of HDP56. Compared to HDP23, HDP56 exhibited 4–32 times improved efficacy against *S. aureus*, MRSA, *Pseudomonas aeruginosa*, and *Fusarium solani* (MIC=3.1–6.3 µm/ml). At 100 µm/ml, HDP56 exhibited good anti-Acanthamoeba trophozoites efficacy (99.8%) and anti-encystation efficacy (80.9%). *S. aureus* did not develop any AMR against HDP56 after 15 treatment passages/days but developed significant AMR (32 times increase in MIC) against levofloxacin after 13 passages/days. Pre-clinical murine studies demonstrated strong efficacy and safety of HDP56 (0.5 mg/ml) in treating MRSA-related keratitis (93% reduction in bacteria, which was equally effective to levofloxacin (5 mg/ml).

**Conclusion** Rational hybridisation of HDPs, with guidance from MD simulations, has enabled the development of a novel HDP-based therapy for IK.

#### OP-5 MEASURING BOWMAN'S LAYER IN THE CLINIC

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**Purpose** To assess the accuracy, repeatability, and performance limits of in vivo Mirau ultrahigh axial resolution (UHR) line

field spectral domain (LF-SD) optical coherence tomography (OCT) for the clinical in vivo measurement of Bowman's layer thickness in subjects with and without keratoconus.

**Methods** Patients with keratoconus and volunteers with no corneal disease were included. The thickness of Bowman's layer was measured in the clinic. An in vivo graph search image segmentation of the central cornea was obtained at the normal interface vector orientation. The Mirau-UHR-LF-SD-OCT system used has an axial resolution down to 2.4 µm in air (1.7 µm in tissue), with an A-scan speed of 204.8 kHz and a signal to noise ratio (sensitivity) of 69 (83) dB.

**Results** 40 patients with keratoconus and 20 healthy volunteers were included. The repeatability of mean Bowman's and epithelial thicknesses were 0.3 and 1.0 µm, respectively. The measured 95% population range for Bowman's layer thickness was 13.7 to 19.6 µm for healthy (mean 16.65, SD 1.48) and 10.94 to 16.99 for 23 of the keratoconics (mean 13.96 SD 1.51) ( $p < 0.05$ ).

**Conclusions** The measured thicknesses of Bowman's layer using the Mirau-UHR-LF-SD-OCT were both accurate, with the range for healthy in vivo thicknesses matching prior confocal and OCT systems of varying axial resolutions and repeatable. Bowman's layer was significantly thinner in patients with keratoconus. Bowman's layer can be accurately measured in the clinical setting using a Mirau-UHR-LF-SD-OCT and can be useful for disease monitoring.

#### OP-6 SIMULATED LAMELLAR AND ENDOTHELIAL KERATOPLASTY USING THREE-DIMENSIONAL PRINTED AND THIN-FILM MODELS

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**Background** Corneal transplantation techniques' evolution has resulted in faster visual recovery, lower immunological rejection, and improved graft survival. However, the number of transplants that can be performed can be limited by a lack of donor corneas, a steep learning curve, and the need for specialised expertise.

**Methods** A literature search was undertaken of Ovid/MEDLINE and PubMed/EMBASE to review current corneal surgery simulation models and best-practice lamellar and endothelial keratoplasty techniques. A DALK simulation model was designed using Fusion 360 (Autodesk, San Rafael, California, USA) and printed with the J850 (Stratasys, Eden Prairie, Minneapolis, USA). A DMEK simulation model was created using thin films to allow the practice of the intraocular DMEK unfolding manoeuvres.

**Results** The DALK simulation model was produced with a shore hardness A value consistent with the mammalian cornea. Dimensions of the simulation models were based on the emmetropic model eye. Experienced corneal surgeons performed simulated surgery on the models and evaluated face and content validity.

**Conclusion** 3D printed and thin film models have practical benefits compared with cadaveric models; they do not decompose and can be standardised to model specific surgical scenarios. 3D printing is an innovative technology with applications across many fields, including healthcare. It allows for the