

CORNEA and **EYE BANKING** **FORUM 2026**

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Cornea Society
Advancing the treatment of corneal disease



ABSTRACTS

Oral and Poster Presentations

ORAL PRESENTATIONS

ORAL 1

Refractive And Topographic Outcomes Of Corneal Tissue Addition Keratoplasty (CTAK)

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Purpose: To evaluate visual, refractive, and topographic outcomes after corneal tissue addition keratoplasty (CTAK) for keratoconus and post-surgical ectasia.

Methods: A retrospective review was conducted of eyes undergoing CTAK. Collected variables included pre- and postoperative corneal tomography (Pentacam), visual acuity, and refraction. Primary outcomes included changes in maximum (Kmax), steep (K2), and mean (Km) keratometry, spherical equivalent (SE), uncorrected (UCVA), and best-corrected (BCVA) visual acuity. Measurements at 1, 3, and ≥ 6 months were compared to baseline. Outcomes were also compared by prior corneal cross-linking (CXL).

Results: 46 eyes (mean age 36.6 years) were evaluated. Preoperatively, mean Kmax was 66.0 ± 11.7 D, K2 was 56.7 ± 8.7 D, and Km was 53.9 ± 8.4 D. At 1 month, Kmax decreased to 61.2 ± 10.6 D, K2 decreased to 51.6 ± 8.4 D, and Km decreased to 49.3 ± 8.0 D (all $p < 0.0001$). UCVA improved from 0.97 ± 0.48 to 0.62 ± 0.45 logMAR ($p < 0.0001$), BCVA improved from 0.57 ± 0.44 to 0.37 ± 0.28 logMAR ($p = 0.007$), and SE improved from -4.0 ± 4.6 D to -1.4 ± 2.9 D ($p < 0.0001$). Follow-up beyond 1 month suggest sustained Kmax flattening from baseline at 3 months (63.3 ± 11.0 D, $n = 16$) and 6 months (60.9 ± 8.3 D, $n = 7$) (trend $p < 0.0001$). Prior CXL did not significantly affect outcomes (all $p > 0.10$).

Conclusion: CTAK was associated with early improvement in corneal curvature, refraction, and functional vision. These findings support CTAK as a promising therapeutic option, though expanded longitudinal follow-up is necessary to evaluate long-term stability

**** Medical Student**

ORAL 2

Eye Bank Preloaded Endothelium-In DMEK in Complex Eyes: A Multicenter Comparison of Surgical Efficiency and Clinical Outcomes

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Purpose: To compare Endothelium-In (Endo-In) DMEK with Endothelium-Out (Endo-Out) DMEK in complex eyes, with attention to intraoperative efficiency, graft safety, and clinical outcomes in a two-center setting.

Methods: A retrospective multicenter study of 302 DMEK eyes from March 2024 to May 2026 was performed at a US center (US) and an international center (IC), with two primary attending surgeons, EHK and LH respectively. The complex-eye subgroup included 120 eyes with prior glaucoma drainage device, pars plana vitrectomy, previous graft failure, or altered iris-lens diaphragm. Outcomes included OR time, intraoperative graft taps, graft unfolding time, BCVA, central corneal thickness (CCT), rebubbling (RB), primary graft failure (PGF), and regrant. Continuous variables were compared using Mann–Whitney U tests and categorical variables using Fisher’s exact tests.

Results: Among complex eyes, 35 underwent Endo-In and 85 underwent Endo-Out. Endo-In demonstrated greater intraoperative efficiency, with shorter OR time (time-in to time-out-of-room) at US (48.4 vs. 54.0 minutes) and fewer graft taps (26.2 vs. 128) with shorter graft unfolding time (33.9 vs. 166.3 seconds) at IC. Visual recovery was comparable at 6 months (0.14 vs. 0.30, $p=0.883$) and 12 months (0.46 vs. 0.30, $p=0.213$). At 12 months, the Endo-In cohort had significant reduction in CCT compared to Endo-Out (207 vs. 96 μm , $p=0.049$). PGF and regrant were comparable (0% vs. 4.7% [$p=0.321$], 8.6% vs. 2.4% [$p=0.148$] respectively). RB was higher in Endo-In (34.3% vs. 16.5%, $p=0.049$).

Conclusion: Endo-In DMEK improved intraoperative efficiency while maintaining comparable visual recovery and graft survival in complex eyes. Endo-In was also associated with significantly greater CCT reduction at 12 months, suggesting favorable anatomic recovery in this challenging cohort. Although RB was higher with Endo-In, the reduction in graft manipulation and significant improvement in CCT suggest meaningful surgical and clinical advantages in complex DMEK cases.

ORAL 3

PDEK-S The Thinnest DSAEK, Preparation Technique

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Purpose: To describe the techniques for PDEK-S graft preparation using either whole cornea or post DSAEK cut tissue. PDEK-S consists of: Pre-Descemet layer, Descemet layer and endothelial cells with a thin ring of peripheral stroma. Uneven tissue thickness post DSAEK cut may be reprocessed using these techniques to generate the thinnest DSAEK.

Methods: Whole cornea or post DSAEK cut tissue may be used. First step is to score peripheral DM to avoid a type 2 bubble. Use of Trypan blue stain initially and later is used to observe any stress lines or endothelial defects. Careful, stepwise air injection to cause peripheral emphysema in stroma, then gradual needle advancement to create a central (type 1) bubble. The goal is to form the bubble slowly to minimize endothelial cell loss. The bubble is titrated to at least 6 mm and up to 7 mm in diameter. An artificial anterior chamber is used to hold the cornea to dissect most of the stroma in 3 steps: central cap, peripheral, anterior, outer ring, then layer by layer deeper stroma dissection in the periphery to get to desired depth. The peripheral ring of attached stroma thickness less than 80 microns is tapered down to 35 microns leaving PDL, DM and endo layer. Punch size determines if the graft is a PDEK only or PDEK-S (with some stroma).

Results: This technique differs from other published methods (Dua & Agarwal), in that intentional air escape in the periphery greatly reduces the risk of a type 2 or 3 bubble (4/50, 8%). Slow bubble formation results in less cell loss (<15%), N=42/50, and allows titration of the bubble up to 7 mm. Subsequent dissection and removal of almost all of the stroma results in further bubble area enlargement and PDL-DM-endo only areas up to 8.0 or more (PDEK grafts), the Outcomes: 90% success rate with experienced (MS) or novice (TT) technicians. Donor age range 8 to 77 yrs with 14/50 tissues under age 50.

Conclusion: 1. Uniform central thickness of 35 microns for 6 to 7 mm.

2. Thin peripheral ring of attached stroma allows for a larger than typical PDEK graft.
3. Can use younger tissue than used for DMEK and therefore expand the donor pool.
4. Less graft scrolling
5. May use post DSAEK tissue with uneven thickness.
6. Challenging to prepare; however, is the thinnest DSAEK for those wanting <70 microns.

ORAL 4

Method for Ultrathin DSAEK Graft Implantation Without Pull Through Technique with Incision Under 3.0 Millimeters

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Purpose: To review current DSAEK graft delivery systems with particular emphasis on their suitability for ultrathin DSAEK (UT-DSAEK) and PDEK procedures, and to present a novel hydraulic injector designed to enable controlled graft implantation through a 2.8-mm incision without a pull-through technique.

Methods: A transparent hydrophobic polymer injector incorporating an enlarged graft storage chamber and a tapered delivery tip was developed to minimize compression of ultrathin DSAEK grafts during storage and simulated transportation. The injector was designed to enable implantation through a 2.8-mm corneal incision using liquid flow (injection) delivery principles similar to those employed in DMEK surgery. Graft injectability was assessed using DSAEK tissues of varying thicknesses immediately after preparation and following simulated 24- or 48-hour storage within the injector. Graft delivery characteristics and unfolding behavior were evaluated after simulated transplantation.

Results: The injector maintained graft integrity during storage and transportation while reducing tissue compression compared with conventional loading approaches. Reliable graft delivery through a 2.8-mm incision was achieved without requiring pull-through instrumentation. Ultrathin DSAEK grafts (<100 µm) demonstrated the most consistent delivery performance. Although liquid flow-driven implantation required greater fluid flow and injection forces than DMEK procedures, stable graft control was achieved by positioning the tissue at the distal tip before injection. All grafts successfully unfolded following simulated implantation, including tissues stored within the injector for up to 48 hours.

Conclusion: The proposed injector provides a standardized liquid flow-driven approach for implantation of ultrathin DSAEK grafts through small-incision surgery without the need for pull-through techniques. By combining controlled graft storage with injector-based delivery, the system may simplify DSAEK transplantation while preserving the inherent advantages of endothelial keratoplasty. The platform may also provide a practical delivery method for future tissue-engineered endothelial grafts with biomechanical properties similar to DSAEK.

ORAL 5

Middle Segment Surgery: Pars Plana Assisted Endothelial Keratoplasty in the Unicameral Eye

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Purpose: Endothelial keratoplasty in the unicameral eye can be challenging, mostly due to graft or air/gas migration into the vitreous cavity, as well as difficulty achieving graft tamponade when needed. This frequently leads to graft dislocation or failure. We describe a technique of using the pars plana to assist in and optimize outcomes of endothelial keratoplasty in the unicameral eye.

Methods: 12 patients with corneal endothelial decompensation in unicameral eyes (3 aphakic and 9 pseudophakic with open or no capsule) underwent endothelial keratoplasty with an iso-expansile concentration of sulfur hexafluoride. After performing a pars plana vitrectomy, posterior infusion was continued to maintain normal pressure in the eye. The endothelial graft was inserted in the usual manner while selectively using pars plana fluid infusion to maintain intraocular pressure and prevent posterior migration of the graft. Similarly, posterior infusion was maintained while injecting gas to prevent the graft or the gas from migrating posteriorly and tamponade the graft in place for 2 to 10 minutes postoperatively. No anchoring sutures were used.

Results: All 12 patients enjoyed normal post-operative courses with the endothelial grafts well-apposed to the host stroma and clearing of the stroma postoperatively. Vision improved in all cases

Conclusion: Middle segment surgery can assist in successful completion of endothelial keratoplasty in unicameral eyes and prevent posterior migration of the donor tissue and injected gas. This increases the chance for surgical success in otherwise challenging settings.

ORAL 6

DMEK Without Anesthesia Support: Safety, Efficiency, and Patient Experience

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Purpose: To compare outcomes and patient experience of Descemet Membrane Endothelial Keratoplasty (DMEK) completed under surgeon-directed, nurse-administered sedation (NAS) versus monitored anesthesia care (MAC).

Methods: In this prospective comparison study, patients seen 2022-26 planned for DMEK or phaco-DMEK without limiting health factors were randomized to surgery under NAS or MAC. One of four cornea fellows was primary surgeon for all cases. Patient questionnaires were given on POD1 to rate subjective procedural pain/anxiety (0-10). Outcome measures included OR time, surgical time, pain/anxiety scores, complication and rebubble rate, and postop visual acuity.

Results: 167 surgeries were included. 125 underwent DMEK under NAS (93 DMEK, 32 phaco-DMEK), and 42 under MAC (32 DMEK, 10 phaco-DMEK). There were no differences in age, gender, or surgical indication among groups. Mean OR and surgical time was shorter under NAS vs. MAC for both DMEK and phaco-DMEK, although only significant for OR time of DMEK ($p=0.04$). Patients receiving NAS reported lower pain scores than those under MAC (0.32 vs. 0.59; $p=0.04$). Anxiety scores were lower for NAS vs. MAC but not statistically significant. There were no intraoperative complications and a single graft failure among all cases. Rebubble rate did not differ between NAS (23/125, 18.4%) and MAC (8/42, 19.0%). Postoperative logMAR was similar between groups ($p=0.71$).

Conclusion: DMEK under NAS was associated with shorter OR time without any adverse effects on patient pain/anxiety scores, complication or rebubble rate, or visual acuity - even with fellows as primary surgeon. In the face of shortages and increasing costs for anesthesia providers, NAS may expand access to DMEK.

+ Cornea Fellow

ORAL 7

Insulin Supplementation of Storage Media Enhances Survival of Diabetic Donor Corneal Grafts

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Purpose: Our previous work has shown that diabetic donor corneas are intrinsically more immunogenic due to activation of resident immune cells that can subsequently sensitize graft recipients. The goal of the current study was to determine whether insulin supplementation of storage media holding diabetic donor tissue improves graft survival following penetrating keratoplasty (PK) and to investigate the associated immune mechanisms.

Methods: Diabetes was induced in C57BL/6 mice using streptozotocin administered at 50 mg/kg/day for five consecutive days. Hyperglycemia was confirmed by blood glucose levels ≥ 16.8 mmol/L. Corneas harvested from diabetic donors were incubated for 6 hours in Chen's medium, either with or without insulin supplementation at 10 mg/mL and were subsequently transplanted into non-diabetic fully disparate BALB/c recipients. Grafts were monitored by slit-lamp microscopy for opacity (graded on a 0–5 scale), and central corneal thickness (CCT) was measured using anterior segment OCT through week 16. Graft survival and neovascularization (scored on a 0–12 scale) were assessed over 8 weeks. Draining lymph nodes (DLNs) were collected 2 months after transplantation for flow cytometry analysis.

Results: Kaplan–Meier survival analysis showed significantly improved graft survival in recipients of insulin-treated diabetic donor corneas compared with controls, with 80% versus 40% survival at 8 weeks respectively ($p = 0.004$). Graft opacity scores were consistently lower in the insulin-treated group across all assessed time points. Central corneal thickness was also significantly lower in the insulin-treated group compared to controls (243 ± 17 μ m vs. 295 ± 22 μ m, $p < 0.05$). Flowcytometry analysis showed significantly lower frequencies of interferon- γ producing T cells in the DLN of recipients transplanted with insulin-treated corneas compared to controls ($p = 0.0012$). In addition, recipients of insulin-treated corneas showed reduced frequencies of CD11b+ myeloid cells ($9.2 \pm 1.7\%$ vs. $18.5 \pm 2.1\%$, $p = 0.001$), Ly6G+ neutrophils ($5.4 \pm 1.0\%$ vs. $12.3 \pm 1.6\%$, $p = 0.002$), and MHC-II+CD86+ antigen-presenting cells ($11.0 \pm 1.4\%$ vs. $22.1 \pm 2.0\%$, $p = 0.003$) compared to controls. Moreover, the insulin-treated group demonstrated increased frequencies of CD25+ FoxP3+ regulatory T cells ($7.6 \pm 0.9\%$ vs. $3.2 \pm 0.6\%$, $p = 0.002$).

Conclusion: Insulin supplementation of storage media holding diabetic donor corneas significantly improves graft survival by suppressing host immune sensitization following keratoplasty. These findings may be of particular relevance when diabetic tissue is being considered for transplantation into hosts with high-risk characteristics such as graft bed vascularity.

ORAL 8

Clinical Outcomes Following DMEK Using Donor Corneas Stored in Optisol-GS Versus XTRA4

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Purpose: To evaluate clinical outcomes of Descemet membrane endothelial keratoplasty (DMEK) using grafts prepared from corneas preserved in the novel XTRA4 hypothermic storage solution.

Methods: A retrospective review of DMEK tissue implanted at a single institution from July 1, 2025 - April 7, 2026. Donor corneas were either preserved in Optisol-GS or XTRA4 prior to DMEK preparation and transplantation. Comparison of re-bubble rate, rate of primary graft failure (PGF), and endothelial cell loss (ECL) at 3 months were compared.

Results: 80 DMEK grafts were implanted, 26 of which were stored in XTRA4 and 54 in Optisol-GS. Mean donor age was 69 years for XTRA4 and 65 years for Optisol-GS ($p=0.19$). Death to preservation was 13:39:09 for the XTRA4 group and 13:18:41 for the Optisol-GS group ($p=0.81$). Death to surgery was 6.8 days and 6.9 days for XTRA4 and Optisol-GS respectively ($p=0.88$). Pre-resection cell count was 2794 cells/mm² for XTRA4 and 2733 cells/mm² for Optisol-GS ($p=0.44$). Rebubble rate for XTRA4 was 31% (8/26) compared to 13% (7/54) for Optisol-GS ($p=0.07$). PGF was 4% (1/26) for XTRA4 and 2% (1/54) for Optisol-GS. ECL at 3-months was 29% and 30% for XTRA4 and Optisol-GS respectively ($p=0.79$).

Conclusion: DMEK grafts stored in Optisol-GS and XTRA4 have similar clinical outcomes at 3 months, although the rebubble rate is approaching significance. Enrollment and data collection are ongoing, and updated findings will be presented during the symposium.

+ Cornea Fellow

ORAL 9

Effect of Strict Sepsis/SIRS Donor-Eligibility Criteria on the U.S. Corneal Donor Supply

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Purpose: Proposed FDA criteria exclude donors with documented, unresolved sepsis, suspected sepsis, or SIRS due to infection. We quantified the corneal supply loss and the transmissible-infection risk identified.

Methods: The AATB Sepsis Pilot chart prevalence (486 charts) was triangulated against death-certificate sepsis (CDC WONDER) and hospital-death rates, then applied to observed 2024 EBAA donors (71,778). Loss was computed as gross and net of medical-director-adjudicated risk, and as keratoplasty tissue vs. U.S. exports. Benefit was each criterion's PPV for adjudicated risk with number needed to exclude (NNE).

Results: The chart prevalence (23-38%) fell between independent comparators (certificate sepsis 7.3-19.4%; hospital-death 35-56%). Gross loss was 16,541 (95% CI 14,012-19,374) to 27,323 donors; net, 14,639-24,870. The diagnosis-or-SIRS tissue loss (32,708) exceeds total U.S. exports (26,732). Adjudicated risk was in 30/486 charts (6.2%); PPV was 14.6% (10.2-20.4), so 85.4% of excluded donors lacked adjudicated risk (NNE 6.9).

Conclusion: A strict, syndrome-based criterion would remove roughly a quarter to nearly 40% of the U.S. corneal supply — a tissue loss exceeding the entire U.S. export volume — while excluding about seven donors for every one with adjudicated risk. Such a criterion withdraws medical-director discretion rather than removing dangerous donors. Screening should target identifiable transmissible infection, not the sepsis label.

** Medical Student

ORAL 10

Trends and Determinants of Corneal Tissue Utilization and Discard: 14 Years of Data from United States Eye Banks

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Purpose: To characterize national trends in corneal tissue recovery, release, utilization, and discard across the United States, quantify seasonality and the COVID-19 shock, and identify associations between donor features and tissue discard.

Methods: We conducted a retrospective analysis of Eye Bank Association of America data from 2011 to 2024. Temporal trends in tissue recovery, release, utilization, and discard (defined as pre-release or post-release) were modeled with regression-based analyses. Seasonality was assessed with decomposition and month-of-year models. Multivariable regressions were employed to investigate associations between donor characteristics and tissue discard.

Results: While national recovery volumes increased from 2011 to 2024, the likelihood of utilization declined. The proportion of corneas discarded pre-release fell, but post-release discard rose, indicating a shift of attrition downstream. Monthly activity showed consistent troughs in December and a pronounced dip during March–May 2020. Among reasons for pre-release discard, shares attributed to tissue quality, failed testing, serologic findings, and medical record/autopsy findings increased between 2011 and 2024. Post-release discard due to tissue damage during processing and handling increased, while discard due to surgeon or recipient issues and expiration decreased. In multivariable models, older donor age and causes of death including cancer, trauma, and cardiac disease were associated with higher probabilities of pre-release discard.

Conclusion: Corneal graft attrition has shifted downstream, with rising discard after tissue release despite improved pre-release yield. These data may shape strategies to maximize the efficiency of corneal transplantation. Further research is needed to determine whether shifts in tissue utilization have corresponded with improved patient outcomes.

[^] Resident

ORAL 11

DEKS ACD Ancillary Study: Tech Estimates & Automated Software for Analyzing Area of Cell Damage

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Purpose: Area of cell damage (ACD) on trypan staining is a useful metric for quantifying post-processing endothelial damage and determining tissue suitability. Several ACD quantification methods, including tech estimation, Weka segmentation, and automated software (Kerify), are currently used by eye banks; however, their accuracy and clinical relevance remain unclear. The goal of this study is to compare the accuracy of estimates and Kerify to Weka and to correlate ACD to change in endothelial cell density (Δ ECD) at post-op year 1 (POY1) in the Diabetes Endothelial Keratoplasty Study (DEKS).

Methods: Standardized images of post-processed, trypan-stained DMEK grafts were prospectively captured at 5 DEKS eye banks prior to preloading or distribution. ACD was estimated by techs per DEKS protocols as 0-5%, 5-10%, 10-15%, or 15-20% (>20% was excluded). ACD was calculated from images using Weka and Kerify. Weka was measured by 2 independent grading centers and adjudicated via DEKS methodology for spec review. Accuracy of estimates and Kerify vs. Weka were evaluated using the Wilcoxon and Stuart-Maxwell tests, respectively. ACD was correlated to Δ ECD at POY1 using ANOVA (estimates) and regression analysis (Weka, Kerify).

Results: Tech estimates differed from Weka ($p < 0.01$) and Kerify ($p < 0.001$) and classified more corneas as having >10% ACD. Mean ACD was similar between Weka ($4.28 \pm 1.56\%$) and Kerify ($4.24 \pm 2.46\%$) ($p = 0.79$). Estimates ($p = 0.008$), Weka ($p = 0.027$), and high-confidence Kerify ACD ($p = 0.045$) all correlated with Δ ECD at POY1.

Conclusion: Estimates overshot Weka and Kerify at higher ACD, but sample size was limited at higher ACD. ACD was correlated with higher Δ ECD for all 3 methods.

ORAL 12

Development and Evaluation of Indigenous Bioengineered Corneal Implant Derived from Donor Corneas Unsuitable for Transplantation.

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Purpose: To develop and characterize a bioengineered corneal implant (BCI) from human donor corneas unsuitable for transplantation and evaluate feasibility, safety and early clinical outcomes in a pilot clinical study.

Methods: Independent ethics committee approval was taken. Twenty human donor corneas unsuitable for keratoplasty were processed: Fifteen were decellularized (DC) using 0.1% Triton X-100 in a customized perfusion bioreactor; ten were further crosslinked (BCI) with oxidized chondroitin sulfate and five unprocessed as native corneas (NC) and preserved in glycerol. Corneas were characterized and compared using histopathology, DAPI staining, residual DNA quantification, Fourier-transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), oxidative stress analysis, optical transparency, and microbiological assessment. Following successful preclinical evaluation, a prospective pilot clinical study was initiated. Six patients diagnosed with infectious keratitis (2), non-healing corneal ulcers (2) and healed keratitis with stromal thinning (2) were enrolled and underwent deep anterior lamellar keratoplasty or lamellar patch graft using BCI after obtaining patient informed consent. The clinical outcomes included visual acuity, graft integration, re-epithelialization, graft clarity, and anterior segment OCT findings.

Results: FTIR confirmed successful decellularization by the absence of plasma membrane stretching peaks (2800-3100 cm⁻¹). Residual DNA decreased from 25ng/mg in NC to 12.3ng/mg after decellularization, with no detectable DNA following crosslinking in the BCI group. Histology and DAPI staining confirmed the removal of cellular and nuclear material, while TEM demonstrated the restoration of native like collagen fibrillar architecture in BCI. Compared with DC, BCI exhibited significantly lower reactive oxygen species generation (1.0-2.3µm vs. 0.6-0.8µm; p<0.001) while maintaining optical transparency. Sterility was achieved using isopropyl alcohol, followed by plasma sterilization. Interim clinical analysis showed that all six implanted grafts remained attached with stable host integration. Complete re-epithelialization occurred within 21 ± 5 days, with graft clarity and improvement in visual acuity. No BCI-related adverse events were observed during follow up.

Conclusion: Donor corneas unsuitable for keratoplasty can be successfully repurposed by decellularization and crosslinking for clinical use as anterior lamellar or therapeutic patch grafts.

ORAL 13

Phase 3 Trials of Ripasudil in Patients with Fuchs Endothelial Corneal Dystrophy Undergoing Descemet Stripping Only

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Purpose: To assess the efficacy and safety of ripasudil eye drops (K-321) after Descemet Stripping Only (DSO) in patients with Fuchs endothelial corneal dystrophy (FECD).

Methods: Two randomized, prospective, double-masked studies included FECD patients with central guttae undergoing DSO with (study 303) or without (study 301) cataract surgery. Participants were randomized 1:1 to K-321 or placebo, administered four times daily for 12 weeks, followed by a 2-week taper and 38-week follow-up. The primary endpoint was time to 40-letter improvement from Day 1 after DSO in best-corrected visual acuity (BCVA). Secondary endpoints included time to resolution of corneal edema and central corneal thickness (CCT).

Results: 107 and 110 patients were enrolled in studies 301 and 303. K-321 showed a trend toward faster BCVA improvement although the primary endpoint was not met. Median time to corneal edema resolution was significantly shorter (63 vs. 85 days, $p=0.0262$; 37 vs. 51 days, $p=0.0182$) and CCT recovered faster with K-321 (50 vs. 65 days, $p=0.0517$; 33 vs. 65 days, $p<0.0001$). No significant adverse events were reported.

Conclusion: Ripasudil promoted corneal healing after DSO, which is the clinically relevant benefit, regardless of cataract surgery with a trend of faster BCVA improvement. It was safe and well tolerated. The benefit is to be confirmed in a further phase 3 study.

ORAL 14

Nrf2 Gene Therapy Promotes Corneal Endothelial Cell Survival and Function in Fuchs Dystrophy

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Purpose: Fuchs Endothelial Corneal Dystrophy (FECD) is the most common cause of corneal endothelial cell (CEnC) degeneration that affects 4% of population. Deficiency in Nrf2-mediated antioxidant defense has been a common denominator in all forms of FECD, despite genetic background. Here, we designed and evaluated the delivery of a novel adeno-associated virus serotype 9 (AAV9) constructs containing Nrf2 gene into corneal endothelium and established its effectiveness in augmenting the cytoprotective defense in FECD.

Methods: Female wild-type (WT) mice were intracamerally injected with a CMV promoter-driven AAV9-control or AAV9-Nrf2 constructs at the dosage of 10^{11} GC/eye on the right eye, while the left eye served as control. At week-2 post-AAV transduction, Nrf2 transduction efficiency was assessed by immunofluorescence (IF) and the right eyes with AAV induction were exposed to UVA (500 J/cm^2). At week-4 post-UVA, we assessed the effect of Nrf2 overexpression on central corneal thickness (AS-OCT) and endothelial cell density (ECD; HRT and ZO-1 IF). We also evaluated the CEnC function by assessing ROS levels (Amplex-Red assay) and pump function (Na^+/K^+ ATPase IF).

Results: UVA exposure showed a notable 51% decrease in ECD at week-4 in AAV9-controls, which was remarkably rescued by 45.8% in AAV9-Nrf2 pre-treated mice showing only 5% cell loss. Junctional staining with ZO-1 established a progressive decrease in cell number post-UVA in AAV9-control, which was protected with Nrf2 overexpression (OE) at week-4 ($65 \pm 2\%$ vs. $20 \pm 2\%$). UVA induced significant cornea edema at week-4 in AAV9-controls ($140.25 \pm 10 \mu\text{M}$), which was 34% lower ($103.2 \pm 7.3 \mu\text{M}$) post-Nrf2 OE. ROS production in aqueous humor was inhibited by 82% in AAV9-Nrf2 at day-1 post-UVA, demonstrating its antioxidant effect. Furthermore, Na^+/K^+ ATPase protein expression increased by 79% in the AAV9-Nrf2 in week 4 post-UVA, suggesting the role of Nrf2 in promoting pump function and preventing corneal edema.

Conclusion: We demonstrate that AAV9-Nrf2 increased endothelial cell density, improved endothelial cell pump function and rescued corneal edema by upregulating the cytoprotective defense in response to UVA, the physiological stressor of corneal endothelium. This study has implications in eye banking as well as designing genotype-agnostic therapeutic strategies for FECD.

ORAL 15

Peripheral DNA Correlates with Corneal TCF4 Repeat Expansion in FECD

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Purpose: To evaluate whether TCF4 repeat expansion in peripheral blood and/or buccal epithelial cells reflects expansion in corneal tissue from patients with Fuchs endothelial corneal dystrophy (FECD), facilitating genetic assessment for clinical and eye bank applications.

Methods: Corneal tissue, buccal epithelial cells and peripheral blood samples were collected from patients with FECD undergoing keratoplasty. TCF4 expansion was defined as >50 CTG repeats assessed using short tandem repeat and triplet repeat-primed PCR; concordance of TCF4 expansion across tissue types was evaluated.

Results: 79 patients with FECD were evaluated. Buccal swabs were obtained from all, whole blood from 40, and corneal tissue from 78. Pairwise concordance was 100% for buccal swab versus whole blood (40/40, 33+, 7-), whole blood versus corneal tissue (39/39, 32+, 7-), and buccal swab versus corneal tissue (78/78, 61+, 17-). Among 39 participants with all three tissue types, concordance was 100% (32+, 7-). Overall, 62/79 participants (78.5%) were TCF4+.

Conclusion: 100% cross-tissue concordance of TCF4 repeat expansion supports buccal swab as a non-invasive alternative and peripheral blood as a minimally invasive alternative to corneal tissue for FECD genetic testing, facilitating diagnosis for appropriate corneal donor identification, and patient selection for studies evaluating emerging TCF4 targeted therapies.

ORAL 16

The Effect of SLC4A11 Mutation on the Outcomes of Keratoplasty in Congenital Hereditary Endothelial Dystrophy

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Purpose: To study the effect of SLC4A11 mutation on the outcomes of keratoplasty in Congenital Hereditary Endothelial Dystrophy (CHED)

Methods: An ambispective observational study was done, which included 48 (76 eyes) CHED patients who underwent keratoplasty in the last 10 years at a tertiary care centre in North India. Clinical evaluation was done for the prospective cases, while the records were screened for retrospective cases. Blood samples from 32 patients were collected for Whole Exome Sequencing (WES) to identify mutations/variations.

Results: 25 (52%) patients were male, and 23 (48%) were female. The mean age of the patients enrolled was 17.9 years. 28 (58.3%) patients had bilateral surgery. Out of the 76 operated eyes, 33 (43.4%) underwent Descemet Stripping Automated Endothelial Keratoplasty (DSAEK) while 43 (56.5%) underwent penetrating keratoplasty (PK). WES revealed SLC4A11 mutations in 20 of the 32 cases tested, and 12 cases did not show any mutations. No other mutations were found in these patients. Patients with and without mutations had no significant difference in the type of surgery performed and the risk of graft failure. However, patients with SLC4A11 mutations had significantly higher rates of glaucoma as compared to patients with no mutations. The overall frequencies of secondary glaucoma, graft failure, and graft infection following PK were 35%, 53%, and 7%, respectively, while they were 9.1%, 21%, and 6.1% following DSAEK, with the differences being significant for glaucoma and graft failure.

Conclusion: Multiple factors can affect the success rate of keratoplasty in CHED patients. SLC4A11 mutations predispose patients to developing glaucoma post-keratoplasty. The frequency of glaucoma and graft failure was more following PK as compared to DSAEK in CHED patients.

[^] Resident

ORAL 17

Novel Ultra High-Resolution Corneal OCT Imaging Yields Clinically Relevant Biomarkers in Fuchs Endothelial Corneal Dystrophy

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Purpose: The Pentacam Cornea OCT (OCULUS, Wetzlar, Germany) received FDA 501(k) clearance in March 2026 as a novel technology combining Scheimpflug tomography with 1.9 μm ultra high-resolution OCT imaging of the anterior segment. The purpose of this pilot study was to determine if thickness of the endothelium-Descemet membrane complex (EDM) and diameter of guttae involvement could be measured using this device in patients with Fuchs endothelial corneal dystrophy (FECD).

Methods: Participants with presurgical FECD were enrolled consecutively from the Cornea clinic and underwent Scheimpflug tomography with high-resolution cornea OCT imaging in one or both eyes. Two masked graders (RLC, SRS) independently measured EDM thickness (pupil center and ± 2 , ± 4 and ± 6 mm optical zones) and diameter of guttae involvement on a horizontal raster from ultra high-resolution OCT images. Two one-sided tests (TOST) and Bland-Altman analyses assessed inter-grader equivalence, with involvement of a third independent grader (MAG) if needed. Associations between demographics, clinical variables, and imaging biomarkers were evaluated using Pearson correlation, ANOVA, and t-tests.

Results: Twenty-eight images from 20 subjects with FECD were analyzed. Mean participant age was 68.4 ± 14.7 years. Twenty-two images (78.6%) were from women, and 12 images (42.9%) were from former smokers. Mean EDM thickness was 23.4 ± 6.39 μm for RLC and 23.6 ± 6.48 μm for SRS, and mean guttae diameter was 5808.7 ± 963.3 μm for RLC and 5805.7 ± 1054.0 μm for SRS, with equivalence demonstrated by TOST and Bland-Altman testing. Both mean EDM thickness and mean guttae diameter increased with advancing clinically determined FECD severity (modified Krachmer grade [mKg]). Significant differences between mKg 4 versus 5 and mKg 4 versus 6 were seen for both EDM thickness ($P=0.021$ and $P<0.001$, respectively) and guttae diameter ($P=0.046$ and $P=0.010$, respectively). EDM thickness significantly correlated with both prior smoking ($P=0.010$) and increasing posterior densitometry ($P<0.001$, $r=0.624$).

Conclusion: Near-histological anatomical details in the posterior cornea can be measured in presurgical FECD patients using ultra high-resolution corneal OCT imaging. EDM thickness and diameter of guttae involvement are clinically relevant imaging biomarkers that may be useful in tracking disease progression and measuring treatment efficacy in future FECD treatment trials.

+ Cornea Fellow

ORAL 18

Real-Time Ultra-Widefield Mosaics of the Corneal Endothelium from Contact Specular Microscopy Video

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Purpose: To create ultra-widefield composites of the corneal endothelium at cellular resolution from contact specular microscopy video in healthy, dystrophic, and post-surgical eyes.

Methods: Wide-field scanning specular microscopy video was acquired with a Konan CellChek® C (CCC, Konan Medical, Irvine, CA) in healthy and diseased eyes between 2023 and 2026, with each video scanning the cornea in cross or raster patterns. A custom software stitched video frames in real time into a single continuous mosaic, ensuring complete image acquisition. Visualization of disease extent, as well as metrics for mosaic area, endothelial surface coverage, and cell number were assessed.

Results: We generated mosaics for a normal cornea, mild and severe Fuchs, and after Descemet stripping only (DSO). The healthy mosaic had 62,595 cells across 42.1 mm², or ~32.3% of the full endothelial surface area. We successfully imaged the distribution of guttae across the endothelium as well as the area of stripping and the surrounding periphery after DSO.

Conclusion: For the first time, this technology allows imaging of the entire endothelium in real time. These mosaics are the largest cellular-resolution images of the endothelium to date, representing a near-100-fold expansion over a single specular microscopy frame. This software is an important advance in our evaluation of the endothelium following various medical and surgical therapies.

ORAL 19

Tear MicroRNA Diagnostics for Ocular Surface Squamous Neoplasia: Updated Diagnostic Performance and Clinical Translation

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Purpose: To evaluate the diagnostic performance of tear-derived microRNAs for ocular surface squamous neoplasia (OSSN) and identify practical considerations for clinical implementation.

Methods: Tear samples were prospectively collected from patients with OSSN, pterygium, and healthy controls using a standardized collection protocol. Following microRNA sequencing and RT-qPCR validation, a more comprehensive statistical evaluation of the diagnostic performance of a four-miRNA panel was performed. Workflow considerations for future clinical implementation were identified.

Results: A four-miRNA panel demonstrated excellent discrimination between OSSN and pterygium (AUC 0.938, $p=0.002$), with a sensitivity of 88.9%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 90.0%. Three key translational areas were identified: obtaining high-quality tear samples, generating reproducible molecular results, and scaling the assay for routine clinical applications.

Conclusion: Updated diagnostic performance data support tear microRNA analysis as a promising noninvasive diagnostic platform for OSSN. Standardized tear collection, robust laboratory workflows, and prospective clinical validation will be essential for clinical implementation.

**** Medical Student**

ORAL 20

Artificial Intelligence-Based Automated Guttae Density Scoring in Fuchs Endothelial Corneal Dystrophy

Authors: Sujin Kang, MD¹; Douglas R. da Costa, MD, PhD¹; Rafael Scherer, MD, PhD¹; Allen O. Eghrari, MD²; Sonia H. Yoo, MD¹; Felipe A. Medeiros, MD, PhD¹; Ellen Koo, MD¹

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Purpose: In Fuchs endothelial corneal dystrophy (FECD), guttae are commonly counted manually, a process that is examiner-dependent, time-consuming, and potentially less accurate when guttae become confluent. We developed an automated, continuous AI-based tool to quantify and score guttae density.

Methods: The reference density was defined as the expert manual count per unit area within the region of interest. After quality control, 32 images from 16 patients were analyzed. Because individual guttae become difficult to distinguish and count in advanced disease, pixel-level counting was avoided. Within expert-defined regions of interest, images were tiled, contrast-normalized using contrast-limited adaptive histogram equalization (CLAHE), and summarized using 52 texture descriptors, including gray-level co-occurrence matrix features (GLCM), local binary patterns (LBP), and Gabor features. A gradient-boosted model predicted local guttae density, which was then aggregated into an image-level score. Agreement with expert counts was assessed using patient-grouped five-fold cross-validation and Bland-Altman analysis.

Results: The automated score agreed strongly with the expert reference standard (Spearman $\rho=0.89$, 95% CI 0.77-0.93; $R^2=0.77$; $n=32$), preserving the rank order of guttae burden across three orders of magnitude (19-7,781 guttae/image). On average, the automated score underestimated the reference by 19%, corresponding to a mean bias of -0.21 log-density units, with 95% limits of agreement from -1.83 to $+1.41$. Underestimation was slightly greater at the highest guttae burdens, where expert counts are themselves least reliable.

Conclusion: This reproducible, texture-based AI score provides a continuous alternative to categorical grading and manual counting of FECD guttae burden, particularly in advanced, confluent disease.

ORAL 21

IK-FOUND with OCUTRACE: A Multiclass Foundation AI System for Diagnosis, Prognostic Stratification, and Treatment Outcome Prediction in Infectious Keratitis

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Purpose: Infectious keratitis (IK) remains a major cause of global corneal blindness, and rapid etiology-specific diagnosis and treatment are essential for preventing irreversible vision loss. Existing automated IK classifiers often rely on resource-intensive architectures and only on the diagnosis. There is also limited external generalizability. This retrospective multi-center study evaluates IK-FOUND, one of the first lightweight, globally generalizable IK classifiers with multi-institution external validation, and deploys a publicly accessible diagnostic upload tool for real-time clinical use.

Methods: A total of 12,968 de-identified slit-lamp images from 1,721 patients with confirmed acanthamoeba, bacterial, fungal, or herpetic keratitis were collected across three international centers, with the development dataset used exclusively for training and all external sites held out for patient-level evaluation. IK-FOUND was trained using our previously published dataset of 10,739 slit-lamp images. Performance was assessed using accuracy, sensitivity, specificity, and micro/macro-averaged AUROC, with no site-specific fine-tuning.

Results: Threshold-optimized predictions yielded the strongest cross-site diagnostic performance. Overall multiclass diagnostic accuracy was 95.1%, with micro-AUROC 0.992, macro-AUROC 0.988, and expected calibration error of 0.004. Per-class recall was 97.0%, 95.2%, 94.1%, and 94.0% for acanthamoeba, bacterial, fungal, and herpetic keratitis, respectively. Corresponding specificities were 99.1%, 97.4%, 95.6%, and 97.2%. Using the OCUTRACE prognostic module, IK-FOUND also stratified patients by predicted clinical trajectory and treatment outcome. For prediction of an adverse clinical course, defined as poor early response, progression requiring escalation, tissue loss, or need for tectonic/therapeutic keratoplasty, the model achieved an AUROC of 0.93, AUPRC of 0.86, sensitivity of 90.1%, specificity of 88.3%, and calibration error of 0.018. Prognostic risk scores separated low-, intermediate-, and high-risk groups, with predicted adverse outcome rates of 6%, 22%, and 61%, respectively. Advanced threshold optimization reduced diagnostic false positives by approximately 20% while preserving high sensitivity for vision-threatening infections, improving both clinical specificity and real-world decision support. The public upload platform generated predictions within two seconds and consistently highlighted clinically meaningful corneal regions on attention maps.

Conclusion: IK-FOUND with OCUTRACE demonstrated robust multicenter performance for infectious keratitis diagnosis, prognostic stratification, and treatment-outcome prediction. To our knowledge, this represents one of the first internationally validated AI frameworks in infectious keratitis designed to move beyond multiclass image diagnosis toward calibrated trajectory modeling and clinically actionable risk prediction. By integrating diagnostic classification, prognosis, and real-time deployment in a public-access platform, IK-FOUND with OCUTRACE may support earlier recognition of high-risk cases, timely escalation of care, and more standardized management of vision-threatening corneal infections.

ORAL 22

Beyond Xerophthalmia: Non-Xerotic Corneal Disease Associated With Adult Vitamin A Deficiency

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Purpose: To characterize the clinical spectrum and severity of adult vitamin A deficiency (VAD)—associated corneal disease occurring without classic xerophthalmia and to identify concurrent laboratory abnormalities that may serve as clinical clues to unrecognized VAD.

Methods: This retrospective case series conducted at a tertiary referral center included 17 adults with laboratory-confirmed VAD (reference range, 20.1–62.0 µg/dL) who presented between 2018 and 2025 with corneal epithelial defects, ulceration, keratolysis, descemetocoele, or perforation. Demographic characteristics, ocular phenotype, systemic and social risk factors, laboratory findings, microbiology, treatment, and outcomes were reviewed. All patients lacked conjunctival xerosis, Bitot spots, and clinically apparent corneal xerosis.

Results: The cohort included 9 women (53%) and 8 men (47%), with a mean age of 55.1 ± 11.9 years. Nine patients (53%) had severe VAD (<7 µg/dL), 5 (29%) had moderate VAD (7 to <14 µg/dL), and 3 (18%) had mild VAD (14 to <20.1 µg/dL). Presentations ranged from persistent epithelial defects and infectious- or neurotrophic-appearing ulcers to keratolysis, descemetocoele, and frank perforation. Nine patients (53%) presented with descemetocoele or corneal perforation, and all corneal perforations occurred in patients with vitamin A levels <10 µg/dL. Eight patients (47%) required tectonic keratoplasty, and 1 additional patient died before planned keratoplasty. VAD was frequently accompanied by a constellation of laboratory abnormalities: 13/17 patients had albumin <3.0 g/dL, 10/17 had hemoglobin <10 g/dL, 10/17 had magnesium <1.7 mg/dL, 9/17 had calcium <8.5 mg/dL, 8/17 had vitamin D <15 ng/mL, 7/17 had phosphorus <2.5 mg/dL, 7/17 had total protein <6.0 g/dL, and 6/17 had INR >1.4. Six patients (35%) had hepatic cirrhosis, most commonly associated with alcohol use, and 5 (29%) were malnourished or homeless. VAD also coexisted with other recognized contributors to corneal injury, including microbial keratitis, autoimmune keratolysis, severe dry eye disease, and neurotrophic dysfunction. Three patients (18%) died from complications of systemic disease before ocular stabilization.

Conclusion: Adult VAD may present with severe corneal epithelial failure, keratolysis, descemetocoele, and perforation despite the absence of classic xerophthalmic signs. Greater biochemical deficiency clustered with more severe structural corneal disease, and all perforations occurred at vitamin A levels <10 µg/dL. The frequent coexistence of hypoalbuminemia, anemia, hypomagnesemia, hypophosphatemia, hypocalcemia, vitamin D deficiency, low total protein, and elevated INR provides a recognizable constellation of laboratory clues to occult VAD. In adults with unexplained corneal epithelial breakdown, ulceration, or corneal melting, and the presence of one or more of these laboratory abnormalities should prompt consideration of serum vitamin A testing, even when conjunctival xerosis, Bitot spots, and corneal xerosis are absent.

ORAL 23

Efficacy of Topical Losartan Potassium for Treatment of Recent Infectious Keratitis-Induced Corneal Scars

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Purpose: This study aims to assess the effect of topical losartan on reducing corneal scar in recent post-infectious keratitis patients.

Methods: Retrospective study, including patients diagnosed with recent corneal scar due to infectious keratitis (2020-2026). Inclusion criteria were topical losartan use within a year of infectious keratitis onset, and pre- and post-treatment visual acuity (VA, logMAR). Data presented as mean $\pm$ SD or median(range) based on distribution. Pre- and post-treatment VA and corneal scar area were also assessed using Wilcoxon signed-rank test ($p < 0.05$).

Results: Eight eyes ($n=8$, age=51.2 $\pm$ 19.6 years, 50.0% male) were included. Corneal scar etiology included keratitis due to Herpes simplex virus ($n=4$), Acanthamoeba ($n=2$), Herpes zoster ophthalmicus ($n=1$), Staphylococcus sp. ($n=1$) and filamentous fungi ($n=1$). The pre-treatment VA was 0.8 $\pm$ 0.7, with scar area of 12.4 $\pm$ 9.9mm². The mean duration of the topical losartan treatment was 136.5 $\pm$ 148.4 days. Corneal opacity improved in all patients. After treatment, VA improved to 0.3 $\pm$ 0.5 ($p=0.011$) and scar reduced to 3.7(3.9)mm² (80% improved; $p=0.068$).

Conclusion: In this study, the introduction of topical losartan within a year of the infectious keratitis showed improvement in VA and corneal scar opacity. Early introduction of topical losartan potassium may reduce corneal scar area, however, further studies are necessary to elucidate the long-term efficacy.

POSTER PRESENTATIONS

POSTER 1

Graft Survival and Visual Outcomes in Repeat Keratoplasty: Real-World Experience from a Tertiary Care Center

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Purpose: To evaluate graft survival and visual outcomes of penetrating (PKP) and endothelial keratoplasty (EK) in patients with prior corneal transplantation.

Methods: A retrospective chart review was conducted for corneal transplant recipients at the University of Illinois Chicago between January 1997 and December 2013. Patients >18 years old, with a history of >1 prior failed grafts and >6 months of follow-up were included. Data at presentation on demographics, diagnosis of glaucoma, prior glaucoma and/or intraocular surgery, prior and current corneal transplant (PKP vs. EK), number of any prior grafts (one vs. two or more), were analyzed with multivariable analysis to identify factors associated with graft failure and Snellen best corrected (CDVA) of <20/200, at the end of follow-up. A multivariable shared frailty survival model was used to assess risk factors for graft failure and vision loss, accounting for non-independent clustering.

Results: Of 2,536 grafts performed within the study period, 896 (35%) were repeated grafts. Of those, 672 grafts (461 eyes, 418 patients) fulfilled the inclusion criteria and thus were included. Mean age at the time of surgery was 62 ± 17 years (range: 18–98 years), and mean follow-up time was 64 ± 59 months (range: 6–311 months). While 387/672 (58%) had 1 prior graft, 170/672 (25%) had 2, and 115/672 (17%) had >3 prior grafts. 378 of 672 grafts (56%) failed during follow-up, 270/494 (55%) in eyes with prior PKP only, 62/116 (53%) in eyes with prior EK only, 46/62 (74%) in eyes with both (P = 0.011). There was a significantly lower graft survival rate in eyes with >3 prior grafts (30%) than in those with 2 (38%) or 1 (51%; P < 0.001). The cumulative graft survival probability at 1-, 2-, and 3-years was 85%, 70%, and 59%. The median CDVA significantly improved from 1.8 (~20/1260) preoperative to a best-obtained vision of 0.5 (~20/63) during follow-up. However, the final median CDVA was 1.5 (~20/632). Of 672 grafts, 472 (70%) achieved a CDVA >20/200, with 200/472 grafts (42%) developing vision loss, 139/343 (32%) in eyes with prior PKP only, 35/89 (39%) in eyes with prior EK only, and 26/40 (65%) in eyes with both (P = 0.010). There was a statistically significant difference in vision retention among eyes with 1 (67%), 2 (50%), and >3 prior grafts (21%; P < 0.001). The cumulative probability of retaining vision of >20/200 at 1-, 2-, and 3-years was 91%, 79%, and 70%, respectively. Multivariable analyses showed that preoperative glaucoma surgery and >2 prior grafts were significant risk factors for graft failure (aHR: 1.59; 95% CI: 1.19–2.13 and aHR: 1.26; 95% CI: 1.02–1.55, respectively) and a CDVA <20/200 (aHR: 1.51; 95% CI: 1.05–2.17 and aHR: 1.61; 95% CI: 1.21–2.15, respectively).

Conclusion: The overall probability of graft survival and a >20/200 vision was 44% and 58% at the end of follow-up, respectively. Glaucoma surgery and >2 prior grafts were significant risk factors for both graft failure and vision loss.

+ Cornea Fellow

POSTER 2

An Analysis Of The Unfolding Pattern Of No-Touch Endo In DMEK

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Purpose: To review if pre-loaded Endo-In DMEK (Descemet Membrane Endothelial Keratoplasty) grafts unfold in specific patterns after insertion into the anterior chamber.

Methods: All DMEK grafts were pre-loaded at the Lions World Vision Institute (Tampa, USA) in a specially designed cannula and shipped to South Africa. All surgeries were performed at the Cape Eye Hospital in Cape Town. Real time videos of recorded Endo-In DMEK surgeries were analyzed in this retrospective case series. Grafts were inserted into the anterior chamber via fluid injection by connecting the cannula to a 3 mL syringe. The mean time to unfold grafts were calculated as well as the mean number of taps required to unfold grafts. The mean endothelial cell densities (ECD) were calculated at final visit. Graft unfolding was classified as complete unfolding (at least 90 % of graft open), partial unfolding with external manipulation leading to complete unfolding and external tapping leading to complete unfolding.

Results: 45 real-time videos of 45 Endo-In DMEK surgeries were reviewed. Endo-In DMEK required a mean of 21.18 seconds and 16.24 taps to unfold the grafts completely. 30 grafts unfolded completely (66.67%), 6 grafts required external manipulation (13.33%) and 9 grafts required external tapping (20%) to completely unfold grafts. Mean ECD at final visit was 1309.81 cells/mm² ($\pm$ 199.625).

Conclusion: In this surgical analysis of No-touch Endo-In DMEK, most grafts (66.67%) opened completely without any external manipulation. Approximately a third of the grafts (33.33%) required some form of tapping or manipulation to completely unfold grafts.

POSTER 3

Endothelial Cell Density Measurement Variability and Discordant Donor Cornea Suitability Decisions

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Purpose: Endothelial cell density (ECD) determines donor suitability, yet the same cornea measures differently between graders and banks. We assessed how often this variability, not tissue, changes the accept/reject decision near a threshold, and which quality step reduces it.

Methods: A Monte Carlo simulation modeled each cornea as a true ECD plus a persistent eye-bank/method offset and random read noise, fixed from published eye-bank and reading-center data. The primary outcome, decision discordance, was two measurements of one cornea giving different verdicts (no reference). Near-threshold meant within 150 cells/mm² of a 2300 cutoff; 250,000 corneas were simulated (95% uncertainty intervals, UI).

Results: Near the cutoff, two eye banks disagreed on the decision for 47.9% of near-threshold corneas (20.3% overall; 95% UI 14.8-22.2%). A same-bank repeat read reversed 36.9%, repeating that bias. Standardizing each bank against a reference cut near-threshold error from 40.7% to 32.6%; a repeat read did not (40.5%).

Conclusion: ECD variability makes near-threshold decisions inconsistent: the same cornea may be accepted at one bank, rejected at another. Because borderline values matter little clinically, the impact is decision consistency and allocation, not graft outcome. Standardizing each bank against a reference helps; re-reading does not, discouraging rigid cutoffs.

** Medical Student

POSTER 4

Intravenous Corticosteroid Induction with Oral Taper for Rejection Prophylaxis in High-Risk Penetrating Keratoplasty

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Purpose: To evaluate graft survival and rejection-free survival after high-risk penetrating keratoplasty (HRPK) treated with intravenous (IV) corticosteroid induction followed by an oral corticosteroid taper.

Methods: This longitudinal, single-center, single-surgeon study included consecutive HRPK eyes receiving intraoperative IV corticosteroids followed by an oral taper with no adjunctive non-steroidal immunosuppression. Taper behavior was classified as standard/extended, short-course, or non-compliant/self-discontinued. Outcomes were Kaplan-Meier graft survival, rejection-free survival at 1 year, and adverse event (AE) rate.

Results: Forty-four eyes were included, mean follow-up 10.5 months (range 1.12-27.4). Taper was standard/extended in 28, short-course in 9, and non-compliant in 7 eyes. At 1 year, Kaplan-Meier estimated graft survival was 87.3%, rejection-free survival 88.6% (number at risk at 1 year, n = 13). By group, graft survival was 90.9% (standard/extended), 87.5% (short-course), 80.0% (non-compliant); rejection-free survival was 92.3%, 87.5%, 80.0%, respectively. Four rejection reactions occurred; 3 resolved, 1 progressed to failure. Graft failure occurred in 5 eyes (11.4%). No protocol-related AEs occurred.

Conclusion: Intravenous corticosteroid induction with an oral taper achieved favorable 1-year graft and rejection-free survival in HRPK, numerically higher with standard/extended tapering. A structured systemic corticosteroid regimen is a potentially valuable, well-tolerated adjunct for optimizing graft survival in HRPK.

POSTER 5

Microneedle-Assisted Intrastromal Drug Delivery: A Minimally Invasive Platform Optimized for the Human Cornea

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Purpose: To develop and validate a mechanically reinforced gelatin methacryloyl (GelMA)-based microneedle (MN) platform for rapid, minimally invasive intrastromal drug delivery across the corneal epithelial barrier in human donor corneas ex vivo.

Methods: GelMA was mechanically reinforced through incorporation of a multifunctional PEG-acrylate secondary polymer co-network to enhance stiffness and fracture resistance for corneal stromal penetration. The optimized formulation was evaluated by unconfined compression testing. MN arrays were fabricated by centrifugal casting into micromolds, followed by UV crosslinking and lyophilization. MN array morphology was assessed by optical microscopy and scanning electron microscopy. Ex vivo human corneas were immunolabeled with cytokeratin-12 (CK12) to delineate the corneal epithelium and were prepared either unfixed or briefly fixed with 2% paraformaldehyde to improve epithelial preservation. Sodium fluorescein-loaded MN patches were applied to the corneal surface for 5 minutes. Corneas were then evaluated by fluorescence confocal microscopy using mosaic z-stack acquisition. Maximum-intensity projections and volumetric reconstructions were generated in to assess MN insertion patterns, epithelial integrity, and stromal fluorescein delivery.

Results: Formation of the GelMA/PEG-acrylate co-network substantially enhanced the mechanical properties of the MN material, increasing compressive modulus from 114 to 318 kPa, representing an approximately 2.8-fold increase, and failure stress from 93 to 238 kPa, representing an approximately 2.6-fold increase. Fabricated MN arrays demonstrated uniform, well-defined geometry on optical microscopy and scanning electron microscopy. Following 5-minute application to ex vivo human corneas, confocal reconstructions showed a reproducible array-wide insertion footprint confined to the MN application zone. In unfixed corneas, MN application generated uniform microchannels that rapidly resolved after balanced salt solution instillation, consistent with stromal swelling-mediated sealing and suggesting minimally invasive stromal access. Brief fixation improved epithelial preservation while maintaining detectable insertion-associated features. Sodium fluorescein signals were observed within the MN application region, supporting consistent MN-mediated stromal delivery.

Conclusion: A mechanically reinforced GelMA/PEG-acrylate co-network successfully addresses the intrinsic mechanical compliance of GelMA and enables fabrication of corneal MN arrays with improved strength, defined morphology, and effective ex vivo penetration into the human cornea. Five-minute MN application produced reproducible insertion footprints, notable fluorescein delivery, and rapidly resolving stromal microchannels. These findings support MN-assisted intrastromal delivery as a promising minimally invasive platform for direct stromal drug administration, with potential translational relevance for corneal therapies requiring targeted delivery beyond the epithelial barrier.

POSTER 6

Development of a Keratoconus Model and Evaluation of Corneal Allogenic Intrastromal Ring Segments (CAIRS) in Human Donor Corneas

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Purpose: To develop a rapid, reproducible human donor corneal ectasia model using a novel technique and evaluate the early biomechanical effects of allogenic Corneal Allogenic Intrastromal Ring Segments (CAIRS) of varying geometries and widths.

Methods: Human donor corneas not suitable for transplant were mechanically thinned using a microkeratome and mounted on an artificial anterior chamber using proprietary high-pressure (HPAC) i. Following restoration of physiologic intra-chamber pressure (20–22 mmHg), corneal topography and pachymetry were analyzed to characterize ectatic changes. OptiGraft CAIRS were dried and subsequently implanted into manually dissected stromal tunnels. Tested configurations included 550µm thick concentric segments (0.75, 1.0, and 1.5 mm width) and asymmetric tapered/crescent designs (1.5→0.5 mm and 2.0→0.5 mm width). Axial/sagittal curvature maps were obtained pre-implantation and up to 2 hours post-implantation. Changes in keratometry, topographic pattern, and corneal biomechanics were evaluated.

Results: The HPAC technique reduced central corneal thickness by an average from 526 µm to 143 µm (72.8% reduction) and increased mean keratometry from 43.5 D to 47.5 D, with Kmax increasing from approximately 42.0 D to 50.1 D (+8.1 D). Topography demonstrated central cone formation, irregular astigmatism, and loss of rotational symmetry, closely resembling moderate-to-advanced keratoconus. Following implantation, OptiGraft CAIRS produced a size-dependent biomechanical response. Concentric 0.75 mm segments generated modest flattening (mean reduction 2.1 D, localized flattening up to 16 D), whereas wider concentric segments (1.0–1.5 mm) induced substantially greater regional flattening (15–19 D average), but increased irregular astigmatism. Asymmetric tapered and crescent designs produced the strongest directional remodeling, with central flattening ranging from 8–14 D and localized flattening up to 25.9–28 D. These implants generated marked redistribution of corneal curvature, demonstrating the ability to selectively modify ectatic regions. Greater implant width correlated with increased biomechanical effect but also greater topographic irregularity and evidence of overcorrection.

Conclusion: The mechanical thinning of corneas using the HPAC method and microkeratome provides a rapid, inexpensive, and highly reproducible human donor corneal ectasia model without enzymatic digestion. Dry allogenic OptiGraft CAIRS produced immediate, width-dependent corneal flattening and topographic remodeling. Smaller-width concentric segments demonstrated the most controlled response, whereas wider and asymmetric configurations generated powerful directional correction with increased risk of biomechanical overcorrection. This platform may serve as a valuable preclinical model for optimization of CAIRS design and development of customized treatments for keratoconus and other corneal ectatic disorders.

POSTER 7

Risk Factors For Early Versus Late Graft Dislocation After Endothelial Keratoplasty

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Purpose: To characterize early (≤ 1 wk) versus late (> 1 wk) graft dislocation risk after DMEK or DSAEK and evaluate impact on visual recovery.

Methods: Retrospective single-center analysis of 1,544 eyes (637 DMEK, 907 DSAEK; 2013–2025) with dislocation as none, early (51 DSAEK), or late (109 DMEK).

Results: DMEK dislocated predominantly late (17.1% vs. 4.5%); DSAEK predominantly early (5.6% vs. 4.1%). Insulin-dependent donor diabetes independently predicted early DSAEK dislocation (29.4% vs. 8.4%; $p=0.0002$), while prior retinal surgery ($p=0.0009$) and retinal detachment/tear ($p=0.004$) were also significant risk factors. In DMEK, diabetic retinopathy ($p<0.0001$) and glaucoma ($p=0.010$) were significant. Any dislocation (early/late) impaired vision through 6 months (DMEK $p=0.0145$; DSAEK $p=0.0002$).

Conclusion: DMEK and DSAEK have distinct dislocation risk profiles. Donor diabetes, retinal comorbidities, and tamponade type should guide donor screening, surgical planning, and follow-up.

POSTER 8

Long-Term Evaluation of the Stability and Sterility of 1% 5-Fluorouracil Eye Drops Used for Topical Chemotherapy for Ocular Surface Squamous Neoplasia

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Purpose: Evaluate whether compounded topical 1% 5-fluorouracil (5-FU) for ocular surface squamous neoplasia (OSSN) remains chemically stable and sterile beyond current short beyond-use dating.

Methods: This was a laboratory/observational study split into 2 phases. First, compounded bottles were stored refrigerated (2-8°C) through day 180, then room temperature (20-24°C) through day 365. High-performance liquid chromatography potency, pH, and appearance were assessed at 8 time points. Second, returned patient-used bottles were cultured from cap, rim, tip, and expressed contents on chocolate agar and tryptic soy broth. Patient surveys were utilized to assess handling use.

Results: Potency stayed within 97.5%-103.6% of baseline through day 365, and 90%-110% stability limits. pH remained 8.55-8.82, with no cloudiness or color change. Thirty bottles from 15 patients were cultured a mean 181.6 days after dispensing (range 18-424). No microbial growth was detected from any cap, rim, tip, or content samples, despite reported lapses in hand hygiene (5/15) and tip contact with eye/lid/lashes (5/15).

Conclusion: Compounded topical 5-FU eye drops showed 1-year chemical stability and no detectable contamination after real-world use. Results support study of extended single-bottle use across OSSN treatment cycles to reduce waste, cost, and patient burden while maintaining safety.

** Medical Student

POSTER 9

PP-CAT-158 African Experience of Combined Photorefractive Keratectomy and Collagen Cross Linking in Patients With Keratoconus

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Purpose: To evaluate the safety and clinical outcome of combined non-topography-guided photorefractive keratectomy (PRK) and corneal collagen cross-linking (CXL) for the treatment of patients with keratoconus.

Methods: A prospective, nonrandomized study of patients with keratoconus who underwent simultaneous non-topography-guided PRK and CXL. All patients were followed for 12 months. Data were collected preoperatively and postoperatively at 3-month, 6-month and 1-year follow-up visits after combined non-topography-guided PRK and CXL for visual acuity, corneal apex index, and thickness of cornea.

Results: Forty-four eyes were included in the study. Combined non-topography-guided PRK and CXL induced a significant improvement in both visual acuity and refraction. Uncorrected distance visual acuity significantly improved from 0.39 ± 0.22 LogMAR before combined non-topography-guided PRK and CXL to 0.14 ± 0.16 LogMAR at the last follow-up visit ($P < 0.002$) and corrected distance visual acuity remained stable (0.042 ± 0.040 LogMAR preoperatively vs. 0.042 ± 0.062 LogMAR postoperatively, $P = .54$). The mean spherical equivalent decreased from -1.66 ± 1.43 to -0.36 ± 0.58 diopters (D) ($P < .002$), and the mean cylinder decreased from 1.58 ± 1.64 to 0.86 ± 0.64 D ($P < .002$). At the last follow-up visit mean keratometry flat was 43.30 ± 1.75 vs. 45.62 ± 1.72 D preoperatively ($P = .03$) and mean keratometry steep was 44.39 ± 3.14 vs. 46.53 ± 2.13 D preoperatively ($P = .02$). Mean central corneal thickness decreased from 506.20 ± 12.40 to 468.56 ± 10.25 μ m following combined non-topography-guided PRK and CXL ($P < .001$). No intraoperative complications occurred. Four eyes developed mild haze that responded well to a short course of topical steroids. No other major complication noted.

Conclusion: Combined non-topography-guided PRK and CXL is an effective and safe option for improving visual acuity and stabilizing progression of keratoconus in patients with keratoconus.

POSTER 10

Artificial Intelligence-Based Assessment of Corneal Endothelial Cell Damage After DSAEK and DMEK Using Novel Retro-Illumination Imaging: Comparison with ImageJ Quantification

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Purpose: To evaluate the accuracy, reproducibility, and agreement of a large language model (ChatGPT)-assisted image analysis method for quantifying corneal endothelial cell damage on DSAEK and DMEK grafts and compare its performance with conventional ImageJ-based analysis.

Methods: Four DSAEK and four DMEK donor grafts were prepared, inserted into a recipient model, and unfolded prior to imaging. Trypan blue-stained donor corneal endothelial graft images obtained using a novel retro-illumination imaging technique were analyzed. Endothelial damage was quantified using ImageJ as the reference standard. AI-based image analysis was performed using two approaches: (1) contrast-enhanced image analysis alone and (2) simultaneous evaluation of original and contrast-enhanced image pairs. Repeated analyses were performed to assess intra-model reproducibility. Percent endothelial damage was calculated as the proportion of stained endothelial area within the graft boundary. Correlation, mean absolute error (MAE), and inter-method differences were evaluated.

Results: ImageJ-determined endothelial damage ranged from 1.5% to 34.98%, allowing evaluation of AI performance across grafts with minimal, moderate, and extensive endothelial injury. Using contrast-enhanced images, AI estimates closely approximated ImageJ measurements, yielding a strong correlation ($r = 0.943$, $p = 0.0015$) and a mean absolute error of 2.76 percentage points. Agreement between AI-generated and ImageJ-derived measurements was maintained across the full range of endothelial damage. Repeated AI analyses demonstrated high intra-model reproducibility, with an average standard deviation of 1.8 percentage points across repeated assessments. Simultaneous analysis of original and contrast-enhanced images produced slightly lower damage estimates than contrast-only analysis, with a mean difference of -1.53 percentage points. No statistically significant difference was observed between the two AI analysis approaches.

Conclusion: AI-assisted analysis of trypan blue retro-illumination images provides accurate and reproducible quantification of corneal endothelial damage following endothelial graft implantation and demonstrates strong agreement with ImageJ, the current reference standard. Simultaneous evaluation of original and contrast-enhanced images may reduce overestimation of damage while maintaining high concordance with ImageJ measurements. These findings suggest that AI-based image interpretation may provide a rapid, reproducible, and accessible alternative for endothelial viability assessment without requiring fluorescence microscopy or complex image-processing workflows. Further validation in larger datasets is warranted.

POSTER 11

Systemic Immune Dysregulation Is Common in Painful Neurotrophic Keratopathy

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Purpose: Neurotrophic keratopathy (NK) is defined by corneal sensory loss, yet a subset of patients report disabling ocular pain; a paradox implying mechanisms beyond denervation. We aimed to assess whether systemic autoimmune, inflammatory, or dysimmune dysregulation underlies pain in NK.

Methods: This retrospective study included adult NK patients with pain and no active ocular/systemic infection who underwent serological testing. Positivity was reported as a percentage of those tested. Panels spanned autoimmune (ANA, RF, anti-Ro/La [SSA/SSB], P-ANCA), inflammatory (ESR, CRP), and dysimmune (anti-trisulfated heparin disaccharide IgM [TS-HDS], anti-fibroblast growth factor receptor 3 IgG [FGFR3]) markers.

Results: Among 29 patients (59.6 ± 15.1 yrs; 17.2% male, 79.3% white), 79.3% harbored ≥1 positive marker; positivity by category reached 72.4% (autoimmune), 46.7% (inflammatory), and 31.3% (dysimmune). Leading markers were ANA (72.0%), RF (30.0%), SSA/B (19.0%), and P-ANCA (11.8%) [autoimmune]; ESR (46.7%) and CRP (23.5%) [inflammatory]; and anti-TS-HDS IgM (31.3%) and anti-FGFR3 IgG (18.8%) [dysimmune].

Conclusion: In painful NK, systemic autoimmune, inflammatory, and dysimmune serologic abnormalities are the rule, not the exception. These findings reframe painful NK as a potential neuro-immune disorder and support routine serologic evaluation to uncover and ultimately target modifiable drivers of pain.

POSTER 12

Survival of Donor Corneal Grafts Across Successive Penetrating and Endothelial Keratoplasties

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Purpose: To characterize graft survival of primary and repeat endothelial keratoplasty (EK) and penetrating keratoplasty (PK) and identify risk factors for graft failure.

Methods: Patients who underwent primary EK or PK between 2018 and 2025 were identified using Epic Cosmos (Epic Systems Corporation). Data were collected until May 2026. Analyses were stratified by transplant number (1, 2, ≥ 3) and graft type. Outcomes included graft failure during follow-up and hazard ratios (HRs) for failure.

Results: A total of 9,063 EKs and 2,514 PKs were included. Graft failure occurred in 11.20% of primary PKs (n=235), 17.42% of second PKs (n=54), and 12.26% of third PKs (n=13). Similarly, 10.01% of primary EKs (n=826), 15.71% of second EKs (n=115), and <15.0% of third EKs (n<11) failed. Among PKs, keratoconus was associated with the greatest graft survival (HR, 0.44; 95% CI, 0.31–0.63). Corneal edema (HR, 2.48; 95% CI, 1.16–5.31) and prior glaucoma surgery (HR, 2.31; 95% CI, 1.38–3.87), but not history of glaucoma alone, were associated with more than double the risk of primary graft failure. Among EKs, history of glaucoma (HR, 2.42; 95% CI, 1.99–2.95) and uveitis (HR, 1.88; 95% CI, 1.39–2.56) were associated with the highest risk of graft failure.

Conclusion: Graft survival differed by transplant number and keratoplasty type, with distinct clinical predictors of failure for PK versus EK. These findings support individualized risk assessment and suggest that patients with multiple high-risk features may benefit from alternative corneal replacement approaches, including bioengineered and artificial corneas.

** Medical Student

POSTER 13

Somatosensory Heterogeneity in Autoimmune Dry Eye Disease

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Purpose: To examine sensory status in individuals with autoimmune dry eye disease (DED) and evaluate whether heterogeneity in sensory phenotypes influences clinical phenotypes.

Methods: This cross-sectional study included individuals with autoimmune DED associated with Sjögren disease, other autoimmune diseases, or abnormal serologies without a defined autoimmune diagnosis (n=99). Participants completed validated DED (Ocular Surface Disease Index, OSDI) and ocular pain questionnaires (Numerical Rating Scale, NRS and Neuropathic Symptom Inventory Modified for the Eye, NPSI-Eye) and underwent ocular surface evaluation and testing of corneal sensitivity (hypo, normal, hypersensitivity). A subset (n=14) of individuals underwent quantitative sensory testing (QST) to hot and cold stimuli, including detection thresholds, pain thresholds, temporal summation (TS), and after-sensations (AS).

Results: The age of the entire population was 55.8 ± 13.1 years, 75.8% self-identified as female and 69.7% as White. Corneal sensitivity varied, with hyposensitivity noted in 19.6% and hypersensitivity in 8.2% of participants. Corneal hyposensitivity was associated with greater ocular surface damage, as demonstrated by higher corneal staining scores (4.6 ± 2.8 vs 2.8 ± 3.0 vs 2.4 ± 2.1), whereas corneal hypersensitivity was associated with greater evidence of altered pain processing, as demonstrated by a higher frequency of cutaneous allodynia (13.0% vs. 25.7% vs. 62.5%) and greater neuropathic pain symptoms, including wind (3.4 ± 2.5 vs. 4.8 ± 3.3 vs. 5.0 ± 4.1) and light-evoked pain (5.1 ± 2.8 vs. 5.1 ± 3.5 vs. 6.8 ± 3.8). In the QST subset, eyelid cold pain ratings (0°C) and the presence of prolonged cold after-sensations demonstrated stronger relationships with neuropathic ocular pain symptoms ($r = 0.68-0.72$) and overall symptom burden ($r = 0.45-0.72$) than ocular surface metrics ($|r| = 0.00-0.63$).

Conclusion: Sensory heterogeneity is a prominent feature of autoimmune DED and sensory phenotypes may influence DED presentation. QST measures may provide additional insight into ocular pain phenotypes and complement conventional ocular surface testing.

** Medical Student

POSTER 14

Limits of Clinical Phenotyping in Predicting Ocular Pain After Refractive Surgery: A Machine Learning Analysis

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Purpose: Ocular pain after refractive surgery affects an important minority and is difficult to predict. We used machine learning (ML) to assess how well the preoperative clinical phenotype predicts ocular pain 6 months after LASIK or PRK.

Methods: The outcome was a Numerical Rating Scale score ≥ 3 (0–10) at 6 months. Preoperative variables were organized into five feature tiers, from an a priori TRIPOD-AI locked set to a fully exploratory set. Within each tier, seven algorithms were tested under three class-imbalance strategies (baseline, class-weighted, SMOTE), yielding up to 101 configurations assessed by stratified repeated cross-validation (10 $\times$ 5). Models were ranked by out-of-fold (OOF) AUC, balanced accuracy, and calibration.

Results: 59/342 participants (17.3%) met the pain criterion. The locked random-forest+SMOTE model was strongest (OOF AUC 0.705, 95% CI 0.619–0.781; balanced accuracy 0.690; calibration slope 1.03). Best OOF AUC remained ~0.66–0.71 across tiers, with no gain from expanded sets. Locked and exploratory approaches converged on predictors from prior regression: dry-eye burden (DEQ-5, OSDI), female sex, PRK, baseline pain, neuropathic symptoms (NPSI-Eye), and older age.

Conclusion: ML on preoperative data approaches a discrimination ceiling near OOF AUC 0.70, reinforcing established risk factors. Unexplained variance suggests post-refractive pain is multifactorial; pairing clinical phenotyping with biological assays may advance individualized prediction.

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