CORNEA and EYE BANKING FORUM 2023

SAN FRANCISCO, CA
FRIDAY, NOVEMBER 3

EYE BANK ASSOCIATION OF AMERICA

Cornea Society
Advancing the treatment of corneal disease

FINAL PROGRAM

CorneaSociety.org | RestoreSight.org

CORNEA and EYE BANKING FORUM 2023

CORNEA AND EYE BANKING FORUM

Friday, November 3, 2023
Marines' Memorial Club
San Francisco, CA

Hosted by
Eye Bank Association of America and Cornea Society

EYE BANK ASSOCIATION OF AMERICA

Cornea Society
Advancing the treatment of corneal disease

MESSAGE FROM PROGRAM CHAIRS

November 2023

The Eye Bank Association of America (EBAA) and Cornea Society are pleased to welcome you to the Cornea and Eye Banking Forum. This year's meeting features the presentation of scientific free-papers, two industry awards, a Best Paper of Session Award, and invited sessions on timely and relevant topics. We are excited about the line up of presenters and topics; we hope you enjoy this year's event!

On behalf of the joint planning committee, we would like to thank the following companies for their generous support of this year's program through unrestricted educational grants:

- **Lions Gift of Sight**
- **Wolters Kluwer**
- **OneLegacy**
- **Rocky Mountain Lions Eye Bank**

The **Bausch + Lomb Foundation** will be sponsoring the R. Townley Paton Luncheon, which features a lively moderated discussion during lunch. All physician registrants are invited to attend.

In addition to the Cornea and Eye Banking Forum, the EBAA and Cornea Society encourage you to attend the following events at the American Academy of Ophthalmology (AAO) Annual Meeting taking place at the Moscone Center. Separate registration is required.

- Cornea Subspecialty Day 2023, **"What to See in 2023,"** on Saturday, November 4, from 8:00 am – 5:31 pm.
- The Cornea Society Symposium, **"Laser Surgery and Imaging for Corneal Diseases: When and How,"** featuring the Castroviejo Lecture on Sunday, November 5 from 3:45 pm – 5:00 pm.

November is Eye Donation Month! The theme, A New View, celebrates the new perspective on life that corneal transplant recipients experience after having their sight restored. Thank you to everyone in the cornea and eye banking community for the role that you serve in the facilitation of the gift of sight!

We hope you enjoy San Francisco and the 2023 Cornea and Eye Banking Forum!

Sincerely,

Sophie Deng, MD, PhD
Cornea Society Scientific Program Chair

Joshua Hou, MD
EBAA Scientific Programs Committee Chair

CORNEA and EYE BANKING FORUM 2023

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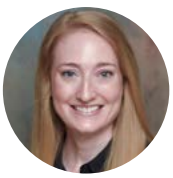

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SUPPORT

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CORNEA and EYE BANKING FORUM 2023

LEARNER NOTIFICATION AND FINANCIAL INTEREST DISCLOSURES

LEARNER NOTIFICATION

Eye Bank Association of America/ Cornea Society
2023 Cornea and Eye Banking Forum
November 3, 2023
San Francisco, CA

ACKNOWLEDGEMENT OF FINANCIAL COMMERCIAL SUPPORT

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ACKNOWLEDGEMENT OF IN-KIND COMMERCIAL SUPPORT

No in-kind commercial support was received for this educational activity.

SATISFACTORY COMPLETION

Learners must complete an evaluation form to receive a certificate of completion. Your chosen sessions must be attended in their entirety. Partial credit of individual sessions is not available. If you are seeking continuing education credit for a specialty not listed below, it is your responsibility to contact your licensing/certification board to determine course eligibility for your licensing/ certification requirement.

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In support of improving patient care, this activity has been planned and implemented by Amedco LLC and Eye Bank Association of America. Amedco LLC is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.

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Eye Bank Association of America approves this activity for a maximum of 7 CEUs. To claim CEUs for participating in this event, visit:
https://www.surveymonkey.com/r/2023ForumCEU

OBJECTIVES – AFTER ATTENDING THIS PROGRAM YOU SHOULD BE ABLE TO

1. Learn new developments, techniques and therapies in sight restoration.
2. Analyze the efficacy of emerging technologies and innovative processes in corneal transplantation and eye banking that can improve patient outcomes.
3. Cite new research findings in cornea regarding disease, treatment, transplantation, preservation, preparation and processing.

HOW TO GET YOUR CERTIFICATE

1. Go to **http://EBAA.cmecertificateonline.com**
2. Click on the "**2023 Cornea & Eye Banking Forum**" link.
3. Evaluate the meeting and click the hyperlink provided on the last page to claim your credit certificate.
4. Save/Download/Print all pages of your certificate for your records.

Questions? Email **Certificate@AmedcoEmail.com**

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DISCLOSURE OF CONFLICT OF INTEREST

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NOVEMBER 2023

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CORNEA and EYE BANKING FORUM 2023

PROGRAM SCHEDULE

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EVENT SCHEDULE

6:45 am – 2:00 pm	**Registration** (Club Lobby)
6:45 am – 7:45 am	**Breakfast** (Commandants Room)
8:00 am – 5:00 pm	**Cornea and Eye Banking Forum** (Marines' Memorial Theater)
12:15 pm – 1:15 pm	**Paton Luncheon*** (Commandants Room) *Supported by the Bausch + Lomb Foundation

8:00 am – 10:05 am SECTION I

8:00 am – 8:02 am	**Welcome and Introductions** Sophie Deng, MD, PhD, and Joshua Hou, MD
8:03 am – 8:14 am	**Insulin for Treatment of Neurotrophic Ulcers: Clinical Evidence and Potential Mechanism** Victoria Zeisberg, MD,* *University of Erlangen Medical School*
8:15 am – 8:26 am	**Outcome of Cenegermin in the Treatment of Neurotrophic Keratopathy across Various Causes** Golshan Latifi, MD,† *Jules Stein Eye institute, UCLA*
8:27 am – 8:38 am	**A Stronger Alternative to Standard-of-Care Cyanoacrylate Glue for Infectious and Sterile Corneal Perforations – The Shelf-Stable K-plug Allograft: Pilot Laboratory Study of Burst Pressure Compared to SOC** Christopher Sales, MD, MPH, *University of Iowa/ Iowa Lions Eye Bank*
8:39 am – 8:50 am	**Long-Term Outcomes of Glued (Sutureless) Amniotic Membrane Transplantation in Acute Stevens-Johnson Syndrome/Toxic Epidermal Necrolysis: A Comparative Study** Ramy Rashad, MD, MBA,* *Boston Medical Center*
8:51 am – 9:02 am	**Evaluation of Corneal Vascularization Following Ex Vivo Cross-Linking of Corneal Donor Carrier Tissue for the Boston Keratoprosthesis** Joseph Ciolino, MD, *Massachusetts Eye and Ear*
9:03 am – 9:14 am	**Dynamics of Corneal Swelling During Hypotonic Riboflavin in Corneal Collagen Crosslinking For Progressive Keratoconus Patients** Julia Yu,†† *Wills Eye Hospital*
9:15 am – 9:26 am	**Reticular Corneal Epithelial Edema with Topical Rho-kinase Inhibitor: How Does it Occur?** Friedrich Kruse, MD, *Univeristy of Erlangen Medical School*

†Undergraduate Student ††Medical Student *Resident †Cornea Fellow

9:27 am – 9:52 am	**Invited Session: Emerging Therapeutics for Corneal Diseases**
	The Present and Future of Cornea Collagen Cross-Linking M. Soledad Cortina, MD, *University of Illinois, Chicago*
	Updates in Artificial Cornea Marjan Farid, MD, *University of California, Irvine*
9:53 am – 9:55 am	**Claes Dohlman Award** 2023 Recipient: Christopher J. Rapuano, MD Announced by Bennie H. Jeng, MD
9:55 am - 10:05 am	**Cornea Society Business Meeting**
10:05 am – 10:20 am	**Break**

10:20 am – 12:00 pm SECTION II

10:20 am – 10:22 am	**Welcome Back** Joshua Hou, MD, and Sophie Deng, MD, PhD
10:23 am – 10:25 am	**EBAA High Impact Research Grant Announcement** Bennie H. Jeng, MD, *EBAA Research Committee*
10:26 am – 10:37 am	**Sociomedical Factors on Corneal Donor Recovery** Wuqaas Munir, MD, *University of Maryland School of Medicine*
10:38 am – 10:49 am	**Development of Novel Corneal Preservation Media to Optimize the Vitality and Proliferative Potential of Corneal Cells** Onkar Sawant, PhD, *Eversight*
10:50 am – 11:01 am	**Donor Cornea Automatic Endothelial Cell-Density Analysis** Ved Shivade,† *Case Western Reserve University*
11:02 am – 11:13 am	**Longitudinal Analysis of Fuchs Corneal Dystrophy using Anterior Segment OCT** Amy Pohodich, MD, PhD,* *Oregon Health and Science University*
11:14 am – 11:25 am	**Therapeutic Potential of the Neuropeptide alpha-Melanocyte Stimulating Hormone in Fuchs Dystrophy** Francesca Kahale, MD, *Schepens Eye Research Institute*
11:26 am – 11:37 am	**A Study of Human Ocular Surface Fungal Microbiome in Post Mortem Eyes** Aravind Roy, MS, *LV Prasad Eye Insititute*

11:38 am – 11:42 am	**R. Townley Paton Award Introduction** Anthony J. Aldave, MD, *2022 Paton Award Recipient*
11:43 am – 12:00 pm	**R. Townley Paton Award Lecture: It's All About Time** David D. Verdier, MD, *2023 Paton Award Recipient*
12:15 pm – 1:15 pm	**R. Townley Paton Luncheon — A Moderated Discussion**

1:30 pm – 3:15 pm SECTION III

1:33 pm – 1:50 pm	**Spotlight: Research Utilizing Big Data**
	Corneal Transplantation in the Medicaid Population 2015-2020 Khala Webb, BS,[++] *Johns Hopkins University School of Medicine*
	Demographics, Costs, and Complications of Cornea Transplant Patients Insured Under the Affordable Care Act: A Nationwide Analysis Shravika Lam, BS,[++] *Vanderbilt Eye Institute*
	Epidemiology, Healthcare Utilization, and Risk Factors Associated with Extended Length of Stay in Hospitalized Corneal Ulcer Patients Sinan Akosman, BA,[++] *George Washington University*
1:51 pm – 2:02 pm	**Have it Your Way: Minor Modification to the EndoGlide Ultrathin Enables Preloaded DSAEK Delivery Using Either Pull-through or Injection Techniques** Joshua Galloway, CEBT, *VisionGift*
2:03 pm – 2:14 pm	**Novel Technique and Device for Delivering Correctly Oriented Preloaded DMEK Grafts into Anterior Chamber without Direct or Indirect Manipulation** Eric Abdullayev, MD, MBA, CEBT, *Lions World Vision Institute*
2:15 pm – 2:26 pm	**Clinical Outcomes for DMEK vs DSAEK in Eyes with Prior Glaucoma Surgery** Jessica Chen, MD, *Devers Eye Institute*
2:27 pm – 2:38 pm	**Outcomes of Pediatric Corneal Transplantation Post-Minimally Invasive Corneal Neurotization** Emily Witsberger, MD,[†] *The Hospital for Sick Children / University of Toronto*
2:39 pm – 2:50 pm	**The Influence of Chronic Steroid Use on DMEK Rejection Rates and Endothelial Cell Survival** Brent Hoffman, MD,[†] *Devers Eye Institute*
2:51 pm – 3:02 pm	**Donor Diabetic State Significantly Amplifies the Immunogenicity of Corneal Grafts** Reza Dana, MD, MPH, MSc, *Massachusetts Eye and Ear/ Harvard Medical School*

3:03 pm – 3:05 pm	**Richard Troutman Prize Award Introduction** Douglass Lazzaro, MD, *NYU Langone Health*
3:06 pm – 3:15 pm	**Richard Troutman Prize Lecture: Effects of Type 2 Diabetes Mellitus and Smoking on Changes in Corneal Endothelial Morphology and Cell Density** Marija Antičić-Eichwalder, MD, *2023 Troutman Prize Recipient*
3:15 pm – 3:30 pm	**Break**

3:30 pm – 5:00 pm SECTION IV

3:30 pm – 3:32 pm	**Welcome Back** Joshua Hou, MD, and Sophie Deng, MD, PhD
3:33 pm – 4:05 pm	**Invited Session: Innovations in Cornea and Eye Banking** **With An Eye to the Future: Present and Future Trends in Eye Banking** Jennifer Y. Li, MD, *University of California, Davis* **Limbal Mesenchymal Stem Cells for Corneal Scarring** Sayan Basu, MD, LV *Prasad Eye Institute*
4:06 pm – 4:17 pm	**Clinical Profile and Donor Characteristics of Post Keratoplasty (PK, EK and ALK) Adverse Events – 10 Year Analysis from Single Eye Bank in India** Sunita Chaurasia, MD, LV *Prasad Eye Institute*
4:18 pm – 4:29 pm	**Peripheral Macular Endothelial Dystrophy (PMED): Clinical, Histopathologic and Genetic Characterization** Anthony J. Aldave, MD, *Stein Eye Institute, UCLA*
4:30 pm – 4:41 pm	**Possible Underlying Etiologies in Patients with Neuropathic Corneal Pain and Prior Refractive Surgery** Chloe Bogen, MS, *Tufts Medical Center*
4:42 pm – 4:53 pm	**Corneal Sensation and Subbasal Nerve Density are Reduced in Eyes with Limbal Stem Cell Deficiency** Clémence Bonnet, MD, PhD, *Cochin Hospital, Paris Cité Université/ Stein Eye Institute, UCLA*
4:54 pm – 4:56 pm	**Best Paper of Session** Presented by Jennifer Y. Li, MD, and Bennie H. Jeng, MD *Supported by an unrestricted educational grant from Lions Gift of Sight.*
4:57 pm – 5:00 pm	**Closing** Sophie Deng, MD, PhD, and Joshua Hou, MD

CORNEA JOURNAL

The Cornea Society sponsors and supports

Cornea: The Journal of Cornea and External Disease

Initially published by Raven Press, Inc., with Frank M. Polack, MD, as the founding editor, the journal has grown in scientific quality, circulation, and stature. Currently published monthly by Lippincott, Williams & Wilkins, the present Editor-in-Chief is Reza Dana, MD, MSc, MPH.

In 1998, the name of the journal was altered to include the subtitle “The Journal of Cornea and External Disease” in an effort to reflect the disciplines encompassed by the journal and the interests of its readers.

Cornea currently enjoys a steadily enhanced citation index and is recognized as the journal of record of the subspecialty of cornea and external disease.

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Advancing the treatment of corneal disease

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CORNEA and EYE BANKING FORUM 2023

INVITED SESSIONS

INVITED SESSIONS

Emerging Therapeutics for Corneal Diseases

SECTION I: 9:27 AM – 9:50 AM

The Present and Future of Cornea Collagen Cross-Linking
M. Soledad Cortina, MD, *University of Illinois, Chicago*

Updates in Artificial Cornea
Marjan Farid, MD, *University of California, Irvine*

Invited Session: Innovations in Cornea and Eye Banking

SECTION IV: 3:33 PM – 4:05 PM

With An Eye to the Future: Present and Future Trends in Eye Banking
Jennifer Y. Li, MD, *University of California, Davis*

Limbal Mesenchymal Stem Cells for Corneal Scarring
Sayan Basu, MD, *LV Prasad Eye Institute*

CORNEA and EYE BANKING FORUM 2023

AWARD LECTURES

AWARD LECTURE

R. TOWNLEY PATON LECTURE

It's All About Time

David D. Verdier, MD, 2023 Paton Award Recipient

Time and service have played major roles in shaping my, and I suspect your, life. One can measure success by achievements. I could stand before you and list the exemplary contributions I have made to our profession or the care of my patients. But that would be a very short talk. And boring. I think that in my case, and for many of us, the journey is more interesting than the destination.

AWARD LECTURE

RICHARD TROUTMAN CORNEA PRIZE LECTURE

Effects of Type 2 Diabetes Mellitus and Smoking on Changes in Corneal Endothelial Morphology and Cell Density

Marija Antičić-Eichwalder, MD, PhD, *General Hospital Klagenfurt*
2023 Richard Troutman Cornea Prize Recipient

Co-Authors: Susanne Lex, MD; Stephanie Sarny, MD, PhD; Jakob Schweighofer, MD; Ivana Maric, MD, PhD; and Yosuf El-Shabrawi, MD, PhD

Purpose: The purpose of this study was to compare the corneal endothelial morphology and cell density of diabetic smokers and nonsmokers with 50 to 70 age-matched healthy subjects and to determine whether smoking increases the effects of type 2 diabetes mellitus (DM) on these corneal parameters.

Methods: This prospective cohort study included 200 patients who were assigned to 4 groups, including smokers with type 2 DM (group 1), nonsmokers with type 2 DM (group 2), healthy smokers (group 3), and healthy nonsmokers (control group, group 4). Noncontact specular microscopy was used to measure central endothelial cell density (ECD), coefficient of variation of cell area, percentage of hexagonal cells, and central corneal pachymetry (CCT).

Results: According to the ECD and CCT values ($P < 0.001$ and $P = 0.013$, respectively), a significant difference was observed between the groups. The mean ECD was lowest in diabetic smokers (1917 ± 399 cells/mm2). Healthy smokers and diabetic smokers had significantly lower ECD compared with the control group ($P = 0.03$ and $P < 0.001$, respectively). Healthy smokers and diabetic smokers had significantly lower ECD compared with diabetic nonsmokers ($P = 0.012$ and $P < 0.001$, respectively). The cornea was significantly thicker in the diabetic smokers than in the control group ($P = 0.013$).

Conclusions: The coexistence of DM and smoking causes a significant decrease in ECD and an increase in CCT. Cigarette smoking is more harmful to corneal endothelial cells than DM alone.

R. TOWNLEY PATON LUNCHEON

12:15 – 1:15 PM

COMMANDANTS ROOM

(Located on the 10th Floor)

All physician attendees are invited to join for lunch and a lively moderated discussion.

Not a CME event.

Supported by: BAUSCH + LOMB

CORNEA and EYE BANKING FORUM 2023

SCIENTIFIC ABSTRACTS

SCIENTIFIC ABSTRACT

8:03 am – 8:14 am

Insulin for Treatment of Neurotrophic Ulcers: Clinical Evidence and Potential Mechanism

Victoria Zeisberg, MD*
Univeristy of Erlangen Medical School

Co-Authors: Matthias Zenkel, PhD; Andreas Giessl; Ursula Schlötzer-Schrehardt, PhD; Theofilos Tourtas, MD; Julia M. Weller, MD; Victor A. Augustin, MD; and Friedrich E. Kruse, MD

Purpose: Neurotrophic keratopathy causing non-healing epithelial defects represents a significant clinical challenge. Besides nerve growth factor, insulin has been shown to be a promising therapeutic agent promoting epithelial wound healing, but proper dosing and cellular mechanisms have not been clarified. In this study, we substantiated clinical use of insulin for treatment of refractory neurotrophic corneal ulcers in vivo and investigated potential cellular mechanisms underlying re-epithelialization of corneal epithelial wounds in vitro.

Methods: In a retrospective, single-center case series, the outcomes of 20 eyes of 20 patients treated with topical insulin eye drops (25 U/ml at differing intervals) for neurotrophic corneal ulcers, refractory for conservative treatment, were analyzed. Corneal epithelial wound closure was monitored daily. Human primary limbal epithelial cells were incubated in serum-free medium without or with different concentrations (0.05 to 150 µg/ml) of insulin for 24 hours. Gene expression profiles were analyzed using the Human Wound Healing PCR array and verified using specific real-time PCR assays and immunocytochemistry. The influence of insulin on cell migration and proliferation was assessed using appropriate assays.

Results: Complete corneal re-epithelialization was observed in all 20 eyes (100%) following insulin standard treatment regimens (25 U/ml = 0.5 U/drop QID). Higher doses did not enhance outcome but appeared to induce corneal angiogenesis. Experimental analyses provided evidence for a significant dose-dependent effect of insulin on epithelial migration with lower doses (0.5-1.0 µg/ml) being most effective. Expression profiling studies revealed significant upregulation of genes involved in cell migration (e.g. FSCN2, TSPAN1) and downregulation of cell adhesion molecules, including integrin subunits and ICAM1, upon exposure to 1.0-5.0 µg/ml insulin. However, higher doses (50-150 µg/ml) induced a 2.5-fold upregulation of VEGFA (vascular endothelial growth factor A).

Conclusion: The findings confirm previous studies on a beneficial effect of topical insulin on corneal epithelial wound healing following standard treatment regimens. At lower doses, insulin stimulates corneal epithelial cell migration by coordinated effects on cell detachment and increased motility, whereas higher doses appear to induce angiogenesis. These findings may have important implications in treating neurotrophic keratopathy and epithelial wound healing defects.

*Resident

SCIENTIFIC ABSTRACT

8:15 am – 8:26 am

Outcome of Cenegermin in the Treatment of Neurotrophic Keratopathy across Various Causes

Golshan Latifi, MD†
Stein Eye institute, UCLA

Co-Authors: Piseth Dalin Chea, MD; Saba Al-Hashimi, MD; Reza Ghaffari, MD; Anthony J. Aldave, MD; Sophie Deng, MD, PhD; and Simon S.M. Fung, MD

Purpose: To assess the efficacy of Cenegermin in treating patients with neurotrophic keratopathy (NK) resulting from various causes.

Methods: This study is a retrospective, consecutive case series that reviewed the medical records of patients who received Cenegermin 20 µg/ml for at least one course of 8 consecutive weeks at Jules Stein Eye Institute between February 2019 and April 2023. All the patients included in the study had reduced corneal sensation and had previously shown inadequate responses to conventional medical therapies for at least two weeks. Data, including demographic information, underlying etiology, stage (Makie classification) and clinical characteristics of NK at baseline and 8 weeks were collected. The primary outcome was the improvement in NK, defined as a decrease in epithelial defect (ED) size, if present, or in surface areas of epitheliopathy if ED was not present at 8 weeks.

Results: Forty-three eyes of 43 patients (26 females, 17 males, mean age 64.1±18.56 years) were enrolled in this study. The primary etiology for NK was severe dry eye in 2 (4.6%) patients, exposure keratopathy in 5 (11.6%), LSCD in 13 (30.2%), and primary NK in 23 (53.5%) patients. At week 8, NK improved in 29 (67.4%) patients, did not significantly change in 7 (16.3%), and worsened in 7 (16.3%). The percentage of eyes that improved at 8 weeks was significantly higher in the primary NK group compared to LSCD (82.6% vs. 53.8%, p= 0.03). Twenty patients experienced recurrence during follow-up, with a mean time to recurrence of 15.15 weeks (range 5-85 weeks). Twelve patients received a second course of Cenegermin later in their disease course. At 8 weeks of the second course, six (50%) patients improved, 2 (17%) showed no significant change, and 4 (33%) worsened.

Conclusion: Cenegermin demonstrated effectiveness in treating NK with various etiologies. We observed a significantly higher efficacy in primary NK compared to LSCD. In cases where patients experienced worsening despite treatment, NK was often influenced by other etiologic factors, such as dry eye, exposure, or decompensated graft. Cenegermin does not appear to prevent future recurrences.

†Cornea Fellow

SCIENTIFIC ABSTRACT

8:27 am – 8:38 am

A Stronger Alternative to Standard-of-Care Cyanoacrylate Glue for Infectious and Sterile Corneal Perforations – The Shelf-Stable K-plug Allograft: Pilot Laboratory Study of Burst Pressure Compared to SOC

Christopher Sales, MD, MPH
University of Iowa/ Iowa Lions Eye Bank

Co-Authors: Luke Grandgenett; Geb W. Thomas, PhD; Aaron D. Dotson, MD; and Noah Healy, MS

Purpose: To establish proof-of-concept efficacy and fabrication of a corneal plug for treating infectious and sterile corneal perforations.

Methods: Reproducible corneal perforations were made in 20 corneas (832 ± 126um) by mounting a donor cornea on an artificial anterior chamber (AAC), eroding the corneal apex with a 6 mm high-speed woodworking burr until it perforated, and widening the hole by stabbing it with a stationary 1 mm burr. Group 1 (n=10, control) was treated with cyanoacrylate (CA) glue and a 2 mm plastic disc punched from a surgical drape (i.e., SOC); group #2 (n=5) was treated with CA glue and a k-plug, which was cut manually with a crescent blade from a 2 mm glycerin-preserved corneal button to ~1000um in thickness with a ~500um-deep lamellar ring positioned ~500um from Bowman's layer. Group #3 (n=5) underwent the same treatment as group #2, except the k-plug prototypes were fabricated using a cutting device. All of the treated perforations were pressure-tested to failure (i,e,. burst pressure) using a syringe pump connected in series to the AAC and a digital manometer.

Results: All plugs in group 3 held the maximum pressure generated by the pump without bursting. Burst pressure was highest and most consistent in group 3, followed by group 2, and the worst in group 1 (>465 ± 17 vs. 385 ± 105 vs. 68 ± 136 mmHg, respectively; ANOVA $p<0.001$).

Conclusion: K-plugs fabricated with our cutter withstood consistently higher pressures than hand-cut plugs and the SOC. Small corneal perforations repaired with k-plugs of this specification can withstand at least 450 mmHg without bursting (nb eye rubbing raises IOP to <310 mmHg). Future studies will assess usability at the slit lamp in human cadaveric globes.

SCIENTIFIC ABSTRACT

8:39 am – 8:50 am

Long-term Outcomes of Glued (Sutureless) Amniotic Membrane Transplantation in Acute Stevens-Johnson Syndrome/Toxic Epidermal Necrolysis: A Comparative Study

Ramy Rashad, MD, MBA*
Boston Medical Center

Co-Authors: James Kwan, MD; Panotsom Ngowyutagon, MD; Swapna S. Shanbhag, MD; Mohammad A Tahboub, MD; Abid Haseeb, MD; and Hajirah N. Saeed, MD, MPH

Purpose: To compare the effectiveness and efficiency of a glued (sutureless) technique for amniotic membrane transplantation (AMT) with a traditional sutured one in the setting of acute Stevens-Johnson syndrome/toxic epidermal necrolysis (SJS/TEN).

Methods: This retrospective study evaluated all patients diagnosed with SJS/TEN from 2008 to 2012 within a single hospital system who received AMT in the acute phase according to our protocol and had at least one ophthalmic follow-up in the chronic phase. Primary outcomes included best corrected visual acuity (BCVA) at most recent visit, presence of a severe ocular complication (SOC) via predefined criteria, time to procedure, and duration of procedure. Random effects model analysis was used to evaluate the impact of potential covariates on outcomes.

Results: A total of 23 patients (45 eyes) were included: 14 patients (27 eyes) in the AMT suture group and 9 patients (18 eyes) in the AMT glue group. There was no difference between the two groups in BCVA at the most recent visit ($P=0.5112$) or development of a SOC ($P=1.000$). The glue method was shorter in duration than the suture method ($P<0.001$). Random effects model additionally indicated that there was no difference in BCVA at most recent follow up between patients who had received glued versus sutured AMT ($P=0.1460$).

Conclusion: The glue technique for AMT is as effective as the suture technique in stabilizing the ocular surface and mitigating chronic ocular complications in SJS/TEN. It is shorter in duration and can be performed more expediently in acutely sick patients.

*Resident

SCIENTIFIC ABSTRACT

8:51 am – 9:02 am

Evaluation of Corneal Vascularization Following Ex Vivo Cross-Linking of Corneal Donor Carrier Tissue for the Boston Keratoprosthesis

Joseph Ciolino, MD
Massachusetts Eye and Ear

Co-Authors: Ana M. Roldan, MD; Rohan Bir Singh, MD; Elizabeth L. Gatto; Alexander Melki; Sofia De Arrigunaga, MD; and Steven Staffa

Purpose: To evaluate the effect of corneal cross-linking (CXL) on corneal neovascularization (CNV) between eyes that were randomized to receive either CXL or non-CXL donor corneas as the carrier tissue for Boston Keratoprosthesis (BKPro).

Methods: A retrospective, masked analysis of CNV from slit-lamp photographs taken at post-operative week 16, 24, 36, and 52 from the eyes of participants that were randomized to receive either CXL or non-CXL carrier tissue for BKPro surgery. Sixty-eight donor corneas were prospectively randomized 1:1 to receive either donor corneas that either underwent ex vivo CXL or were non-CXL. The images of 47 corneas which were suitable for evaluation were included in the final analysis. The slit-lamp photos were analyzed morphometrically using a standardized protocol on Photoshop® CS5 (Adobe Systems Inc.) and ImageJ software (National Institutes of Health). The two primary metrics used to quantify CNV were - Neovascular Area, defined as the area of corneal vessels projected onto the plane of a photograph, and Invasion Area, defined as the fraction of corneal area in which vessels are present. The Mann Whitney U-test and Mixed Effects linear model were used for the statistical analysis.

Results: Based on the Mixed Effects linear model, the Percentage of NA is lower in the CXL (3.57) compared to the non-CXL (5.59) group as the effects of CXL reduce the Percentage of Neovascular Area over the time period by 2.02% (p-value 0.009). Similarly, there is an average reduction of 8.99% in the Percentage of Invasion Area in the CXL compared to the non-CXL group (p-value 0.032).

Conclusion: This study found the CNV to be lower in CXL donor corneas than the non-CXL, suggesting that the CXL of donor corneas may confer resistance to CNV. The role of ex vivo cross-linking of donor corneas in preventing CNV needs to be explored further through prospective randomized studies to find long-term implications.

SCIENTIFIC ABSTRACT

9:03 am – 9:14 am

Dynamics of Corneal Swelling During Hypotonic Riboflavin in Corneal Collagen Crosslinking for Progressive Keratoconus Patients

Julia Yu[++]
Wills Eye Hospital

Co-Authors: Zeba Syed, MD, and Clark Chang

Purpose: To evaluate the rate of corneal swelling induced by hypoosmolar riboflavin 0.146% in keratoconus (KCN) patients during FDA-approved epithelium-off corneal crosslinking (CXL).

Methods: After riboflavin induction, progressive KCN patients undergoing CXL with thinnest corneal point (TCP) of < 400 µm were recruited. Preoperative assessment of corneal hysteresis, specular microscopy and Pentacam tomography were performed. After epithelial debridement, hyperosmolar riboflavin with 20% dextran (Photrexa Viscous, Glaukos) was applied in 2-minute intervals during a 30-minute induction phase. At end of the induction phase, all eyes dehydrated to a TCP < 400 µm. Hypoosmolar riboflavin 0.146% (Photrexa, Glaukos) was then used every 10-seconds to induce stromal swelling until TCP is ≥ 400 µm. Intraoperatively, ultrasound pachymetry was repeated at TCP before epithelial debridement, after epithelial debridement, after 30 minutes of hyperosmolar riboflavin induction ("intraoperative baseline pachymetry"), every 30 seconds after instilling hypoosmolar riboflavin until TCP swells to ≥ 400 µm ("post-swelling pachymetry") and after 30 minutes of UV irradiation ("final pachymetry"). Corneal swelling rate was calculated using regression analysis.

Results: A total of 31 eyes from 31 patients were recruited (mean age 29.7 ± 8.7 years). After induction phase, mean intraoperative baseline pachymetry was 338.4 ± 28.7 µm and post-swelling pachymetry via hypoosmolar riboflavin was 413.4 ± 15 µm, achieved in a mean time of 5.2 ± 3.2 minutes (range 1-13.5), and the mean stromal swelling rate was 10.3 µm / 30 seconds. All eyes achieved a post-swelling pachymetry of ≥ 400 µm. Final pachymetry was 412.0 ± 49.9 µm. A thicker intraoperative baseline pachymetry was moderately associated with a faster rate of swelling. Preoperative corneal hysteresis or endothelial cell density had no effect on the rate of corneal swelling.

Conclusion: Utilizing FDA-approved hypoosmolar riboflavin, all 31 eyes with intraoperative baseline pachymetry < 400 µm were able to achieve at least 400 µm to undergo epithelium-off CXL. Additionally, we reported a mean stromal swelling rate of 10.3 µm / 30 second and observed this swelling rate to be dependent on intraoperative baseline pachymetry values. This allows for a more accurate prediction of total administration time in KCN patients with thinner preoperative corneas who otherwise would be excluded from conventional CXL.

[++]Medical Student

SCIENTIFIC ABSTRACT

9:15 am – 9:26 am

Reticular Corneal Epithelial Edema with Topical Rho-kinase Inhibitor: How Does it Occur?

Friedrich Kruse, MD
Univeristy of Erlangen Medical School

Co-Authors: Andreas Giessl, PhD; Matthias Zenkel, PhD; Theofilos Tourtas, MD; Victoria Zeisberg MD; Julia M. Weller, MD; Bettina Deak MD; and Ursula Schlötzer-Schrehardt, PhD

Purpose: The use of topical Rho-kinase (ROCK) inhibitors for treatment of corneal endothelial disease is expanding rapidly, but various ocular side effects including reticular bullous epithelial edema, particularly after topical netarsudil, have been reported. The mechanisms of development is unclear, but hypotheses suggest direct effects on corneal epithelial cell junctions. Here, we analyzed the effects of ROCK inhibitors netarsudil and ripasudil on cell adhesion and function of corneal epithelial and endothelial cells in vitro.

Methods: Primary human corneal endothelial and epithelial cells were incubated with netarsudil (1 µm) and ripasudil (10 and 30 µm) for up to 7 days. Gene and protein expression analyses were performed by quantitative real-time PCR assays and immunocytochemistry. Functional assays assessed cell migration, proliferation (BrdU), viability (Life-Dead), Na+, K+-ATPase activity, transepithelial electrical resistance (TEER), and permeability for FITC-Dextran.

Results: In corneal endothelial cells, both ripasudil and netarsudil significantly stimulated cell proliferation and migration, and improved pump and barrier function compared to untreated control cells. Both drugs further induced significant upregulation of genes and proteins related to pump and barrier function including Na+, K+-ATPase subunits, bicarbonate transporter, monocarboxylate transporter, chloride transporter, aquaporins, and tight junction proteins. In contrast, differential effects of both ROCK inhibitors were observed on expression of corneal epithelial cell junctions: Whereas expression levels of adherens junction, (hemi)desmosome and tight junction genes were upregulated by ripasudil, they were not affected or even downregulated by netarsudil along with a corresponding decline in epithelial barrier function. Expression changes normalized after 6 days upon discontinuation of ROCK inhibitors on day 3.

Conclusion: The findings suggest that both ripasudil and netarsudil can improve corneal endothelial cell function, but exert differential effects on corneal epithelial cell junctions and barrier function. Reticular bullous epithelial edema, occasionally reported after the use of netarsudil, may be caused by direct but reversible effects on corneal epithelial cell-cell and cell-basement membrane junctions.

*Resident

SCIENTIFIC ABSTRACT

10:26 am – 10:37 am

Machine Learning Evaluation Using Natural Language Processing of Sociomedical Factors on Corneal Donor Recovery

Wuqaas Munir, MD
University of Maryland School of Medicine

Co-Authors: Saleha Z. Munir, OD, MS, FAAO

Purpose: To evaluate how co-morbid sociomedical conditions affect corneal donor endothelial cell density and transplant suitability.

Methods: This retrospective cohort study examined corneal donor transplant information collected from the CorneaGen eye bank between June 1, 2012 and June 30, 2016. Demographics, time of death to preservation, cell density, lens status, sociomedical history, and suitability for transplantation data were obtained for each corneal donor. A natural language processing algorithm was applied to generate an index of co-morbid sociomedical conditions for each donor. Variables of importance were identified using 4 machine learning models (random forest, Glmnet, Earth, nnet), each fit using both a categorical outcome variable (transplant suitability) and a continuous outcome variable (endothelial cell density). SHAP (SHapley Additive exPlanations) values were generated after fitting an additional XGBoost model for both transplant suitability and endothelial cell density, with beeswarm and box plots to visualize the contribution of each feature to the models.

Results: A total of 23,522 unique donors were identified after exclusion criteria were met. Natural language processing generated 30,573 indices, which were reduced to the 41 most common co-morbid sociomedical conditions. For transplant suitability, hypertension ranked the top overall variable of importance for 2 of the models. Across all 4 machine learning models, hypertension, chronic obstructive pulmonary disease, history of smoking, and alcohol use appeared consistently in the top variables of importance. By SHAP feature importance, hypertension (0.042), alcohol use (0.017), ventilation of donor (0.011), and history of smoking (0.010) contributed the most to the transplant suitability XGBoost model. For endothelial cell density, hypertension was the sociomedical condition of highest importance in 3 of the 4 initial models. SHAP scores were highest among the sociomedical conditions of hypertension (0.037), alcohol use (0.013), myocardial infarction (0.012), and history of smoking (0.011).

Conclusion: In a large cohort of corneal donor eyes, hypertension was identified as the most commonly contributor to machine learning models examining sociomedical conditions for corneal donor transplant suitability and endothelial cell density. Sophisticated machine learning techniques can highlight novel associations with corneal donor tissue health that may instigate further study.

SCIENTIFIC ABSTRACT

10:38 am – 10:49 am

Development of Novel Corneal Preservation Media to Optimize the Vitality and Proliferative Potential of Corneal Cells

Onkar Sawant, PhD
Eversight

Co-Authors: Jessica Ludwig; Madison Castellanos; Caitlin Qualter; Lisette Raygoza; Nambi Nallasamy, MD; and Shahzad I. Mian, MD

Purpose: Current corneal preservation media lack the ability to promote or maintain the stemness of various corneal cells. None of the currently used media formulations are developed with consideration for the future of eye banking and corneal transplantation including cell specific transplantations. Therefore, there is an urgent unmet need for the development of new corneal storage media formulation. The purpose of our study is to identify the effect of current corneal preservation media and novel agents on stemness, proliferative and regenerative potential of corneal endothelial cells (CECs) and limbal epithelial stem cells (LESCs).

Methods: We evaluated the effect of addition of Rho Kinase Inhibitor (RKi) in corneal preservation media. Left and right corneas were preserved in a media without and with RKi from research consented donors, respectively. Specular microscopy and Optical Coherence Tomography (OCT) were performed by a group of masked technicians on day 0, 3, 7, 10 and 14. The endothelial cell density (ECD), coefficient of variance (CV), percentage hexagonality (Hex) and central corneal thickness (CCT) were recorded. Effect of RKi on CEC migration and proliferation was studied using the ex-vivo DSO model. The effect of current corneal preservation media storage practices on stemness of LESCs was also evaluated using p63α immunohistochemistry.

Results: Our data demonstrates that addition of RKi to corneal storage media significantly reduces the rate of corneal decomposition during cold storage conditions. We observed that the rate of ECD decrease and CCT increase from day 0 to day 3 was reduced in the corneal preservation media supplemented with RKi compared to the control group. Under organ culture conditions, media supplemented with RKi was able to heal the endothelium by 82% compared to only 34% in the control group after ex-vivo DSO protocol ($P<0.05$, paired t-test). Density of p63α positive LESCs on day 7 was 0% in the Caucasian population and 24% in the non-Caucasian population under cold storage conditions ($P<0.05$, t-test).

Conclusion: Taken together, our studies indicate that addition of RKi might be beneficial to preserve vitality of CECs. Current corneal storage conditions and media are not conducive to preserving stemness of LESCs. We recommend that eye banks and surgeons should consider using non-Caucasian donors for KLAL and allogenic-SLET procedures to maximize the transplantation of LESCs from donor tissues and to increase the probability of post-operative success.

SCIENTIFIC ABSTRACT

10:50 am – 11:01 am

Donor Cornea Automatic Endothelial Cell-Density Analysis

Ved Shivade[+]
Case Western Reserve University

Co-Authors: Naomi Joseph, PhD; Nathan Romig; Jameson Clover; Nathan Yoganathan; Michael S. Titus, CEBT; Onkar B. Sawant, PhD; Harry Menegay, PhD; David Wilson, PhD; Jonathan Lass, MD; and Beth Ann Benetz, CRA, MA

Purpose: Develop self-supervised deep learning method for calculating endothelial cell (EC) segmentation and density (ECD) of real-world donor cornea images.

Methods: Two eye banks' (Eversight, VisionGift) donor EC images were used—174 with automatically generated borders (labeled) and 4,745 with eye bank determined ECD without borders (unlabeled). Unlabeled images were split in two groups: those grafted (A) and those not suitable for grafting based on slit-lamp exam (B). A vision transformer (ViT) was trained using a 60-20-20 split of the unlabeled data, with the latter 20% excluded for segmentation predictions. The ViT weights then initialized a U-Net transformer, which was fine-tuned on labeled data.

Results: Our model automatically calculated ECD from 1,092 (A) and 323 (B) held-out images, segmenting 100-1,263 cells per image, a larger region than eye bank analysis of 100-300 cells per image. The mean % difference between eye-bank-determined and automated ECD was 6.02% (A) and 6.24% (B). These differences are statistically significant ($p < 0.01$), but not clinically significant. Also, 82% (A) and 81% (B) of automated ECD calculations fell within 10% of eye-bank-determined ECD values. A Wilcox test showed no significant difference in ECD calculation between the two groups ($p=0.93$).

Conclusion: Machine learning analysis provides consistent, accurate ECD of donor images, potentially reducing analysis time and training requirements.

[+] Undergraduate Student

SCIENTIFIC ABSTRACT

11:02 am – 11:13 am

Longitudinal Analysis of Fuchs Corneal Dystrophy using Anterior Segment OCT

Amy Pohodich, MD, PhD*
Oregon Health and Science University

Co-Authors: Yan Li, PhD; David Huang, MD, PhD; and Winston D. Chamberlain, MD, PhD

Purpose: Use anterior segment optical coherence tomography (AS-OCT) data from normal controls and serial images over time from patients with Fuchs endothelial corneal dystrophy (FECD) to monitor disease progression and response to endothelial keratoplasty (EK).

Methods: AS-OCT imaging was done at enrollment for FECD patients and controls, and at follow-up visits for FECD patients. A central 5mm diameter disk from each AS-OCT image was segmented into epithelium and stroma layers. Corresponding volume and thickness measurements were obtained, and the pattern standard deviation (PSD) of each individual thickness map was calculated.

Results: When compared to controls (n=50), FECD eyes (n=74) showed significant differences in the PSDs of their full-thickness cornea ($p<0.001$), epithelium ($p<0.001$) and stroma ($p<0.001$), and had larger mean stromal volumes (control: 9.59 mm^3 vs. FECD: 9.99 mm^3; $p<0.001$). Over time, untreated FECD eyes (n=18) had a small loss of epithelial volume (baseline: 0.99 mm^3 vs. follow-up: 0.97 mm^3; $p=0.03$). Post-EK FECD eyes (n=19) showed significant changes in their total cornea ($p=0.02$) and stroma ($p=0.03$) PSDs compared to preoperative measurements, and stromal volumes were not significantly different between post-EK eyes and controls (9.43 mm^3 vs. 9.59 mm^3, $p=0.3$).

Conclusion: FECD eyes have marked differences in AS-OCT thickness patterns and increased stromal volume compared to controls. Further, FECD eyes have a loss of epithelial volume over time, and eyes that underwent EK showed normalization of their stromal volumes and improvement in variation of their pattern deviation maps. These changes may provide tools to predict the optical benefits of EK vs. observation.

*Resident

SCIENTIFIC ABSTRACT

11:14 am – 11:25 am

Therapeutic Potential of the Neuropeptide alpha-Melanocyte Stimulating Hormone in Fuchs Dystrophy

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Schepens Eye Research Institute

Co-Authors: Hamid Alemi, MD, MPH; Neha Deshpande; Reza Dana, MD, MPH, MSc; Seokjoo Lee, PhD; Jia Yin, MD, PhD; Ula Jurkunas, MD; and Thomas Dohlman, MD

Purpose: To investigate the therapeutic potential of alpha-melanocyte stimulating hormone (α-MSH) in counteracting ultraviolet-A (UV-A) induced corneal endothelial damage using a pre-clinical model of Fuchs endothelial corneal dystrophy (FECD).

Methods: Mice were exposed to 500 J/cm^2 of 365 nm UV-A focused on the central cornea to induce FECD and then received α-MSH treatment via intraperitoneal injection either immediately after exposure (early treatment) or beginning 2 weeks after exposure (delayed treatment). Corneal endothelial cell density and morphology were analyzed via in vivo confocal microscopy. Central corneal thickness was measured by anterior segment optical coherence tomography. Oxidative DNA damage and cell death were assessed in cultured hCEnC-21T cells treated with H2O2 and α-MSH using immunofluorescence and flow cytometry.

Results: α-MSH significantly reduced DNA double-strand breaks induced by H2O2 in cultured human corneal endothelial cells ($p<0.0001$). α-MSH also attenuated endothelial cell apoptosis and necrosis after oxidative challenge. In a mouse model of Fuchs dystrophy, early α-MSH treatment initiated on day 1 after UV-A exposure maintained corneal endothelial cell density close to baseline levels throughout follow-up ($p<0.0001$). Delayed α-MSH treatment starting 2 weeks after UV-A exposure stabilized further endothelial cell loss. At 3 months after UV exposure, both early and delayed treatment with α-MSH suppressed the increase in corneal thickness observed in control dystrophic corneas ($p<0.0001$), preventing corneal edema.

Conclusion: α-MSH demonstrates therapeutic potential in counteracting development of the Fuchs phenotype warranting further investigation of its role as a corneal endothelial cytoprotectant.

SCIENTIFIC ABSTRACT

11:26 am – 11:37 am

A Study of Human Ocular Surface Fungal Microbiome in Post Mortem Eyes

Aravind Roy, MS
LV Prasad Eye Insitiute

Co-Authors: Sisinthy Shivaji; Savitri Sharma; Sujata Das; and Himansu Behera

Purpose: To report the ocular surface fungal microbiome of cadaveric eyes prior to excision of corneoscleral rim for keratoplasty.

Methods: Trained eye bank technicians obtained Isohelix conjunctival swabs (moistened with PBS pH7.2) from each cadaveric eye within 24 hours of death, after retracting the eyelids manually and prior to disinfection of the ocular adnexa with povidone iodine. Swabs were taken prior to retrieval of the corneoscleral rim. DNA extraction followed by PCR amplification of the ITS2 fungal ribosomal RNA region was performed. Using next generation sequencing (NGS) fungal amplicon libraries were prepared according to standard illumina protocol using a Miseq platform. Taxonomic assignments for denovo-OTUs (operational taxonomic units) were obtained using a Wang Classifier with a bootstrap of 80%. OTUs containing < 0.001% of the total number of high quality reads (sparse OTUs) were removed from further analysis.

Rarefaction curves and Alpha diversity indices (Chao 1, Shannon diversity, Simpson and, invSimpson index) were performed for measuring richness and relative abundance of fungi within the sample using R-Vegan 2.4-2 and Phyloseq R package.

Results: We reviewed fungal microbiome of 6 suitable donor eyes. An OTU with 97% sequence identity were included. The total no. of OTUs observed were 592. Assignment of OTUs was done at Phylum and genus level. The commonest identified phyla were Ascomycota 89% and Basidiomycota 11%. Commonest three genera were Aspergillus (23.2%), Blumeria (11.5%), Cutaneotrichosporum (8.5%). Other fungi noted were Candida (6.1%) and Malassezia (4.8%).

Conclusion: NGS revealed Ascomycota to be the predominant fungal phylum on the ocular surface after death until 24 hours. Aspergillus is the commonest pathogenic fungal species. Candida and Malassezia were also found, although in less abundance.

SCIENTIFIC ABSTRACT

1:33 pm - 1:36 pm

Corneal Transplantation in the Medicaid Population 2015-2020

Khala Webb, BS[++]
Johns Hopkins University School of Medicine

Co-Authors: Chen Dun, MHS; Divya Srikumaran, MD; Fasika Woreta, MD, MPH; Xi Dai; and Martin A. Makary, MD, MPH

Purpose: Previous studies have demonstrated disparities in access to and types of corneal transplants received by race/ethnicity and gender. No prior studies have assessed corneal transplant trends in the Medicaid population. The purpose of our study was to examine types of corneal transplants performed in Medicaid patients and assess for any racial/ethnic or gender disparities.

Methods: This was a retrospective analysis using Medicaid claims data to identify different types of corneal transplant procedures performed from 2015 to 2020. Corneal transplant types including penetrating keratoplasty (PK), endothelial keratoplasty (EK), and anterior lamellar keratoplasty (ALK) were identified by Current Procedural Terminology (CPT) codes. Patients of any age with Medicaid as a primary or secondary insurance type who received a corneal transplant within the study period were included. Patient characteristics were obtained from Medicaid demographic and eligibility data. A sub-analysis comparing the demographics among sole Medicaid beneficiaries versus dual Medicare + Medicaid beneficiaries was also conducted.

Results: We analyzed 16,029 corneal transplants performed on Medicaid beneficiaries from 2015-2020. 50.1% of all transplants were performed on patients ages 55 and older. The most common types of transplants performed were PK (60.2%), followed by EK (33.5%). The majority (90.53%) of EK patients were older than 45, while most (61.52%) PK patients were younger than 45. Most patients (56.2%) were female. Men received 33.10% of all EK's in the study period. A total of 37.5% of patients identified as White, 21.3% as Black, 0.85% as Hispanic, 1.69% as Asian, and 15.77% as other. Patients were least commonly located in rural areas (17.97%) and the Northeast (8.98%). 67.21% of all patients in our dataset were covered by Medicaid alone and 32.79% had dual Medicare + Medicaid coverage. 50.1% of dual-insured Medicare + Medicaid beneficiaries underwent PKs, while 64.8% of sole Medicaid beneficiaries underwent PKs ($p < 0.001$). Comparing the Medicaid beneficiaries with the dual-insured Medicare + Medicaid beneficiaries, we found that non-White patients represented a greater proportion of the sole Medicaid beneficiaries. Black, Asian, and Hispanic identifying patients made up 22.88%, 1.93%, and 1.04% of sole Medicaid beneficiaries, while they comprised 18.02%, 1.20%, and 0.46% of dual Medicare + Medicaid beneficiaries respectively ($p<0.001$). Lastly, more dual-insured patients were women (61.38%) than Medicaid only beneficiaries (53.70%).

Conclusion: Despite the increasing adoption of lamellar techniques in the U.S., most transplants performed in the Medicaid population from 2015-2020 were penetrating keratoplasties. Non-white patients were more often covered by Medicaid alone. Overall, men represented a smaller proportion of patients receiving corneal transplants than women. Further research to explore racial/ethnic and gender disparities in corneal transplantation are warranted.

[++]Medical Student

SCIENTIFIC ABSTRACT

1:37 pm - 1:40 pm

Demographics, Costs, and Complications of Cornea Transplant Patients Insured Under the Affordable Care Act: A Nationwide Analysis

Shravika Lam, BS[++]
Vanderbilt Eye Institute

Co-Authors: George T. Lin, MD; Sapna Gangaputra, MD; Jeremy B. Hatcher, MD; Xiangyu Ji, MS; Qingxia Chen, PhD; and Christine Shieh, MD

Purpose: To investigate the demographics, costs, and complications of cornea transplant patients among the Wakely Affordable Care Act (WACA) 2015-2019 dataset.

Methods: Multivariable logistic and linear regression models were used to assess costs and complication rates using demographic/clinical data and insurance plan type.

Results: Among 26,997,610 enrollees, 0.005% (n =1266) underwent cornea transplants. The majority of patients were from the South (45.5%, n=576) and enrolled in the silver cost-sharing reduction plan type (33.5%, n= 424). Endothelial cornea dystrophy was the primary transplant indication (38.9%, n=493). 626 patients (49.4%) underwent endothelial keratoplasty, 559 underwent penetrating keratoplasty (44.2%), 87 underwent lamellar keratoplasty (6.9%), and 6 (0.5%) underwent keratoprosthesis. 32.9% (n=416) of patients experienced a postoperative complication. The most common complications were corneal transplant failure (15.6%) and infectious keratitis (11.5%). Non-corneal intraocular surgery within ninety days prior to, or one year after, transplant was associated with increased rate of infectious keratitis and cystoid macular edema (both $p<0.01$) but not corneal transplant failure ($p=0.24$). Insurance plan type was not associated with rate of postoperative complications ($p=0.84$). Patients with a bronze plan type had the highest out-of-pocket cost ($p<0.01$), while those with a silver cost-sharing reduction plan type had the lowest ($p<0.01$).

Conclusion: This study is the first to assess the demographics, costs, and complications of corneal transplant patients within the ACA population.

[++]Medical Student

SCIENTIFIC ABSTRACT

1:41 pm - 1:44 pm

Epidemiology, Healthcare Utilization, and Risk Factors Associated with Extended Length of Stay in Hospitalized Corneal Ulcer Patients

Sinan Akosman, BA[++]
George Washington University

Co-Authors: Renxi Li, BS; Bryan Kwon, BA; William West, MD; Masumi Asahi, MD; and Keith Wroblewski, MD

Purpose: To report demographics risk factors associated with length of stay in patients hospitalized for the management of corneal ulcers in the United States.

Methods: A retrospective cross-sectional study of adult patients (>18 years old) admitted with a primary diagnosis of corneal ulcer in the US between 2016-2020 was conducted utilizing data from the National Inpatient Sample (NIS) Database. Patient were stratified into two cohorts based on hospital LOS compared to the medium length-of-stay (LOS) of the group: LOS</=4 and LOS>4 days. Predictors for LOS>4 were examined by multivariable regression.

Results: A total of 187 patients were included for analysis. The LOS>4 cohort had higher total cost of admission than the LOS</=4 group ($26,474.26 ± 20,743.42 versus $79,503.82 ± 86,719.01, p=<0.01). Independent risk factors associated with LOS>4 days were African Americans race (p=0.03), Medicare insurance (p=<0.01), and housing instability (p=<0.01). Medical risk factors included alcohol use (p=0.05), dementia (p=<0.01), diabetes (p=0.04), drug abuse (p=0.02), and legal blindness (p=0.02). Based on NIS national estimates, corneal ulcers are estimated to have a direct annual healthcare expenditure of $35,819,590 in the United States.

Conclusion: Corneal ulcer hospitalizations represent a significant burden of disease for patients as well as healthcare systems. This study highlights pertinent factors which may help clinicians to identify high-risk patients most vulnerable to complications and morbidity due to corneal ulcers.

[++]Medical Student

SCIENTIFIC ABSTRACT

1:51 pm - 2:02 pm

Have it Your Way: Minor Modification to the EndoGlide Ultrathin Enables Preloaded DSAEK Delivery Using Either Pull-Through or Injection Techniques

Joshua Galloway, CEBT
VisionGift

Co-Authors: Emma Letchworth, CEBT; Megan M.W. Straiko; Philip Dye, CEBT; and Khoa D. Tran, PhD

Purpose: To evaluate the feasibility and graft quality of preloaded DSAEK grafts in a modified EndoGlide Ultrathin cartridge for graft injection.

Methods: Twelve grafts were processed by the same processing technician (EM). Grafts were pre-cut to targets 60-100 µm and examined by slit-lamp and specular microscopy to ensure pre-cutting did not cause excessive endothelium damage. Grafts were then punched to 8.0 mm and preloaded into a modified Tan EndoGlide Ultrathin. Tubing was subsequently added to the proximal end of the cartridge and the preloaded grafts were placed back into storage solution. Graft were shipped across the country and analyzed using Calcein-AM vital dye staining and FIJI segmentation. Endothelial cell loss (ECL) was compared with a reference cohort containing 12 preloaded DSAEK grafts in the Tan EndoGlide Ultrathin configured for the pull-through technique.

Results: Average ECL for the 12 preloaded and injected grafts was 16.2 ± 4.7% and comparable to the reference cohort (n=12) with an average ECL of 12.2 ± 5.4% (P=0.07). No grafts were displaced during transit over 3 separate cross-country shipments. Grafts can be ejected with minimal difficulty onto microscope slides for analysis as well as into surgical simulation models.

Conclusion: The Tan EndoGlide Ultrathin can be modified to accommodate the attachment of a syringe, enabling it to be used for graft injection. Moreover, this modification did not compromise the ability to use the pull-through method for graft delivery. The flexibility provided by this modified setup offers potential benefits to eye banks and surgeons, enhancing the options available during DSAEK procedures.

SCIENTIFIC ABSTRACT

2:03 pm - 2:14 pm

Novel Technique and Device for Delivering Correctly Oriented Preloaded DMEK Grafts into Anterior Chamber without Direct or Indirect Manipulation

Eric Abdullayev, MD, MBA, CEBT
Lions World Vision Institute

Co-Authors: Art Kurz, BS, and Benjamin Lambright, MD

Purpose: Traditionally DMEK graft delivers into AC in an endothelium side out orientation and requires a variety of external or international manipulations to unfold. Introducing a novel carrier and technique to transfer preloaded DMEK grafts in the correct orientation using a no-touch fluid injection without external tapping of direct graft manipulation.

Methods: A novel DMEK glass carrier was loaded with eye bank prepared DMEK grafts with healthy endothelium but unsuitable for transplant. After a tri-fold introduction into the carrier's flat holding chamber, the graft is securely held with stromal side out and endothelium in. We compared the endothelial viability of 8mm corneal grafts pre-loaded into the carrier for 24hrs (n=13) and 48 hrs (n=5). Then connected to a 3ml syringe filled with BSS and transferred using fluid injection into an artificial anterior chamber (ACC). Grafts were evaluated after overnight shipping. Unfolding in AAC and endothelial analysis were performed using specular microscopy, vital dye staining with devitalized areas semi-quantitatively assessed by digital imaging. Digital images were processed with ImageJ-win64 software.

Results: The same graft position inside the carrier was observed after overnight shipping. All insertions were performed through a 3.0-3.2 mm wound. Grafts are transferred into ACC by fluid injection without observed difficulties and unfold without tapping or other manipulation. Mean devitalized areas of 4.1% after 24 hrs and 4.5% after 48 hrs hours preloaded were observed. Average endothelial cell density prior to preloaded (2645 cells/mm^2) wasn't significantly different when compared at 24 hrs (2723 cells/mm^2) and 48 hours (2654 cells/mm^2) preloaded.

Conclusion: A novel glass carrier allows secure storage of preloaded DMEK grafts stromal side out and endothelium in and delivery by fluid injection into AAC in correct anatomical orientation streamlining graft unfolding with minimal cell damage.

SCIENTIFIC ABSTRACT

2:15 pm – 2:26 pm

Clinical Outcomes for DMEK vs DSAEK in Eyes with Prior Glaucoma Surgery

Jessica Chen, MD
Devers Eye Institute

Co-Authors: Brent Hoffman, MD; Alex J. Bauer; Michael Straiko, MD; and Mark A. Terry, MD

Purpose: To compare the clinical outcomes of Descemet membrane endothelial keratoplasty (DMEK) versus Descemet stripping automated endothelial keratoplasty (DSAEK) in eyes with a glaucoma filtration tube or trabeculectomy.

Methods: A retrospective analysis of DMEK and DSAEK surgeries in eyes with a prior glaucoma filtration tube or trabeculectomy was conducted. Rebubble rate, primary graft failure (PGF) rate, 6-month BSCVA, and 6-month endothelial cell loss (ECL) were compared.

Results: Thirty-nine eyes were in the DMEK group and 145 eyes in the DSAEK group. Rebubble rate for DMEK and DSAEK was 15.4% vs. 5.5%, P=0.039. PGF rate was 2.6% and 6.7% in the DMEK and DSAEK group, respectively, P=0.85. 6-month BSCVA and ECL was 20/40 and 51% in the DMEK group and 20/64 and 37% in the DSAEK group, P=0.028 and P=0.013, respectively.

Conclusion: There was a statistically significant lower rebubble rate and 6-month ECL in the DSAEK group. The significant difference in BSCVA and non-significant difference in PGF rate for DMEK may be due to the more complex anterior segment anatomy of the DSAEK eyes.

SCIENTIFIC ABSTRACT

2:27 pm – 2:38 pm

Outcomes of Pediatric Corneal Transplantation Post-Minimally Invasive Corneal Neurotization

Emily Witsberger, MD[†]
The Hospital for Sick Children / University of Toronto

Co-Authors: Larissa Gouvea, MD; Kamiar Mireskandari, MBChB, PhD, FRCOphth; and Asim Ali, MD, FRCSC

Purpose: To describe the outcomes of corneal transplantation following minimally invasive corneal neurotization in pediatric patients.

Methods: Medical records of all children diagnosed with neurotrophic keratopathy who underwent corneal neurotization with sural nerve graft followed by later corneal transplantation between 2015-2021 were reviewed retrospectively. Data collected included demographic information, ocular comorbidities, corneal sensitivity by Cochet-Bonnet aesthesiometer (CBA), graft survival (primary outcome), and rejection.

Results: Of 28 eyes which underwent corneal neurotization, 6 underwent corneal transplant (mean age 11.9 + 4.4 years) 2.4 + 0.4 years after initial surgery. Mean maximum recorded CBA prior to corneal transplantation was 53.3 + 9.4 mm. Re-epithelialization was observed in all eyes by postoperative month 1. Mean follow-up was 4.5 + 2.1 years. Penetrating keratoplasty (PK) was performed in 2 cases, and deep anterior keratoplasty (DALK) in 4 cases. Graft survival at final follow-up was 83.3%. No improvement was observed in visual acuity from baseline (1.2 + 0.4 logMAR) to final postoperative follow-up (1.1 + 0.4 logMAR; p=0.68).

Conclusion: Optical corneal transplantation following corneal neurotization has low rejection and failure rates. Manual DALK can be performed in patients who have not undergone previous PK despite scarring. Although graft may stay clear, improvement in BCVA may be limited by amblyopia.

[†]Cornea Fellow

SCIENTIFIC ABSTRACT

2:39 pm – 2:50 pm

The Influence of Chronic Steroid Use on DMEK Rejection Rates and Endothelial Cell Survival

Brent Hoffman, MD[†]
Devers Eye Institute

Co-Authors: Alex J. Bauer; Jessica Chen, MD; Michael Straiko, MD; and Mark A. Terry, MD

Purpose: To compare the rejection rate in DMEK recipients who stop steroid use at the 1 year postoperative visit versus continue steroid use until the 2 year postoperative visit. A secondary objective was to determine if steroid use has any influence on endothelial cell loss (ECL) at the 2 year postoperative visit.

Methods: A retrospective analysis of 572 DMEK eyes for Fuchs' dystrophy was conducted. Rejections in the first 2 years postoperative were recorded. Patients who stopped steroid drops after the 1 year visit (group 1) were compared to patients who stayed on steroid drops until the 2-year visit (group 2) for rejection rate and ECL. Patients with confounding variables such as previous glaucoma surgery, retina surgery, or uveitis were excluded.

Results: Group 1 rejection rate was 1.4% (2/144 eyes) versus 1.2% (5/428 eyes) in group 2, P=0.83. Two year ECL for Group 1 was 34.6% ± 17.6% (n=142) and group 2 was 36.3% ± 17.8% (n=408), P=0.34. None of the eyes with a rejection episode experienced a graft failure due to the rejection in the first 2 postoperative years.

Conclusion: There was no statistically significant difference in rejection rate or 2-year ECL between groups. Steroid use for 2 years postoperative did not influence endothelial cell survival. For most DMEK patients, it is safe to stop steroid use after 1 year postoperative. Yearly check-ups should still be encouraged to monitor the health of the graft.

[†]Cornea Fellow

SCIENTIFIC ABSTRACT

2:51 pm – 3:02 pm

Donor Diabetic State Significantly Amplifies the Immunogenicity of Corneal Grafts

Reza Dana, MD, MPH, MSc
Massachusetts Eye and Ear/ Harvard Medical School

Co-Authors: Francesca Kahale, MD; Seokjoo Lee; Thomas Dohlman, MD; Tomas Blanco; Akitomo Narimatsu; and Rohan Bir Singh, MD

Purpose: Diabetes mellitus (DM) is increasing in prevalence world-wide at an alarming rate. The aim of our study was to evaluate changes in phonotype and function of cornea-resident immune cells in diabetic vs. non-diabetic donors and determine if these changes alter the immunogenicity of donor buttons.

Methods: Insulin-treated or untreated streptozotocin-induced type 1 DM and transgenic Lepob/ob type 2 DM mice were used as donors, and nondiabetic BALB/c mice as recipients of fully mismatched penetrating (PK; N=12/group) and endothelial (EK; N=16/group) grafts. Biomicroscopy was used to assess graft survival. Flow cytometry was used to assess cell phenotype. ELISPOT assays were used to assess activation of host T cells.

Results: DM was associated with a significant increase in frequency of corneal antigen-presenting cells (APCs) with an acquired immunostimulatory (MHC-IIhi CD80hi) phenotype (PK, $P<0.01$; EK, $P<0.05$). PK and EK recipients that received either type I or type II diabetic donor tissue showed significantly increased migratory APC (PK, $P<0.01$; EK, $P<0.05$), host T cell activation (PK, $P=0.001$; EK, $P<0.01$), and graft rejection (PK, $P<0.001$; EK, $P<0.001$). Interestingly, insulin treatment in type I DM led to a significantly lower T cell activation (PK, $P=0.001$; EK, $P<0.001$) and higher graft survival in both PK ($P<0.001$) and EK ($P<0.001$).

Conclusion: Both type I and type II DM in donors can impact corneal immune cell function, rendering the tissue more immunogenic and thereby increasing the risk of graft failure for both PK and EK.

SCIENTIFIC ABSTRACT

4:06 pm – 4:17 pm

Clinical Profile and Donor Characteristics of Post Keratoplasty (PK, EK and ALK) Adverse events — 10 Year Analysis from Single Eye Bank in India

Sunita Chaurasia, MD
LV Prasad Eye Institute

Co-Authors: Joveeta Joseph, PhD; Sushma Sri, MSc; and KB Srinivas

Purpose: To report the clinical profile and donor characteristics of post keratoplasty adverse events notified at an eye bank in Southern India.

Methods: Retrospective chart review of tissues utilized from Jan 2013 to Dec 2022. During this period 37,041 donor corneas were utilized for optical keratoplasty (PK, EK and ALK). The adverse events reported within the first 6 weeks of optical keratoplasty were analyzed for donor related parameters.

Results: During the 10-year period, a total of 43 (0.11%) recipients had post keratoplasty infections. The majority (77%) of the adverse events were noted after EK (30 after DSAEK, and 3 after DMEK), 2 after DALK, 8 after PK. The clinical presentation was keratitis/ interface infiltrate in 16 eyes and associated with endophthalmitis in 23 eyes. The organisms isolated were Gram negative bacilli in 19, fungus in 4, Gram positive in 2, mixed organisms in 5, and microbiology inconclusive in 13 eyes. All the Gram-negative infections were due to multi-drug resistant organisms. In all except 6, the donor corneas were harvested from hospital premises. The cause of donor mortality was following polytrauma in 25, cardiorespiratory arrest in 13, organophosphorus poisoning in 4 , natural causes in 1. The mean duration of presentation was 6.69 (Range 0-80) days. The death to utilization time was 3.62 (1- 8) days.

Conclusion: The year wise incidence of adverse reactions ranged from 0.08-0.36%. Majority (81.3%) of the adverse events were following lamellar surgeries, of which DSEK was the commonest. Gram-negative bacteria dominated majority of the bacterial infections.

SCIENTIFIC ABSTRACT

4:18 pm – 4:29 pm

Peripheral Macular Endothelial Dystrophy (PMED): Clinical, Histopathologic and Genetic Characterization

Anthony J. Aldave, MD
Stein Eye Institute, UCLA

Co-Authors: Wenlin Zhang, MD, PhD; Huong Duong, MD; Passara Jongkhajornpong, MD; Charlene Choo, MD; Dominic Williams, MD; and Shunji Tomatsu, MD, PhD

Purpose: To report a previously undescribed corneal endothelial dystrophy associated with peripheral posterior corneal macular opacities, endothelial guttae and corneal edema.

Methods: Affected and unaffected individuals from seven previously unreported families underwent a comprehensive ophthalmic examination. The diagnosis of PMED was established based on the presence of round, gray-white opacities located in the peripheral posterior corneal stroma or Descemet membrane, endothelial guttae and corneal edema. Whole-exome sequencing was performed in three families and Sanger sequencing of CHST6 was performed in all individuals. Histologic examination of Descemet membrane (DM) excised at the time of endothelial keratoplasty was performed for three probands. Serum keratan sulfate (KS) levels were measured in members of six families.

Results: Thirteen of the 35 individuals from seven families who were examined were diagnosed as affected. Five affected individuals from four families underwent endothelial keratoplasty, resulting in the resolution of corneal edema. CHST6 sequencing revealed a promoter mutation (c.-690G>C) in the homozygous state in affected individuals from three families, and in the compound heterozygous state with a coding mutation (p.R211Q, p.Y268C; or p.P280L) in affected individuals from the other four families. While neither the rare c.-690G>C nor the novel p.P280L mutation has been associated with macular corneal dystrophy (MCD), both p.P211Q and p.Y268C have been. The level of sulfated KS was increased in DM and endothelium but was not altered in the serum of affected individuals.

Conclusion: A novel corneal endothelial dystrophy characterized by peripheral posterior corneal macular opacities and endothelial dysfunction without stromal opacities is associated with promoter and coding region mutations in CHST6. We suggest the name peripheral macular endothelial dystrophy (PMED) to describe this dystrophy that may be successfully managed with endothelial keratoplasty.

SCIENTIFIC ABSTRACT

4:30 pm – 4:41 pm

Possible Underlying Etiologies in Patients with Neuropathic Corneal Pain and Prior Refractive Surgery

Chloe Bogen, MS
Tufts Medical Center

Co-Authors: Pedram Hamrah, MD, and Fabiana Mallone, MD

Purpose: To identify potential predisposing conditions in patients with neuropathic corneal pain (NCP) and history of refractive surgery.

Methods: This retrospective study identified patients seen at New England Eye Center between January 2015 - December 2022 diagnosed with NCP. Patients were included if they were above 18 years old, had serological testing, and had a prior history of LASIK or PRK. Patients were tested for multiple autoimmune, dysimmune, inflammatory markers, or vitamin abnormalities.

Results: The majority of the 69 patients included (aged 38.0 ± 10.9 years) were female (59.4%), white (78.3%), and of Non-Hispanic or Latino origin (92.2%). Overall 53.6% of patients tested positive for a dysimmune, autoimmune, or inflammatory marker (37.3%, 32.4%, 17.5%, respectively). The most common markers were TS-HDS (29.8%), FGFR3 (10.3%), ANA (35.1%), and ESR (17.5%). The most common vitamin abnormalities were low vitamin B2 levels (25.9%) and low vitamin D25OH (15.8%).

Conclusion: Inflammatory and auto-dysimmune markers, such as ESR, ANA, TS-HDS and FGFR3, as well as vitamin B2 and D low levels are commonly observed in NCP patients with a prior history of refractive surgery. Investigating these markers in a healthy control group with prior refractive surgery history could further illustrate these as predisposing conditions. These markers may be used to develop a serology screening panel to identify patients at risk of developing NCP following refractive surgery.

SCIENTIFIC ABSTRACT

4:42 pm – 4:53 pm

Corneal Sensation and Subbasal Nerve Density are Reduced in Eyes with Limbal Stem Cell Deficiency

Clémence Bonnet, MD, PhD
Cochin Hospital, Paris Cité Université/ Stein Eye Institute, UCLA

Co-Authors: Duangratn Niruthisard; Chi-Hong Tseng; and Sophie Deng, MD, PhD

Purpose: To evaluate corneal sensation and characterize subbasal nerve plexus in eyes with limbal stem cell deficiency (LSCD).

Methods: This prospective cross-sectional comparative study was approved by the IRB and adherent to the Declaration of Helsinki. Forty-six eyes (35 subjects) with LSCD and 14 normal control eyes (14 subjects) were recruited between 2019-2022. The central corneal sensation was measured by Cochet-Bonnet esthesiometer and subbasal nerve plexus was imaged at the central cornea and 4 limbal regions (superior, inferior, nasal and temporal) using in vivo confocal microscopy. Characteristics of subbasal nerve plexus namely subbasal nerve density (SND), subbasal nerve and branch density (SNBD), were quantified using CCMetrics (M.A. Dabbah, Imaging Science, University of Manchester) by 2 masked examiners. The severity of LSCD was graded using a previously published composite grading system including clinical score, central corneal epithelial thickness, and central corneal basal cell density. A composite score of <5 was defined as stage I, between 5-9 as stage II and ≥10 as stage III LSCD. Statistical analyses were performed using the Kruskal-Wallis test and Pearson correlation.

Results: Seven, 18 and 21 eyes were classified as stage I, II and III LSCD, respectively. The mean sensation (mm+SD) at the central cornea and limbus were 29.2 + 21.5 and 33.5 + 15.1 in the LSCD group and 57.6 + 5.8 and 54.3 + 4.7 in the control group (all $p<0.001$), respectively. All parameters of subbasal nerve plexus were significantly decreased at the central and limbal regions in the LSCD group compared to the control ($p<0.05$). The central corneal and limbal sensation had moderate negative correlation with the LSCD composite scores (rho=-0.64), $p<0.001$) and had moderate positive correlation with SND (rho=0.63, $p<0.001$) and SNBD (rho=0.57, $p<0.001$).

Conclusion: Corneal sensation, SND, and SNBD are reduced in LSCD at both central cornea and limbal regions. The reduction of central corneal and limbal sensation had a positive correlation with the reduction in SND and the severity of LSCD. This study demonstrated the co-existing neurotropic keratopathy in the pathophysiology of LSCD.

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CLAES DOHLMAN AWARD

Presented by the Cornea Society

Christopher J. Rapuano, MD

2023 Claes Dohlman Award Recipient

PAST AWARDEES

2022	Mark Terry, MD
2020	Eduardo Alfonso, MD
2019	Ivan Schwab, MD
2018	Ronald Smith, MD
2017	Mark J. Mannis, MD
2016	Deborah Pavan-Langston, MD
2015	Roger F. Steinert, MD
2014	Dan B. Jones, MD
2013	Richard K. Forster, MD
2012	Prof. Peter Watson
2011	S. Arthur Boruchoff, MD
2010	Herbert E. Kaufman, MD
2009	Jay H. Krachmer, MD
2008	Gilbert Smolin, MD
2007	Peter R. Laibson, MD
2006	Claes H. Dohlman, MD, PhD

Cornea Society
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TROUTMAN CORNEA PRIZE

Presented by the Cornea Society

Marija Antičić-Eichwalder, MD, PhD

2023 Troutman Prize Recipient

PAST AWARDEES

2022	Jodi Hwang, MD
2021	Maria A. Henriquez, MD, MSc, PhD
2020	C. Drew Salisbury, MD
2019	Marina Bertolin, MSc
2018	Gregory Moloney, MBBS, BSc (Med), MMed, FRANZCO
2017	Khoa D. Tran, PhD
2016	Konstantinos T. Tsaousis, MD
2015	Mark A. Greiner, MD
2014	Fei-fei Huang, MM
2013	Rafael A. Oechsler, MD
2012	Kaevalin Lekhanont, MD
2011	Daniel Bohringer, MD
2010	Vanitha Ratnalingam, MSurg (Ophthal)
2009	Jay Bradley, MD
2008	Hui-Jung Yeh, MS

CORNEA and EYE BANKING FORUM 2024

CHICAGO, IL
FRIDAY, OCTOBER 18

EYE BANK ASSOCIATION OF AMERICA

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WASHINGTON, DC
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20–22 MARCH 2025
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corneasociety.org/wcc-2025

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SAN FRANCISCO, CA
FRIDAY, NOVEMBER 3

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