

Cornea

Change of corneal curvature following non-ablative thermomechanical skin treatment for dry eye disease

Presenting author: Sunil Shah, United Kingdom

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 17:15 - 17:21

Location: Auditorium

Purpose:

To determine the change of corneal curvature following novel thermo-mechanical action based peri-orbital fractional skin treatment for the treatment of dry eye disease (DED) with reference to the importance for biometry prior to cataract surgery.

Setting:

A multicentre, prospective, controlled, open labelled study was conducted at Midlands Eye, UK, Vallmedic Vision, Andorra and Khmer-Sight Foundation, Cambodia.

Methods:

Consented participants attended visit-1, 2, 3, and 4 every two weeks and visit-5 for 3 months follow up. Participants received three sets of skin treatments for dry eye on visit-1, 2 and 3. Detailed ophthalmic examinations including vision, intraocular pressure (IOP), were conducted as well as corneal topography.

Results:

One hundred and thirteen participants (83 females; mean age 55.5 ± 14.6 years) with signs and symptoms of DED. This novel dry eye treatment was associated with no change in vision ($P=0.998$), IOP ($P=0.894$) or any adverse events. DED as measured by OSDI questionnaires, tear break up time and tear osmolarity showed significant improvements in DED. Following cumulative analysis, a total of 6.7% of participants had more than 1 Dioptre change in keratometry, 11.7% had more than 0.75 dioptres and 25.0% had 0.50 dioptre change in keratometry following treatment.

Conclusions:

Thermo-mechanical action based peri-orbital fractional skin can have a major impact on corneal curvature. When performing biometry for intraocular surgery, it is vital to treat dry eye first. If not, major refractive errors from measurement error may occur.

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Phase 1 Trial Evaluating the Safety, Tolerability and Efficacy of a Sustained-release Cyclosporine Intracanalicular Insert for the Treatment of Dry Eye Disease

Presenting author: Mitchell Jackson, United States

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 17:21 - 17:27

Location: Auditorium

Purpose:

Challenges with current dry eye disease (DED) therapies, such as topical cyclosporine drops, include tolerability issues (e.g., stinging and burning), a slow onset of therapeutic effect and frequent dosing. OTX-CSI is a novel, hydrogel-based, resorbable, intracanalicular insert designed to treat DED by delivering a sustained-release dose of 0.36 mg preservative-free cyclosporine to the ocular surface for up to 16 weeks along with punctal occlusion. In this Phase 1 study, we evaluate the safety, tolerability, and efficacy of OTX-CSI in subjects with DED.

Setting:

Prospective, open-label, Phase 1 study in the United States.

Methods:

Five DED subjects (10 eyes) were enrolled in the study and received OTX-CSI insert bilaterally. After insertion, subjects were assessed at 2, 4, 6, 9, 12 and 16 weeks. Safety and tolerability were assessed by adverse event (AE) collection. Efficacy was assessed by Schirmer Test (unanesthetized), corneal and conjunctival staining (NEI scale), Eye Dryness Score (visual analogue scale [VAS]), Ocular Surface Disease Index (OSDI) and Standardized Patient Evaluation of Eye Dryness (SPEED) score. Total corneal fluorescein staining (CFS) was measured on a 0-15 scale, 5 quadrants per eye. VAS dryness and severity were measured on a 0-100 scale.

Results:

No AEs were reported in any subjects (n=5) throughout the 16-week study, including ocular stinging, burning, blurred vision or redness. Efficacy measures started improving at Week 2. OTX-CSI improved mean Schirmer scores from 4.2mm (baseline) to 8.2mm (Week 16). One subject (20%) demonstrated a ≥ 10 mm increase in Schirmer score at Week 12. The greatest improvement in mean total CFS occurred at Week 12 with a 4.0-point reduction from 6.7 at baseline. At Week 16, VAS dryness severity and frequency improved by 28 and 23 points from 51 and 51 at baseline, respectively. No inserts were visualized by Week 12.

Conclusions:

In this study, OTX-CSI demonstrated a favorable tolerability profile with no reports of AEs. OTX-CSI exhibited a quick onset of action with a single insert improving DED signs and symptoms from Week 2 through Week 16. These clinically meaningful improvements support OTX-CSI as a potential sustained-release alternative to ophthalmic drops for the treatment of DED.



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OC-01 Nasal Spray for the Treatment of Dry Eye Disease Signs and Symptoms in Subjects with Mild, Moderate, and Severe Dry Eye Disease as Determined by Baseline Eye Dryness Score: The ONSET-2 Phase 3 Study

Presenting author: Sheraz Daya, United Kingdom

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 17:27 - 17:33

Location: Auditorium

Purpose:

Evaluate the efficacy and safety of OC-01 (varenicline) nasal spray, a nicotinic acetylcholine receptor agonist. The agent has shown to activate the trigeminal parasympathetic pathway stimulating the lacrimal function unit increasing the production of true natural tears with all its components with a goal to restore ocular surface homeostasis.

Setting:

Multi-center, randomized, double-masked, parallel design, vehicle-controlled clinical trial conducted in outpatient ophthalmology and optometry clinical practices throughout the United States.

Methods:

A total of 758 subjects were randomized at a 1:1:1 ratio to treatment with 0.6 mg/mL OC-01 nasal spray (N=260), 1.2 mg/mL OC-01 nasal spray (N=246), or placebo (vehicle) nasal spray (N=252). A placebo run-in period was not employed, and the trial enrolled all subject reported symptoms as assessed by baseline Eye Dryness Score (EDS, 0-100 scale). Subjects were administered OC-01 (varenicline) nasal spray twice daily for 4 weeks. Outcome measures included Schirmer's Test Score (STS) with anesthesia and mean change from baseline EDS at Week 4.

Results:

Both dose concentrations showed a statistically significant ($p < 0.0001$) improvement compared with placebo as indicated by an increase in STS of ≥ 10 mm from baseline by Week 4. The percentage of eyes demonstrating improvement in the 0.6 mg/mL, 1.2 mg/mL, and placebo groups were 47.3%, 49.2%, and 27.8%, respectively. A (nominally) significant reduction in EDS from baseline was demonstrated with 0.6 mg/mL and 1.2 mg/mL compared with placebo at Week 2 of -16.5 mm ($p < 0.05$), -17.9 mm ($p = 0.008$) and -12.7 mm, respectively; and at Week 4 of -19.8 mm ($p < 0.05$), -22.2 mm ($p = 0.001$), and -15.4 mm, respectively.

Conclusions:

Compared with placebo, OC-01 nasal spray demonstrated improvement in dry eye disease signs and symptoms by Week 4 in a population of subjects with mild, moderate, and severe baseline EDS. OC-01 nasal spray was shown to have a favorable safety and tolerability profile in the trial, with minimal ocular adverse events (AE) and no serious AEs related to drug reported by any treated subjects. The most common AE in the treated groups was transient sneezing after nasal spray administration. The stimulation of natural tear film may represent a novel treatment for dry eye disease with a unique mechanism of action.



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Efficient capture of real world data for dry eye: The Save Sight Dry Eye Registry

Presenting author: Pauline Khoo, Australia

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 17:33 - 17:39

Location: Auditorium

Purpose:

The prevalence of dry eye disease (DED) ranges from 5 to 50% worldwide. Despite available therapies many continue to suffer. There is an unmet need for outcomes data collection in dry eye to assess real world treatment outcomes and allow benchmarking to improve outcomes. The Save Sight Dry Eye Registry (SSDER) is the world's first web-based multinational, interdisciplinary registry able to collect high-quality outcome data from patients in clinical settings. We report the characteristics of patients with DED at their baseline visit from routine clinical practice.

Setting:

International web-based registry

Methods:

The SSDER collected data from routine clinical practice in Australia and Europe. Patient demographics, medical history and index visit characteristics, such as visual acuity and tear break up time (TBUT) were recorded in the prospectively designed electronic database. Ocular surface disease index (OSDI) questionnaires were also recorded. CPD accreditation for registry use was via the Royal Australian College of Ophthalmologists and Optometry Australia. Primary outcomes were the baseline demographic data and dry eye diagnosis and secondary outcomes visual acuity in logMAR letters, TBUT, and the OSDI score.

Results:

Currently, 18 clinicians from 13 practices are registered to use the registry. Data collection can be performed in under 2 minutes for baseline and follow-up visits and the registry can produce a 'real-time' graphical output of the patient's treatment journey. To date, 56 eyes from 28 patients are registered. The mean \pm SD age was 62.5 \pm 16.1 years (range 24-80). 50% of eyes had mixed DED, followed by evaporative DED (n=24, 43%). The median visual acuity and TBUT were 79.5 (IQR 73-83) logMAR letters and 3 (IQR 1-5) seconds, respectively. 86% of patient completed the OSDI, the median score was 30 (IQR 16-44).

Conclusions:

The SSDER is an easy-to-use CPD tool able to facilitate the collection of large amounts of data for DED. The data collected will allow the comparative analysis of existing DED treatments and assessment of patient outcomes.



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Management of Microbial Keratitis in the COVID-19 Era

Presenting author: Simon Neary, Ireland

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 17:45 - 17:51

Location: Auditorium

Purpose:

The ongoing COVID-19 pandemic presents ophthalmologists with many new challenges in delivering safe and effective patient care, including reduced outpatient capacity and elective theatre access. Significant fear exists amongst clinicians and patients alike regarding hospital admission in light of alarmingly high nosocomial COVID infections and outbreaks. Microbial keratitis (MK) is the most common non-surgical ophthalmic admission in Ireland and is also one of the most common causes of corneal blindness worldwide. In this modern COVID era, the ophthalmologist must therefore strike a balance between preventing serious ocular morbidity whilst considering patient and staff safety during hospital admissions.

Setting:

Ophthalmology department in a large tertiary referral hospital. We collaborated with our hospital pharmacy and devised a new protocol to administer intensive topical fortified antibiotics in an outpatient setting.

Methods:

Acute presentations of MK to a large tertiary care hospital were retrospectively analysed during the 6 month period March to August 2020. Data was compared to the same period in 2019. We compared inpatient versus outpatient management of MK with resolution of infection and cessation of antimicrobial agents as an endpoint. The clinical notes of patients undergoing corneal scrapes were also analysed for risk factors, treatment regimes, culture growth, visual outcomes and surgical interventions.

Results:

In total, 67 samples were taken from 64 eyes. 36% or 24 patients were admitted, 57% or 38 patients were managed as outpatients, while 7% or 5 patients were initially managed as outpatients but were subsequently admitted for worsening keratitis or failure to respond to treatment. In total 28 patients were treated with ceftazidime and vancomycin, 24 of whom were admitted for intensive inpatient treatment. 2 patients on this regime were treated as outpatients while 2 others were initially treated with this regime were originally treated as outpatients and were subsequently admitted to hospital for worsening keratitis.

Conclusions:

Only 2 cases of MK were successfully managed at home with ceftazidime and vancomycin. 2 other cases on outpatient ceftazidime and vancomycin treatment were subsequently admitted for worsening keratitis. Our results suggest that inpatient management of MK remains safer in terms of visual recovery. Outpatient management of MK is extremely burdensome for patients and should be reserved for milder cases in reliable patients in whom follow up can be ensured. The patient should be involved in the decision making process, however clinical judgment and senior input remain vital in avoiding vision loss.



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Corneal Neurotization in Neurotrophic Keratitis: ?Italian Experience? update

Presenting author: Simone Alex Bagaglia, Italy

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 17:51 - 17:57

Location: Auditorium

Purpose:

To analyze the comparative safety and efficacy of two techniques of corneal neurotization (CN) (direct corneal neurotization [DCN] vs indirect corneal neurotization [ICN] for the treatment of neurotrophic keratopathy (NK).

Setting:

ASST Santi Paolo e Carlo University Hospital, Milan; S.Orsola- Malpighi University Hospital, Bologna; Santa Maria alle Scotte University Hospital, Siena.

Methods:

25 Consecutive patients with NK undergoing CN between November 2014 and October 2020; Intervention Procedures: DCN was performed by transferring contralateral supraorbital and supratrochlear nerves; ICN was performed using sural nerve graft. Main Outcome Measures: NK healing; corneal sensitivity; corneal nerve fiber length (CNFL) measured by in vivo confocal microscopy (IVCM);

Results:

26 eyes of 25 patients were included: 16 were treated with DCN and 10 with ICN. After surgery, NK healed in all patients after a mean period of 3.9 months without differences between DCN and ICN. Mean corneal sensitivity improved significantly 1 year after surgery (from 3.07 to 22.11 mm; $p < 0.001$) without differences between the two groups. Corneal sub-basal nerve plexus that was absent before surgery in all patients except 4 become detectable in all cases (mean CNFL 14.67 ± 7.92 mm/mm² 1 year postoperatively). No major complications were recorded in both groups

Conclusions:

CN allowed the healing of NK in all patients as well as the improvement of corneal sensitivity in the majority of them thanks to nerve regeneration documented by IVCM. One year postoperatively, DCN and ICN showed comparable outcomes.

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Biomechanical characterization of a COL5A1 -haploinsufficient mouse model of classic type Ehlers-Danlos syndrome with tensile extensometry and OCT elastography

Presenting author: Hormoz Abdshahzadeh, Switzerland

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 17:57 - 18:03

Location: Auditorium

Purpose:

To quantify biomechanical properties in a col5A1-based mouse model for classic type Ehlers-Danlos syndrome (EDS) and to compare two different measurement approaches suited for murine corneal mechanical characterization.

Setting:

Laboratory of Ocular Cell Biology, Center for Applied Biotechnology and Molecular Medicine, University of Zurich, Zurich, Switzerland OPTIC team, Computer Vision Laboratory, ETH Zurich, Switzerland

Methods:

A total of 14 eyes of a col5A1-haploinsufficient mouse model (col5A1het) and 14 eyes of wild-type littermates (wt) were analyzed by optical coherence elastography (OCE) and 2D stress-strain extensometry. Quasi-static OCE was conducted non-invasively during ambient pressure modulation by -3 mmHg. Corneal displacements were analyzed by phase-difference processing. 2D extensometry measurements consisted of a pre-conditioning cycle, followed by a stress-relaxation test and finally a rupture test

Results:

Compared to wt corneas, col5A1het corneas had a thinner corneal thickness (125±11 vs 148±10 micrometer, $p < 0.001$). and short-term elastic modulus in het corneas was significantly increased in OCT measurements (506±88 vs 430±103 kPa, $p = 0.023$), and. the same trend was observed in stress-strain extensometry (30.7±12.1 kPa vs 21.5±5.7, $p = 0.057$). In contrast, in stress relaxation tests, col5A1het corneas experienced a stronger relaxation (55% vs 50%, $p = 0.010$). The two distinct behaviors indicate increased short-term stiffness and reduced long-term stiffness in het corneas.

Conclusions:

A reduced expression of COL5A1 in cornea seems to predominantly affect the viscoelastic properties of the tissue. The results presented here support and rationalize the counterintuitive clinical reported findings, in which even thinner corneas with potential alterations in the structure of collagen manage to maintain a normal topographic pattern.

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Topical insulin – utility and results in refractory neurotrophic keratopathy stages 2 and 3

Presenting author: Ricardo Machado Soares, Portugal

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 18:03 - 18:09

Location: Auditorium

Purpose:

To evaluate the clinical progression of patients with refractory Neurotrophic Keratopathy (NK) in stages 2 and 3 treated with topical insulin.

Setting:

Centro Hospitalar Vila Nova de Gaia e Espinho, Portugal

Methods:

A retrospective analysis of 21 eyes with NK in stages 2 and 3 that were refractory to standard medical and/or surgical treatment and treated with off-label topical insulin was performed. Topical insulin drops (1 unit /1 mL) were applied 4 times per day; treatment was continued until NK persistent epithelial defect or ulcer resolved and then tapered accordingly. The primary outcome of the study was the complete resolution of the corneal wound. Best-corrected visual acuity (BCVA), days until complete resolution and anterior segment photographs were attained. Data was compared before and after treatment in both groups using paired T-test.

Results:

The majority of patients (19 out of 21 eyes - 90%) had complete resolution of the persistent epithelial defect and/or ulcer within 7-45 days of follow-up. The mean number of days until complete reepithelialization was significantly lower in NK type 2 (18 ± 9 days) when compared to NK type 3 (29 ± 11 days) ($p = 0.025$). BCVA improved significantly in both NK type 2 (logMAR 0.73 ± 0.50) ($p = 0.001$) and in NK type 3 (logMAR 0.95 ± 0.77) ($p = 0.004$) after treatment. No side-effects were reported during the full extent of the treatment.

Conclusions:

Our results suggest that topical insulin drops could be an effective treatment in refractory NK due to its high efficacy, accessibility, low-cost and low morbidity.

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Bowman's layer biomechanical impact assessed with extensometry and quasi-static optical coherence elastography

Presenting author: Emilio Torres-Netto, Switzerland

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 18:15 - 18:21

Location: Auditorium

Purpose:

Whether Bowman's layer (BL) contributes to corneal biomechanical strength is subject to controversy. While atomic force microscopy has shown BL to have an E-modulus 3 times greater than corneal stroma, whole-cornea studies have failed to show that the BL plays a clinically significant role. We evaluated and compared Bowman's biomechanical impact on human corneas with two different technologies: stress-strain extensometry and quasi-static optical coherence elastography.

Setting:

Laboratory for Ocular Cell Biology, Center for Applied Biotechnology and Molecular Medicine, University of Zurich, Zurich, Switzerland; ELZA Institute, Dietikon/Zurich, Switzerland; and Computer Vision Laboratory, Swiss Federal Institute of Technology, Zu

Methods:

Fifty healthy human donor corneas were stripped of Descemet's membrane and the endothelium as per DMEK. Corneas were divided groups in which BL was ablated with an excimer laser, or groups in which BL was left intact. Separately, the elastic and viscoelastic material properties of 26 thin corneal flaps were then analyzed by two-dimension stress-strain extensometry. Additionally, corneal biomechanical behavior of 23 whole corneas were investigated with quasi-static optical coherence elastography (OCE) in order to quantify full corneal strain distributions.

Results:

When evaluating the thin corneal lamellae, no significant differences between flaps with and without BL were observed in the tangential E-modulus, neither during preconditioning ($p=0.086$), nor in destructive testing until break ($p=0.080$). However, anterior stiffness in whole corneas with Bowman's layer was significantly ($p=0.043$) higher than in corneas without. Interestingly, the differences in strain distribution observed between whole corneas with and corneas without BL were located inside the stroma, and not (as expected) on top of the anterior surface.

Conclusions:

Corneal strain distribution is more complex than previously assumed. Although minor localized differences in corneal strain distribution of whole corneas were observed, the presence or absence of Bowman's layer did not alter corneal stiffness in corneal thin flaps. These results may have implications for both refractive laser surgery procedures, but also for Bowman's layer transplantation for keratoconus.



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Corneal properties in primary open angle glaucoma assessed through Scheimpflug corneal topography and densitometry

Presenting author: MERCEDES MOLERO-SENOSIAIN, Spain

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 18:21 - 18:27

Location: Auditorium

Purpose:

To compare corneal topography and densitometry measurements in patients with primary open angle glaucoma (POAG) and healthy subjects.

Setting:

Clinico San Carlos University Hospital, Madrid, Spain

Methods:

200 eyes of 200 participants 75 patients with POAG and 125 healthy controls underwent corneal topography and densitometry (Oculus PentacamHR). The data compared in the two groups were: anterior chamber angle, depth and volume, keratometry (Kminimum, Kmaximum and Kmean), central corneal thickness (CCT), central anterior elevation (CAE), anterior elevation apex (AEA), maximum anterior elevation (MAE) and posterior elevation apex (PEA). Densitometry measurements were made at three depths on a 12 mm-diameter circle divided into 4 concentric rings (0-2mm, 2-6mm, 6-10mm and 10-12mm). The diagnostic capacity of the corneal variables was assessed through the areas under the receiver operator characteristics (ROC) curve (AUC).

Results:

The corneal density of practically all depth layers and total corneal density were significantly higher in the POAG than control group ($p < 0.05$). Total corneal density was positively correlated with age ($r = 0.623$; $p < 0.001$) and also showed a good diagnostic capacity for glaucoma ($AUC = 0.617$; IC 95% [0.541-0.697]; $p < 0.001$). In a multiple linear regression designed to assess its relationship with age, gender, CCT and Km, age emerged as a significant confounder both in controls (coef. 0.315; $p < 0.001$; 95% CI [0.246-0.384]) and patients (coef. 0.370; $p < 0.001$; 95% CI [0.255-0.486]).

Conclusions:

Corneal densitometry measurements showed a good diagnostic capacity for POAG suggesting this type of examination could have clinical applications in the diagnosis and management of glaucoma.

Cornea

Corneal findings in patients treated with Belantamab Mafoditin for refractory multiple myeloma: A case series.

Presenting author: MARÍA DEL PILAR RODRÍGUEZ MERCHANTE, Spain

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 18:27 - 18:33

Location: Auditorium

Purpose:

To report corneal findings in five patients treated with the new immunoconjugated drug Belantamab Mafoditin for relapsed or refractory multiple myeloma (MMRR) and to describe the evolution of bilateral microcystic-like corneal epithelial changes (MECs) developed in most of cases.

Setting:

Ophthalmology Department, Fundación Jiménez Díaz Hospital, Madrid (Spain).

Methods:

Ophthalmological follow-up of five patients with MMRR that have received the new immunoconjugated Belantamab Mafoditin at different doses intravenously. We focused on variations observed in best-corrected visual acuity (BCVA), autorefractometer, performed slit-lamp biomicroscopy (SLB), corneal topography, anterior segment optical coherence tomography (AS-OCT), macular optical coherence tomography (macular-OCT), no invasive keratograph break-up time (NIK BUT) and meibography.

Results:

All patients underwent screening ophthalmic examinations before starting the new therapy. Four patients developed haze and MECs with centripetally progression. In AS-OCT appeared multiples pancorneal epithelial, subepithelial and stromal opacities. Just in two cases the BCVA decreased after first and third doses, which lead to interrupt or delay of treatment. In these two patients, topical corticosteroids were instilled four times a day until MECs returned completely. In one patient the autorefractometer revealed a temporal increase of corneal astigmatism. One patient developed multiple neurosensory detachments in macular-OCT. The NIK BUT and the tear meniscus remained stable.

Conclusions:

The immunoconjugated Belantamab Mafoditin represents a new option of treatment in MMRR. A multidisciplinary approach between hematologists and ophthalmologists is necessary for a correct therapeutic management of the patients. The effectiveness of corticosteroid eye drops for the treatment of the MECs has not been demonstrated yet. Further studies are needed to know the corneal changes and the pathophysiological mechanism of MECs.



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The Effect of Eye Rubbing in Corneal Epithelium of Children with Atopy

Presenting author: Tomás Loureiro, Portugal

Session name: Cornea Medical and Biomechanics

Date and time: 08 October 2021, 17:15 - 18:45

Presentation time: 18:33 - 18:39

Location: Auditorium

Purpose:

The aim of this study was to evaluate the effect of rubbing in epithelial thickness profile and to compare the eyes according to the dominant hand.

Setting:

Single-center prospective study.

Methods:

Forty right-handed boys (average age 11.2 years) with eye rubbing tendency due to atopy, were evaluated using Pentacam® and Cirrus High-Definition Anterior Segment Optical Coherence Tomography (AS-OCT). The average epithelial thickness (ET) and corneal thickness (CT) with predefined concentric corneal ring-shaped zones were assessed in specific regions (central, superior, inferior, temporal, nasal, superonasal, inferotemporal, superotemporal and inferonasal). The difference between minimum and maximum ET (min-max), the difference in corresponding octants and standard deviation (SD) were considered for analyses.

Results:

All eyes had no tomographic criteria for keratoconus. The min-max ET were lower in right eyes (-2.8 μ m vs. -3.5; $p=0.02$). Despite the higher ET were registered in inferior areas, the difference between inferior and superior (I - S) octants were under the range and was lower in right eyes (1.1 μ m vs. 1.9 μ m; $p=0.03$). The highest ET difference were registered between nasal and temporal octants and was more pronounced in right eyes (2 μ m vs. 3.1 μ m; $p=0.01$).

Conclusions:

AS-OCT analyses reveals epithelial thickness in eye rubbers to be different than physiologic thickness distribution. Inferior and temporal epithelial thickness seem to be more affected, with the dominant hand side being more damaged. Our results seem to illustrate the effect of eye rubbing in corneal epithelium and could represent one of the earliest stages of keratoconus.

Cornea

Development and validation of a deep learning-based blinking identification and classification system

Presenting author: Aristeidis Konstantinidis, Greece

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 13:15 - 13:21

Location: Hall 13 / Elicium Ballroom

Purpose:

Primary objective of this study was to design, develop and validate a deep learning-based system that automatically detects and classifies blinks as “complete” or “incomplete”, in image sequences acquired during clinical examination by a simple web-camera. The system utilizes state of the art deep learning architectures and signal processing techniques to identify and classify blinks without user intervention.

Setting:

The design and implementation of the software system for the video-based blink identification was carried out in the Department of Computer Science and Biomedical Informatics, Lamia, Greece. The clinical video acquisition, blink annotations and ground truth

Methods:

The iris and sclera were segmented in both eyes from the acquired videos, using DeepLabv3+ deep learning neural network (DLNN) and the height of the palpebral fissures and iris diameters were automatically calculated. These quantities were processed and adaptively thresholded to identify blinks and classify them into “complete” and “incomplete”, independently for each eye. The DeepLabv3+ was trained using 481 images with both iris and eye-lid contour manually segmented. The proposed system was tested on eight previously unseen participants. The ground truth for the test videos was generated by three independent experts and expert-conflicts were resolved by a senior expert.

Results:

Test videos from 8 participants comprised of 72,800 frames and contained 1,309 complete and 292 incomplete blinks. Several metrics of blink classification performance of the proposed system and the performance of the three experts were calculated against the ground truth. The system’s accuracy for blink detection was greater than 98.5% for six participants. The proposed system achieved blink classification accuracy between 78.5% and 98.7% for each of the 8 participants. It outperformed all three experts in terms of accuracy for 4 participants and at least one of the three experts for the remaining 4 subjects.

Conclusions:

The proposed system achieved high accuracy both in blink detection and blink classification, for a number of participants, with and without spectacles, which was comparable to or better than the experts. It was proven robust in handling unexpected movements of the face, actions like putting on and off reading glasses, as well as glare and reflections from the glasses. Consequently, it may be used in research and clinical settings for quantifying parameters for complete and incomplete blinks (i.e., frequency and time between blinks), to be used as biomarkers for a number of ophthalmic (i.e., dry eye disease) and neurologic disorders.

Cornea

Detecting subclinical keratoconus by biomechanical analysis in tomographically regular keratoconus fellow eyes

Presenting author: Victor A Augustin, Germany

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 13:21 - 13:27

Location: Hall 13 / Elicium Ballroom

Purpose:

To analyze the tomographically non-affected second eyes of keratoconus patients using the Corvis ST to detect any biomechanical abnormalities or subclinical keratoconus.

Setting:

The David J Apple Center for Vision Research, Department of Ophthalmology, Heidelberg University Hospital, Heidelberg, Germany

Methods:

In this ongoing, single-center, consecutive case series, the clinical records of 224 eyes of 122 keratoconus patients have been assessed so far. Fourteen fellow eyes fulfilled the inclusion criteria and showed no clinical or tomographic signs of keratoconus. Main outcome measures included best-corrected visual acuity (BCVA), tomographic and biomechanical analyses using Scheimpflug imaging: Pentacam and Corvis ST (Oculus, Wetzlar, Germany). Tomographic analyses included anterior and posterior simulated keratometry, K-Max, central corneal thickness (CCT), thinnest corneal thickness, and Belin/Ambrosio Ectasia Display (BAD-D). For biomechanical analyses, the Corneal Biomechanical Index (CBI) and Tomographic Biomechanical Index (TBI) were used.

Results:

The mean BCVA was 0.01 ± 0.10 log MAR. Mean K-Max was 43.79 ± 1.12 D, mean CCT 529 ± 25 μ m, mean thinnest corneal thickness 524 ± 23 μ m, and mean BAD-D 1.0 ± 0.32 . The mean CBI was 0.30 ± 0.21 . Regular CBI values were found in six of 14 patients. The mean TBI was 0.47 ± 0.22 with regular values observed in only two of 14 patients. No signs of tomographic or biomechanical abnormalities were shown in only one of 14 keratoconus fellow eyes, with regular BAD-D, CBI and TBI values.

Conclusions:

Tomographically normal fellow eyes of keratoconus patients are rare. In these cases, a biomechanical analysis of the cornea may help detect a subclinical keratoconus. The TBI was the most sensitive index to verify a mild ectasia. Further prospective, randomized studies are necessary to perform longitudinal biomechanical analysis in tomographic regular keratoconus fellow eyes.

Cornea

Agreement of Scheimpflug-based and Swept-Source optical biometries in Keratoconic eyes - Preliminary results.

Presenting author: Panos Gartaganis, Greece

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 13:27 - 13:33

Location: Hall 13 / Elicium Ballroom

Purpose:

To evaluate the comparability of corneal power measurements, anterior chamber depth (ACD) and white-to-white (WTW) distance between a Scheimpflug-based tomography (Pentacam AXL;Oculus GmbH, Wetzlar, Germany) and a swept-source optical biometry (IOL Master700;Carl Zeiss Meditec AG, Jena, Germany) in patients with keratoconus.

Setting:

Department of Ophthalmology, 251 Hellenic Airforce General Hospital, Athens, Greece.

Methods:

This prospective, interinstrument reliability analysis included 30 keratoconic eyes of 15 individuals who had not undergone any kind of corneal surgery. Standard K and total refractive power (TK[®]) of the flattest and steepest axis of the IOLMaster 700 were compared with standard keratometry (SimK), true net power (TNP), equivalent keratometer readings(EKR) and total corneal refractive power (TCRP) of the Pentacam. The Bland-Altman analysis evaluated the agreement between the measurements of both devices. A paired samples t-test and a Wilcoxon signed-rank test were performed to compare the mean values of the variables obtained by the devices.

Results:

K1 value of the IOL Master 700 was significantly higher from EKR K1 along 3mm-, 4mm- and 4.5mm-zone and TNP K1 along 3mm-and 4mm-zone. TK1 value was significantly higher from EKR K1 along 2mm-,3mm-,4mm- and 4.5mm-zone and TNP K1 along 3mm- and 4mm-zone. K2 value of the IOLMaster 700 was significantly higher from TK2 and all the corresponding variables of the Pentacam device. TK2 value was significantly higher from all the corresponding variables of the Pentacam device.

Conclusions:

The IOL Master measured significantly greater keratometry readings in the steep axis for all the variables studied. The keratometry and WTW measurements of the investigated devices cannot be used interchangeably in keratoconus.



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Cornea

The agreement between Scheimpflug and Swept Source Optical Coherence Tomography in various grades of keratoconus

Presenting author: Magali Vandevenne, Netherlands

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 13:33 - 13:39

Location: Hall 13 / Elicium Ballroom

Purpose:

To evaluate the repeatability and agreement of a swept-source anterior segment ocular coherence tomography system (CASIA SS-1000) and a high-resolution rotating Scheimpflug system (Pentacam HR) in patients with various grades of keratoconus.

Setting:

University Eye Clinic Maastricht, Maastricht University Medical Centre+, the Netherlands. A prospective cohort study.

Methods:

Forty-nine patients with various grades of keratoconus were enrolled during their regular follow-up visit. Three consecutive measurements were taken with the CASIA SS-1000 and the Pentacam HR by the same operator. Patients with clinically diagnosed keratoconus above the age of 16 were included. Patients with corneal diseases, corneal scarring or corneal surgery were excluded. Axial keratometry, elevational parameters and pachymetry were recorded. Raw data from both devices were used to determine cone location and size. ANOVA was used to check the repeatability. The Bland-Altman plots with 95%-limits of agreement were used to show the agreement between the two devices.

Results:

Repeatability of the SS-OCT was significantly better for the thinnest and apical corneal pachymetry, but it was significantly less for the measurements of cone size based on elevational data ($p < 0.05$). All other parameters showed similar measurement variability. The Pearson correlation between the two devices was > 0.90 for all parameters. However the paired t-test showed significant differences for almost all parameters. Agreement was influenced by the severity of keratoconus, e.g. in mild keratoconus there was better agreement for astigmatism compared to severe cases. There was a significant difference between the two devices in determining cone location based on curvature and pachymetry.

Conclusions:

Overall repeatability was similar between the SS-OCT and the Pentacam HR for keratometry, pachymetry, elevation and cone size. The correlation between the two devices was high for the investigated parameters, however proportional bias was shown in the agreement between the two devices. Furthermore the agreement was influenced by the severity of the disease. We can conclude that the SS-OCT and the Pentacam HR aren't interchangeable tools in the diagnosis and follow-up of keratoconus.

Cornea

Comparison of Scheimpflug Imaging and Spectral Domain Anterior Segment Optical Coherence Tomography in healthy and keratoconus eyes

Presenting author: Marina João, Portugal

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 13:39 - 13:45

Location: Hall 13 / Elicium Ballroom

Purpose:

To evaluate the agreement of corneal topography and tomography parameters between a Scheimpflug imaging device (Pentacam[®], Oculus Inc.) and an anterior segment optical coherence tomography device [AS-OCT (Anterion[®], Heidelberg Engineering)] in both healthy and keratoconus eyes.

Setting:

Ophthalmology Department, Hospital de Braga, Braga, Portugal

Methods:

62 eyes [group 1 (healthy eyes): 41 eyes; group 2 (keratoconus eyes): 21 eyes] were submitted to topography and tomography imaging with the two devices. Both measurements were obtained on the same day. Parameters included keratometry (k) in both the steep and flat meridians, mean k, maximum K, and Q-value (8 mm) from the anterior and posterior surfaces. The corneal central thickness (CCT), thinnest corneal thickness (TCT), and location, best fit sphere (BFS), and white to white (WTW) were also evaluated.

Results:

When comparing the two devices in healthy eyes, we found a statistically significant difference in most parameters, except in anterior and posterior flat k axis. In keratoconus eyes, we found differences in maximum k, anterior surface Q-value, BFS, posterior surface steep k, CCT, TCT, and WTW. Nonetheless, the interclass correlation coefficient was excellent in most parameters [anterior and posterior surface flat k, steep k, mean k; maximum k, BFS, CCT, and TCT ($p < 0.001$)]. We found a moderate correlation in healthy eyes ($p = 0.001$) and in keratoconus eyes ($p = 0.013$) regarding anterior surface Q-value and in both groups regarding posterior surface Q-value ($p < 0.001$).

Conclusions:

The interclass correlation coefficient between the two devices is excellent in most evaluated parameters. Both Q-values had the lowest interclass correlation coefficient. In healthy eyes, the AS-OCT provided higher mean values than the Scheimpflug imaging device in most parameters. In eyes with keratoconus, the AS-OCT provided lower maximum k, BFS, CCT, and corneal thinnest thickness, and higher anterior surface Q-value, posterior surface steep k, and WTW values.

Cornea

Ten years outcomes after Intracorneal Ring Segment Implantation for Keratoconus Treatment

Presenting author: Alfredo Vega Estrada, Spain

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 13:51 - 13:57

Location: Hall 13 / Elicium Ballroom

Purpose:

To report the long term visual, refractive and keratometric outcomes, as well as the complication rate of intracorneal ring segment implantation (ICRS) for keratoconus treatment

Setting:

Vissum Grupo Miranza. Alicante, Spain. Hospital Virgen de los Lirios de Alcoy. Alicante, Spain.

Methods:

Retrospective, consecutive, clinical study including 37 keratoconus cases mean age 31.5 ± 9.5 years that were treated with ICRS. Visual, refractive, keratometric readings, corneal higher order aberrations and explantation rate were evaluated during a follow up period of at least 10 years.

Results:

A significant improvement was observed in the uncorrected visual acuity that came from 0.25 ± 0.24 to 0.47 ± 0.33 one year after the surgery ($p < 0.01$) with no further changes in the remaining ten years ($p > 0.50$). A reduction of the sphere and cylinder from preoperative -2.29 ± 3.51 and -3.53 ± 2.58 to postoperative ten years -1.21 ± 2.55 and -2.70 ± 1.74 respectively was also found. A significant reduction in the mean keratometry was observed from 49.33 ± 5.02 to 46.65 ± 3.77 at ten years ($p < 0.01$). ICRS explantation was found in 10.8% of the cases.

Conclusions:

Intracorneal ring segment for keratoconus treatment provides stable visual, refractive and keratometric outcomes during long term of follow up. Severe complications leading to ICRS explantation might be observed in 10% of the cases.

Cornea**Intracorneal ring segments implantation in advanced central keratoconus with high corneal asphericity – short-term clinical results.**

Presenting author: Tiago Monteiro, Portugal

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 13:57 - 14:03

Location: Hall 13 / Elicium Ballroom

Purpose:

Intracorneal ring segments (ICRS) implantation is a safe and effective surgical procedure for the treatment of mild-to-moderate keratoconus. The visual and topographic outcomes in advanced disease are less predictable and effective; in those cases, corneal keratoplasty procedures remain as an alternative option. The purpose of this study is to describe the visual, refractive and topographic results of a 300-degree arc-length ICRS implantation with femtosecond laser-assisted surgery in a specific advanced disease phenotype of keratoconus: the central advanced keratoconus with high asphericity.

Setting:

Ophthalmology Department of Hospital CUF Porto, Portugal

Methods:

Prospective study including patients with central advanced keratoconus with high asphericity: thinnest point between 0,0 and 0,8 mm of the pupil center, mean central keratometry above 50,0 D and corneal asphericity higher than -1.25. The Ferrara ICRS 300 degrees (AJL, Spain) was implanted at an optical zone of 5.0 mm with the corneal incision at 90-degree axis, surgery assisted by femtosecond laser. Parameters evaluated at preoperative and 6 months after surgery were: uncorrected (UDVA) and corrected (CDVA) distance visual acuity, manifest refraction, corneal topography and corneal aberrometry with Pentacam (Oculus, Germany).

Results:

The study included 15 eyes, mean age of 31.0 ± 18.6 years. At 6 months, we observed a significant improvement in UDVA and CDA, all patients gained two or more lines of CDVA. In terms of refractive results, sphere was significantly reduced from -10.0 ± 7.07 D to -1.0 ± 4.83 D ($p < 0.05$); no significant change was registered for refractive astigmatism ($p = 0.45$). Regarding the topographic parameters, we observed a significant reduction of K2, topographic astigmatism, Kmean and Kmax; no significant change was observed regarding Coma HOA at 6 months. No intra or postoperative complications were observed.

Conclusions:

In the case of central advanced keratoconus with high asphericity, surgical options are normally restricted to corneal keratoplasty procedures. In this study, the implantation of a 300-degree arc-length implant at the 5.0 mm optical zone demonstrated to be safe and effective, improving visual acuity and topographic parameters. This new ICRS design is an alternative to corneal keratoplasty procedures in advanced disease with corneal transparency; allowing the possibility to postpone or avoid a corneal transplant.

Cornea

Intrastromal corneal ring segments: the effect of depth of implantation in visual, refractive and topographic outcomes in keratoconus treatment

Presenting author: Carlos Cruz, Portugal

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 14:03 - 14:09

Location: Hall 13 / Elicium Ballroom

Purpose:

Intrastromal corneal ring segments (ICRS) implantation is a widely accepted procedure in the treatment of keratoconus in order to flatten the cornea, reduce irregular corneal astigmatism and improve visual acuity. This study aims to evaluate visual, refractive and topographic outcomes of ICRS relative to the achieved depth of implantation using manual technique.

Setting:

Department of Ophthalmology, Hospital de Braga, Braga, Portugal

Methods:

This retrospective study evaluated 104 eyes of 93 keratoconus patients submitted to Ferrara Ring™ (AJL®, Spain) ICRS implantation using manual technique. The intended depth of implantation was set at 80% of the thinnest corneal thickness at 6 mm optical zone. The achieved depth of implantation was measured using anterior-segment optical coherence tomography - CASIA SS-1000 (Tomey Corporation, Japan). Subjects were divided into 3 groups according to achieved depth: <70% (Group 1), 70-80% (Group 2), and >80% (Group 3). Visual, refractive and topographic variables were evaluated at baseline and 6-months. Topographic evaluation was performed using Pentacam HR (Oculus Optikgerate, Germany).

Results:

We found a significant improvement of corrected-distance visual acuity in all groups at 6-months (P-values<0.005); safety indexes were $1,71\pm 0,95$, $1,55\pm 0,58$ and $1,72\pm 2,04$ in group 1, 2 and 3, respectively (P-value=0.09). Efficacy indexes were 0.98 ± 0.91 , 0.77 ± 0.48 and 0.84 ± 1.03 , respectively (P-value=0.44). Manifest cylinder and spherical equivalent revealed a significant reduction in all groups (P-values<0.05). Topographic evaluation showed a significant improvement of anterior K2, anterior Kmax, posterior K2, posterior keratometric cylinder, coma and asphericity in all groups (P-values<0.05). Refractive and topographic changes after ICRS implantation were similar between all groups despite the different depths of implantation (P-values>0.05). No intra or postoperative complications occurred.

Conclusions:

ICRS implantation is an effective surgical option to restore visual acuity and corneal topography in patients with keratoconus. In our series, ICRS implantation with a manual technique showed to be equally effective despite the varying depth of implantation in the corneal stroma.

Cornea

Artificial Lenticular implants (XENIA) in advanced Keratoconus - 2 year follow up

Presenting author: Marwan Ghabra, United Kingdom

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 14:15 - 14:21

Location: Hall 13 / Elicium Ballroom

Purpose:

To evaluate the efficacy of implanting decellularized Artificial Lenticule (XENIA Implant) in a constructed pocket for management of advanced Keratoconus with clear corneas. The Artificial Lenticules (XENIA lenticules) are produced by Gebauer Medical, extracted from Porcine tissue, subjected to a decellularization process, and intensely cross linked.

Setting:

Dar Al Oyoun Eye Hospital, Damascus, Syria

Methods:

A prospective, non randomized, non comparative, case series on six eyes of five patients 5/6 patients were diagnosed with advanced Keratoconus, 1/6 post LASIK Ectasia Each patient underwent visual acuity evaluation, corneal topography (Pentacam AXL, Orbiscan) to obtain baseline measurements. Comparative pre and post parameter, visual acuity, central corneal thickness and mean K. Manual intrastromal pockets 9mm in diameter were created using a guarded knife and corneal dissector, with manual introduction of the XENIA implant into the created pocket. Xenia Lenticules measure 7mm in diameter with a thickness between 110-80 microns.

Results:

At the 2 year point, 6 out of the 6 patients enrolled demonstrated an improvement of BCVA from counting fingers to 0.3-0.4 with glasses. Furthermore, corneal thickness increased in all patients, corresponding with implant thickness, while Mean K demonstrated an overall reduction at the 2 year point. Lastly, the degree of transparency improved significantly after 9 months

Conclusions:

Tissue augmentation with Artificial decellularized lenticules (XENIA Implants) results in improvement in visual acuity, corneal flattening, Two year follow up, confirmed the transparency, absence of significant immunological reaction, improvement of Topography parameters, and increased thickness Over two years, Artificial Implants show that it can be an effective way to avoid Corneal transplantation (DALK) in patients with advanced Keratoconus.

Cornea

Clinical and Confocal Microscopy Correlation in a Pioneer Experience of Advanced Cell Therapy in Keratoconus

Presenting author: Mona El Zarif, Spain

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 14:21 - 14:27

Location: Hall 13 / Elicium Ballroom

Purpose:

Managing Keratoconus is performed by different surgical procedures, recently we described a new surgical approach based on advanced regenerative therapy, using autologous adipose-derived adult stem cells (ADASCs) and decellularized/recellularized human corneal stromal lamins with ADASCs into corneas with advanced keratoconus. We report herein the safety and efficacy of the surgery, the clinical results of three-years, and corneal confocal microscopy evolution in vivo of the cell density in the stroma, as well in the decellularized/recellularized implanted lamins, along one year of follow up, also to evaluate the presence of fibrotic structures and the association between the degree of fibrosis and recellularization.

Setting:

Division of Ophthalmology, Miguel Hernandez University, Alicante-Spain. Visum Instituto Oftalmológico de Alicante. Grupo Miranza, Alicante, Spain. And Optica General, Saida-Lebanon.

Methods:

Fourteen consecutive patients were selected and divided into 3 experimental groups. Group-1 patients underwent implantation of autologous ADASCs (3x10⁶ cells/1 ml) (n = 5). Group-2 patients received decellularized donor corneal stromal lamina with 120 µm thick (n =5). Group-3, patients received implantation of recellularized lamina with ADASCs (1x10⁶ cells/1ml) (n = 4). Implantation was performed into a femtosecond-assisted 9.5 mm diameter lamellar pocket, under topical anesthesia. 36 months of follow-up clinical data are presented. Besides, one-year follow-up of the cell density evolution, morphological changes of implanted cells, as well the formation of fibrotic structures using confocal microscopy.

Results:

three-year clinical outcomes were obtained in (G-1, G-2&G-3) regarding the preoperative mean values: An increase of 1-2 logMar lines with the UDVA, CDVA, and CLDVA. We obtained a statistically significant increase in CCT with G-2 [P=0.012] and G-3 [P<0.001], Thinnest-point in G-2 [P=0.007], and G-3 [P=0.001] when compared to G-1. A significant increase [P<0.001] was observed in the cell density in the anterior and posterior corneal stroma with all the groups, in the mid stroma with G-1, on the surfaces, and within the implanted lamins. There was not a significant association between recellularization and the presence of fibrotic tissue.

Conclusions:

Intrastromal implantation of ADASCs and decellularized/ADASCs-recellularized human corneal stroma lamins did not have complications at 3 years in advanced keratoconus. The technique showed a moderate improvement in UDVA and CDVA and a significant increase in corneal thickness with the groups that received lamins. Using corneal confocal microscopy, we were able to observe a significant increase in cell density up to one postoperative year at the corneal stroma following the implantation of ADASCs alone, and in those cases with implanted lamins. The increase in the corneal cell density was not significantly correlated with the presence the fibrotic tissue.



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Cornea

Corneal Stromal Demarcation Line and Safety of Transepithelial Corneal Cross-Linking with Supplemental Oxygen in Keratoconus

Presenting author: Li Lim, Singapore

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 14:27 - 14:33

Location: Hall 13 / Elicium Ballroom

Purpose:

To evaluate the corneal stromal demarcation line and safety of transepithelial corneal cross-linking (CXL) with supplemental oxygen in the treatment of keratoconus.

Setting:

Singapore National Eye Centre

Methods:

This is a retrospective review of 25 patients with progressive keratoconus who underwent epithelial-on CXL with supplemental oxygen from December 2019 to January 2021 at the Singapore National Eye Centre. Outcomes measured include post-treatment corneal stromal demarcation line depth, volume of cornea treated, pre- and post-treatment endothelial cell count and post-treatment adverse events.

Results:

25 eyes of 25 patients were included and mean age was 28.3 years. Pre-operatively, mean \pm standard deviation (SD) of K1, K2, Kmax and minimal corneal thickness were $45.9D \pm 0.76D$, $50.2D \pm 0.97D$, $57.5D \pm 1.40D$ and $482.3\mu m \pm 7.37\mu m$ respectively. The mean post-treatment corneal stromal demarcation line was $337.3\mu m \pm 20.1\mu m$. The volume of treated cornea including and excluding the central corneal epithelial thickness were $67.3\% \pm 4.14\%$ and $63.7\% \pm 4.57\%$ respectively. There was no reduction in endothelial cell count (ECC) post-procedure (pre-treatment mean ECC \pm SD: 2701.9 ± 61.6 , post-treatment ECC 2691.7 ± 80.3 , p-value = 0.46).

Conclusions:

The corneal stromal demarcation line depth achieved with this technique is comparable to standard epithelial-off corneal cross-linking (Dresden protocol).



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Cornea

Bowman layer onlay grafting: New technique to flatten the corneal curvature and reduce progression in keratoconus

Presenting author: Lydia van der Star, Netherlands

Session name: Keratoconus

Date and time: 09 October 2021, 13:15 - 14:45

Presentation time: 14:33 - 14:39

Location: Hall 13 / Elicium Ballroom

Purpose:

To describe the results of a new surgical technique for flattening the corneal curvature and to reduce progression in eyes with advanced progressive keratoconus by using Bowman layer (BL) onlay grafting.

Setting:

Prospective, interventional case series conducted at the Netherlands Institute for Innovative Ocular Surgery.

Methods:

Ten patients with advanced progressive keratoconus, underwent BL onlay grafting. After removal of the epithelium, a BL graft was placed and “stretched” onto the stroma, and a bandage lens was placed to cover the BL graft. Best spectacle- and/or best contact lens-corrected visual acuity (BSCVA/BCLVA), refraction, biomicroscopy, corneal tomography, anterior segment optical coherence tomography and complications were recorded at 1 week, and 1, 3, 6, 9, and 12-18 months postoperatively.

Results:

All ten surgeries could be performed successfully. Average Kmax went from 74D preoperatively to 69D at 9-18 months postoperatively. BSCVA improved at least one Snellen line (or more) in 6/10 cases and BCLVA remained stable, improving by 3 Snellen lines in case 1 at 18 months postoperatively. Satisfaction was high and all eyes again had full contact lens tolerance.

Conclusions:

BL onlay grafting may be a feasible surgical technique, providing up to -5D of corneal flattening in eyes with advanced progressive keratoconus, while maintaining the visual acuity.



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Cornea

Does Ocular Biometry in Adults Change Over Time?

Presenting author: Surendra Basti,

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 13:15 - 13:21

Location: Hall 13 / Elicium Ballroom

Purpose:

Setting:

Methods:

Results:

Conclusions:

Cornea

Deformations and ruptures in human lenses with cortical cataract subjected to ex vivo simulated accommodation

Presenting author: Ralph Michael, Spain

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 13:27 - 13:33

Location: Hall 13 / Elicium Ballroom

Purpose:

Human cortical opacities are most commonly accompanied by changes in lens fiber structure in the equatorial region at the lens nucleus-cortex interface. Cortex and nucleus have different elastic properties which change with age. We therefore subjected ex vivo lenses to simulated accommodation and studied the internal deformations to better understand the mechanism of cortical cataract formation.

Setting:

Experimental Research Lab, Centro de Oftalmologia Barraquer, Barcelona

Methods:

Nine human donor lenses (33 to 88 years old) were tested using a bespoke radial stretching device for anterior eye segments. Seven of the lenses exhibited cortical cataracts. The other two lenses, without cataract, were used as controls. Frontal and cross-sectional images of the lens obtained during stretching facilitated measurements on equatorial lens diameter and central lens thickness in the stretched and unstretched states.

Results:

Stretching caused the lens equatorial diameter to increase in all cases. Conversely, the lens central thickness showed no systematic variation during stretching. For four of the lenses with cortical cataract, ruptures were observed during stretching at the nucleus-cortex boundary adjacent to the cortical cataracts. Ruptures were not observed in the control lenses and the three other lenses with cortical cataract.

Conclusions:

Internal ruptures can occur in aged ex vivo lenses subjected to simulated disaccommodation. These ruptures occur at the nucleus-cortex interface; at this location a significant stiffness discontinuity is expected to develop with age. It is hypothesized that ruptures occur in in vivo lenses during accommodation – or attempted accommodation.

Cornea

Objective Evaluation of Limbal Ischemia in Ocular Surface Burns

Presenting author: onur furundaoturan, Turkey

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 13:45 - 13:51

Location: Hall 13 / Elicium Ballroom

Purpose:

To evaluate the limbal ischemia involvement objectively in ocular surface burns by using Anterior Segment Optical Coherence Tomography Angiography (AS-OCTA).

Setting:

This cross-sectional study was conducted in Ege University Ophthalmology Department, Izmir, Turkey.

Methods:

Acute ocular burn patients with less than one-week injury history were enrolled. Anterior segment photographs and AS-OCTA images were obtained and used for the assessment of limbal ischemia. To visualize the limbal vasculature, the device was positioned, and the focus was modified manually in order to get a sharp image of the limbus. The absence of vasculature was regarded as ischemia and the amount was defined in clock hours. The limbal ischemia extensity evaluation was performed by two different specialists and the clinical evaluation were compared with the AS-OCTA results in each patient to make a conclusion for the correlation.

Results:

Five patients with acute ocular surface burn were enrolled to the ongoing study (1 female, 4 male). According to the early results, the mean age was 42.6 ± 10.4 (39-55). The mean best-corrected visual acuity was 0.89 ± 1.25 (0.15-3.10) LogMAR. The causative agents were acid in 1, alkaline in 3, thermal in 1 patient. The limbal ischemia involvement determined by AS-OCTA was larger than the biomicroscopic evaluation (5.8 ± 1.9 (5-9) clock hours vs 4.4 ± 2.0 (2-7) clock hours, p is lower than 0.005).

Conclusions:

AS-OCTA has significant importance on limbal vascularity visualization, therefore its use for objective and sensitive evaluation of limbal ischemia in ocular surface burns seems to have a crucial impact. AS-OCTA images may reveal the extension of limbal ischemia more precisely than clinical evaluation with biomicroscopy. However, to make a specific conclusion, future research is required.

Cornea

Measurement of lacrimal punctum by spectral domain anterior segment optical coherence tomography in patients with aqueous and evaporative type of dry eye

Presenting author: Murat KAŞIKÇI, Turkey

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 13:51 - 13:57

Location: Hall 13 / Elicium Ballroom

Purpose:

It was aimed to visualize the lacrimal punctum and measure the thickness of the tear meniscus with anterior segment optical coherence tomography (AS-OCT) in aqueous, evaporative and healthy cases.

Setting:

This study was conducted in Mugla Training and Research Hospital, Department of Eye Diseases. Mugla/Turkey

Methods:

A total of 75 patients (25 aqueous, 25 evaporative and 25 healthy) 150 eyes were included in this study. Punctal parameters and tear meniscus height (TMH) were measured using AS-OCT scans. Outer punctal diameter (OPD), punctal depth (PD), tear well diameter (TWD), tear well depth (TWDM), punctal reserve (PR) and lower eyelid TMH were assessed. Punctal reserve was defined as the difference between punctal depth and tear well depth.

Results:

In healthy cases, OPD was $596.6 \pm 201.6 \mu\text{m}$, PD $525.8 \pm 278.8 \mu\text{m}$, TWD $231.2 \pm 130.4 \mu\text{m}$, TWDM $452.3 \pm 250.4 \mu\text{m}$, PR $106.9 \pm 76.7 \mu\text{m}$ and TMH $220.8 \pm 89.9 \mu\text{m}$. In the aqueous insufficiency group OPD was 485.8 ± 155.5 , PD $435.8 \pm 250.4 \mu\text{m}$, TWD 193.1 ± 128.2 , TWDM $392.4 \pm 240.5 \mu\text{m}$, PR $92.4 \pm 75.1 \mu\text{m}$ and TMH $187.9 \pm 121.7 \mu\text{m}$. In the evaporative group OPD was $615.5 \pm 204.7 \mu\text{m}$, PD $550.9 \pm 90.1 \mu\text{m}$, TWD $255.8 \pm 140.3 \mu\text{m}$, TWDM $463.4 \pm 249.8 \mu\text{m}$, PR $109.7 \pm 79.8 \mu\text{m}$ and TMH $223.4 \pm 90.1 \mu\text{m}$.

Conclusions:

AS-OCT provides clear information about lacrimal punctal structures. Patients with dry eye due to aqueous insufficiency were found to be lower in all parameters compared to healthy individuals and evaporative type dry eye cases.

Cornea

First clinical experience with ophthalmic e-Device for patient self-examination during Covid-19 lockdown

Presenting author: Lydia van der Star, Netherlands

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 13:57 - 14:03

Location: Hall 13 / Elicium Ballroom

Purpose:

To evaluate and describe a new medical investigational e-Device that allows for internet enabled patient self-screening, without the aid of an ophthalmic professional. Through biomicroscopy self-imaging and self-measurement of the best corrected visual acuity.

Setting:

Prospective non-randomized comparative study.

Methods:

Fifty-six patients were instructed to screen their own eyes using a custom-built e-Device containing miniaturized slit-lamp optics and a visual acuity Snellen chart virtually projected at 20 feet. Best corrected visual acuity (BCVA) measurements were recorded and biomicroscopic videos were scored for image quality of the anterior segment status on a scale from 1-5 (1=poor; 5=excellent) by a blind observer.

Results:

After a short instruction, all patients were able to self-image their eyes and perform a self-BCVA measurement using the e-Device. Patient self-image quality with the e-Device scored on average 3.3 (± 0.8) for videos (n=76) and 3.6 (± 0.6) for photographs (n=49). Self-BCVA measurement was within one Snellen line from routine BCVA levels in 66/72 (92%) of eyes. Compared to conventional biomicroscopy, patient self-biomicroscopy allowed recognition of the relevant pathology in 26/35 eyes (74%); nine cases showed insufficient image quality attributed to device operating error (n=6), and corneal edema and/or scarring (n=3). Patient satisfaction with the device was 4.4(± 0.9).

Conclusions:

Self-assessment by an e-device may allow for diagnostic screening with an image quality approaching that of a conventional slit-lamp. An e-Device for combined BCVA self-measurement and biomicroscopy self-imaging may have potential as an aid in remote ophthalmic examination in the absence of an ophthalmic professional and may be considered for patients who are unable to visit an ophthalmic clinic for routine follow-up.

Cornea

How to differentiate adenoviral subepithelial infiltrates and scars by AS-OCT

?

Presenting author: Dhouha Gouider, Tunisia

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 14:03 - 14:09

Location: Hall 13 / Elicium Ballroom

Purpose:

To describe, by anterior segment optical coherence tomography (AS-OCT) findings, the structural changes occurring during the course of epidemic keratoconjunctivitis (EKC).

Setting:

Ophthalmology Department, Military Hospital of Tunis, Tunisia

Methods:

A prospective observational study included 38 eyes (28 patients) with a presumed EKC complicated by subepithelial infiltrates (SEI) and treated with topical steroids for three months. Slit-lamp examinations and serial AS-OCT were performed before treatment, and after one month (M1) and three months (M3) of treatment.

Results:

In all patients, SEI corresponded to hyperreflectivity under Bowman's layer extending towards the anterior stroma. In M1, they gradually decreased in number, intensity, and extent following treatment by topical steroids in 71,4% of the cases. In M3, only two patients had persistent SEI. They were refractory to treatment by steroids. In these cases, AS-OCT showed well-defined plaque-like hyperreflective lesions having sharp edges associated with a disruption of Bowman's layer, a localized epithelial thickening, a stromal thinning, and a decrease in pachymetry. This description corresponded to scars called also « degenerative iron line ».

Conclusions:

AS-OCT provides a range of characteristic patterns of EKC and may help in monitoring it under treatment.

Cornea

Fourier analysis of corneal power using optical coherence tomography in eyes with very asymmetric ectasia and normal topography

Presenting author: Shizuka Koh, Japan

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 14:15 - 14:21

Location: Hall 13 / Elicium Ballroom

Purpose:

To assess the optical characteristics of the anterior, posterior, and total cornea in eyes with very asymmetric ectasia and normal topography (VAE-NT).

Setting:

Osaka University Hospital, Osaka, Japan

Methods:

This was a prospective, case-control study, including 50 patients with VAE-NT and 45 normal controls, in Osaka University Hospital. We obtained corneal tomographic data using anterior segment optical coherence tomography (OCT). Dioptric data of the anterior, posterior, and total cornea were expanded into the spherical, regular astigmatism, asymmetry, and higher-order (HO) irregularity components with Fourier analysis. The main outcome measures were quantitative Fourier analysis of irregular corneal astigmatism with OCT.

Results:

Asymmetry and HO irregularity components from the posterior cornea were significantly greater in patients with VAE-NT than in controls (0.13 ± 0.08 D vs. 0.05 ± 0.03 D and 0.03 ± 0.02 D vs. 0.02 ± 0.01 D, respectively; $p < 0.001$ for both). No difference was observed between components of the anterior cornea and the total cornea. Posterior irregular corneal astigmatism increased with no difference in the anterior and total cornea in 40% of VAE-NT cases, and the remaining 60% of VAE-NT eyes displayed very asymmetric ectasia with normal topography and tomography.

Conclusions:

Quantitative Fourier analysis with OCT can investigate the optical characteristics of the anterior, posterior, and total cornea. Abnormal posterior irregular astigmatism was observed in 40% of VAE-NT eyes.

Cornea

Scheimpflug corneal densitometry as a predictive diagnostic tool for visual acuity outcomes 5 years after Descemet membrane endothelial keratoplasty (DMEK)

Presenting author: Nikolaos Kappos, Greece

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 14:27 - 14:33

Location: Hall 13 / Elicium Ballroom

Purpose:

To investigate possible correlations of preoperative corneal densitometry (CD) with postoperative visual acuity outcomes after Descemet membrane endothelial keratoplasty (DMEK) throughout 5 years follow-up time.

Setting:

(1) Department of Ophthalmology, Philipps University of Marburg, Germany (2) First Department of Ophthalmology, National and Kapodistrian University of Athens, Athens, Greece

Methods:

From a larger pool of DMEK procedures, 60 cases (51 patients) with a minimum follow-up of 5 years were included. CD of various corneal layers (anterior, central, posterior and total layer) and zones (0-2 mm, 2-6 mm and 6-10 mm) was measured with Scheimpflug tomography. Endothelial Cell Density (ECD), Best Corrected Visual Acuity (BCVA) and, Central Corneal Thickness (CCT) were also evaluated. Pre- and postoperative BCVA were correlated with preoperative corneal densitometry data. Diagnostic power was assessed by the receiver operating characteristic (ROC) analysis.

Results:

Postoperative BCVA was significantly better after DMEK for every examination time point ($p < 0.001$). ECD and CCT significantly decreased from preoperatively to 5 years time point ($p < 0.001$). Moderate correlations of preoperative CD data with pre- and postoperative BCVA were noted at the anterior and central layers of the 0-2 mm and 2-6 mm corneal zones. Weaker correlations were noted at the posterior corneal layer of all corneal zones. The best CD predictive power assessed with ROC analysis was noted at the 2-6 mm zone.

Conclusions:

Preoperative CD data seem to correlate with postoperative BCVA after DMEK throughout 5 years. Thus, early surgical intervention could contribute to better visual outcomes in the mid-term.



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Cornea

Automatic Analysis of Descemet Membrane Detachment After DMEK Surgery

Presenting author: Yoav Nahum, Israel

Session name: Imaging Anterior Segment

Date and time: 10 October 2021, 13:15 - 14:45

Presentation time: 14:33 - 14:39

Location: Hall 13 / Elicium Ballroom

Purpose:

Proof-of-concept study of an algorithm which analyzes Anterior Segment Optical Coherence Tomography images taken after Descemet Membrane Endothelial Keratoplasty (DMEK) and which calculates the area and volume formed by graft detachment.

Setting:

Rabin Medical Center, a University Hospital, in collaboration with Afeka college for engineering

Methods:

Image acquisition was performed on four different patients that underwent DMEK surgery, one patient with a full 21 image-set and the other three patients with a total of ten images captured from different cross sections. The developed algorithm includes segmentation (using Chan-Vese and Otsu methods), noise reduction, morphological filtering, contrast enhancement (Frangi filtering) and other image processing tools. The computed areas were compared to manually-obtained values.

Results:

Thirty-one images were tested with the algorithm for area calculation (thirteen images with graft detachment, eighteen images without graft detachment). Twenty-eight images were successfully analyzed. The mean DICE coefficient of the area for thirty-one tested images is 0.85 (± 0.25). For the full image set, the DICE coefficient for the volume was calculated as well and resulted in 0.73. In two cases the algorithm detected a false detachment and in one case the algorithm mis-detected a detachment.

Conclusions:

Our study demonstrated the feasibility of using image processing as a tool to assess graft detachments after DMEK surgery



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Cornea

Manchester Royal Eye Hospital Virtual Keratoconus Clinic - Preliminary Findings

Presenting author: Yee Ling Wong, United Kingdom

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 08:00 - 08:06

Location: Hall 13 / Elicium Ballroom

Purpose:

The virtual keratoconus clinic was set up during the COVID-19 pandemic to ensure that patients are seen in a safe and timely manner due to the growing backlog in follow up. Virtual diagnostic assessment clinics consisted of visual acuity, intraocular pressure checks and a corneal tomography scan. In addition, subjective assessments were carried out including questions relating recent change in vision and any issues to be relayed to the ophthalmic team. The purpose of this study was to assess the efficacy of virtual keratoconus clinics, demographic factors, non-attendance rates, and the proportion of patients who were listed for cross linking.

Setting:

Manchester Royal Eye Hospital, United Kingdom

Methods:

It was a retrospective data collection of patients who were given an appointment to attend the virtual keratoconus clinic from July 2020 to January 2021. Data collated include demographic details (age, ethnicity, gender, diagnosis), ocular comorbidities, relevant systemic comorbidities, history of previous collagen cross-linking and their complications, the nonattendance rate and the outcomes of virtual clinic assessments including those who were listed for relevant procedures such as corneal collagen cross linking.

Results:

Of 397 patients, 272 (68.5%) were male and 125 (31.5%) were female with mean age of 32.153 (38.5%) were Asian, 235 (59.2%) were Caucasian and 9 (2.2%) were Afro-caribbean. 355 (89.4%) had a diagnosis of keratoconus, 21 (5.3%) had pellucid marginal degeneration, 17 (4.3%) had astigmatism. 8 (2.3%) already had a corneal transplant in one eye. 55 (13.9%) patients had allergic eye disease and 43 (11%) had history of atopy. 82/397 (20.7%) patients had CXL, of which 23/82 (28.0%) had CXL in both eyes. 2/23 (8.6%) showed progression in tomography scan and were listed for re-treatment. Non-attendance rate was 51/397 (12.8%) where 22/51 (43%) were subsequently discharged. 10/346 (2.9%) who attended were listed directly for CXL, and 21/346 (6.1%) was invited to have a face-to-face consultation to discuss CXL.

Conclusions:

The virtual keratoconus clinic has proven to be effective not just for monitoring of keratoconus, but other corneal conditions. Patients with corneal grafts could also be monitored the same way, as corneal thickness would be evident on tomography scan. The attendance rates have been exceptionally good. It is interesting to see that 9% of those who were noted to have progression were either listed/ invited for a consultation to discuss CXL. Not only we are able to review such a high number of patients within a short period of time, we were also able to provide them with treatment within a timely manner.

Cornea

High-fluence accelerated corneal cross-linking to achieve Dresden protocol-like corneal strengthening

Presenting author: Reyhaneh Abrishamchi, Switzerland

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 08:06 - 08:12

Location: Hall 13 / Elicium Ballroom

Purpose:

To quantify CXL induced changes in corneal biomechanics achieved by optimized ultraviolet-A (UVA) fluence, intensity and exposure time.

Setting:

The study was conducted at the Ocular Cell Biology Laboratory, Center for Applied Biotechnology and Molecular Medicine at the University of Zurich (Switzerland).

Methods:

Three hundred fresh enucleated porcine eyes were divided equally into 6 groups for analysis. All samples underwent epithelial debridement and soaking with riboflavin 0.1% solution for 20 minutes. CXL was performed using 5 different epithelium-off protocols: S-CXL (intensity in mW/cm² * time (minutes); 3*30), A-CXL (9*10) [total fluence: 5.4 J/cm²], A-CXL (9*13'20"), A-CXL (18*6'40") [total fluence: 7.2 J/cm², A-CXL (18*9'15") [total fluence: 10 J]. Control corneas were treated similarly and not irradiated. Young's modulus of 5-mm wide corneal strips was used as an indicator of corneal stiffness.

Results:

All irradiated groups had significantly higher Young's modulus than controls ($p < 0.05$): with a stiffening effect of 133% S-CXL (3*30), 122% A-CXL (9*10), 120% A-CXL (9*13'20"), 114% A-CXL (18*6'40") and 149% A-CXL (18*9'15"). The new accelerated epi-off protocol A-CXL (18*9'15") had the highest stiffening effect among all our study groups compared to controls. Elastic modulus at 5% strain (from 1 to 5% strain) showed significant difference between A-CXL (18*9'15") and three other accelerated protocols: A-CXL (9*10) ($p=0.01$), A-CXL (9*13'20") ($p=0.003$) and A-CXL (18*6'40") ($p=0.0001$) respectively.

Conclusions:

We identified a high-fluence epi-off clinical protocol using A-CXL (18*9'15") that provides significantly more stiffening effect than any other accelerated protocols and is indistinguishable from the Dresden protocol, while accelerating irradiation time from 30 to 9 minutes. This new protocol might become a new standard in epi-off CXL treatments.

Cornea

Flattening of various topographic cone locations after accelerated and non-accelerated epithelium off corneal crosslinking in keratoconus: a multicentre study

Presenting author: Zahra Ashena, United Kingdom

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 08:12 - 08:18

Location: Hall 13 / Elicium Ballroom

Purpose:

To assess the relationship between the flattening of various topographic cone locations in relation to preoperative maximum keratometry (Kmax) in keratoconus following epithelium-off accelerated and non-accelerated corneal crosslinking (CXL) at two international centres.

Setting:

Sussex Eye Hospital, Brighton & Sussex University Hospitals NHS Trust, Brighton, United Kingdom and Department of Ophthalmology, University of Auckland, New Zealand

Methods:

200 eyes (200 patients- 100 non-accelerated and 100 accelerated) were included in this study. Cone locations were defined based on the Kmax as central (within the central 3mm), paracentral (within 3-5mm) and peripheral (beyond central 5mm) based on X and Y coordinates on tomography. Following 10 minutes of soak time with riboflavin 0.1%, continuous CXL was performed for 30 minutes (intensity: 3mW/cm², fluence: 5.4 J/cm²) in non-accelerated and 3 minutes (intensity: 30 mW/cm², fluence: 5.4 J/cm²) in accelerated group. Anterior and posterior cone flattening in various cone locations were compared and their correlation with preoperative Kmax was assessed.

Results:

In non-accelerated and accelerated groups, the majority had central cones (63%,72%), followed by paracentral (28%,23%) and peripheral (9%,5%). Central cones were the steepest (58.44D±7.45, 60.76D±8.06, p=0.09), followed by the paracentral (54.04D±6.24, 54.91D±5.38, p=0.6) and peripheral cones (51.49D±3.51, 53.10D±5.3, p=0.5) respectively. Anterior Kmax flattened in central (1.52D±1.96, p= 0.01 and 1.09D±1.79, p=0.00, between centres p=0.18) and paracentral (0.62D±1.59, p= 0.04 and 0.55D±0.98, p=0.03, between centres p=0.86) but remained stable in peripheral cones (p=0.61, p=0.37). There was a positive correlation between pre-op Kmax and cone flattening in paracentral cones only in both groups (r=0.45, p=0.02 and r=0.47, p=0.02). Posterior Kmax remained unchanged.

Conclusions:

With the same fluence rate and riboflavin soak time, central and paracentral cones significantly flattened following epithelium off CXL, with more flattening effect in the central group in both non-accelerated and accelerated CXL, and there was no difference between these treatment groups. In both treatment groups, whilst there was no correlation between pre-operative Kmax and flattening effect in the central group, a positive and statistically significant correlation was noticed between these two variables in the paracentral group. CXL did not flatten posterior Kmax and this may be due to variation between anterior and posterior corneal stromal biomechanical properties.



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Transepithelial Accelerated Corneal Collagen Crosslinking in Patients with Progressive Keratoconus: Long Term Follow-up Results

Presenting author: Rodrigo Vilares Morgado, Portugal

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 08:18 - 08:24

Location: Hall 13 / Elicium Ballroom

Purpose:

To systematically evaluate the long-term efficacy and safety of transepithelial accelerated corneal collagen crosslinking (TE-ACXL) in the treatment of patients with progressive keratoconus, reporting its visual and morphological outcomes throughout a 4-year follow-up.

Setting:

Retrospective, single-centre, observational cohort study that took place in Centro Hospitalar Universitário S. João (Porto, Portugal), a tertiary university hospital.

Methods:

39 eyes from 30 patients who underwent TE-ACXL (6mW/cm² for 15 minutes) for progressive keratoconus were included. Best-corrected visual acuity (BCVA), keratometry measurements, thinnest corneal thickness (PachyMin), and topographic indexes were analysed preoperatively and every 6 months after TE-ACXL, up to a maximum of 48 months. Disease progression was defined as an increase ≥ 1.00 D in corneal astigmatism, an increase ≥ 1.00 D in maximum keratometry (Kmax), a decrease $\geq 2\%$ in PachyMin or an increase ≥ 0.42 units in D-index.

Results:

No significant differences were observed in BCVA, corneal astigmatism, Kmax, index of surface variance (ISV), index of height decentration (IHD), and keratoconus index (KI) between baseline and subsequent evaluations ($p > 0.05$). Mean keratometry increased at 12- (0.66 ± 1.07 D, $p = 0.001$), 24- (0.66 ± 1.07 D, $p = 0.001$) and 36-months follow-up (1.48 ± 1.19 D, $p = 0.002$). D-index also increased at 12- (0.50 ± 1.05 ; $p = 0.011$), 24- (0.53 ± 1.19 ; $p = 0.024$) and 36-months follow-up (1.29 ± 1.11 ; $p = 0.003$). 28 (71.8%) eyes presented progression by ≥ 1 criterion. 2 (5.1%) eyes fulfilled all 4 progression criteria. Surgery and follow-up were uneventful in all subjects.

Conclusions:

TE-ACXL proved to be a safe and effective treatment for progressive keratoconus in our cohort, preventing visual and corneal topographic deterioration. Despite a large proportion of eyes fulfilling at least one progression criteria, only 2 cases fulfilled all 4 criteria. Thus, future definition of new specific and significant progression criteria and further prospective studies with larger cohorts are recommended.

Cornea

Scheimpflug Corneal Densitometry Analysis After Accelerated Cross-linking in Pediatric and Adult Keratoconus Patients

Presenting author: Ömer Özer, Turkey

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 08:24 - 08:30

Location: Hall 13 / Elicium Ballroom

Purpose:

The aim of this study is to compare the changes of corneal thickness and corneal densitometry in pediatric and adult keratoconus patients undergoing dextran-free riboflavin-UV-A accelerated corneal collagen crosslinking (CXL).

Setting:

Seventy-four eyes of 55 patients who underwent accelerated CXL with the diagnosis of progressive keratoconus between January 2018 and August 2019 in the Department of Ophthalmology, Faculty of Medicine, Mersin University, Turkey.

Methods:

At 1-year follow-up, patients with an increase in Kmax of 1 diopter (D) or more were included. Group 1 is under 18 years old, group 2 is over 18 years old. Corneal densitometry before and after CXL was measured from the 0-2 mm central area with the Pentacam Scheimpflug (Oculus Optikgeräte GmbH, Wetzlar, Germany) imaging system. Corneal thickness was also measured before and after CXL by both ultrasound pachymetry (Tomey SP-3000) and Pentacam Scheimpflug (Oculus Optikgeräte GmbH, Wetzlar, Germany).

Results:

Corneal densitometry before CXL was 19.84 ± 2.67 in group 1, 18.74 ± 1.56 in group 2, and after CXL 21.54 ± 3.32 in group 1, 24.53 ± 10.46 in group 2, and the difference was statistically significant ($p = 0.048$, $p < 0.0001$ respectively). In the measurements made with ultrasound pachymetry, after CXL corneal thickness values were significantly higher than the Scheimpflug imaging system ($p < 0.0001$ for both groups).

Conclusions:

Corneal densitometry measurements provide objective information in the follow-up of haze that develops after CXL in keratoconus patients. Since the haze that develops after CXL may adversely affect the central corneal thickness measurements made with the Scheimpflug imaging system, it is more beneficial to make these measurements with ultrasonic pachymetry.

Cornea

Individualized topography-guided crosslinking for keratoconus – comparison of epi-on in high oxygen to epi-off in room air protocols.

Presenting author: Anders Behndig, Sweden

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 08:36 - 08:42

Location: Hall 13 / Elicium Ballroom

Purpose:

To compare the efficacy, safety and healing phase of two different Customized Remodeled Vision (CuRV) crosslinking protocols for keratoconus.

Setting:

Department of Clinical Sciences/Ophthalmology, Umeå University, Umeå, Sweden.

Methods:

This ongoing study so far includes 19 patients at 12 month follow up with bilateral progressive keratoconus treated with bilateral CuRV; one eye with a high-oxygen epi-on protocol, the other eye with an epi-off protocol in room air, which was randomized and masked to the participant. Uncorrected (UDVA) and corrected visual acuities (CDVA), low-contrast visual acuities (LCVA) at 10% and 2.5%, refractive spherical equivalents (SE), keratometry readings (Kmax), endothelial cell count (ECC) and adverse events were analyzed pre- and post treatment. The discomfort symptoms during the healing phase for each eye was registered during the first week post treatment.

Results:

UDVA improved at 12 months (-0.26 ± 0.34 logMAR for epi-on; -0.18 ± 0.25 logMAR for epi-off, ($p < 0.01$), as did the CDVA (-0.13 ± 0.15 , -0.10 ± 0.11 , respectively, $p < 0.01$), the Kmax (-2.44 ± 2.28 , -1.29 ± 2.77 D, respectively, $p < 0.01$) and 10% LCVA (-0.29 ± 0.42 and -0.14 ± 0.13 , respectively, $p < 0.01$). LCVA 2.5 % improved more in epi-on (-0.65 ± 0.91 , -0.15 ± 0.25 , respectively, $p < 0.05$). The epi-on eyes had less discomfort during the first week post-treatment. A slight reduction in ECC was noted in epi-off (-175 ± 212 cells/mm², $p < 0.01$). No adverse events occurred.

Conclusions:

Our preliminary results indicate that the novel high-oxygen epi-on treatment protocol may be a promising alternative to epi-off CuRV. Inclusion of more patients and a longer follow up will show if this preliminary impression can be confirmed.



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Corneal cross-linking at the slit lamp - first results

Presenting author: Farhad Hafezi, Switzerland

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 08:42 - 08:48

Location: Hall 13 / Elicium Ballroom

Purpose:

To assess the depth of the demarcation line in epi-off corneal cross-linking (CXL) performed in the sitting position at the slit lamp at one month after the procedure.

Setting:

ELZA Institute, Dietikon/Zurich, Switzerland

Methods:

Eleven patients underwent epi-off CXL at the slit lamp. In brief, de-epithelialization was followed by instillation of hypo-osmolaric riboflavin without HPMC (Ribo-Ker, EMAGine AG, Zug, Switzerland) for 10 minutes. Irradiation was performed with an intensity of 9 mW/cm² for 10 minutes, accumulating in a total fluence of 5.4 J/cm². At one month after the procedure, demarcation line imaging was performed using a high-resolution anterior segment OCT (MS-39, CSO Italia, Scandicci, Italy). The depth of the demarcation line was assessed using a patented automated OCT image analysis software (OCTanalysis.com).

Results:

Surgery was uneventful in all cases. The demarcation line depth was identified in 10 of the 11 eyes using the OCT image analysis software. Demarcation line depth was 190 +/- 59 µm.

Conclusions:

The depth of the demarcation line is in line with previous findings in epi-off CXL using riboflavin solutions with dextrane (184+/-38.9 µm) and HPMC (200+/-99.76 µm), suggesting that the stromal depth to which cross-links occur in CXL in the upright position is similar to what has been reported for the lying position. Please note: Number of eyes will increase to 25 eyes by the time of the congress.

Cornea

Comparison of standard versus accelerated corneal collagen cross-linking for keratoconus: long-term outcomes from the Save Sight Keratoconus Registry

Presenting author: Himal Kandel, Australia

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 08:48 - 08:54

Location: Hall 13 / Elicium Ballroom

Purpose:

Long term-effectiveness of Standard (UV power: 3mW/cm², duration: 30 min) vs Accelerated (UV power: 9mW/cm², duration: 10 min;) corneal cross-linking (CXL) for stabilizing progressive keratoconus is unknown. This study aimed to compare the long-term (5 years) efficacy and safety of these protocols in keratoconus using the real-world data from the Save Sight Keratoconus Registry (SSKR).

Setting:

Data from the routine clinical practice (15 sites in Australia, New Zealand and Italy) captured through a web-based registry system

Methods:

This observational study included 98 eyes (73 patients) who had standard CXL and 81 eyes (66 patients) who had accelerated CXL, with a follow-up visit at five-year post-CXL. The mean age of the participants was 24.95 ± 7.96 (standard 24.3±7.2 vs accelerated 25.7±8.1) years, and 35.3% were female (standard 32.9% vs accelerated 37.9%). The outcome measures included changes in visual acuity, keratometry (maximum keratometry, Kmax; and central steepest keratometry, K2), minimum corneal thickness (MCT), and frequency of adverse events. The outcomes were compared using mixed-effects regression models adjusted for age, sex, visual acuity, keratometry, pachymetry, doctor, practice, and eye laterality.

Results:

The adjusted mean changes (95% CI) in outcomes were slightly better in standard CXL than in accelerated CXL [visual acuity, 9.38(-3.06 to 21.8) vs 6.42(-3.48 to 16.3) logMAR letters; Kmax, -1.20(-2.68 to 0.29) vs -0.61(-2.24 to 1.01)D; K2, -0.39(-1.22 to 0.44) vs 0(-0.89 to 0.89)D; MCT, -5.17(-18.4 to 8.01) vs -16.93(-34.4 to 0.58)µm. However, none of the differences between the CXL protocols was statistically significant (all p>0.05). The frequency of adverse events at a 5-year follow-up visit was low in both groups [standard, 5 (5.1%; haze 3; scarring 1, epithelial defect 1) and accelerated, 3 (3.7%; haze 2, scarring 1)].

Conclusions:

This real-world observational study found that both standard and accelerated CXL were similarly safe and effective in stabilizing keratoconus at five years post-surgery. Overall, both protocols improved visual and keratometry outcomes in the long term.

Cornea**The effect of topography-guided corneal crosslinking on the curvature of the posterior corneal surf****Presenting author:** Emmanuel Neves, Portugal**Session name:** Cross-linking**Date and time:** 11 October 2021, 08:00 - 09:30**Presentation time:** 08:54 - 09:00**Location:** Hall 13 / Elicium Ballroom**Purpose:**

Corneal crosslinking (CXL) is an evolving therapy for the treatment of progressive keratoconus (KC). Topography-guided CXL has been proposed as an alternative to standard CXL, targeting greater flattening of the cone apex and improved visual function. While structural changes in the posterior surface of the cornea commonly precede anterior irregularities, the irradiating effect of CXL is limited to the anterior half of the cornea and its effectiveness is usually assessed looking only at the anterior corneal surface. Our goal was to evaluate the stabilizing effect of CXL on the posterior corneal surface of patients treated with a topography-guided CXL protocol.

Setting:

Unidade de Oftalmologia de Coimbra (UOC), Coimbra, Portugal

Methods:

Prospective case series of KC patients consecutively submitted to CXL using the KXL-II® platform (Avedro, Waltham, MA, USA). We designed a treatment protocol of centripetally increasing fluence from 5.4J/cm² to 10J/cm² centered on the thinnest corneal point as chosen on corneal tomographies (Oculus Pentacam, Optikgerate GmbH, Wetzlar, Germany). We collected data on pre- and post-treatment BCVA, anterior and posterior corneal curvature parameters from Oculus Pentacam®. Post-treatment values were measured at 12 months after the intervention. Student's t tests were used to compare pre- and post-treatment continuous variables. An α level of 0.05 was considered as significant.

Results:

We included 62 eyes from 52 patients, age 23.8 ± 7.3 years. Pre- and post-treatment BCVA were 0.35 ± 0.24 and 0.19 ± 0.14 logMAR ($p < 0.001$). Pre- and post-treatment maximum K values was 58.71 ± 0.86 and 57.06 ± 1.39 ($p = 0.16$). Pre- and post-treatment index of surface variation (ISV) was 105.97 ± 4.37 and 97.48 ± 6.98 ($p = 0.15$). Pre- and post-treatment anterior K at 3mm was 48.38 ± 0.49 and 48.35 ± 0.65 ($p = 0.49$), while pre- and post-treatment posterior K at 3mm was -7.20 ± 0.14 and -7.17 ± 0.15 ($p = 0.56$). Pre- and post-treatment anterior keratometric astigmatism was 3.74 ± 0.21 and 3.89 ± 0.38 ($p = 0.36$) and posterior keratometric astigmatism was and -0.80 ± 0.08 and -0.80 ± 0.06 ($p = 0.49$). Pre- and post-treatment posterior float was 55.62 ± 2.08 and 57.11 ± 3.03 ($p = 0.34$).

Conclusions:

Biomechanical alterations caused by KC induce curvature changes in both the anterior and posterior corneal surface. Despite the tailored and targeted nature of our treatment protocol, in which the inferior cornea receives most of the UV energy, it seems it can effectively stabilize both the anterior and posterior corneal surfaces, while also improving vision.

Cornea**Customized Corneal Crosslinking for Keratoconus – Clinical and Morphological Results****Presenting author:** Joao Chaves, Portugal**Session name:** Cross-linking**Date and time:** 11 October 2021, 08:00 - 09:30**Presentation time:** 09:06 - 09:12**Location:** Hall 13 / Elicium Ballroom**Purpose:**

Conventional corneal cross-linking treatments have shown to stabilize keratoconus progression but its inability to rehabilitate vision remains an important limitation. Recent studies indicate that higher levels of UVA induce more flattening, favoring individualized treatment plans with local treatment augmentation in the most affected areas. We report a novel customized irradiation protocol to treat KC patients. We hypothesize that using focal instead of broad-zone CXL will lead to greater localized cone flattening, less corneal irregularity, and better visual outcomes.

Setting:

Unidade de Oftalmologia de Coimbra (UOC), Coimbra, Portugal; Ophthalmology Unit, Centro Hospitalar e Universitário de Coimbra (CHUC), Coimbra, Portugal; Clinical Academic Center of Coimbra (CACC), Coimbra, Portugal; University Clinic of Ophthalmology, F

Methods:

Prospective case series enrolling eyes with progressive keratoconus and central corneal thickness exceeding 380 μ m. Customized irradiation was performed with the KXL-II platform (Avedro, Waltham, MA, USA) and designed as the superposition of 3 concentric areas centered on the thinnest point on Pentacam maps (Oculus Optikgerate GmbH, Wetzlar, Germany). Treatment starts from a broad-beam irradiation, continuously masked until only the central inner circle is irradiated. Energy exposure is 5.4J/cm² in the outer circle and increases centripetally to 7.2J/cm² and 10J/cm². Corrected distance visual acuity (CDVA), refractive results, and Scheimpflug tomographies were assessed preoperatively and 3, 6 and 12 months after the procedure.

Results:

We included 59 eyes of 50 patients with a mean central corneal thickness of 473.06 \pm 40.58 μ m. Mean CDVA improved significantly from 0.34 \pm 0.19 to 0.19 \pm 0.13 logMAR ($p \leq 0.001$). Average refractive astigmatism reduced from -2.48 \pm 1.16 D to -2.33 \pm 1.37 D ($p \leq 0.001$) and the sphere increased from -1.61 \pm 1.90 to -1.99 \pm 2.35 ($p \leq 0.001$). The maximal curvature (Kmax) decreased from 58.34 \pm 8.06D to 57.11 \pm 7.45D ($p \leq 0.001$). The Index of Surface Variation (ISV) significantly decreased from 99.03 \pm 32.54 to 86.43 \pm 31.75 ($p \leq 0.001$), a decrease that correlated with the improvement in CDVA ($r=0.40$, $p=0.03$). After 1 year 94.1% of eyes showed no signs of progression. None of the patients developed significant complications during the course of the follow-up.

Conclusions:

Our results show positive structural changes induced by a customized cross-linking treatment that modulates the intensity of the irradiation across different areas of keratoconic corneas. An improvement in visual acuity correlated with a reduction in surface irregularity was noted, suggesting an advantage of customized treatments.

Cornea

Comparison of tomographic outcomes after topography-guided photorefractive keratectomy with accelerated cross-linking versus accelerated cross-linking alone in patients with keratoconus

Presenting author: Rasoglou Achilleas, Greece

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 09:12 - 09:18

Location: Hall 13 / Elicium Ballroom

Purpose:

To evaluate the medium to long-term stability of post-operative tomographic outcomes after combined topography-guided photorefractive keratectomy (topo-PRK) and accelerated cross-linking (CXL) versus standalone epithelium-off CXL in patients with progressive keratoconus.

Setting:

Ophthalmica Institute, Thessaloniki, Greece

Methods:

This retrospective study evaluated the medical files of patients with keratoconus who underwent epi-off CXL with VibeX Rapid riboflavin solution and the KXL system, with or without topography-guided PRK, between the dates of 01/2013 and 01/2017. Medical files containing Pentacam tomography outcomes through 3 or more years post-operatively were identified for inclusion. To evaluate the stability of the post-operative outcomes, tomography parameters from the last follow-up visit were compared to the first-postoperative visit. Outcome parameters include maximum keratometry (Kmax), pachymetry at the thinnest location (pachy), flat keratometry (K1), steep keratometry (K2), index of surface variance (ISV) and mean keratometry (Km).

Results:

Ninety-one eyes of 66 patients with a pre-operative diagnosis of progressive keratoconus who underwent topo-PRK + CXL (n=47 eyes) or CXL alone (n=44 eyes) were identified for inclusion in the study. In the topo-PRK + CXL group, mean Kmax at the first post-operative follow-up visit was 48.6 D (± 5.2 D), compared to 51.3 D (± 5.7 D) in the CXL group. Outcome measures showed comparable improvement from the first-post-operative visit through the last follow-up visit in both groups (topo-PRK + CXL, mean difference: Kmax: -1.3 ± 2.9 D; Km: -2.1 ± 2.6 D; ISV: -5.4 ± 19.8 ; CXL group, mean difference: Kmax: -1.1 ± 3.1 D; Km: -1.0 ± 2.8 D; ISV: -1.5 ± 23.9).

Conclusions:

Topo-PRK may reduce corneal irregularity in patients with progressive keratoconus. CXL aims to stabilize against progression of keratoconus but may result in post-operative flattening. To distinguish the gradual flattening induced by the accelerated CXL procedure from the immediate change in curvature induced by topo-PRK, we compared the first post-operative visit to the longest follow-up visit (3-7 years post-procedure). The results of this study suggest that the addition of topo-PRK did not significantly impact the rate of flattening that occurred after CXL.

Cornea

Eight year Results of accelerated epi-off corneal Cross-Linking in Patients with Progressive Keratoconus

Presenting author: Miguel Rechichi, Italy

Session name: Cross-linking

Date and time: 11 October 2021, 08:00 - 09:30

Presentation time: 09:18 - 09:24

Location: Hall 13 / Elicium Ballroom

Purpose:

Evaluate the long-term functional results based on keratometric measurements, spherical and cylinder equivalent in patients with progressive keratoconus treated with 15 mW/cm² pulsed-light epithelium-off accelerated CXL

Setting:

Retrospective study in which 280 eyes from 200 patients affected by keratoconus with minimum thickness of 400 micron was treated with accelerated crosslinking between 2012 and 2020 in three center (Dr Rechichi Eye center, Siena Crosslinking Center and P

Methods:

All patients were evaluated preoperatively, FU was performed at 1, 3, and 6 months and every year from 1 to 8 years after accelerated CXL. After epithelium removal and 10 minutes stromal soaking with riboflavin 0.1% hydroxypropyl methylcellulose solution (Vibex Rapid), all eyes had 15 mW/cm² pulsed- light epithelium-off accelerated CXL for 6 minutes of ultraviolet-A (UVA) irradiation (1 Second on/1 off) (Avedro KXL machine), maintaining a total UVA exposure of 12 minutes at a fluence of 5.4 J/cm². Follow-up examination included uncorrected (UDVA) and corrected (CDVA) distance visual acuities, Scheimpflug tomography, and spectral- domain optical coherence tomography (SD-OCT).

Results:

We observed significant improving in all keratometric values during the follow-up. Kmax decrease become statistically significant at 1 year after CXL and remained statistically significant thereafter up to 8 years. Mean spherical equivalent and mean cylinder both improved during the follow-up. Also uncorrected and corrected visual acuity increased remaining statistically significant, at the 8 years after CXL. We did not observe any case of severe complication.

Conclusions:

Our results show that 15 mW/cm² pulsed-light epithelium-off accelerated CXL was effective and safe, stabilizing keratoconus progression through 8 years of follow-up.

Cornea

Descemet membrane endothelial keratoplasty (DMEK): 10-year clinical outcomes and graft survival

Presenting author: Silke Oellerich, Netherlands

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 11:30 - 11:36

Location: Forum

Purpose:

To evaluate graft survival and clinical outcomes up to 10 years after Descemet membrane endothelial keratoplasty (DMEK).

Setting:

Retrospective cohort study conducted at the Netherlands Institute for Innovative Ocular Surgery.

Methods:

750 consecutive DMEK eyes, not including the very first 25 DMEK eyes that constitute the technique learning curve, were included. Main outcome parameters (survival, best-corrected visual acuity (BCVA), central endothelial cell density (ECD)) were evaluated up to 10-years postoperatively and postoperative complications were documented. Outcomes were analyzed for the entire study group and separately for the subgroup of the first 100 DMEK eyes.

Results:

For the subgroup of 100 DMEK eyes, 82% and 89% reached a BCVA of $\geq 20/25$ (Decimal VA ≥ 0.8) at 5- and 10 years postoperatively, respectively, and preoperative donor ECD decreased by 59% at 5 years and 68% at 10 years postoperatively. Graft survival probability for the first 100 DMEK eyes was 0.83 [95% Confidence Interval (CI), 0.75-0.92] and 0.79 [95% CI, 0.70 -0.88] at 5- and 10-years postoperatively, respectively. For the total study group, clinical outcome in terms of BCVA and ECD were comparable, but graft survival probability was significantly higher at 5- and 10-year postoperatively.

Conclusions:

Most eyes operated in the pioneering phase of DMEK showed excellent and stable clinical outcomes with a promising graft longevity over the first decade after surgery. The increase in DMEK experience resulted in a lower graft failure rate and positively affected longer-term graft survival probability.

Cornea

Customized DMEK for Fuchs Endothelial Corneal Dystrophy

Presenting author: Viridiana Kocaba, Netherlands

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 11:36 - 11:42

Location: Forum

Purpose:

To report the technique and outcome of the first series of Customized-Descemet's membrane endothelial keratoplasty (Custom-DMEK) for the treatment of Fuchs Endothelial Corneal Dystrophy (FECD).

Setting:

Prospective interventional case series at a tertiary referral centre.

Methods:

Ten eyes of 10 patients with Fuchs endothelial corneal dystrophy underwent Custom-DMEK, based on FECD severity. The diameter of DMEK graft was calculated based on the image analysis of retroilluminated picture obtained after full dilatation. Patients were evaluated for best-corrected visual acuity (BCVA), endothelial cell density (ECD) and complications up to 6 months postoperatively. Descemet membranes (DM) obtained from descemetorhexis were analyzed under phase-contrast microscope.

Results:

DMEK grafts from 5 to 7.5mm were performed. At 6 months postoperatively, all eyes reached a BCVA of $\geq 20/25$ (≥ 0.8). Mean central ECD decreased from 2530 (± 150) cells/mm² before to 1700 (± 200) cells/mm² at 6 months after surgery. No complications were reported. All DM samples showed peripheral margins clear from guttae.

Conclusions:

We proposed the Custom-DMEK as a personalized treatment approach based on an objective quantitative evaluation of FECD severity to preserve the healthy peripheral corneal endothelial cells.

Cornea**Customized Stromal Lenticule Implantation for Keratoconus**

Presenting author: Farideh Doroodgar, Iran, Islamic Republic of

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 11:42 - 11:48

Location: Forum

Purpose:

To investigate the potential benefit of keratoconus surgery using customized corneal stromal donor lenticules obtained from myopic small incision lenticule extraction (SMILE) surgery by femtosecond laser.

Setting:

Negah Eye Hospital

Methods:

In this prospective, consecutive, series of cases, 22 lenticules were obtained from 22 myopic patients who had SMILE with a lenticule central thickness greater than 110 μm . The lenticules were implanted in 22 eyes with advanced keratoconus. The lenticules were customized for the implantation with either a simple necklace or necklace-with-ring shape (compound form) depending on the corneal thickness and corneal topography configuration of the implanted keratoconic eyes. The lenticules were implanted into a 9.5-mm corneal lamellar pocket created by the femtosecond laser. Changes in densitometry, thickness, confocal microscopy, corrected distance visual acuity (CDVA), and endothelial cell density was investigated.

Results:

Intrastromal lenticule implantation was successfully performed in all cases without any complication. Corneal thickness showed a mean enhancement of 100.4 μm at the thinnest point. On biomicroscopy, all corneas were clear at 1 year postoperatively, and there was a significant improvement in corneal densitometry during the entire follow-up period. Confocal biomicroscopy showed collagen reactivation without any inflammatory features caused by the implanted fresh lenticules. CDVA improved from 0.70 to 0.49 logMAR ($P = .001$) and keratometry decreased from 54.68 ± 2.77 to 51.95 ± 2.21 diopters ($P = .006$).

Conclusions:

Customized SMILE lenticule implantation by femtosecond laser proved feasible, resulting in an improvement in vision, topography, and refraction in the implanted eyes.

Cornea

Nomogram for single-pass two-speed automated microkeratome graft preparation for ultrathin Descemet stripping automated endothelial keratoplasty

Presenting author: Álvaro Sánchez-Ventosa, Spain

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 11:48 - 11:54

Location: Forum

Purpose:

To create a nomogram that includes the translational speed of the microkeratome blade, microkeratome head size and the precut tissue thickness in order to predict the postcut thickness for Descemet stripping automated endothelial keratoplasty (DSAEK) and thus obtain the thinnest possible graft.

Setting:

Hospital la Arruzafa, Córdoba (SPAIN)

Methods:

This prospective study incorporated 48 grafts for DSAEK. Corneal tissue for DSAEK was prepared using the Moria Evolution3E microkeratome with 400, 450 and 500mm head sizes. Precut central corneal thickness was measured with a DGH550 handheld pachymeter. The microkeratome head was selected according to precut tissue thickness, 150µm less than the donor cornea thickness. The target donor lamella thickness ranged from 70 to 120 µm. Two translational speeds were used for the microkeratome cuts. One month after surgery, the central lenticular thickness was measured with a Visante® Optical Coherence Tomography caliper (Carl Zeiss Meditec Inc, Germany). A descriptive analysis was performed.

Results:

A total of 48 donor grafts were prepared during the study period. The mean graft thickness (GT) was $97,58 \pm 29.84$ µm (range 39 to 176 µm). From the 49 samples, 39 were below 120µm (81.25%), 28 had a central GT of less than 100 µm (58.33%) and 18 were below 80µm (37.50%) at one-month appointment. There was no statically significant difference between both translational speeds.

Conclusions:

The use of a proper nomogram with an automated microkeratome to obtain a thin graft for DSAEK provided good results in terms of graft thickness without donor wastage.



8 – 11
October 2021

Cornea

Tectonic 'mini-DSAEK' or ab interno stromal patch using residual tissue from other keratoplasty for the management of corneal perforations

Presenting author: Chrishan Gunasekera, United Kingdom

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 12:00 - 12:06

Location: Forum

Purpose:

To report a case series of using ab interno donor corneal material to plug corneal perforations secondary to different scenarios including trauma, neurotrophic ulcer in a penetrating keratoplasty (PK), herpes simplex keratitis and microbial keratitis.

Setting:

Southend University Hospital NHS Foundation Trust, UK

Methods:

In this retrospective case series, we describe five cases of ab interno tectonic keratoplasty in 5 patients presenting with corneal perforation to Southend University Hospital, UK, between November 2019 and October 2020. Four patients received tectonic small diameter Descemet Stripping Automated Endothelial Keratoplasty (mini-DSAEK) and one patient received an internal stromal patch graft. One corneal perforation was sufficiently peripheral for which the tectonic mini-DSAEK graft was successfully positioned outside of the central visual axis. Four corneal perforations were central or paracentral for which the tectonic grafts involved the visual axis.

Results:

Anterior chamber remained deep and formed with no evidence of leak in all subsequent follow ups in all patients. Air/gas tamponade was performed in two patients for graft detachment. All tectonic grafts remained attached except one partially detached graft. One patient underwent uneventful phacoemulsification with intraocular lens implant 8 months after the primary intervention with excellent visual outcome. Two patients underwent two-piece mushroom PK for visual rehabilitation 2-4 months after the primary intervention with good visual outcome.

Conclusions:

Tectonic mini-DSAEK and ab interno stromal patch grafts are safe, sutureless, and efficient techniques in the management of corneal perforations with a number of advantages compared with conventional techniques. This would be of interest to ophthalmologists who manage corneal perforations.

Cornea

A machine learning approach to explore predictors of graft detachment and graft failure in posterior lamellar keratoplasty; a nationwide registry study

Presenting author: Marc Muijzer, Netherlands

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 12:06 - 12:12

Location: Forum

Purpose:

To report the variance in practice patterns for posterior lamellar keratoplasty (DMEK/DSEK) and evaluate the influence of these variations on the incidence of graft detachment and graft failure using a machine learning approach.

Setting:

The nationwide prospective Dutch Cornea transplant registry complemented with center-specific practice patterns.

Methods:

All DMEK and DSEK in DCTR between 2015 and 2018 were included and center-specific practice patterns were acquired using an anonymized 35-item survey. All available variables of the donor, graft, recipient, practice patterns, and clinical course were collected for machine learning analyses. Random over-sampling was performed to balance the dataset for the analysis. Linear and non-linear associations were assessed using a LASSO-regression and classification tree analysis (CTA) respectively. Predictor variables were selected and the effect sizes were estimated for graft detachment and graft failure. The predictive power of the model was assessed using sensitivity/specificity and the area under the curve.

Results:

A total of 3647 transplants in 16 centers were included for analysis; 996 DMEK (27%) and 2651 (ultrathin-)DSEK (73%). The variance in practice patterns was considerable. The overall incidence of detachments and graft failures were 17.4% and 8.4% for DMEK, and 7.1% and 3.8% for DSEK. The predictive power of the two models (LASSO/CTA) was moderate with an AUC of 0.68/0.66 for detachments and 0.66/0.77 for graft failure. Prospective risk-assessments considering particular case management choices were constructed for archetypical patients with a Shapely plots: an important tool in Explainable AI.

Conclusions:

Our machine learning analysis using real-world data identified predictor variables in the multifactorial origin of graft detachment and graft failure following DMEK and DSEK. The linear and non-linear analysis provide insight in which factors and mechanisms contribute to the development of these adverse events and their respective effect size. The outcomes of this study can be used to enhance practice patterns and reduce post-operative complications.

Cornea

Effect of Early Endothelial Cell Density Loss on Graft Survival after Descemet Membrane Endothelial Keratoplasty

Presenting author: Indrė Vasiliauskaitė, Netherlands

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 12:12 - 12:18

Location: Forum

Purpose:

To analyze if early endothelial cell density (ECD) loss at 6-months affects long-term ECD outcome and graft survival 5-years after Descemet membrane endothelial keratoplasty (DMEK).

Setting:

Retrospective cohort study conducted at the Netherlands Institute for Innovative Ocular Surgery

Methods:

A total of 669 DMEK eyes (512 patients) were included. The study group was divided into 4 groups based on 6-month ECD quartiles: Group 1 (n=167) with 313-1225 cells/mm², Group 2 (n=171) with 1226-1600 cells/mm², Group 3 (n=167) with 1601-1930 cells/mm² and Group 4 (n=164) with 1931-2760 cells/mm². Group 1 was further split into Subgroup 1a (n=42) with 6-month ECD of ≤ 800 cells/mm², Subgroup 1b (n=42) with 801-990 cells/mm², and Subgroup 1c (n=83) with 991-1225 cells/mm². The main outcome measures were long-term ECD, graft survival probability and postoperative complication rates.

Results:

Overall preoperative donor ECD decreased by 38 ± 18 % to 1570 ± 480 cells/mm² at 6-months postoperatively. For Group 1, ECD decreased from 933 ± 235 cells/mm² at 6-months to 732 ± 210 cells/mm² at 5-years postoperatively. Group 1 graft survival probability was 0.90 at 5-years, which was lower than for Groups 2-4 ($P=0.001$). Five-year graft survival in Subgroup 1a was 0.66, which was lower than in Subgroups 1b and 1c (0.98 and 0.99, respectively) ($P=0.001$). Preoperative ECD did not influence graft survival ($P=0.473$), higher 6-month ECD was associated with lower graft failure rates (HR 0.997, ($P=0.001$)).

Conclusions:

Six-months ECD is associated with DMEK graft survival. High early cell loss after DMEK negatively affects long-term ECD outcome and graft survival. Grafts with ECD ≤ 800 cells/mm² at 6 months are at higher risk of failure within 5-years after DMEK. To ensure sufficiently high ECD at 6-months postoperatively preoperative graft quality assessment should be optimized and cellular stress induced to the graft be minimized. Additionally, developing therapeutical options for the treatment of eyes in which low postoperative ECD could not be prevented, may further improve DMEK graft longevity.



8 – 11
October 2021

Cornea

Impact of TCF4 repeat number on resolution of corneal edema after Descemet's Stripping Only in Fuchs Dystrophy: a pilot study

Presenting author: Nino Hirschall, Austria

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 12:18 - 12:24

Location: Forum

Purpose:

To investigate whether Fuchs endothelial corneal dystrophy (FECD) genotype, specifically TCF4 CTG triplet repeat "load" or presence of SLC4A11 variants, predicts time to clearance following Descemet's Stripping Only (DSO).

Setting:

Sydney Eye Hospital, Australia

Methods:

This prospective, interventional trial was conducted on consecutive FECD patients undergoing DSO. Genetic analysis using patients' saliva was performed to assess the extent of CTG expansion and SLC4A11 variants using short tandem repeat analysis, corroborated with gel electrophoresis and Sanger sequencing. Polymerase chain reaction and bidirectional Sanger sequencing was undertaken. Partial least square regression and logistic regression modelling was used to evaluate the predictive power of TCF4 repeats and SLC4A11 on corneal clearance.

Results:

Of 11 eyes of 11 patients, 8 showed complete corneal clearance. Mean TCF4 allele repeat was 24.8 (SD: 23.7, range: 11-63) and 63.4 (SD: 30.3; range: 11-97), respectively. 9/11 (81.8%) had expanded CTG repeats (>40) in one allele. In cases with an allele repeat ≥ 80 , there was a significantly increased risk of corneal non-clearance (odds ratio 18.2, $p=0.009$).

Conclusions:

Whilst it was not possible to predict time to corneal clearance based on CTG repeats, there is a significant correlation between allele repeats and achievement of corneal clearance.



8 – 11
October 2021

Cornea

Limbal stem cell graft preparation for corneal epithelium reconstruction with the femtosecond laser

Presenting author: Olga Nefedova, Russian Federation

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 12:30 - 12:36

Location: Forum

Purpose:

To assess the possibility of using low-energy (nJ) femtosecond laser for cutting the limbal epithelial stem cell transplant.

Setting:

The S. Fyodorov Eye Microsurgery Federal State Institution, Moscow, Russian Federation

Methods:

Six donor eyes not suitable for clinical use were utilized for dissection of the limbal micro-transplants (LMT) with low-energy femtosecond laser (FSL) and manual blade techniques. In each eye at the upper and lower limbus 200 microns depth FSL cut with custom build trajectory was applied to dissect 4 FSL-LMT to achieve 8 tissue fragments. Adjacent to laser cut, both at the upper and lower limbus 8 (4x2) LMT were dissected with blade. Total of 16 LMT from each eye were collected and cultured. The graft beds were examined by optical and electron microscopy, immunohistochemistry, and optical coherence tomography (OCT).

Results:

Low-energy FSL creates uniform LMT in comparison with those achieved with microsurgical blade. A new custom build trajectory allows to form a limbal graft of the required depth, width and length. There were no or minimal tissue bridges, when pieces were taken out of the graft bed. In culture there were found no statistical difference between the cell outgrowth from the FSL-LMT and manual LMT ($p=0.617$). OCT and electron microscopy revealed that graft bed formed with FSL was having a flat and smooth surface and with uniform cut depth.

Conclusions:

The low-energy femtosecond laser Femto LDV Z8 achieves predictable and accurate results in limbal graft cutting. The energy level used did not affected the cells' ability to outgrow from the limbal fragments.

Cornea

Combined umbilical cord patching with amniotic membrane graft for corneal reconstruction

Presenting author: Karim El Mowafi, Egypt

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 12:36 - 12:42

Location: Forum

Purpose:

The aim of this study is Evaluation role of combined umbilical cord patching with amniotic membrane graft transplantation for corneal perforations and thinning by assessment of healing of corneal perforation and increased corneal thickness in case with corneal thinning by using slit lamp bio microscopy and anterior segment optical coherence tomography

Setting:

This study have been held on patients attending to Mansoura Ophthalmic Center, Mansoura University. Egypt in the period from November 2018 till October 2019.

Methods:

After topical anesthesia for cases with corneal thinning patients and general anesthesia in corneal perforation cases. the base and surrounding of the ulcers were cleaned of necrotic tissue. The UCP with epithelium side facing up was trimmed to fit the shape and depth of the ulcer, and interrupted sutures were placed to anchor the UCP to the cornea .A large piece of the AM with epithelium side up was applied over the entire cornea. Finally, bandage contact lens was applied. All patients were followed up daily throughout the first week, weekly for 1 month, then monthly for the first 6 months.

Results:

There were 20 eyes with Corneal perforation or thinning. The diameter of corneal thinning ulcers of 3.5 ± 2.5 mm. The anterior chamber in all 20 eyes formed at first postoperative day with improvement of preoperative photophobia & foreign body sensation. The corneal thickness was increased in cases with corneal thinning from mean $86.00 \pm 24 \mu\text{m}$ to $194 \pm 25 \mu\text{m}$ postoperatively. Healing of corneal defect of cases with corneal perforation at average of 4 weeks. Best Correction Visual acuity in cases with thinning improvement from (-1.82 ± 3.455) by Log MAR to (-0.66 ± 1.942) . While, cases with perforation there was an improvement from (-0.53 ± 0.548) to (0.79 ± 0.677)

Conclusions:

The current study demonstrated the promising effects of combining UCP with amniotic membrane transplantation is a promising alternative for corneal insult, providing satisfactory reconstruction and preparing the eye for further keratoplasty operative with prognosis improving post-operative . Because of its easy availability and efficacy, UCP could be considered as talented alternative for corneal reconstruction. The amniotic membrane in used with UCP to serve as a substrate for regrowth of deficient epithelium; the aim is to integrate this membrane. The amniotic membrane reinforces the adhesion and differentiation of the corneal epithelial cells, facilitates their migration, and prevents their apoptosis.

Cornea

Assessment of the Role and Timing of Glaucoma Surgery in Boston Keratoprosthesis Type 1 Patients

Presenting author: Dominique Geoffrion, Canada

Session name: Corneal surgical

Date and time: 11 October 2021, 11:30 - 13:00

Presentation time: 12:42 - 12:48

Location: Forum

Purpose:

Glaucoma often develops or progresses after Boston keratoprosthesis type I (KPro) implantation, and it can be managed using glaucoma surgery during follow-up. The purpose of this study is to determine the role and optimal timing of glaucoma surgery in relation to KPro implantation.

Setting:

Centre hospitalier de l'Université de Montréal, Montreal (Quebec), Canada

Methods:

Retrospective study of a total of 100 eyes (100 patients) implanted with a KPro between 2008-2017 and diagnosed with glaucoma. Patients were separated into 2 groups: those with preexisting glaucoma and those who developed glaucoma de novo after KPro. Groups were then divided based on whether patients were medically or surgically managed. Glaucoma surgery included glaucoma drainage device (GDD) implantation, trabeculectomy, and cyclophotocoagulation (CPC). Primary outcomes included best-corrected visual acuity (BCVA), glaucoma progression, and complications. Differences in outcomes were compared using parametric and non-parametric tests, as well as log-rank test to compare time-to-outcome events.

Results:

Among 72 eyes with pre-existing glaucoma, 27 (38%) had glaucoma surgery pre-KPro (18 GDD), while 45 (62%) were medically managed. Among the latter, 19 (42%) needed glaucoma surgery post-KPro (16 GDD). Among 28 eyes with de novo glaucoma, 12 (43%) had glaucoma surgery post-KPro (9 GDD). Eyes with pre-existing glaucoma had greater glaucoma progression with glaucoma surgery performed post-KPro (100%) compared to pre-KPro (74%, $P=0.016$) and medical management (54%, $P=0.002$). Fewer eyes maintained $BCVA \geq 20/200$ over time with medications compared to glaucoma surgery ($P=0.013$). Eyes with de novo glaucoma had similar progression, BCVA and complications between medical and surgical care ($P>0.05$).

Conclusions:

Glaucoma surgery should be performed prior or concurrently to KPro in eyes with preexisting glaucoma. Complication rates are not increased when glaucoma surgery is performed in KPro eyes with preexisting or de novo glaucoma. To ensure optimal IOP control, glaucoma surgery should be performed as early as possible in KPro eyes with good visual potential.