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ARVO ABSTRACTS

Anterior Segment

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Program#/Poster#: 4179/D923

Abstract Title: Repeatability and Reproducibility of Central Corneal Power Measurement Using RTVue FD-OCT System

Presentation Start/End Time: Wednesday, May 04, 2011, 8:30 AM -10:15 AM

Session Number: 418

Session Title: Corneal Imaging

Location: Hall B/C

Reviewing Code: 170 corneal optics and topography - CO

Author Block: Yao Nie, Qienyuan Zhou, Ben Jang, Danny Leung. Optovue Inc, Fremont, CA.

Keywords: 445 cataract; 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound); 729 topography

Abstract Body: Purpose: To assess the repeatability and reproducibility across instruments of central corneal power (CCP) measurement using RTVue with CAM (Optovue, Fremont, CA) and the impact of pupil alignment and fixation.
Methods: The study was conducted with 4 RTVue instruments, 10 subjects, and 1 operator, following an IRB approved study protocol. One eye per subject was randomly selected for the study. To evaluate repeatability and reproducibility, 3 CCP scans were acquired on each of the 4 RTVue instruments for each of the 10 study eyes with alignment centered on pupil and subject fixated on the fixation target center. To evaluate impact of pupil alignment and fixation, 3 CCP scans were acquired per test eye on one randomly selected instrument for 3 pupil alignment positions (central, offset-horizontally, and offset-vertically) with central fixation and for 3 fixation positions (central, offset-horizontally, and offset-vertically) with central pupil alignment. Variance components were calculated to assess repeatability and reproducibility. ANOVA model was used to compare central vs. offset pupil alignment and fixation.
Results: Total 120 CCP measurements were acquired for the repeatability and reproducibility assessment. Variance component due to subject is 2.2323 (97.7%), variance component due to instrument is 0.008483 (0.4%), and residual variance is 0.04352 (1.9%); therefore, the repeatability is 0.209D (SD) and the reproducibility is 0.228D (SD). Ninety (90) CCP measurements were acquired for assessing pupil alignment and fixation impact respectively. With pupil shifted by approximately its radius horizontally or vertically, the measured CCP is reduced by approximately 0.2D on average, which is statistically significant ($p<0.025$). With fixation shifted from the center to the edge of the fixation target horizontally or vertically, the measured CCP is reduced by approximately 0.18D on average, which is statistically significant ($p<0.004$).
Conclusions: CCP measurement with RTVue is repeatable and reproducible across instruments. Pupil alignment and fixation could affect the measurement and operator should pay attention to the two factors during data acquisition.

CommercialRelationships: Yao Nie, Optovue Inc. (E); Qienyuan Zhou, Optovue Inc (E); Ben Jang, Optovue Inc (E); Danny Leung, Optovue Inc (E)

Support: None

Program#/Poster#: 3376/D823

Abstract Title: Optical Coherence Tomography Guided Transepithelial Phototherapeutic Keratectomy for Anterior Corneal Opacities

Presentation Start/End Time: Tuesday, May 03, 2011, 1:45 PM - 3:30 PM

Session Number: 356

Session Title: Pterygium and Corneal Surgery

Location: Hall B/C

Reviewing Code: 155 cornea/conjunctival surgery: non-refractive - CO

Author Block: Yan Li1, Nehal M. Samy El Gendy2, David Huang1. 1Casey Eye Institute, Oregon Health & Science University, Portland, OR; 2Ophthalmology, Cairo University, Giza, Egypt.

Keywords: 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound); 479 cornea: clinical science; 548 image processing

Abstract Body:
Purpose: To use optical coherence tomography (OCT) to guide transepithelial phototherapeutic keratectomy (PTK) of anterior corneal stromal opacities.
Methods: Anterior corneal stromal opacity (stromal dystrophies and scars) cases suitable for transepithelial PTK treatment were recruited. Preoperatively, pachymetry (8 radials, 1024 axial scans each, 6mm diameter) and 3-demensional (3D) volumetric (101 raster scans, 512 axial scans each, 6mm x 6mm scan size) OCT scans centered on the cornea were obtained with a Fourier-domain OCT (RTVue). An algorithm was developed to simulate the effect of transepithelial ablation using the OCT data. An excimer laser (VISX S4) was used to deliver PTK and refractive ablation based on OCT measurements (corneal opacity depth, epithelial thickens and stromal thickness) and the refraction. Postoperatively, OCT measurements, refraction and vision were recorded to evaluate the surgical outcome.
Results: Nine eyes of 8 patients had OCT-guided PTK and refractive ablation procedures and were followed-up for at least 3 months. The operated eyes gained an average of 4.5-line in uncorrected visual acuity and 2.0-line in best spectacle corrected visual acuity to 20/29. The laser ablations were deeper than nominal settings by 19.6%. The laser ablation efficiency was lower centrally than that peripherally, accounting for an 8.2% (% laser depth setting) central island height. The spherical equivalent refractive change (D) was related to epithelial thicknesses measured by OCT, in addition to the refractive ablation setting: Refractive change = -0.29 + 0.1405*(PTK depth - CET) - 0.159*(CET-PET) Where CET and PET were the central and peripheral epithelial thicknesses (μm). Postoperative OCT agreed well with simulated PTK performed on preoperative OCT data, based on both en face and cross-sectional views in terms of the pattern of residual opacities.
Conclusions: 3D OCT could be used to predict residual stromal thickness, refractive change, central island formation, and opacity reduction after PTK. This could help the surgeon plan PTK and refractive ablations to optimize visual outcome.

CommercialRelationships: Yan Li, Optovue, Inc. (F); Nehal M. Samy El Gendy, None; David Huang, Optovue, Inc (F, I, C, P, R)

Support: NIH grant EY018184, Research grants from Optovue, Inc.,

Clinical Trial: http://www.clinicaltrials.gov, NCT01243931

Program#/Poster#: 1745/A225

Abstract Title: Determination Of Optimal Limbal Location And Imaging Conditions For Identifying Schwalbe's Line And Scleral Spur Using Spectral-domain Anterior Segment Optical Coherence Tomography

Presentation Start/End Time: Monday, May 02, 2011, 1:45 PM - 3:30 PM

Session Number: 261

Session Title: New Technologies I /

Location: Hall B/C

Reviewing Code: 309 ocular imaging: new technologies and techniques - MOI

Author Block: Joshua C. Priluck, Deepak P. Edward. Dept. of Ophthalmology, Summa Health Systems, Akron, OH.

Keywords: 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound); 421 anterior segment; 549 imaging/image analysis: clinical

Abstract Body:
Purpose: This study examined the ability of spectral-domain anterior segment optical coherence tomography (AS-OCT) to consistently identify anterior chamber angle landmarks and determine optimal conditions during testing to identify these landmarks.
Methods: This observational study included 30 subjects (age range: 18-65 years) with no known ocular disease. AS-OCT was performed using the RTVue-100 cornea anterior module (Optovue, Fremont, CA). Scans were performed on the right eye in four quadrants. Baseline conditions included: the room lights off, target light on, and the limbus perpendicular to the coherence light beam. Scans of the temporal quadrant were repeated after varying the following conditions: room light, target light, use of an eyelid speculum, and gaze direction. Scans were reviewed twice for the identification of two landmarks: Schwalbe's line (SL) and scleral spur (SS) based on the termination of corneal endothelium and posterior aspect of trabecular meshwork respectively. Pearson's Chi-Square was calculated to compare the varying testing conditions. Intraobserver reproducibility scans were also tested using Cohen's kappa comparison.
Results: SL and SS were identified most consistently in the temporal quadrant (SL: 100%, SS: 96.7%) followed by the nasal (100%, 93.3%), inferior (73.3%, 33.3%), and superior quadrants (73.3%, 26.7%). Abduction, adduction, or standard positioning did not affect identification of SL (p=0.357) or SS (p=0.51). Modifying other variables including keeping the room and target light on, room light off/target light on, and all lights off did not affect identification of SL (p=0.519) or SS (p=0.833). An eyelid speculum significantly improved SS identification in the superior quadrant (26.7% without the speculum to 60% with; p=0.018). Intraobserver reproducibility comparing repeated interpretation of scans by a single observer found Cohen's kappa value's > 0.6 for SS and SL in all 4 quadrants.
Conclusions: The RTVue-100 CAM can identify SL and SS in the temporal and nasal quadrants and the use of an eyelid speculum improves visualization of these landmarks in the superior quadrant. Intraobserver evaluation of landmarks is reproducible in all quadrants. Spectral-domain AS-OCT may prove a useful tool to manage and screen for disease of the anterior chamber angle, but accurate landmark identification is not reliable in all quadrants; eyelid re-positioning is one technique that improves landmark detection.

CommercialRelationships: Joshua C. Priluck, None; Deepak P. Edward, None

Support: Summa Foundation Project Grant 52409

Program#/Poster#: 6278/D712

Abstract Title: Anterior Chamber Angle Measurement Using Fourier Domain Optical Coherence Tomography

Presentation Start/End Time: Thursday, May 05, 2011, 11:15 AM - 1:00 PM

Session Number: 548

Session Title: Anterior Segment Imaging and Biomechanics in Glaucoma

Location: Hall B/C

Reviewing Code: 229 glaucoma: imaging - GL

Author Block: Bing Qin1, Yan Li2, Maolong Tang2, Xinbo Zhang2, David Huang2. 1Ophthalmology, EENT Hospital, Fudan University, Shanghai, China; 2Casey Eye Institute, Oregon Health and Science University, Portland, OR.

Keywords: 420 anterior chamber; 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound); 549 imaging/image analysis: clinical

Abstract Body:
Purpose: To introduce angle opening distance at Schwalbe's line (AOD-SL) as a new measurement to help evaluate angle closure risks using optical coherence tomography (OCT).
Methods: An 830-nm wavelength Fourier-domain OCT (RTVue, Optovue, Inc.) was used to perform horizontal scans of the nasal and temporal anterior chamber angles in glaucoma subjects. Images were graded by two ophthalmologists who assessed the visibility of landmarks and measured AOD-SL (Figure 1) with computer calipers. Gonioscopy was performed by a glaucoma specialist and classified using the Shaffer system. Shaffer grade of 1 or less was considered occludable. Spearman's rho was used to evaluate correlation between AOD-SL and Shaffer grade. A cut-off value of AOD-SL for occludability was determined with receiver operating characteristic (ROC) analysis. Areas under the ROC curve (AROC) was used to assess the accuracy of angle classification.
Results: Thirty five subjects (65 eyes) were enrolled. Averaging the 2 graders and angle positions, the Schwalbe's line, anterior limbus, angle recess and scleral spur were visible in 85.8%, 85.8%, 40.8% and 15.0% of eyes, respectively. Correlation coefficient between AOD-SL and Shaffer grade were 0.80 (nasal) and 0.81 (temporal). The optimized diagnostic cut-off point for AOD-SL was 290μm. The AROC/sensitivity/specificity were 0.90/0.80/0.87 (nasal) and 0.90/0.85/0.77 (temporal).
Conclusions: Anterior segment OCT at the 830 nm wavelength has shallower limbal penetration, therefore scleral spur is poorly visible. But the Schwalbe's line and anterior limbus can be visualized clearly in most of the OCT images. Measuring AOD-SL by OCT is highly correlated with gonioscopy and may be useful as a noncontact method of assessing angle closure risk.

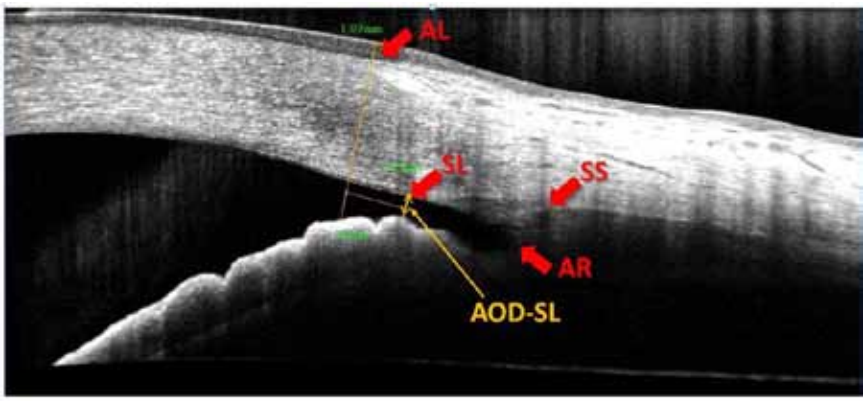


Figure 1. Anterior Chamber Angle Anatomical Landmarks and Measurement of AOD-SL in an Optical Coherence Tomography Line Scan Image (AL = Anterior Limbus, SL = Schwalbe's Line, SS = Scleral Spur, AR = Angle Recess, AOD-SL = Angle Opening Distance at Schwalbe's Line).

CommercialRelationships: Bing Qin, None; Yan Li, Optovue, Inc. (F, R); Maolong Tang, Optovue, Inc. (F); Xinbo Zhang, Optovue, Inc. (F); David Huang, Optovue, Inc. (F, P, R)

Support: NIH Grant R01EY013516

Program#/Poster#: 339/D855

Abstract Title: RTVue CAM Anterior Segment OCT Imaging of Epithelial Lip Overriding Front Plate of Boston Type I Keratoprosthesis

Presentation Start/End Time: Sunday, May 01, 2011, 8:30 AM -10:15 AM

Session Number: 112

Session Title: Keratoplasty and Keratoprosthesis

Location: Hall B/C

Reviewing Code: 255 keratoprosthesis - CO

Author Block: Sahar Kohanim1,2, Tulay Cakiner-Egilmez3, Robert W. Dunphy3, Mary K. Daly3,4. 1Massachusetts Eye and Ear Infirmary, Boston, MA; 2Harvard Medical School, Boston, MA; 3Veterans Affairs Boston Health Care System, Boston, MA; 4Boston University School of Medicine, Boston, MA.

Keywords: 574 keratoprostheses; 549 imaging/image analysis: clinical; 761 wound healing

Abstract Body:
Purpose: Endophthalmitis is one of the the most devastating complications following keratoprosthesis (KPro) surgery. The Boston Type I KPro is comprised of a PMMA front plate and stem, a PMMA or titanium backplate, and a locking ring. These components are assembled with donor cadaveric corneal tissue between the front and back plate. The donor corneal button is then sutured to the recipient corneal bed. Integration of any KPro with recipient tissue is essential to avoid extrusion and to ensure a sealed, closed system that precludes microbial access into the anterior chamber. The ability to visualize corneal epithelial growth around and over the edge of the front plate would therefore be a reassuring sign for surgeons as it may act as a mechanical barrier to microbial ingress.
Methods: RTVue CAM (Optovue, Inc. Fremont, CA) spectral domain anterior segment OCT technology was utilized to image the anterior segment of five eyes of three patients with Boston Type I KPro from the Veterans Affairs Boston Healthcare System. The images were taken at various time points post-operatively (1 day to 6 years) and were retrospectively reviewed to assess the relationship between KPro PMMA front plate and donor corneal tissue.
Results: OCT Images of all 5 eyes demonstrated corneal epithelium extending from the donor corneal tissue and overriding the edge of the KPro front plate, a finding which was not always evident by slit-lamp examination. Serial imaging in the immediate post-operative period demonstrated this growth of epithelium as early as one week postoperatively.
Conclusions: Anterior Segment OCT is useful in demonstrating the presence of an epithelial lip extending from the donor corneal rim over the edge of the Boston Type I KPro front-plate. This protective lip appears to form as early as one week post-operatively, but cannot always be visualized clinically. The presence of such epithelial growth is reassuring as it suggests a tight seal and a barrier to infection.

CommercialRelationships: Sahar Kohanim, None; Tulay Cakiner-Egilmez, None; Robert W. Dunphy, None; Mary K. Daly, None

Support: None

Program#/Poster#:	2408/D956
Abstract Title:	**Use of Fourier-Domain Optical Coherence Tomography to Assess Pterygium Surgery**
Presentation Start/End Time:	Monday, May 03, 2010, 3:45 PM - 5:30 PM
Session Number:	290
Session Title:	Pterygium
Location:	Hall B/C
Reviewing Code:	158 cornea/conjunctival surgery: non-refractive – CO
Author Block:	*J. Ashizawa[1], Y. Hori[2], Y. Saishin[2], T. Maeno[2].* [1]Ophthalmology, Toho Univ Sakura medical center, Sakura, Chiba, Japan; [2]Ophthalmology, Toho Univ Sakura Medical Center, Sakura, Chiba, Japan.
Keywords:	662 pterygium, 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound), 549 imaging/image analysis: clinical
Abstract Body:	**Purpose:** To describe the use of Fourier-domain optical coherence tomography (FD-OCT) in the evaluation of patients with pterygium. **Methods:** Seven eyes of seven patients (4 men, 3 women; mean age, 59.9±7.0 years) with a pterygium from July 2009 to October 2009 were enrolled. The pterygia and corneas were observed using FD-OCT (RTvue100™, Optovue, Inc., Fremont, CA) preoperatively and postoperatively. We observed three points of intersection, i.e., at the top of the pterygial head and two points at the pterygial base to confirm invasion under Bowman's layer, and we measured the edge thickness and the maximum thickness of the pterygium. **Results:** FD-OCT clearly distinguished the boundary of the corneal epithelium, Bowman's layer, and the corneal stroma. FD-OCT also allowed visualization of the pterygial invasion under Bowman's layer. In four of seven eyes (57.1%), the pterygia were observed under Bowman layer. In these four cases, we excised the pterygia smoothly without postoperative corneal turbidity. In three cases in which the pterygia invaded the corneal stroma, the corneas were turbid postoperatively. The edge and the maximum thickness of the pterygia were a mean of 227.9±68.7 µm and 472.1±100 µm, respectively. **Conclusions:** FD-OCT allows observation of the pterygium invasion and prediction of a clear cornea postoperatively.
CommercialRelationships:	**J. Ashizawa**, None; **Y. Hori**, None; **Y. Saishin**, None; **T. Maeno**, None.
Support:	None

Program#/Poster#: 770/D922

Abstract Title: **A Method for Computing Graft-Host Interface Curvature for Analysis of Refractive Shift in Endothelial Keratoplasty**

Start/End Time: Sunday, May 02, 2010, 11:15 AM - 1:00 PM

Session Number: 130

Session Title: Keratoplasty I

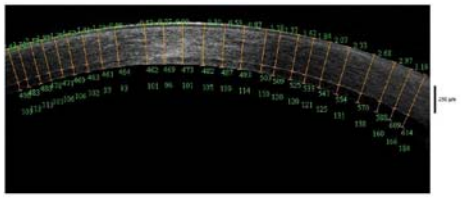
Location: Hall B/C

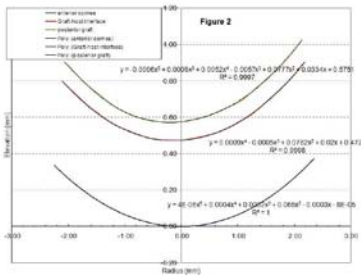
Reviewing Code: 176 corneal transplantation: penetrating and lamellar keratoplasty – CO

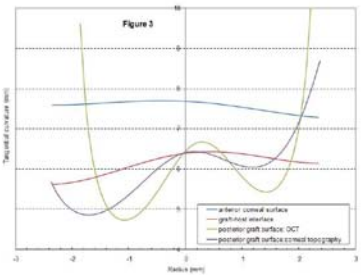
Author Block: *E.M. Meisler[1A], A. Sinha Roy[2], W.J. Dupps, Jr.[3], D.M. Meisler[1B].* [A]Ophthalmology, [B]Cole Eye Institute, [1]Cleveland Clinic Foundation, Cleveland, OH; [2]Ophthamology, Cleveland Clinic Cole Eye Institute, Cleveland, OH; [3]Cole Eye Inst and Lerner Rsch Inst, Cleveland Clinic, Cleveland, OH.

Keywords: 737 transplantation, 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound), 674 refractive error development

Abstract Body: **Purpose:** A Method for Computing Graft-Host Interface Curvature for Analysis of Refractive Shift in Endothelial Keratoplasty
Methods: Post-operative Scheimpflug-based anterior surface elevation maps of the cornea were obtained 3 months after DSAEK. High resolution OCT images of the horizontal corneal meridian were obtained for thickness measurements (Optovue Inc.). The OCT provided automatic segmentation tracings of the anterior surface of the host cornea and posterior surface of the graft. The graft-host interface was then traced using the software measurement tool at multiple locations along the radius. To calculate elevation, a polynomial was fit to the anterior corneal surface and normals at different radii (R) were calculated. Then, the thickness of the cornea and graft at each radius R was resolved along the normals to obtain the 2-D coordinates of the graft-host interface and posterior graft surface. The coordinates of the graft-host interface and posterior graft surface were fit both with polynomial and cubic spline methods, and tangential curvature was calculated from each of the surfaces. Results of the anterior and posterior corneal surfaces were compared with Scheimpflug curvature measurements along the horizontal meridian.
Results: Figure 1 shows the manual segmentation of the surfaces along one meridian. Reconstruction of the surfaces beginning with anterior surface elevation and adding thickness data from OCT provides shapes of the different surfaces in Figure 2. In Figure 3, a comparison of tangential curvatures is shown for each surface. The shape and magnitude of posterior surface curvature obtained from OCT was similar to topography. The same analysis performed using cubic spline yielded noise in the curvature analysis probably due to errors associated with manual segmentation.
Conclusions: This study presents a feasible method of analyzing graft-host interface and posterior graft surface curvatures after DSAEK.







Commercial Relationships: **E.M. Meisler**, None; **A. Sinha Roy**, None; **W.J. Dupps, Jr.**, None; **D.M. Meisler**, None.

Support: None

Program#/Poster#: 5692/D845

Abstract Title: **Intraocular Lens Power Calculation Based on Fourier-Domain Optical Coherence Tomography**

Presentation Start/End Time: Thursday, May 06, 2010, 8:30 AM -10:15 AM

Session Number: 527

Session Title: Corneal Topography Transparency and Imaging

Location: Hall B/C

Reviewing Code: 173 corneal optics and topography – CO

Author Block: *M. Tang, Y. Li, D. Huang.* Ophthalmology, University of Southern CA, Los Angeles, CA.

Keywords: 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound), 566 intraocular lens, 445 cataract

Abstract Body:

Purpose: To calculate intraocular lens (IOL) power using corneal power measured by Fourier-domain optical coherence tomography (FD-OCT) and assess its performance in cataract patients who had previous laser vision correction (LVC).

Methods: Cataract patients with prior LVC were enrolled in the prospective observational study. An FD-OCT (RTVue) was used to measure net corneal power (OCT-K). The corneal power was also measured by automated keratometry (Auto-K by IOL-Master), clinical history (CH-K), rigid contact lens overrefraction (CL-K). The corneal powers were plugged into standard theoretic formulae (SRK/T, Hoffer Q, Holladay II). The formulae prediction was compared with the one-month postoperative manifest refraction spherical equivalent (MRSE). The accuracy of the IOL calculation was assessed by the prediction error, which is equal to predicted MRSE minus the postoperative MRSE. The primary outcome measure was the mean absolute error (MAE), which is the absolute value of the prediction error.Wilcoxon rank-sum non-parametric test to compare the MAEs.

Results: Twenty-seven cataract patients (34 eyes) were enrolled. Of these, 11 patients (13 eyes) had uncomplicated surgery with monofocal IOL implantation and completed study measurements. The previous LVC correction was -7.03 ± 2.99D (mean standard deviation) with a range of -12.46D to -3.75D. Using the best among the 3 standard IOL formulae (Table 1), OCT corneal power measurement provided more accurate IOL power calculations than the other methods(Auto-K, p = 0.069; CL-K, p = 0.026; CH-K p = 0.047).

Table 1. Prediction Error for IOL Calculation by Formula and Method of Corneal Power Measurement

Corneal Power	# Eyes	SRK/T		Hoffer Q		Double K Holladay II	
		MAE (D)	Range (D)	MAE (D)	Range (D)	MAE (D)	Range (D)
Auto-K	13	2.24	(-4.59, 1.42)	1.50	(-3.53, 0.78)	1.20	(-2.91, 0.89)
CL-K	11	2.20	(-5.13, 3.04)	1.86	(-4.14, 3.84)	1.70	(-3.53, 4.08)
CH-K	11	1.35	(-3.72, 1.51)	1.35	(-2.83, 1.63)	1.44	(-2.33, 2.13)
OCT-K	13	1.10	(-3.85, 0.93)	0.87	(-2.69, 1.59)	1.02	(-2.06, 1.92)

Conclusions: In post-myopic LVC eyes, corneal power measured by OCT was more accurate than that measured by contact lens overrefraction and clinical history. This provided for more accurate IOL power calculation using standard theoretic formulae. Furthermore, OCT directly measures posterior corneal power and does not rely an assumed keratometric index (unlike Auto-K), a complete clinical record (unlike CH-K), or good preoperative vision (unlike CL-K).

CommercialRelationships: **M. Tang**, Optovue, Inc., F; **Y. Li**, Optovue, Inc., F; Optovue, Inc., R; **D. Huang**, Optovue, Inc., F; Optovue, Inc., I; Optovue, Inc., C; Carl Zeiss Meditec, Inc., P; Optovue, Inc., P; Optovue, Inc., R.

Support: NIH Grant RO1 EY018184; P30 EY03040; Research to Prevent Blindness; Optovue, Inc.

Clinical Trial: www.clinicaltrials.gov NCT00532051

Program#/Poster#:	5819
Abstract Title:	**Corneal Epithelial Thickness Mapping in Normal and Keratoconic Eyes With Fourier-Domain Optical Coherence Tomography**
Presentation Start/End Time:	Thursday, May 06, 2010, 12:30 PM -12:45 PM
Session Number:	538
Session Title:	Corneal Imaging
Location:	Floridian BCD
Reviewing Code:	246 imaging techniques – CO
Author Block:	*Y. Li[1], O. Tan[2], D. Huang[3].* [1]Ophthalmology, Univ of Southern California, Los Angeles, CA;[2]Ophthalmology, Univ Southern CA & Doheny Eye Inst, Los Angeles, CA; [3]Ophthalmology, University of Southern CA, Los Angeles, CA.
Keywords:	549 imaging/image analysis: clinical, 573 keratoconus,

Abstract Body:

Purpose:
To map corneal epithelial thickness in both normal and keratoconic eyes with optical coherence tomography (OCT).

Methods:
A Fourier-domain OCT (RTVuv-CAM OCT, Optovue, Inc.) system with 26,000 axial-scans/second scan speed and 5μm axial resolution was used. A pachymetry scan pattern (8 radials, 1024 axial-scans each, 6mm diameter) centered at the pupil center was used to image the cornea. Automatic computer algorithm generated the epithelial thickness (tear film included) map. The map was divided into 3 zones by diameter: central 2mm, superior 2-5mm, and inferior 2-5mm. The average epithelial thickness from each zone was calculated. Each eye was scanned 3 times. Pooled standard deviation was used to evaluate the repeatability of the measurement.

Results:
Twenty normal and twenty keratoconic eyes were included in this study. The central, superior, and inferior epithelial thickness averages (± population SD) were 55.6 ± 1.8, 52.9 ± 2.5, 54.1 ± 2.1 μm in normal eyes and 53.7 ± 4.9, 55.2 ± 3.9, 52.7 ± 3.9μm in keratoconic eyes. The central epithelial thickness in normal eyes was thicker than those of keratoconic eyes (mean difference 2.0 μm, *t*-test p = 0.05). The epithelium was thinner superiorly than inferiorly in normal eyes (mean difference -1.1 ± 0.9 μm, $p < 0.001$) while thicker superiorly than inferiorly in keratoconic eyes (2.5 ± 4.1 μm, p=0.01). The repeatability of epithelial thickness measurements was better in normal eyes (central 0.5 μm, superior 0.7 μm, inferior 0.6 μm) than those of keratoconus (central 1.0 μm, superior 1.1μm, inferior 1.2 μm).

Conclusions: High-resolution high-speed FD-OCT is able to map the corneal epithelial thickness in normal and keratoconic eyes with excellent reproducibility. The epithelial thickness asymmetry pattern may be useful to identify keratoconic corneas from the normal.

CommercialRelationships:	**Y. Li**, Optovue, Inc., F; **O. Tan**, Optovue, Inc., F; **D. Huang**, Optovue, Inc., F; Optovue, Inc., I; Optovue, Inc., C; Carl Zeiss Meditec, Inc., P; Optovue, Inc., P; Optovue, Inc., R.
Support:	NIH Grants EY018184, EY03040, Research grants from Optovue, Inc.,Grant from Research to Prevent Blindness, Charles C. Manger III, MD Chair in Corneal Laser Surgery endowment

Program#/Poster#:	758/D910
Abstract Title:	**Impairment of Visual Acuity Due to Permanent Descemet Folds Following Descemet Stripping and Automated Endothelial Keratoplasty (DSAEK)**
Presentation Start/End Time:	Sunday, May 02, 2010, 11:15 AM - 1:00 PM
Session Number:	130
Session Title:	Keratoplasty I
Location:	Hall B/C
Reviewing Code:	176 corneal transplantation: penetrating and lamellar keratoplasty – CO
Author Block:	*C. Mueller[1], W. Sekundo[2], A. Schulze[1], E.M. Hoffmann[1], N. Pfeiffer[1], J. Vetter[1].* [1]Ophthalmology, University Medical Center Mainz, Mainz, Germany; [2]Ophthalmology, Philipps University, Marburg, Marburg, Germany.
Keywords:	479 cornea: clinical science, 737 transplantation, 481 cornea: endothelium
Abstract Body:	**Purpose:** To evaluate the correlation between the extent of postoperative endothelial folds and the best corrected visual acuity (BCVA) following descemet stripping and automated endothelial keratoplasty (DSAEK). **Methods:** 14 patients (4 male, 10 female) were followed up 12 month after DSAEK. The average follow-up was 467 days (range 327 to 727 days). Best corrected visual acuity was measured, endothelial cell count was obtained with a specular microscope (SP 3000, Topcon, Tokyo, Japan) and grafts were examined by fourier-domain optical coherence tomography (RTVue, Optovue, Fremont, USA). The mean height of all descemet folds in 4 corneal sections within the central 4x4 mm was extrapolated from the images. A correlation was assessed using Pearson by coefficient. **Results:** Mean visual acuity (LogMar) was 0.46 (standard deviation ± 0.22). Mean endothelial cell count was 1098 cells/ mm^2 (± 610 cells/ mm^2). On each examination, a mean of 5.6 folds (± 1.6) were visible within the optical zone. The mean height of descemet folds was 18.7 μm (± 13.7 μm). The correlation between BCVA and mean height of the descemet folds was 0.56 (p=0.037), while there was no correlation between BCVA and endothelial cell count (correlation coefficient 0.44). **Conclusions:** Our results show that after DSAEK surgery descemet folds can persist in the graft. The data also suggest a connection between the extent of the folds and BCVA. Further research has to be performed in order to clarify the role of these folds in comparison with other visual acuity-limiting factors after DSAEK. Finally, a better understanding of the underlying mechanisms and prevention strategies is needed.
CommercialRelationships:	**C. Mueller**, None; **W. Sekundo**, None; **A. Schulze**, None; **E.M. Hoffmann**, None; **N. Pfeiffer**, None; **J. Vetter**, None.
Support:	None

Program#/Poster#: 3376/D962

Abstract Title: **Correlation Between Optical Coherence Tomography Tear Meniscus Parameters and Schirmer's Test and Tear Break-Up Time**

Start/End Time: Tuesday, May 04, 2010, 1:45 PM - 3:30 PM

Session Number: 361

Session Title: Dry Eye II Diagnosis, Mechanism and Nerves

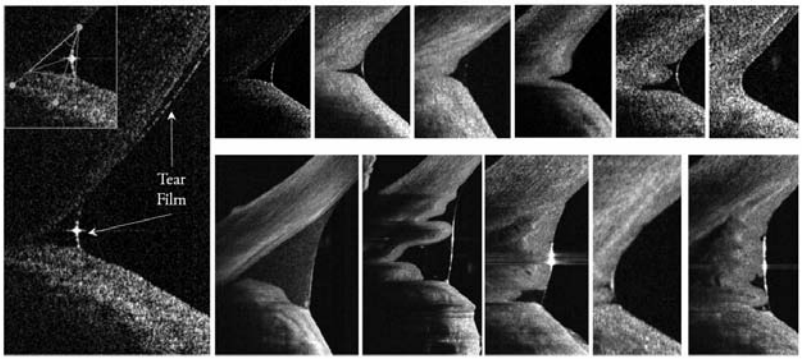
Location: Hall B/C

Reviewing Code: 188 dry eye disease – CO

Author Block: *P. Nguyen[1], D. Huang[1,2], S.R. Sadda[1], R.R. Pappuru[1], S. Ramos[1], Y. Li[1], S.C. Yiu[1,3].* [1]Ophthalmology, Doheny Eye Institute - USC, Los Angeles, CA; [2]Doheny Laser Vision Center, Los Angeles, CA; [3]Ocular Surface Center, Los Angeles, CA.

Keywords: 549 imaging/image analysis: clinical, 421 anterior segment, 575 lacrimal gland

Abstract Body: **Purpose** :To investigate the clinical utility of Fourier-domain optical coherence tomography (FD-OCT) measurements in the evaluation of keratoconjunctivitis sicca (KCS).
Methods: Patients with severe KCS requiring medical therapy (cyclosporine 0.05%) and/or occlusion were recruited. Instillation of all eye drops was stopped 2+ hours before measurements. An FD-OCT system (RTVue; Optovue, Inc., Fremont, CA) was used to image the lower tear menisci in both eyes. Vertical line scans were taken, centered on the inferior limbus. Software caliper was used to measure the meniscus height (H), depth (D) and angle at the inferior cornea-lid angle. Meniscus cross-sectional area (CS-A) was calculated using a two-triangle approximation. A certified technician conducted the 5-minute Schirmer's test with anesthesia and fluorescein tear break-up time (TBUT). Linear regression analysis was done to obtain the correlation (Pearson) between FD-OCT parameters and Schirmer's and TBUT.
Results: Twenty-one patients were recruited and 42 eyes imaged. Mean age was 57 (range 20-89), 80% were female, 65% Caucasian, 18% Asian, and 12% African-American. Figure 1 illustrates measurement techniques and the structural diversity of the angle. Fourteen eyes were excluded because of either conjunctival redundancy or poorly delineated meniscus.
Mean TBUT was 4 minutes (range 1-7) and mean Schirmer's 9 mm (range 0-25). Mean CS-A was 0.035 +/- 0.013 mm^2, H 0.288 +/-0.062 mm, D 0.160 +/-0.041 mm, and angle 30 +/-3 degrees; here, +/- denotes the 95% CI.
Pearson coefficients are +0.40 for CS-A vs TBUT, -0.36 for angle vs TBUT, +0.12 for CS-A vs Schirmer's, and +0.26 for angle vs Schirmer's.
Conclusion: Correlation between Schirmer's and TBUT measurements and OCT was found. Tear meniscus formation and corneal wetability are both functions of tear properties. This may explain the higher correlation between CS-A and TBUT, as well as the negative correlation between angle and TBUT. These findings encourage further investigation.



Commercial Relationships: **P. Nguyen**, None; **D. Huang**, Optovue, Inc, I; Carl Zeiss Meditec Inc., I; Optovue, Inc, C; Optovue, Inc, P; Carl Zeiss Meditec Inc., P; Optovue, Inc, R; **S.R. Sadda**, Optovue, Inc., F; Carl Zeiss Meditec, F; Heidelberg Engineering, C; Genentech, C; Allergan, C; Topcon Medical Systems, P; Topcon Medical Systems, R; **R.R. Pappuru**, None; **S. Ramos**, None; **Y. Li**, Optovue, Inc., F; **S.C. Yiu**, None.

Support: NEI Core Grant EY03040, NEI grant R01 EY018184.

Program#/Poster#:	3374/D960
Abstract Title:	**Serial Measurement of Tear Meniscus by Fourier-Domain Optical Coherence Tomography After Instillation of Artificial Tears in Patients With Dry Eyes**
Presentation Start/End Time:	Tuesday, May 04, 2010, 1:45 PM - 3:30 PM
Session Number:	361
Session Title:	Dry Eye II Diagnosis, Mechanism and Nerves
Location:	Hall B/C
Reviewing Code:	188 dry eye disease – CO
Author Block:	*M.C. Bujak, D. Huang, S.R. Sadda, Y. Li, P. Nguyen, R.K. Pappuru, S. Yiu.* Ophthalmology, Doheny Eye Institute/ USC, Los Angeles, CA.
Keywords:	486 cornea: tears/tear film/dry eye, 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound), 549 imaging/image analysis: clinical
Abstract Body:	**Purpose:** To use Fourier-Domain Optical Coherence Tomography to study the longitudinal effect of instillation of artificial tears on tear meniscus volume in patients with dry eyes. **Methods:** Four patients with significant dry eyes were recruited in a consecutive manner from a tertiary cornea practice. The lower tear meniscus of the right eye in each subject was imaged by vertical scans centered on the inferior cornea and the lower eyelid using a Fourier-domain optical coherence tomography system (RTVue; Optovue, Inc., Fremont, CA) with a corneal adaptor. Two baseline measurements were taken for each subject prior to administration of a drop of artificial tears (Optive). Five serial pairs of measurements were then taken after the instillation of artificial tears at 1 minute, 2 minutes, 5 minutes, 10 minutes, and 15 minutes. Each measurement was taken two seconds after a blink. The lower meniscus height, depth, and angle were measured with a computer caliper. The cross-sectional area was calculated using a two-triangle approximation. **Results:** The baseline tear measurements were 317 µm, 512.5 µm, 0.0695 mm2 for meniscus height, depth, and area respectively. At 1 minute after instillation of artificial tears the measurements increased by 212%, 488%, 2212%. The time to depletion of half of the gains in tear meniscus were 2.75 minutes, 4.75 minutes, and 2 minutes for height, depth, area respectively. The time to depletion of 75% of the tear meniscus gains was 3.5 minutes, 5.5 minutes, and 5.5 minutes. **Conclusion:** Optical coherence tomography is able to quantify the increase in lower tear meniscus after installation of artificial tears in patients with dry eyes. This increase is transient, with a 50% reduction of both height and area within 3 minutes of drop instillation and a 75% reduction in all parameters by 6 minutes. Optical coherence tomography may serve as an invaluable tool in objectively quantifying the efficacy of dry eye treatments.
CommercialRelationships:	**M.C. Bujak**, None; **D. Huang**, optovue inc, C; optovue inc, I; optovue inc, carl zeiss meditec inc, P; optovue inc, R; **S.R. Sadda**, heidelberg engineering, topcon medical systems, carl zeiss meditec, optovue inc, genentech, allergan, C; **Y. Li**, optovue, C; **P. Nguyen**, None; **R.K. Pappuru**, None; **S. Yiu**, None.
Support:	Ro1 EY018184

Program#/Poster#: 5816

Abstract Title: **Pachymetric Mapping Repeatability Using Fourier-Domain Optical Coherence Tomography in Corneal Opacities**

Presentation Start/End Time: Thursday, May 06, 2010, 11:45 AM -12:00 PM

Session Number: 538

Session Title: Corneal Imaging

Location: Floridian BCD

Reviewing Code: 246 imaging techniques – CO

Author Block: *N.M. Samy El Gendy[1,2], Y. Li[1], D. Huang[1], X. Zhang[1]*. [1]Ophthalmology, University of Southern California, Los Angeles, CA; [2]Ophthalmology, Cairo University, Cairo, Egypt.

Keywords: 549 imaging/image analysis: clinical, 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultrasound), 572 keratitis

Abstract Body:

Purpose: To evaluate the repeatability of Fourier-domain optical coherence tomography (FD-OCT) pachymetric mapping in patients with corneal scars or dystrophy

Methods:

A FD-OCT system (RTVue by Optovue, Inc.) was used to map the corneal thickness of 16 eyes of 12 patients with corneal opacity. Six eyes had corneal dystrophy (2 Reis-Buckler,4 granular dystrophy) The remaining 10 eyes had corneal scars due to various causes. The central 6 mm diameter was mapped. The repeatability was measured using pooled standard deviation (PSD) of repeat measurements. A slit-scanning tomography device (Orbscan II by Bausch & Lomb, Inc.) provided pachymetric mapping comparison.

Results:

Statistical analysis showed that repeatability of OCT pachymetric mapping was excellent in terms of pooled SD in both scar and dystrophy groups (Table).

Table. Optical Coherence Tomography Pachymetry Statistics by Region.

The repeatability could also be expressed as coefficient of variation, which range from 0.2% to 0.4% . Compared to OCT (536 +/- 89 μm), Orbscan II significantly under-estimated central corneal thickness (433 +/- 111 μm). The difference was statistically significant (p = 0.002).

Conclusions:

Pachymetric mapping with FD-OCT was highly repeatable even in the presence of opaque areas due to either corneal dystrophies or scars. In comparison, Orbscan II significantly under-estimated corneal thickness in the presence of opacities.

	Central 2mm (μm)		*2-5mm Diam. (μm)*		*Minimum (μm)*	
	Mean ± SD	*Repeatability*	*Mean ± SD*	*Repeatability*	*Mean ± SD*	*Repeatability*
All Cases	536 ± 89	2.1	553 ± 76	1.2	508 ± 93	1.9
Scar Group	560 ± 68	1.2	574 ± 62	1.0	542±61	2.3
Dystrophy Group	523±98	2.6	542 ± 84	1.3	489 ± 104	1.4

CommercialRelationships: **N.M. Samy El Gendy**, None; **Y. Li**, Optovue, Inc., Fremont, CA, F; Optovue, Inc., Fremont, CA, R, F; Optovue, Inc., Fremont, CA, R; **D. Huang**, Optovue, Inc., F; Optovue, Inc., I; Optovue, Inc, C; Carl Zeiss,Optovue, Inc., P; Optovue, Inc, R; **X. Zhang**, None.

Support: NIH grants R01 EY018184,Charles C. Manger III, MD Chair in Corneal Laser Surgery ; Research to Prevent Blindness; Optovue, Inc. doheny core grant NIH P30 EY03040

Program#/: 3852

Abstract Title: ***In-vivo*** **Imaging of the Trabecular Pathway and Schlemm´s Canal With Anterior Segment Fourier-Domain (AS FD OCT) Optical Coherence Tomography**

Start/End Time: Wednesday, May 05, 2010, 8:45 AM - 9:00 AM

Session Number: 409

Session Title: Novel Imaging Techniques in Glaucoma

Location: Grand D

Reviewing Code: 231 glaucoma: imaging – GL

Author Block: *A.R. Castillejos[1], S.K. Dorairaj[2], C.G.V. De Moraes[2,3], J.M. Liebmann[2,3], R. Ritch[1,2].* [1]Ophthalmology, New York Medical College, Valhalla, New York, NY; [2]Ophthalmology, New York Eye and Ear Infirmary, New York, NY; [3]Ophthalmology, New York University Medical Center, New York, NY.

Keywords: 421 anterior segment, 427 aqueous, 551 imaging methods (CT, FA, ICG, MRI, OCT, RTA, SLO, ultras

Abstract Body: **Purpose:**To describe the *in vivo* morphology of the trabecular meshwork (TM) and Schlemm´s canal (SC) area in normal, glaucoma suspect and glaucomatous eyes using FD ASOCT.
Methods: Thirty three consecutive normal (N), glaucoma suspect (GS) and glaucoma (G) subjects were imaged at four limbal quadrants (superior, inferior, nasal and temporal) using the Angle Scan Mode of AS FDOCT (Optovue, Inc., Fremont, CA). The highest quality images in which SC could be outlined for each of the quadrants were analyzed with the standard automated software. A qualitative assessment of the images was done by two investigators, who evaluated for the presence of intrascleral vessels and channels, communications between the TM and the uveoscleral pathway, and images suggestive of filtration over the non-filtering TM (NFTM). A total of 147 images were analyzed.
Results: There was a significant age difference among the 3 groups: N(n=64), 34.4±8.5; GS(n=29), 62.3±9.1; and G(n=54), 58.3±12.3 p≤001. The SC area was measured and compared among groups: N vs G (0.03±0.01 vs 0.01± 0.01 mm^2, p<0.01); N vs. GS (0.03 ±0.01 vs 0.02±0.03 mm^2, p=0.001); GS vs G (0.02 ±.03 vs 0.01±0.01 mm^2, p=0.14). A prominent Schwalbe's line(SL) was found in 20.6% of the N eyes and 27.7% of the G group. In exfoliative glaucoma eyes (4/17), the SL was more prominent and presented higher signal density. Thirty one (20%) of the 147 images were suggestive of possible communications between the TM and the uveoscleral pathway and of filtration occurring across the NFTM. **Conclusions:** The anatomy of the TM pathway and SC can be visualized and objectively measured using AS FDOCT. There was a significant difference in the SC area related to age and possibly glaucoma

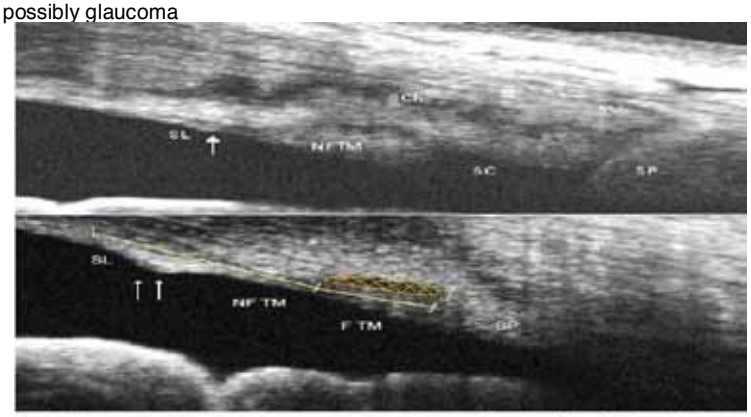


Fig 1. Important landmarks and measurements are shown. Schwalbe's line (SL), Schlemm's Canal (SC), non filtering (NFTM) and filtering (FTM) trabecular meshwork, intrascleral veins (SV) and channels (SCh) and the sclera spur (SP). Measured SC area is outlined. Single arrow signals the end of the endothelium and Descemet's membrane. Double arrows signal a prominent SL found in some eyes.

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Commercia Relationships: **A.R. Castillejos**, None; **S.K. Dorairaj**, None; **C.G.V. De Moraes**, None; **J.M. Liebmann**, Alcon, Allergan, Diopsys Inc., Optovue Inc., Pfizer Inc, Topcon Medical Systems, Inc, C; Diopsys, Inc., Heidelberg Engineering, Optovue Inc., Topcon Medical Systems, Inc., Reichert, Carl Zeiss Meditec, Inc., F; **R. Ritch**, Carl Zeiss Meditec, Inc. Diopsys, Inc. Heidelberg Engineering, GmBH, Topcon, Inc, Reichert, F; Alcon Laboratories, Inc. Allergan, Inc, Danube Pharmaceuticals, Inc., Pfizer Ophthalmics, Inc, C.

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