Currents, the design of a gonio-lens has been guided by the presence of this gel obviates any further testing on the eye at that time. The design of an ideal lens would not only eliminate the need for gel as an optical coupling agent between the corneal surface and the goniolens. The goal of this study was to identify a possible management. The alarming signs of unexpected loss of vision were due to late referral and of pigmentary dispersion syndrome (PDS) with exfoliation syndrome (XFS) causes sudden IOP spike, optic nerve damage progression and associated visual field (VF) loss. This development often remains undetected.

To describe the characteristic signs of XFS and pigmentary glaucoma (PG), and to discuss the specific management of overlap syndrome.

**Methods:** A retrospective analysis of 40 consecutive patients diagnosed with overlap syndrome for a period of 18 mo (January 2014 to June 2015) and follow up period 9 to 18 months. Accumulation of abnormal material on lens capsule and pupil, iris transillumination defects, Krukenberg’s spindle, trabecular pigmentation, increased IOP and more difficult control of IOP are main features. Treatment: topical medications, laser peripheral iridotomy (LPI), and surgical - trabeculectomy (TE) or ExPress implant.

**Results:** Most patients had typical signs of PDS and XFS, with XFS predominating over PDS. Patients with overlap syndrome were 50-65 years of age. Glaucoma progression was registered in all overlapping forms. In 25 (62%) patients we achieved good pressure lowering effect with medication and LPI. At lack of IOP control 15 patients underwent surgery - TE (9) and ExPress implantation (6). In 3 patients with TE additional needling with 5-FU was necessary. In 2 patients with ExPress transient posterior pole edema was registered. As a result of our treatment approach, no progression of glaucoma damage was observed. Visual impairment was due to late referral with very high levels of IOP and advanced VF defects.

**Conclusions:** Awareness of sequential appearance and overlap of those two forms of glaucoma is of decisive importance for appropriate management. The alarming signs of unexpected loss of IOP control, rapid progression of optic neuropathy and VF loss indicate need for more aggressive treatment.

**Commercial Relationships:** Petja I. Vassileva; Yordanka Kirilova, None

**Program Number:** 2071 Poster Board Number: A0132
**Presentation Time:** 3:45 PM–5:30 PM

**Pseudoexfoliation and Pigmentary Glaucoma – Overlap Syndrome**

**Purpose:** Concomitant symptoms, characteristic for a combination of pigmentary dispersion syndrome (PDS) with exfoliation syndrome (XFS) causes sudden IOP spike, optic nerve damage progression and associated visual field (VF) loss. This development often remains undetected.

To describe the characteristic signs of XFS and pigmentary glaucoma (PG), and to discuss the specific management of overlap syndrome.

**Methods:** A retrospective analysis of 40 consecutive patients diagnosed with overlap syndrome for a period of 18 mo (January 2014 to June 2015) and follow up period 9 to 18 months. Accumulation of abnormal material on lens capsule and pupil, iris transillumination defects, Krukenberg’s spindle, trabecular pigmentation, increased IOP and more difficult control of IOP are main features. Treatment: topical medications, laser peripheral iridotomy (LPI), and surgical - trabeculectomy (TE) or ExPress implant.

**Results:** Most patients had typical signs of PDS and XFS, with XFS predominating over PDS. Patients with overlap syndrome were 50-65 years of age. Glaucoma progression was registered in all overlapping forms. In 25 (62%) patients we achieved good pressure lowering effect with medication and LPI. At lack of IOP control 15 patients underwent surgery - TE (9) and ExPress implantation (6). In 3 patients with TE additional needling with 5-FU was necessary. In 2 patients with ExPress transient posterior pole edema was registered. As a result of our treatment approach, no progression of glaucoma damage was observed. Visual impairment was due to late referral with very high levels of IOP and advanced VF defects.

**Conclusions:** Awareness of sequential appearance and overlap of those two forms of glaucoma is of decisive importance for appropriate management. The alarming signs of unexpected loss of IOP control, rapid progression of optic neuropathy and VF loss indicate need for more aggressive treatment.

**Commercial Relationships:** Petja I. Vassileva; Yordanka Kirilova, None

**Program Number:** 2071 Poster Board Number: A0132
**Presentation Time:** 3:45 PM–5:30 PM

**BUBBLE-FREE GONIOSCOPY?**

Frederick M. Kapetansky. Ophthalmology, Ohio State University, Columbus, OH.

**Purpose:** Accurate gonioscopy is necessary for the diagnosis and the treatment of glaucoma. The gold standard for indirect gonioscopy has been the Goldman lens. The design of this lens requires gel as the optical coupling agent between the corneal surface and the goniolens. The presence of this gel obviates any further testing on the eye at that time. The design of an ideal lens would not only eliminate the need for gel, but would at the same time solve the problem of a bubble of air trapped under the lens. The goal of this study was to identify factors involved in designing the goniolens which would meet the needs of the clinician.

**Methods:** Currently, the design of a gonio-lens has been guided by two basic parameters: 1) the diameter of the corneal contact surface and 2) the base curve of this surface. When the diameter of the contact surface of the lens matches or exceeds that of the cornea, and the base curve of the lens is steeper than that of the cornea, a potential space is created between the lens and the cornea, which needs to be filled with an optical coupling gel. When the diameter of the corneal contact surface is less than that of the cornea, this space can be filled with tears, provided that the base curve of the lens matches that of the cornea. The clinical advantage of the tears as the coupling agent is that further testing of the eye can be carried out at the same visit.

**Results:** This study involved several lens on the market (Zeiss, Volk, Sussman, Goldman to name a few). It appears that the critical parameter to eliminate the need for gel and achieve “bubble-free” gonioscopy was the flattening of the base curve of the lens i.e. from 7.45mm to 8.4mm. The area of contact of the original Goldman lens (12.25mm) and down to the area of contact for 4 and 6 mirror lenses (8.4mm) was not a factor in eliminating the need for gel, as long as the base curve was flattened at the same time.

**Conclusions:** Our stated goal of eliminating the need for gel as a optical coupling agent as well as bubble-free gonioscopy was dependent on the base curve of the area of contact and not on the area of contact. When the base curve of the area of contact of the goniolens approached that of the base curve of the cornea, then our goal was achievable no matter what the size of the area of contact was. This observation may have significant applicability for re-designing some of our current lenses which require gel as an optical coupling agent.

**Commercial Relationships:** Frederick M. Kapetansky, None

**Program Number:** 2073 Poster Board Number: A0134
**Presentation Time:** 3:45 PM–5:30 PM

**Improved clustering and quantification of color information in images obtained by the 360-degree automatic gonioscopy**

Masaki Tanito1,2, Simone Pajaro3, Andrea De Giusti4.

1Ophthalmology, Matsue Red Cross Hospital, Matsue, Japan; 2Ophthalmology, Shimane University Faculty of Medicine, Izumo, Japan; 3NIDEK Technologies Srl, Albignasego, Italy.

**Purpose:** Gonioscopy is essential to make a diagnosis of glaucoma, however, it requires an examiner’s skill and only provides subjective information. Assessment of irido-corneal angle (ICA) by using currently available modalities (e.g. ultrasound biomicroscopy or anterior segment optical coherence tomography) doesn’t provide any chromatic information, while color analysis is relevant for many pathologies. Recently developed gonioscopic device (NGS-l Gonioscope, NIDEK Technologies Srl, Italy), was able to automatically acquire true color images of the ICA structures and to combine them in a 360-degree picture of the angle. In this study, image analyses were performed in the pictures obtained by using NGS-l to quantify the color information of the angle.

**Methods:** The NGS-l system detects the ICA using a prism with a soft contact to the corneal surface. The prism has 16 mirrored facets, each of them projecting white light to a single portion of the irido-corneal angle (about 4x4 mm²). A rotating 1.3 megapixel camera element scans all the facets to capture 5 images, at different focus depth, for each of the 16 sectors in less than 2 seconds. On each selected image from 16 sectors, a region of interest (ROI) was manually defined in the trabecular meshwork area by means of a dedicated PC software. From each ROI, pixels’ color information was extracted in the Lab color space and statistical clustering was applied. Images obtained by the 360-degree automatic gonioscopy was the flattening of the base curve of the lens i.e. from 7.45mm to 8.4mm. The area of contact of the original Goldman lens (12.25mm) and down to the area of contact for 4 and 6 mirror lenses (8.4mm) was not a factor in eliminating the need for gel, as long as the base curve was flattened at the same time.

**Commercial Relationships:** Frederick M. Kapetansky, None
perform multi-dimensional data-mining in order to obtain a robust 3-level color classification, similar to the Scheie’s one (Figure 1).

**Conclusions:** By this further image analysis, the Lab color space and clustering can be used to improve the previously proposed classification (Tanito M., et al., Abstract Number 5118, ARVO 2016). The established method can be applied to understand color/pigment variations among specific directions in normal and glaucomatous eyes.

Figure 1 - A, B, C: Examples of 0_I, II, and III_IV grade images. D, E, F: Same images with clustering highlighted. G: Distribution of the L index without clustering showing poor separation between the grades. H: Distribution of the L index for the cluster matched to the trabecular meshwork showing a good separation between the grades.

**Commercial Relationships:** Sonal Shah, None; Anastasia Pilat, None; Viral Sheth, None; Joseph Abbot, None; Irene Gottlob, None

**Program Number:** 2074 Poster Board Number: A0135
**Presentation Time:** 3:45 PM–5:30 PM
**Anterior Optical Coherence Tomography in Children with Primary Congenital Glaucoma**

Sonal Shah¹, Anastasia Pilat¹, Ravi Purohit¹, Viral Sheth¹, Joseph Abbot¹, Irene Gottlob¹. ¹Ophthalmology, University of Leicester, Leicester, United Kingdom; ²Ophthalmology, Birmingham Children’s Hospital, Birmingham, United Kingdom.

**Purpose:** To investigate the potential of the hand held spectral-domain optical coherence tomography (HH SD-OCT) device to improve diagnosis of primary congenital glaucoma (PCG), by visualising anterior segment structures without general anaesthetic/sedation.

**Methods:** The HH SD-OCT (Leica Microsystems, 2.6 µm resolution) device was used to acquire horizontal corneal scans and anterior angle scans in 25 children with PCG (11 females and 14 males; mean age 4.06±3.38, 21-bilateral involvement) and 25 gender, age and ethnicity-matched healthy controls. At the time of examination all patients had intraocular pressures controlled by surgical procedures and/or topical medication.

**Results:** 13% of patients with PCG had Haab’s striae visible on OCT, 8.7% of patients had an uneven corneal structure with severe asymmetry in corneal thickness. Central corneal thickness was significantly thicker in PCG group, although pressure was controlled (p<0.001), as compared to healthy controls. OCT showed flattening of the iris with diminishing of the collarette zone in 45.7% of patients; this feature significantly correlated with horizontal corneal diameter (p=0.03) and number of surgical procedures (p=0.04). Anterior incretion of the iris was found in 10.95% of patients with PCG.

**Conclusions:** Our study provides for the first time evidence of anterior segment changes on OCT in patients with PCG. Iris abnormalities seen on OCT reflect structural changes correlating to the number of surgical procedures. Anterior segment changes observed on OCT have the potential to improve diagnosis and predict severity of the disease. Anterior OCT can also be beneficial in the assessment of angle structures, in defining treatment options and selecting optimal anatomical location for surgery.

**Commercial Relationships:** Sonal Shah, None; Anastasia Pilat, None; Viral Sheth, None; Joseph Abbot, None; Irene Gottlob, None

**Program Number:** 2075 Poster Board Number: A0136
**Presentation Time:** 3:45 PM–5:30 PM

**In vivo imaging and characterization of Schlemm’s canal in response to ocular hypertension**


**Purpose:** We recently provided the first evidence showing that Prox-1, the master control gene for lymphatic development, is expressed on Schlemm’s canal, a critical structure in the drainage of aqueous humor. This study was designed to investigate the responses of Schlemm’s canal in Prox-1-GFP mice after the induction of ocular hypertension.

**Methods:** Ocular hypertension was induced in Prox-1-GFP mice by cirrhumal suture. Intraocular pressure (IOP) was measured using a non-invasive TonoLab tonometer. Morphological changes in Schlemm’s canal were monitored for 8 weeks by our custom built live imaging system. Additionally, retinal nerve fiber layer (RNFL) thickness was evaluated by optical coherence tomography (OCT), full-field flash electroretinogram (ERG) was recorded with a VERIS system, and whole-mount retinae were immunostained for Brn3a positive retinal ganglion cells (RGCs) at 8 weeks post-procedure.

**Results:** In response to IOP elevation, we detected a progressive decrease of Schlemm’s canal area with less continuity, indicating a collapse or occlusion of this structure. Moreover, we quantified significant reductions in RNFL thickness (-8.82%), number of RGCs (-17.32%) and ERG amplitudes for all retinal cell classes (photoreceptors, -12.85%; bipolar cells, -12.81%; and RGCs, -23.37% (P<0.0001) at 8 weeks post-procedure.

**Conclusions:** Intravital imaging of Schlemm’s canal in Prox-1-GFP transgenic mice offers a new approach to study Schlemm’s canal in the murine model of ocular hypertension. Further investigation utilizing this model may facilitate the discovery and development of new mechanisms and therapeutic strategies for glaucoma.

**Commercial Relationships:** Meng Shi, None; Hsin-Hua Liu, None; Liwei Zhang, None; Guangyu Li, None; John G. Flanagan, None; Lu Chen, None

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Program Number: 2076 Poster Board Number: A0137
Presentation Time: 3:45 PM–5:30 PM

Looking into supraciliary space with anterior segment optical coherence Tomography

Purpose: To demonstrate the usefulness of anterior segment optical coherence tomography (OCT) to identify the supraciliary space easily.

Methods: Anterior segment OCT (Visante® Optical Coherence Tomography, Carl Zeiss Meditec Inc., Dublin, CA, USA) was performed in 10 eyes of 7 patients suspected of supraciliary effusion or cyclodialysis cleft. At the time of OCT, The eyeball was moved clockwise, and the estimating line was adjusted to include the 1/3 cornea and 2/3 sclera on the basis of the limbus of the cornea and measured perpendicular to the limbus. And included more than two directions. When the cyclodialysis cleft was suspected, the range of 12 hours was measured at intervals of one hour to determine the range.

Results: After argon laser peripheral iridoplasty (ALPI), intraocular pressure was adjusted to less than 10 mmHg, but supraciliary effusion was observed in 2 eyes of 2 patients with phacomorphic glaucoma. In one eyes with cyclodialysis cleft, the extent and effusion were clearly observed. In 3 eyes of 2 patients with secondary glaucoma due to pseudoxfoliative syndrome or uveitis, intraocular pressure decreased below 10 mmHg and supraciliary effusion was observed after use of glaucoma eye drops. And these supraciliary effusions improved as the intraocular pressure normalized after medication adjustment. Also secondary myopia and ocular hypertension associated with supraciliary effusion occurred in 4 eyes of 2 patients due to drugs side effect (Dorzolamide or Phendimetrazine). These side effects improved after discontinuation of the drugs and supraciliary effusion disappeared.

Conclusions: On the Visante®, the contour of the ciliary body was not clear, but supraciliary effusion and cyclodialysis cleft were easily detected. Unlike UBM, which was used to observe the peripheral structures of the ciliary body, Visante® allows us to quickly and easily observe the actual supraciliary space non-invasively without contact with the eye.

Commercial Relationships: Yun Suk Chung; Su Chan Lee, None

Program Number: 2077 Poster Board Number: A0138
Presentation Time: 3:45 PM–5:30 PM

Evaluation of drainage implant tube position by anterior segment optical coherence tomography in pediatric glaucoma
Veronica H. Yamada, Christiane R. Moura, Norma Allemann, Vespasiano Rebouças-Santos. UNIFESP, Sao Paulo, Brazil.

Purpose: To evaluate the position and length of the tube in the anterior chamber by anterior segment optical coherence tomography in pediatric glaucoma patients

Methods: Retrospective study of patients with pediatric glaucoma, submitted to surgical procedures at São Paulo Hospital – Federal University of São Paulo, from January 2006 to January 2015 (108 months). The intracameral portion of tube implant was evaluated with Visante OCT (Zeiss, software version 2.0.1.88) using a longitudinal scan of the tube. Measurements of the tube parameters were performed using calipers and the angle tool of the device’s software and Image J’s software applied to the images in “RAW mode”. The parameters of the tube considered were length from the bevel-edged to the sclerolimbal junction; position: distance from the extremity of the tube to the anterior iris surface (T-I distance) and to the posterior endothelial surface (T-C distance) and the angle between the tube and the posterior endothelial surface (T-C angle). Age, gender, diagnosis, date of surgery and corneal transparency data were collected as well.

Results: Forty drainage implant tubes of 26 patients were included, 14 were male. Age ranged from 3 to 16 years-old. Etiological diagnosis included: primary congenital glaucoma (18), secondary glaucoma after cataract surgery (3), and glaucoma associated to other anomalies (6). Of the 40 tubes, 22 were implanted in the right eye and 18 in the left eye. Superior-temporal region was the most frequent location for the tube (28), followed by the superior-nasal region (11) and nasal-inferior region (1). Of the 26 patients, 22 corneas were clear, 8 were partially clear and 10 were opacified. Mean time of the first evaluation after surgery was 30.7 months of follow-up, and the mean (SD) T-I distance was 1.42 (±0.91) mm; T-C distance was 0.64 (±0.53) mm; T-C angle was 19.54 (±7.1) degrees; intracameral length was 3.15 (±1.05) mm. A second examination was performed after 48.5 months and the mean (SD) T-I distance was 1.48 (±0.75) mm (p=0.501); T-C distance was 0.48 (±0.47) mm (p=0.212); T-C angle was 13.80 (±7.7) degrees (p=0.096); intracameral length was 3.24 (±0.86) mm (p=0.520).

Conclusions: Anterior segment optical coherence tomography was helpful to evaluate the position of drainage implant tube position in anterior chamber of pediatric patients, sometimes aiding in planning a surgical intervention.
Birefringent imaging of limbal region using Jones matrix optical coherence tomography

Deepa Kasaragod¹, Akari Fujita², Shuichi Makita¹, Yuta Ueno⁰, Sujin Hoshi¹, Tomotaka Okubo¹, Tetsuro Oshika¹, Yoshiaki Yasuno¹,
¹Institute of Applied Physics, University of Tsukuba, Tsukuba, Japan; ²Department of Ophthalmology, Faculty of Clinical Medicine, University of Tsukuba, Tsukuba, Japan.

Purpose: This study aims at depth-wise visualization (intensity and birefringence) of the limbal region using Jones matrix optical coherence tomography (JM-OCT).

Methods: A normal subject (F, 31 y/o) was imaged using a custom built JM-OCT. The system uses a probe wavelength of 1.31 µm and specifically designed for anterior eye. 32 scans across the eye circumference was obtained. Each scan covers 6 × 6 mm transversal area (512 A-lines × 128 frames). A single scan provides a set of four OCT images which form a Jones matrix tomography (JMT) of the sample. OCT intensity is obtained by summation of two OCT images from JMT (non-delayed channels). Birefringence tomography was obtained by processing the JMT by a birefringence estimator based on maximum a-posteriori theory. The OCT volume is flattened to the tissue surface, and then the scleral-uveal interface plane is identified. The en-face slices at 0, 24, 48, 72 and 96 microns above the scleral-uveal interface were obtained for both the OCT intensity and birefringence flattened tomographic volumes. The en-face sum projection of inverted intensity obtained for all volumes are co-registered and patched together by ImageJ with MosaicJ plugin. The same registration information was used to create wide field intensity and birefringence maps at each depth.

Results: Fig 1(a) shows the morphology along with (b) intensity and (c) birefringence cross-sections at the superior eye. High birefringence (green) is seen on both sides of the lumen of Schlemm’s canal (red arrow). It could be scleral spur (+) anterior to the location of ciliary muscle and terminating scleral tissue (+) posterior to corneal boundary. Fig 2 shows the wide field mosaics of intensity and birefringence at 0, 24, 48, 72 and 96 microns above the scleral-uveal interface. The lumen of Schlemm’s canal is evidently seen as low scattering band in the intensity map (Fig 2(a)). The corresponding birefringence map reveals high birefringence zone posterior to the lumen along the sclera-uveal interface (+). Two high birefringence bands interspersed with a low birefringence band is noticed at slices above the scleral-uveal boundary. The birefringence maps provides improved contrast than the intensity maps to highlight the complex morphology of the limbal area.

Conclusions: Morphological and functional differences in the structural organization of limbal region could be visualized using multiple contrast information using JM-OCT.
Purpose: Polarization-sensitive OCT (PS-OCT) allows for detection of fibrous scar in the filtering bleb after glaucoma surgery and can be used to compute an objective diagnostic metric, i.e., the fibrosis score. Needling revision is often used to restore the filtering function of failing blebs. We conducted objective evaluation of fibrous scar using PS-OCT before and after needling revision of a failing bleb.

Methods: This study is a descriptive case observation. Two cases undergoing needling revision after filtration surgery were examined by a custom-build PS-OCT. Conventional OCT and birefringence image were computed from raw PS-OCT data. In figures, high birefringence area is displayed by red pixels and overlaid on the conventional OCT image.

Results: Case 1. A 65-year-old woman with primary open angle glaucoma underwent EX-PRESS shunt surgery. Three months after surgery, intraocular pressure (IOP) was 46 mmHg with full glaucoma medication. PS-OCT images showed thin high-birefringent tissue surrounding the internal fluid pool of the bleb (Figure a). Needling revision was done to restore filtering function of the bleb. At three months of follow-up, IOP was 14 mmHg with full glaucoma medication. The fibrosis score before and after the needling revision was 25.3 and 22.7 %, respectively (Figure a-b).

Case 2. A 49-year-old man with primary open angle glaucoma underwent trabeculectomy. Five weeks after surgery, IOP was 28 mmHg with three glaucoma medications. PS-OCT measurements showed that fluid pool was surrounded by a thick high birefringent tissue (Figure c). Bleb needling revision was done to restore filtering function. Despite of full glaucoma medication, IOP was 21 mmHg and high birefringence area of the bleb wall enlarged at one month of follow-up (Figure d). The fibrosis score before and after needling revision was 47.5 and 58.6 %, respectively (Figure c-d).

Conclusions: We presented two cases with successful or failed needling revision. The successful case (Case 1) had lower fibrosis score than the failed case (Case 2) before the treatment. PS-OCT measurements may be one of the prognosis predictive factors of the bleb undergoing needling revision.

Commercial Relationships: Kuniharu Tasaki, None; Yuta Ueno, None; Deepa Kasaragod, Topcoat (F), Tomey Corp (F), Nidek (F); Sujin Hoshi, None; Akari Fujita, None; Tomotaka Okubo, None; Shinichi Fukuda, None; Yoshiaki Yasuno, Topcon (F), Tomey Corp (F), Nidek (F); Tetsuro Oshika, Topcon (F), Tomey Corp (F), Nidek (F)

Figure: PS-OCT image of two cases before (a, c) and after (b, d) needling revision. The numbers are the fibrosis scores of these cases. Dotted lines indicate overlying birefringence. The images were captured with a custom-build PS-OCT.

Program Number: 2080 Poster Board Number: A0141
Presentation Time: 3:45 PM–5:30 PM

Multimodal imaging analysis in patients with transient ocular hypotony after antiglaucoma surgery
Artur William Caldeira Abreu Veloso, Daniel Vitor de Vasconcelos Santos, Sebastiao Cronemberger. Ophthalmology, Federal University of Minas Gerais, Belo Horizonte, Brazil.

Purpose: In ocular hypotony, permanent structural and functional damage may occur because of a delayed normalization of intraocular pressure (IOP). Early recognition and appropriate treatment of ocular hypotony is crucial to prevent that damage, however the hypotony duration is not very well established. This study tested the hypothesis that even a transient hypotony (≤6 weeks) can pose a risk to the eye.

Methods: We analyzed 14 eyes of 11 patients with transient ocular hypotony (IOP≤6 mmHg) for a maximum period of 6 weeks after either trabeculotomy or trabeculectomy or needling with mitomycin C. They were imaged by spectral domain optical coherence tomography (SD-OCT) including B-scans, improved by enhanced deep imaging mode, topographic macular thickness map, en face images segmented at various levels, retinal nerve fiber layer analysis, blue-light fundus autofluorescence and infrared fundus photo. Images were analyzed by a specialist masked to clinical findings and duration of hypotony.

Results: The mean age of patients was 54±16 [standard deviation (SD)] years (range 14–73 years). Most patients were male (63%). Mean IOP before surgery was 25.7±10.5 mmHg (95% CI 19.6–31.7) and mean central corneal thickness was 530.2µm±25.3µm [95% confidence interval (CI) 492.0-538.6]. During the period of hypotony (mean ± SD: 3±2 weeks), the mean IOP was 3.5±1.7 mmHg (95% CI 2.5–4.4). Abnormal SD-OCT findings [retinal folds and/or intraretinal fluid and/or cystoid macular edema (Fig. 1)] were present in 4 (28%) eyes, 2 of them (50%) had hypotony for less than 4 weeks. Patients with hypotony duration <4 weeks had a reduced mean foveal thickness (245±22 versus 296±30 µm; P<0.007, Student’s t-test) compared to those with ≥4 and ≤6 weeks of hypotony.

Conclusions: The longer period of hypotony was statistically associated with central macular thickening, when comparing the hypotony duration of <4 weeks with that of ≥4 and ≤6 weeks. However, even hypotony duration <4 weeks was associated with changes in the SD-OCT, suggesting that even a transient hypotony may be harmful to patients. If these findings can impose relevant visual disturbances on the long term, is something still to be confirmed by further prospective studies.

Figure 1a. SD-OCT showing cystoid macular edema of the right eye of a patient who had 6 weeks postoperative hypotony.

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Anterior Segment OCT and Specular Microscopy Study in Pediatric Patients: Normal Versus Glaucomatous Eyes

Benjamin Xu, None; Rafaela C. Penteado, None; Robert N. Weinreb, None; Sebastiao Cronenberger, None

Program Number: 2081 Poster Board Number: A0142
Presentation Time: 3:45 PM–5:30 PM

Diurnal Variation in Optical Coherence Tomography Measurements of Anterior Segment Structures

Benjamin Xu, Rafaela C. Penteado, Robert N. Weinreb

Purpose: Anterior segment optical coherence tomography (AS-OCT) has rapidly increased in popularity as a means of studying the anatomy and biomechanics of the anterior segment. While physiologic factors such as pupil size are known to affect AS-OCT measurements, it is not known if measurement values vary with the time of day. This study examines the diurnal variation of anterior segment structures in young healthy eyes by comparing AS-OCT measurements values obtained in the morning and late afternoon.

Methods: Eight subjects ranging from age 28 to 40 with no history of eye conditions or intraocular surgery were selected for this study (6 male, 2 female; mean age 31.2 ± 4.5 years). Anterior segment imaging was performed with a CASIA2 AS-OCT device (Tomey Corporation, Nagoya, Japan) in a fixed lighting environment between the hours of 8 to 9 AM and 4 to 5 PM. Four evenly spaced AS-OCT images per eye were analyzed. Nine parameters including angle opening distance (AOD), angle recess area (ARA), trabecular iris space area (TISA), trabecular iris angle (TIA), iris area (IA), anterior chamber depth (ACD), lens vault (LV), anterior chamber width (ACW), and anterior chamber area (ACA) were measured using the built-in CASIA2 image analysis program.

Results: Pupil diameter was similar between the AM and PM groups (5.10 ± 0.70 mm in AM, 5.18 ± 0.66 mm in PM, p = 0.77). There was no significant difference between AM and PM cumulative measurement values for any of angle parameters (p-value range from 0.22 to 0.93). Additionally, there was no significant difference between AM and PM measurement values obtained from each of the eight sections through the angle (p-value range from 0.25 to 0.99). There were varying amounts of agreement between measurement values for the different parameters (ICC values from 0.63 for TIA500 to 0.99 for ACD), but all qualified as good or excellent.

Conclusions: Minimal diurnal variation of AS-OCT measurement values were detected in young healthy adults.

Commercial Relationships: Artur William Caldeira Abreu Veloso, None; Daniel Vítor de Vasconcelos Santos, None; Sebastiao Cronenberger, None

Support: UCSD Vision Research Core Grant (P30EY022589)

Program Number: 2082 Poster Board Number: A0143
Presentation Time: 3:45 PM–5:30 PM

Anterior Segment OCT and Specular Microscopy Study in Pediatric Patients: Normal Versus Glaucomatous Eyes

Walid Abdallah, Brandon J. Wong, Moon Kim, Dilshad Contractor, Michelle Chen, Susan S. Lee, Bibiana J. Reiser

Purpose: Anterior segment anatomy evaluation in children is challenging and has been restricted to high-frequency ultrasound, that requires immersion technique. Anterior segment optical coherence tomography (AS-OCT) and specular microscopy are important noninvasive imaging tools, however their role in ocular pediatric diseases has not been well reported. In this study, AS-OCT and specular microscopy were used to evaluate and compare the iridocorneal angles and corneal parameters in normal versus glaucomatous eyes in a pediatric population.

Methods: AS-OCT of the temporal iridocorneal angle and specular microscopy were performed on a total of 90 pediatric subjects (70 glaucomatous eyes and 20 normal eyes) from the Children Hospital of Los Angeles using a noncontact technique. AS-OCT images were graded for the ability to visualize Schwalbe’s line (SL), the superior iris surface, and the angle recess. Image J software (1.49v) was used to measure the angle opening distance at SL (SL-AOD) and trabecular-iris-space-area 500 µm posteriorly from SL (SL-TISA) in gradable images. Specular microscopy images were manually analyzed using the center method to determine the endothelial cell density, hexagonality, and coefficient of variation. Student t-test was used to calculate the p-value from the means (statistical significance if <0.05).

Results: OCT and specular microscopy imaging of the anterior segment in the study patients was well tolerated. The mean temporal SL-AOD in the normal eyes is 0.76 +/- 0.22 mm compared with 0.81 +/- 0.26 mm in glaucomatous eyes, with no statistically significant difference between the 2 study groups (P-value: 0.8). The mean temporal SL-TISA in normal eyes is 0.30 +/- 0.17 mm² compared with 0.28 +/- 0.12 mm² in glaucomatous eyes with no statistically significant difference between the 2 groups (P-value: 0.92).

Data obtained from further analysis of the glaucoma subtypes and specular microscopy are summarized in table-1 & 2

Conclusions: In the present study, there does not appear to be a clinically significant difference in iridocorneal angle biometrics between normal and glaucomatous eyes, however, the endothelial cell density is observed to be lower in glaucomatous eyes. Noncontact AS-OCT and specular microscopy demonstrated to be effective techniques to evaluate the anterior segment providing anatomic details and are useful to clarify diagnoses in the pediatric population.

Alcon (C), Carl Zeiss Meditec (F), Sensimed (C), Quark (F), Topcon (F), Optovue (F), Eyenovia (C), Bausch & Lomb (C), Genentech (F), Allergan (C), Unity (C)

Support: UCSD Vision Research Core Grant (P30EY022589)
Mean SL-AOD  |  Mean SL-TISA  
--- | --- 
Congenital  |  0.79±0.27  |  0.26±0.13  
JOAG  |  0.79±0.15  |  0.27±0.05  
Uveitic  |  0.84±0.23  |  0.3±0.12  
Other (includes SWS, Aphakic)  |  0.83±0.36  |  0.29±0.17  

|  | Normal Eyes  | Glaucomatous Eyes  | p-value  
--- | --- | --- | --- 
Cell density  | 3198±538  | 2767±1002  | 0.0047  
Coefficient of variation  | 29.6±10.06  | 27.97±10.72  | 0.3724  
Hexagonality (%)  | 69.3±8.4  | 62.8±19  | 0.0203  
Pachymetry (µm)  | 581.1±75.5  | 592±68.2  | 0.3762  

Commercial Relationships: Walid Abdallah, None; Brandon J. Wong, None; Moon Kim, Allergan, Inc (C); Dilshad Contractor, Allergan, Inc (F); Michelle Chen, Allergan, Inc (E); Susan S. Lee, Allergan, Inc (E); Bibiana J. Reiser, Allergan, Inc (F)  
Support: Research grant by Allergan  

Program Number: 2083  
Poster Board Number: A0144  
Presentation Time: 3:45 PM–5:30 PM  
360-degree measurement of anterior chamber angle dimensions in primary angle closure (PAC) with swept-source optical coherence tomography (SS-OCT)  

FEIHUI ZHENG, Christopher K. Leung. Ophthalmology & Visual Sciences, The Chinese University of Hong Kong, Hong Kong, Hong Kong.  

Purpose: Evaluation of the anterior chamber angle dimensions is crucial to the diagnosis and management of PAC diseases. While gonioscopy has been a reference standard for examination of the anterior chamber angle, reliable measurement of the anterior chamber angle width can only be attained with OCT. Yet, high resolution topography analyzing the distribution of the angle dimensions for 360° has not been investigated. We evaluated the test-retest variability of a new anterior segment SS-OCT (CASIA2, Tomey, Nagoya, Japan) for measurement of the anterior chamber angle and examined the 360° distribution of the angle dimensions in open angle eyes and in eyes with PAC diseases.  

Methods: Anterior segment imaging was performed with CASIA2 SS-OCT (50,000 A-scans/s; 800 A-scans/B-scan) in 30 open angle glaucoma eyes (age: 55±11.5 years) and 30 eyes with PAC/PACS/ PACG (age: 61.5±8.4 years). Each eye was imaged for three times (total scan time was 0.26sX3) in the dark. Angle opening distance (AOD) at 500µm from the sclera spur (SS) and trabecular iris space area (TISA) at 500µm from the SS were measured automatically by the software after manual detection of SS by two observers in 32 angle meridians. Comparisons of AOD/TISA between open-angle and angle-closure eyes were performed with ANOVA and Bonferroni correction. Inter-observer test-retest variabilities were evaluated with intra-class correlation coefficient (ICC).  

Results: The AOD/TISA measurements are shown in Fig. 1. AOD and TISA were significantly greater in open angle eyes than in PAC eyes in all 32 angle meridians (p<0.001). AOD/TISA were smallest at 45°-101° (superonasal meridians) in open angle eyes and at 56°-124° (superior meridians) in PAC eyes. The greatest difference in AOD/TISA between open-angle and PAC eyes was located at 180°-270° (inferotemporal meridians). ICC(AOD) and ICC(TISA) ranged between 0.817 and 0.982 and between 0.714 and 0.972, respectively, for eyes with open angle; and between 0.808 and 0.996 and between 0.779 and 0.985, respectively, for eyes with PAC.  

Conclusions: The new SS-OCT is reliable for 360° measurements of the anterior chamber angle and differentiation between eyes with PAC and eyes with open angle.
of this study was to evaluate the influence of LPD on PAC/G pathophysiology.

**Methods:** This study involved 88 normal Japanese subjects (22 males/66 females; mean age 66.6±5.6 years) and 25 PAC/G patients (6 males/19 females; 66.6±8.8). Inclusion criteria were those who 1) visited the outpatient clinic of Kyoto Prefectural University of Medicine, Kyoto, Japan between June 2014 and April 2016, 2) were diagnosed by glaucoma specialists as normal or PAC/G based on several ophthalmic examinations, and 3) in whom reliable horizontal images could be obtained using anterior segment optical coherence tomography (AS-OCT) (CASIA SS-1000; Tomey, Nagoya, Japan).

In all eyes, AS-OCT images were imported to image processing software (Image J 1.48q; NIH). The line connecting the scleral spur (SS) was regarded as the SS-line, and anterior chamber depth (ACD), width (ACW), and LV were defined as described (Nongpiur ME et al., Ophthalmology 2011). LPD were defined as previously reported (Mori K et al., ARVO 2016). In brief, the averaged perpendicular distance at the point of nasally and temporally 2mm apart from visual axis, from the anterior lens surface to the horizontal line at the anterior pole parallel to the SS-line were defined as LPD. The clinical features of age, gender, and axial length (AL) were also obtained. Stepwise multiple regression analysis was performed, regarding LPD as a descriptive variable, and age, gender, AL, ACD, LV, and ACW as explanatory variables. Multiple logistic regression analysis with forward selection method was also performed between the normal and PAC/G.

**Results:** LV and LPD of normal vs. PAC/G subjects were showed in Table 1. Stepwise multiple regression analysis showed that AL was the statistically significant determinant of LPD (p=0.001) in PAC/G patients. Multiple logistic analysis showed that ACD (p=0.001) and LPD (p=0.03) were significant explanatory variables for PAC/G.

**Conclusions:** Anterior curvature of the lens and anterior chamber depth were significantly related to the PAC/G pathophysiology.

### Table 1.

<table>
<thead>
<tr>
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<th>N</th>
<th>LV (mean ± SD)</th>
<th>LPD (mean ± SD)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>88 (22 males/66 females)</td>
<td>0.51 ±0.29</td>
<td>0.227 ±0.030</td>
</tr>
<tr>
<td>normal</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PAC/G</td>
<td>25 (6 males/19 females)</td>
<td>0.73 ±0.41</td>
<td>0.226 ±0.050</td>
</tr>
</tbody>
</table>

**Commercial Relationships:** Kazuhioko Mori, Santen (P), Ocular Instruments Inc. (R); Ayumi Miura, None; Junta Kubo, None; Yuji Yamamoto, None; Kengo Yoshii, None; Yoko Ikeda, Santen (P); Morio Ueno, Santen (P), Senju (P); Kojiro Imai, None; Noriko Koizumi, None; Shigeru Kinoshita, Santen (P), Senju (P); Chie Sotozono, None.

**Program Number:** 2085 Poster Board Number: A0146
**Presentation Time:** 3:45 PM - 5:30 PM
**Reproducibility in Identifying Schwalbe’s Line on new High Definition Angle scans using Spectral Domain Optical Coherence Tomography**

**Purpose:** OCT-based anterior chamber metrics such as angle opening distance are important in quantitatively evaluating the anterior chamber. For spectral domain optical coherence tomography (SDOCT) scans, these metrics are dependent on correctly identifying landmarks such as Schwalbe’s Line (SL).

This study assesses the inter-grader reproducibility of identifying SL on the new High Definition (HD) Angle anterior segment SDOCT scan, which uses oversampling and enhanced depth imaging.

**Methods:** 90 eyes of 45 participants were imaged in this IRB approved, prospective research study. Both normal and primary open angle glaucoma eyes were included as long as they had an open angle allowing for SL detection. HD Angle scans were captured using the Zeiss Cirrus 5000 (v9.5) (Carl Zeiss Meditec Inc. Dublin, CA). Two certified Doheny Image Reading Center evaluators analyzed the images in a masked, independent fashion. Each evaluator annotated the location of SL on each dewarped image using ImageJ v1.48 software (NIH, Bethesda, MD). The point selected as SL was captured as XY coordinates given by ImageJ, based on a scan width and height of 6233.7 µm and 4019.4 µm respectively. The Euclidean distance was calculated between the SL coordinates from each evaluator. Intraclass correlation coefficients (ICC) were calculated for both X and Y coordinates using IBM SPSS Statistics for Windows, v.19 (IBM Corp., Armonk, NY).

**Results:** Mean difference of SL placement between evaluators was 76.88 ± 92.63 µm (0 - 411.26 µm). Exact concordance of SL placement between evaluators occurred in 5 scans. The mean XY coordinates for evaluator 1 and evaluator 2 were (3030.29, 2096.76) µm and (3027.73, 2089.80) µm respectively, with a mean absolute difference of (X= 50.20 and Y= 56.02) µm. The ICC for X-coordinates was 0.99 (0.993 - 0.997) and Y-coordinates was 0.98 (0.976 - 0.989) (p <0.001 and p <0.001).

**Conclusions:** This study is the first to quantify reproducibility of SL location identification using the Zeiss HD Angle OCT scan. Inter-grader reproducibility is excellent. The results contextualize precision of quantitative SDOCT anterior chamber metrics that rely on SL. Additionally, these findings establish a human benchmark for automated SL identification algorithms, which are needed to expand the set of anterior chamber measurement tools available to clinicians.
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Commercial Relationships: Dennis Jenkins, None; Yue Shi, None; Sean Pitetta, None; Ken Marion, None; Alex Ho, None; Srinivas R. Sadda, Novartis (C), Optos (C), Allergan (F), Genetech (F), Carl Zeiss Meditec (F), Genentech (C), Thrombogenics (C), Optos (F), Iconic (C), Allergan (C); Philip Le, Allergan (C), Allergan (F); Vikas Chopra, Allergan (C), Allergan (F)

Program Number: 2086 Poster Board Number: A0147
Presentation Time: 3:45 PM–5:30 PM
Automated grading of anterior segment Swept Source OCT images: A validation study for assessment of angle closure
Natalia Porporato1, Baskaran Mani1, Xu Yanwu1, Tin A. Tun1, Sameer Trikha1, Damon W. Wong1, Tin Aung1. 1Glucoma, Singapore Eye Research Institute, Singapore, Singapore; 2Institute for Infocomm Research, Singapore, Singapore; 3Institute for Infocomm Research, Singapore, Singapore.

Purpose: To evaluate the performance of an automated machine-learning algorithm for detecting angle closure in a single frame anterior segment swept source optical coherence tomography (SSOCT, CASIA, Tomey Corp, Japan) image, compared to gonioscopic angle closure in a community based sample.

Methods: 1900 subjects from a community screening study underwent gonioscopy and CASIA 360 degree SSOCT scans. Of these, horizontal scans from 578 subjects (957 eyes) underwent a machine-learning algorithm for detecting angle closure (based on histogram of oriented gradients and linear support vector machine techniques) and manual grading of images by a clinician (masked to gonioscopy). Manual grading and machine-learning assessment were compared to gonioscopic angle closure definition using receiver operating characteristic curves.

Results: Of the 957 eyes, 2 quadrant gonioscopic angle closure was seen in 32 (3.3%) eyes and 3 quadrant closure was seen in 26 (2.7%) eyes. The AUC (area under the curve) for manual grading of images was 0.78 (95% CI 0.75, 0.8) and 0.83 (95% CI 0.8, 0.85) for 2 and 3 quadrants gonioscopic closure. The AUC for the automated machine learning algorithm was 0.71 (95% CI 0.69, 0.75) and 0.75 (95% CI 0.72, 0.78) respectively. The AUC for the automated machine learning algorithm was 0.83 (95% CI 0.8, 0.85) for detecting a closed-angle in images graded by the clinician. With a fixed specificity of 0.9, false positive rate was 0.1 and sensitivity was 0.74.

Conclusions: The algorithm for automated assessment of angle closure in SSOCT images showed moderate performance when compared to gonioscopy. We suggest further enhancement of the algorithm using feature extraction methods and deep learning in future experiments.

Commercial Relationships: Natalia Porporato, None; Baskaran Mani, None; Xu Yanwu, None; Tin A. Tun, None; Sameer Trikha, None; Damon W. Wong, None; Tin Aung, None

Program Number: 2087 Poster Board Number: A0148
Presentation Time: 3:45 PM–5:30 PM
Iris incompressibility in Indian patients with occludable angles post laser peripheral iridotomy
Matthew Wojcik1, Anu Pant2, Priyanka Gogte1, Allie Stanley1, Chidiebere Animeze2, Syril K. Dorairaj1, Vanita Pathak-Ray4, Rouzbeh Amini1. 1Biomedical Engineering, University of Akron, Akron, OH; 2Department of Ophthalmology, Mayo Clinic, Jacksonville, FL; 3LV Prasad Eye Institute, Hyderabad, India.

Purpose: Previous studies have shown that the iris is less compressible in angle closure glaucoma patients (Ophthamology, 117:3–10). Using a theoretical model, we have shown that incompressible irides crowd into the anterior chamber angle independent of the commonly known culprit, i.e. the pupillary block phenomenon (IOVS, 54:2977-84). In this study, we examined dilation-induced changes in the iris biometrics in patients with occludable angles who had undergone laser peripheral iridotomy (LPI).

Methods: Anterior segment cross-sectional images were taken at eight different clock-hours under standard and dim lighting conditions using a Visante anterior segment optical coherence tomography device (Carl Zeiss Meditec, Inc., Dublin, CA) in LV Prasad Eye Institute in Hyderabad, India. Two groups of eyes were scanned: (i) patients with occludable angles who had undergone LPI (n=20) and (ii) a healthy control group (n=10). An internally-developed software was used to quantify fifteen anterior segment biometric parameters in these images. Paired Student t test was performed to find significant difference between the light and dim conditions in different groups.

Results: In both groups, the pupil diameter changed significantly confirming the response of the iris constituent muscles to the changes in the ambient light (P<0.05, Fig 1a). In the control group, the iris volume significantly decreased from 62.20 ± 4.24 mm³ (mean ± standard deviation) under standard light to 59.05 ± 2.41 mm³ under dim light (p <0.05). The iris concavity also increased significantly from 0.220 ± 0.0563 mm under dim light to 0.243 ± 0.0560 mm under standard light in the control group (p <0.05). However, no

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significant difference was found for the same two parameters in the post-LPI group (p > 0.05).

Conclusions: Consistent with previous studies in angle closure glaucoma patients, we observed that patients with occludable angles have less compressible irides. One could postulate that crowding of the iris periphery during dilation causes the narrowing of the angle in such patient groups. Since LPI equalizes the pressure between the anterior and posterior chambers, one could conclude that in these patients iris tissue properties (e.g., incompressibility) play more dominant roles than the increased aqueous humor pressure on the posterior side of the iris due to pupillary block.

Conclusions: The majority of eyes with aniridia and glaucoma have open anterior chamber angles, similar to patients with aniridia without glaucoma. Eyes with aniridia and glaucoma that had closed angles had a prior history of ocular surgery, which likely contributed to development of angle closure.

Commercial Relationships: Eitan S. Burstein, None; Asima Bajwa, None; Jill A. Nerby, None; Robert M. Grainger, None; Peter A. Netland, None

Support: Research supported by Aniridia Foundation International

Program Number: 2089 Poster Board Number: A0150
Presentation Time: 3:45 PM–5:30 PM
Using Anterior Segment Optical Coherence Tomography (ASOCT) Parameters to Determine Pupillary Block versus Plateau Iris Configurations
Eric Crowell1, 2, Alice Chuang1, Laura Baker1, Lauren S. Bleden1, 2, Nicholas P. Bell1, 2, Robert M. Feldman1, 2. 1Ruiz Department of Ophthalmology and Visual Science, McGovern Medical School at The University of Texas Health Science Center at Houston, Houston, TX; 2Robert Cizik Eye Clinic, Houston, TX.

Purpose: To investigate which anterior segment parameters can be used to distinguish between 2 mechanisms of angle closure: pupillary block (PB) and plateau iris (PI) configurations, using Swept Source Fourier Domain ASOCT

Methods: ASOCT images from prior IRB-approved studies with narrow angle eyes were reviewed. PI configuration was defined either by ultrasound biomicroscopy and/or clinically when an iridoplasty was performed. All ASOCT imaging was performed in the dark with the CASIA SS-1000 (Tomey, Nagoya, Japan) instrument using the angle analysis 3D mode. Images were read by an experienced, masked reader using customized software to identify the scleral spur landmarks (SSL). The software then interpreted and calculated the following (Figure 1): scleral spur landmark line (SSL); anterior chamber width (ACW), depth (ACD), area (ACA), and volume (ACV); lens vault (LV); pupil arc (PA) and pupil arc area (PAA); center point of SSLL-pupil margin angle (CIV); iris area (IA) and volume (IV); central iris-scleral spur angle (CISSA); angle between central iris-scleral spur and pupil margin-scleral spur angle (PMSSA); angle between central iris-scleral spur and pupil margin-scleral spur (CPIMA); central iris vault (CIV, length between central iris to SSL); and pupil margin vault (PMV, length between pupil margin and SSL). ASOCT parameters were summarized and compared using a 2-sample t-test.

Results: 78 eyes (67 PB and 11 PI) of 78 participants were reviewed. There were no differences between groups demographically. Of all studied ASOCT parameters, mean PA (both horizontal and vertical) was 0.72 mm (18%) larger (P =0.016) and mean PAA was 4.27 (22%) in PI eyes than PB eyes. Mean CPMA was 8 degrees (35% at temporal, superior, inferior) to 9 degrees (41% at nasal) smaller (P <0.001), mean CIV was 0.13 mm (22% at nasal, superior and temporal) to 0.16 mm (26% at inferior) smaller (P <0.017), and PMV was 0.18 mm (22% at inferior) to 0.22 mm (31% at nasal) smaller (P <0.005) in PI eyes (Figure 2).

Conclusions: The parameters that can potentially be used to differentiate PI from PB are larger PA or PAA and a smaller CIV.
Individual Variation in Accommodative Change of the Iris Profile among Young Adults

Ji C. He, New England College of Optometry, Boston, MA.

**Purpose:** The function of accommodation is to change refractive power of the eye for near vision, but meanwhile, it also changes intraocular pressure (IOP) in the anterior chamber due to a forward movement of the anterior lens surface. For pigmented glaucoma patients, accommodation causes iris to be bowed, and the iris bowing was attributed to a pressure reversal between the anterior and posterior chambers. The purpose of this study was to measure accommodative change of the iris profile for normal young adults in order to better understand dynamics of the aqueous humor in the normal eyes.

**Methods:** Accommodations from 0D to 6D in a step of 2D were induced and measured in the right eyes of 16 young adults (age ranged 22 to 27 years) by using a customized anterior segment OCT system, and the accommodative changes in the lens shape and refractive power have been previously reported in ARVO 2014 and 2015. In this study, the OCT images were re-processed with a customized anterior segment OCT system by outlining the posterior profile of the iris after correcting refractive distortion with a customized ray tracing procedure. A 2nd order polynomial function was used to fit the iris profile, and the coefficients were derived to assess slope and curvature of the iris profile.

**Results:** For all subjects, mean slope coefficient of posterior iris profile was 0.177±0.155 at 0D and changed to -0.012±0.119 at 6D accommodation. The mean curvature coefficient was changed from 0.035±0.027 in convex shape at 0D to -0.036±0.022 in concave shape at 6D accommodation. The difference of curvature coefficient between the 0D and 6D changed substantially from subject to subject, with a minimum of -0.005 and a maximum of -0.128. The accommodative change of curvature coefficient was not significantly correlated to accommodative change of ACD.

**Conclusions:** There is a substantial variation in accommodative change of the iris profile among young adults, and the iris bowing is not associated with the amount of forward movement of the anterior lens surface. The results suggest that accommodative change of iris profile might be associated with fluid dynamics of the anterior chamber, and the test of iris change during accommodation could be an interesting method in clinical practice to assess risk factor of glaucoma.

**Commercial Relationships:** Ji C. He, None

**Program Number:** 2090 **Poster Board Number:** A0151

**Presentation Time:** 3:45 PM–5:30 PM

**Evaluation of filtration blebs by anterior segment optical coherence tomography (AS-OCT) after conventional trabeculectomy and trabeculectomy with antifibrotic agents**


**Purpose:** Evaluate the anatomic characteristics of filtering blebs in patients with conventional trabeculectomy (TBC) vs trabeculectomy with Mitomycin C (TBC+MM) and Collagen-polyvinylpyrrolidone (TBC+CP) using AS-OCT. We measured the wall thickness, presence of microcysts, and cavities, in order to find clinical correlation between the anatomy of the bleb, the intraocular pressure (IOP) and the amount of drugs used before and after surgery

**Methods:** Cross-sectional, observational and descriptive study. We included patients with TBC, TBC+MM and TBC+CP. We measured the IOP and amount of antihypertensive drugs before, and one year after surgery, with a subsequent complete ophthalmologic evaluation emphasized in anatomical features of the bleb. AS-OCT was performed for morphological evaluation.

**Results:** 25 eyes were included; 36% in the TBC+MMC group, 32%TBC+CP, and 32%TBC. The average age was 64.36 years (SD 16.7). A reduction of 11.1mmHg IOP was observed in TBC+MMC, TBC+CP 9.88mmHg, and TBC 7.13mmHg, which was clinically relevant but not statistically significant (p =0.220). A reduction of antihypertensive drugs in TBC+MMC was 2.8, TBC+CP 2.1, and 0.8 TBC, being statistically significant (p=0.002). In anatomical assessment of the filtration bleb, the wall thickness average of the bleb in TBC+MMC was 51 microns, TBC+CP of 57 and TBC 83. There was statistical difference between the TBC+MMC vs TBC (p=0.001), and in the TBC+CP vs TBC (p=0.021). No significant statistical difference was found between TBC+MMC vs TBC+CP (p=0.806). In TBC+MMC we found moderate microcysts in 33.3%, abundant in 66.7% and cavities (subconjunctival lagoons) in 67.7%, no fibrosis observed. In TBC+CP moderate microcysts 75% and 25% abundant, formation of cavities in 34%, no fibrosis was found. In TBC few microcysts in 37.5%, moderate in 37.5% and 25% abundant, subconjunctival fibrosis in 37.5%.

**Conclusions:** The use of MMC and CP improves the function of the filtration bleb, achieving surgical success. It was observed that the reduction of IOP in patients that use antifibrotics was clinically but not statistically significant, compared with the conventional TBC.
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However, there was a significant statistical relevance regarding the reduction of ocular hypotensive drugs used after surgery, which correlates with the anatomical findings of the bleb.

**Commercial Relationships:** Yael Azses, None; Cindy Anahi Haro Zuno, None; Jesus Jimenez Arroyo, None; Magdalena Garcia Huerta, None; Mauricio Turati Acosta, None; Felix Gil Carrasco, None; Jesus Jimenez-Roman, None

**Program Number:** 2092 Poster Board Number: A0153
**Presentation Time:** 3:45 PM–5:30 PM
**Anterior segment OCT predictors of intraocular pressure drop after phacoemulsification: One year follow up**
**Kristin Hirabayashi, Marisse Masis, Shan C. Lin. Ophthalmology, University of California, San Francisco, Burlingame, CA.**

**Purpose:** To use anterior segment optical coherence tomography (AS-OCT) to evaluate anatomical predictors of intraocular pressure drop one year after phacoemulsification in glaucomatous eyes without angle closure.

**Methods:** This was a prospective study of consecutively enrolled glaucoma patients who had cataract surgery between July 2009 and July 2015. Patients were screened and enrolled at the University of California, San Francisco Medical Center. Subjects with a diagnosis of glaucoma but without peripheral anterior synchiae (PAS), pigment dispersion, pseudoxefoliation, other secondary causes of glaucoma, prior surgery or trauma were included. Subjects received AS-OCT prior to and 1 year after phacoemulsification cataract surgery. Intraocular pressure by Goldmann application was checked by a single, masked observer in the early afternoon on all study visits. Subjects were kept on the same glaucoma regimen as prior to surgery. The main outcome was intraocular pressure change at 1 year compared to baseline. Predictors were the following anterior segment parameters: 1) anterior chamber depth (ACD); 2) lens vault (LV); and 3) anterior chamber volume (ACV). Mixed effects regression, adjusting for gender, age, race and central corneal thickness was performed to correlate the main outcome with the AS-OCT parameters.

**Results:** We enrolled 189 eyes from 139 subjects. The mean age of all participants was 75 ± 8 years and a majority were women (63%). The mean IOP drop was 2.9 ± 3 mmHg in the entire group. When correcting for age, gender, and CCT, there was a significant correlation with IOP reduction with ACD (β 0.22, p =0.05), (ACV (β 0.011, p=0.01) and LV (β 0.003, p=0.04). There was a significant IOP reduction in our cohort of glaucoma subjects. This reduction was correlated with ACD, ACV, and LV—parameters which may be helpful predictors in glaucoma subjects.

**Commercial Relationships:** Kristin Hirabayashi, None; Marisse Masis, None; Shan C. Lin, Iridex (C), Allergan (C)

**Support:** Institutional grant from Research to Prevent Blindness

**Program Number:** 2093 Poster Board Number: A0154
**Presentation Time:** 3:45 PM–5:30 PM
**Anterior segment parameters measured by ultrasound biomicroscopy in the subtypes of angle-closure**
**SOON YOUNG CHO1, Yong Yeon Kim2, Chungkwon Yoo3, Tae-Eun Lee4. Ophthalmology, Dongguk University Gyeongju Hospital, Gyeongju, Korea (the Republic of); 2Ophthalmology, Korea University Kuro Hospital, Seoul, Korea (the Republic of); 3Ophthalmology, Korea University Anam Hospital, Seoul, Korea (the Republic of); 4Ophthalmology, Chonbuk University Hospital, Junju, Korea (the Republic of).**

**Purpose:** To compare anterior segment parameters in primary angle closure suspect (PACS), primary angle closure (PAC), and primary angle closure glaucoma (PACG) using ultrasound biomicroscopy (UBM P60, Paradigm Inc, Utah, USA).

**Methods:** 59 eyes of 59 patients with PACS, 41 eyes of 41 patients with PAC, and 51 eyes of 51 patients with PACG were investigated. Definitions of PACS, PAC, and PACG were based on the recommendation from the International Society for Geographic and Epidemiological Ophthalmology. In each participant, slit lamp examination, funduscopy, gonioscopy, Goldmannplanation tonometry and UBM were performed. Anterior segment parameters such as anterior chamber depth (ACD), anterior chamber width (ACW), lens vault (LV), angle opening distance 500 (AOD 500), trabecular meshwork-ciliary process distance (TCPD), iris thickness (IT) and iris zonular distance (IZD) were evaluated.

**Results:** AOD500 were significantly different among the angle-closure subtypes in nasal, inferior, and temporal quadrants (PACS>PACG>PAC; p<0.05). TCPD were significantly different among the subtypes in all quadrants (PACG>PAC>PACS; p<0.05). ACD were significantly different among the subtypes (PACG>PACS>PAC; p<0.05). ACW, LV, IT and IZD were not significantly different among the subtypes (p>0.05).

**Conclusions:** AOD500, TCPD, and ACD were the smallest in PAC, and ACW, LV, IT, and IZD were similar among the angle-closure subtypes. There may be a consequence in the development of angle-closure from mild to severe damages, from PACS to PAC to PACG, in terms of intraocular pressure, angle status, and optic nerve head status. However, our results suggested that such consequence may not exist in terms of anterior segment parameters measured by UBM.

**Commercial Relationships:** SOON YOUNG CHO, None; Yong Yeon Kim, None; Chungkwon Yoo, None; Tae-Eun Lee, None

**Program Number:** 2094 Poster Board Number: A0155
**Presentation Time:** 3:45 PM–5:30 PM
**Anterior segment growth from infancy to early adulthood using ultrasound biomicroscopy**
**Gianna Stoleru1, Azam Qureshi2, Mona A. Kalem3, Osamah Saeedi4, William P. Madigan4, Janet L. Alexander1. University of Maryland School of Medicine, Baltimore, MD; 3Children’s National Medical Center, Washington, DC.**

**Purpose:** To describe anterior segment anatomy and structural changes with eye growth in normal infants, children, and young adults using ultrasound biomicroscopy (UBM) in order to provide a baseline for future comparison to eyes with primary congenital and juvenile glaucoma.

**Methods:** Anterior segment UBM imaging was performed on 15 normal eyes of 15 patients age 0 to 25 years. Each image was analyzed according to a prospective protocol with quantitative measurements of each structure using ImageJ software. 19 parameters in 6 images of 1 eye per patient were evaluated using independent t-test and ANOVA. Pediatric and adult age groups were defined as patients under age 18 years and patients age 18-25 years, respectively (M=11.227 years). Patients were 36% male, 64% female, 57% African American, 21% Hispanic, and 21% Caucasian.

**Results:** Mean anterior chamber (AC) width, area, perimeter, and height were significantly smaller in the pediatric age group (p=0.0091, 0.0016, 0.0034, 0.0011, respectively). AC width increased by 50% in the first year and was relatively unchanged until adulthood. AC height increased by 10% in the first year and an additional 15% by 5 years but did not undergo significant change from age 5 to early adulthood. The adult age group had a central corneal thickness (CCT) of 567.2+/−30.3um and a statistically significant negative correlation with age (R=−0.085, p<0.05), consistent with previously established trends. Sulcus to sulcus distance and trabecular-ciliary process (CP) distance increased linearly (R=0.2676, 0.4234, p=0.05, respectively).
Obtained results confirm the efficacy of this method.

We included 11 consecutive patients with unilateral traumatic hyphema. Projectiles thrown by male preponderance (n=10, 90.9%). Results:

Pupillary diameter (PD) without accommodation compared to the maximum value of the cornea signal FC increased significantly in all groups, and no statistically significant differences between groups were observed at this control group and cataract group (respectively, p=0.044 and p=0.041). After 2h and 6h, FC in the glaucoma group decreased from 91 to 64 [ng/mL], in the control group, this parameter was maintained at a level of 46 and 42 [ng/mL]. A statistically significant difference was obtained for the FAC parameter after 4h and 6h in the glaucoma group compared to the control group and cataract group (respectively, p=0.017 and p=0.003). After 4h and 6h, FAC in the glaucoma group was maintained at a level of 42 and 34 [ng/mL], in the cataract group, this parameter decreased from 29 to 22 [ng/mL], and the values for the control group decreased from 20 to 18 [ng/mL].

Conclusions: Obtained results confirm the efficacy of this method in diagnostics of drainage path function. Fluorophotometry may be a tool that makes it possible to detect irregularities in conventional aqueous drainage path function in a safe and non-invasive manner.

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In vivo imaging of human aqueous outflow and calculation of aqueous column diameter

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Purpose: Aqueous drains from the eye into the episcleral venous circulation, giving rise to aqueous veins. The importance of this relationship is evidenced by multiple disease processes in which raised episcleral venous pressure and glaucoma are associated. In this study, we used haemoglobin video imaging (HVI), a non-invasive technique that enables detailed dynamic examination of microvascular rheology in the episcleral circulation, to study aqueous outflow in vivo.

Methods: We used HVI to perform an observational study on 30 eyes. Images were captured using a monochromatic Prosilica GC1380H camera attached to a Zeiss slit lamp with a bandpass filter of wavelength 520-600nm. Quantification was undertaken on 9 of these eyes (4-10 images per eye). The images were stabilised in MATLAB using both rigid and affine image registration to offset saccadic eye movement. We developed a mathematical model of the relationship between density profiles of vein transepts (figure 1) and the diameter (hence, cross-sectional area - CSA) of a central aqueous stream (AQC). This corresponded with the separation of intensity troughs (δ), measured immediately up-stream of a vessel confluence (figure 2).

Results: The HVI technique demonstrates aqueous as an erythrocyte void in episcleral venous blood. Aqueous tended to centralise within a laminar venous column, regardless of its point of entry into the episcleral circulation. The length of aqueous streams varied, but some continued beyond the conjunctival reflection. Fluctuations arose in the aqueous stream, corresponding with cardiac rhythm, eye movements and digital pressure on the globe. The CSA calculations arising from δ were consistent and repeatable for each eye measured. The mean CSA varied widely in different aqueous veins: from 53.1px² to 507.4px². The standard error of δ ranged from 0.16 to 0.45.

Conclusions: We have used HVI to develop a method for the detailed observation and quantification of aqueous columns in episcleral venous blood. We are currently using this method to explore the relationship between AQC area, episcleral venous pressure and IOP, and the effect of glaucoma medications and selective laser trabeculoplasty on these variables.

Figure 1: Pixel transect across aqueous vein.

Figure 2: Measurement of δ during stable laminar flow

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Iridial vasculature and pericyte morphology in different types of glaucoma

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Purpose: To study iridial vasculature and pericyte morphology of iris vessels in different types of glaucoma

Methods: Iris samples were obtained from patients who underwent standard trabeculectomy after informed consent. Tissues were fixed in 10% formalin and then cut at 4 µm size thin sections. The sections were collected in poly L lysine coated slides and stained with routine haematoxylin and eosin, examined under light microscope with 10x, 20x,40x and 100x magnification. Iris morphology was compared in glaucoma cases and control iris tissue obtained from enucleated eyes.

Results: Iris specimens were obtained from patients with POAG(Primary open angle glaucoma), PACG(Primary angle closure glaucoma) and PCG(Primary congenital glaucoma) (n=1 each) who underwent trabeculectomy which were compared with iris morphology obtained from enucleated eye. Iris from glaucoma cases...
(POAG and PACG) appeared to have significantly narrowed inner luminal calibre with thickened tunica media as compared to control. Interestingly, the endothelial cells were very sparse and significantly reduced with flattened pericytes in iris of glaucoma cases which was seen in POAG, PACG and PCG compared to controls.

**Conclusions:** A definite reduction in iridial vessel calibre with reduced pericytes are novel findings which suggest structural damage to pericytes and basement membrane barrier functions in different glaucoma types.

Histopathology section of Iris in control under 20x magnification showing thin vessel wall with plump endothelium and pericytes lining vessel wall.(Inset black arrows).

Histopathology section of Iris in PCG under 20x magnification showing thin vessel wall with flattened endothelial cells and sparse flat pericytes.(Inset white arrows).

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