Purpose: Fundus-controlled perimetry in patients with reticular drusen (RDR) in the context of a cross-sectional, single-center, observational study.

Methods: Twenty eyes from 18 patients (mean age 75.8 years) with RDR identified by confocal scanning laser ophthalmoscopy near infrared reflectance imaging and confirmed by spectral-domain optical coherence tomography and 20 eyes from 20 healthy controls (mean age 75.5 years) were included. Scotopic and photopic fundus-controlled perimetry (Nidek MP1S) was performed in patients. The localized outer retinal thickness at the site of test stimuli was determined as the distance between the outer border of the outer plexiform layer and the inner border of the ellipsoid zone and topographically corrected according to measurements in controls.

Results: The mean outer retinal thickness in patients was 65.8 μm over areas with RDR and 76.4 μm (p<0.0001) over non-affected retinal areas. Photopic and scotopic sensitivity were reduced corresponding to areas with RDR (mean scotopic 12.8 dB and mean photopic 17.2 dB) as compared to non-affected retinal areas (18.2 dB and 18.4 dB) (p<0.001; p=0.001). On average a reduction of outer retinal thickness by 1 μm was associated with a decrease of scotopic function of 0.96 dB.

Conclusions: The extent of outer retinal thinning in the presence of RDR is spatially associated with the extent of impairment in scotopic retinal function, indicating a direct structural-functional correlation of structural changes to loss of rod-mediated function. High-resolution retinal imaging in combination with scotopic fundus-controlled perimetry allows for a refined structure-function correlation in diseases with a presumed higher vulnerability of rod compared with cone function.

Commercial Relationships: Steffen Schmitz-Valckenberg, Julia S. Steinberg, Optos (F), Heidelberg Engineering (F), Carl Zeiss MediTec AG (F); Marlene Sassmannshausen, Car Zeiss MediTec AG (F), Heidelberg Engineering (F), Optos (F); Monika Fleckenstein, Genentech (R), Novartis (R), Optos (F), US20140303013 patent (P), Genentech (F), Heidelberg Engineering (R), Bayer (R), Heidelberg Engineering (F), Merz (C), Carl Zeiss MediTec AG (F); Rolf Fimmers, None; Akio Oishi, Bayer (R), Heidelberg Engineering (F), Carl Zeiss MediTec (F), Optos (F), Novartis (R), Alcon Japapn (F); Frank G. Holz, Novartis (C), Alcon (C), Carl Zeiss MediTec (F), Optos (F), Heidelberg Engineering (C), Bayer Healthcare (C), Allergan (C), Genentech (C), Roche (C), Heidelberg Engineering (F)

Support: Gertrud Kusen foundation
SS-OCTA (1060nm, 400,000 A-scans/s, 16°, 5mm x 5mm SPOCTA method) and second, using the AngioVue (OptoVue, CA) SD-OCTA (840nm, 70,000 A-scans/s, SSADA technology, 3x3 or 6x6 mm). For visualization of the neovascular complex in en face projection images, a horizontal detection plane and automated layer segmentation were used in 1060 and 840 nm OCTA, respectively. Two physicians independently graded CNV-patterns. 

**Results:** 13 of 19 eyes were available for evaluation, excluding cases of strong motion artefacts. 840 nm OCTA revealed a vascular loop pattern in 23.1% (3), a dense net configuration in 30.8% (4) and no eyes with mixed pattern. In 1060 nm OCTA 15.4% (2) had a vascular loop pattern, 38.5% (5) a dense net pattern and in 30.8% (2) a mixed pattern was observed. 5 eyes were graded differently in 840 and 1060 nm OCTA images. However, the inter-grader reliability coefficient was κ=1 for CNV patterns. In 46.2% (6) of treatment-naive nAMD eyes no CNV associated pattern could be detected in 840 nm OCTA. 1060nm OCTA did not show a neovascular complex in two eyes (15.4%). This equals a test sensitivity of .54 for 840 and .85 for 1060 nm OCTA (n=13), respectively.

A detailed CNV classification revealed heterogeneous characteristics. However, 1060 nm OCTA was able to detect CNV patterns involving small details such as well defined CNV lesions (7/4), branching tiny capillaries (8/5) and Anastomosis loops (7/5) more often than 840 nm OCTA.

**Conclusions:** In conclusion we could show that 1060 nm OCTA was able to detect CNV associated vascular patterns more reliably than 840 nm OCTA. Also CNV characteristics involving small details are displayed better in 1060 nm OCTA.

**Commercial Relationships:** Louis W. Lim, None; Colin S. Tan, Bayer (R), Heidelberg (R), Novartis (R); Isaac W. Chay, None; Vernon Chow, None; Shoun Tan, Tock H. Lim, Heidelberg (R), Novartis (R)

**Program Number:** 4933 **Poster Board Number:** A0293

**Presentation Time:** 11:00 AM–12:45 PM

**Optical Coherence Tomography Angiography Features of Polypoidal Choroidal Vasculopathy and its Correlation with Indocyanine Green Angiography**

**Methods:** A study of 24 eyes of 24 consecutive patients with PCV seen at Tan Tock Seng Hospital, Singapore. The diagnosis of PCV was confirmed using standardized diagnostic criteria. The OCTA images of these patients were then described and then correlated with the ICGA images.

**Results:** The mean age of the 24 patients was 68.5 years. Of these, 87.5% were male and 12.5% females. The most common OCTA feature was branching vascular network (BVN) at the choriocapillaris which occurred in 95% of eyes. BVN was also seen in 70% of patients at the outer retina but not in the superficial or deep retina. Other features of PCV include polyps, which were most commonly seen in the choriocapillaris (78.6%) and outer retina (71.4%). The most common polyp feature over these layers was a internal architecture and hollow structure respectively. Correlating with ICGA findings, 54.2% of BVN were more easily seen on OCTA than ICGA compared to 13.3% for polyps.

**Conclusions:** We have described novel and distinct OCTA features of PCV that correlates well with the features seen on ICGA. OCTA provides a non-invasive means to image and diagnose patients and may aid in the diagnosis of PCV in patients who are allergic to ICG in the future.

**Purpose:** To improve the visualization of CNV feeder vessels in swept source OCT-angiography data sets. This is needed due to the difficulty a fully automated segmentation method has with complex pathologies as well as subtle structures.

**Methods:** OCT-angiography data sets of patients with type 1 and type 2 CNV as well as myopic CNV were collected using a Topcon Triton Swept Source DRI OCT. The patients had been treated with intra-vitreal anti-VEGF between 4 and 23 times. The resulting raw data was exported and enhanced using temporal as well as de-flickering noise reduction algorithms and specialized plugins in Adobe After Effects. A custom built method inside Maxon Cinema 4D was created in order to facilitate a semi manual override of the inherent layer detection. This method enables the user to manually place 10 points along the layer to be segmented. This is repeated every 50 to 100 frames depending on complexity of pathology. The system automatically places an adaptive cubic spline in the x/z axis and interpolates between the splines in the y axis. The resulting data can then be viewed both as summed or maximum intensity z-projects in ImageJ.

**Results:** 10 eyes of 10 patients were processed. In all 10 cases an effective noise reduction and increase in visibility of CNV feeder vessels through re-segmentation was achieved.

**Conclusions:** Improvement of the feeder vessel visualization will increase our understanding of the effect that treatment with anti-VEGF is having on the vascular structures of lesions. The presented method is a step towards increasing the quality and clarity of such a visualization.
Drusen has been reported in adolescents and in children at ARVO 2015. This study assesses the appearance of drusen on both OCT and fundus photos in Asian pediatric patients.

**Methods:** Using EHR, cClinicalWorks, from a retina practice from 1/2013-11/2015, pts were identified with CPT code 92250 and 92134 with Va=20/15-20/30. Inclusion criteria: no macular disease, best corrected visual acuity 20/15-20/30. Age range 6-18 years. Exclusion criteria: poor quality fundus photos, macular disease, inability to cooperate with OCT exam. TRC-50EX Topcon camera was used to examine color and red-free photos. OIS Winstation AREDS retinal grid was used to identify drusen and measure drusen size. The grid was superimposed on the fundus photo, centered at the fovea. Using the OIS Topcon software 3x zoom feature, all subfields, para and perifoveal regions were inspected for drusen. A subset of pts were evaluated by using OCT (20x20 volume, density 240um, 8.8frames/sec, Heidelberg Engineering Spectralis HRA+OCT), and fundus photos. The Brightness & Contrast tab was used and was decreased to 0, (default setting=12).

**Results:** 60 pts: 41 were Asian. Avg age=12.59yrs, sd=4.12, range=6-18. Males=20, avg age=12.15yrs, sd=4.3; Females n=21, avg age=13.00yrs, sd=3.86.

76 fundus photos of 41 pts were examined. No drusen (D) in 29/76 (38%) eyes. The remaining 47/76 (62%) eyes had D from 31 pts. 20 pts (49%) had D in both eyes. Average number of D per eye OD=2.20 ± 2.59 and OS=1.78 ± 2.27. In total, 163 D were counted, all less than 65um in diameter (C0 on the AREDS grid). 134 of 163 D appeared in the outer subfields vs. 29 found in the inner subfields. 90 D (55%) appeared in right eyes vs 73 D (45%) in left eyes (p=.08). 43% of D were temporal, 10% were nasal (p=0.005). 28% were superior, 19% were inferior (p=0.04). 21 of 41 Asian pts had both OCT and fundus photos. Avg age=14.62yrs, sd=3.58, range=6-18. Males n=10, avg age=14.00yrs, sd=3.71, Females n=11, avg age=15.18yrs, sd=3.54. 42 OCT images were examined and 38 OCT images (90.5%) correlated with photos. With Brightness & Contrast, 37/42 (88.1%) correlated with photos.

**Conclusions:** Drusen can be found in Asian children as early as age 6. A majority of drusen were found in the perifoveal subfields and OCT correlation was found in majority of study patients. This small study suggests that drusen may be seen in children age 6-18yrs.
Differences in retinal cone morphology between subjects with dry AMD and healthy participants observed with OCT and narrow-angle Heidelberg Retinal Angiograph

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1 UCL Institute of Ophthalmology, University College London, London, United Kingdom; 2NIHR Biomedical Research Centre, Moorfields Eye Hospital, London, United Kingdom; 3Optometry and Vision Science, University of Auckland, Auckland, New Zealand; 4Vision Science, University of Ulster, Coleraine, United Kingdom.

Purpose: We used a multimodal imaging approach to uncover differences in outer retinal layer and cone mosaic morphology between patients with dry age related macular degeneration (AMD) and age matched normal controls.

Methods: Five subjects with early to intermediate dry AMD (69 ± 5 years) and five age matched controls with healthy eyes (66 ± 5 years) underwent Spectralis 30° infrared reflectance imaging, optical coherence tomography (OCT) and cone photoreceptor imaging using a narrow-angle Heidelberg Retinal Angiograph (HRA2). OCT images were analyzed manually using the manufacturer’s software and callipers to measure outer retinal (outer plexiform layer to retinal pigment epithelium) and outer segment (ellipsoid zone to retinal pigment epithelium) thickness. The HRA2 was modified in order to visualise parafoveal cone photoreceptors through a reduction in the scan angle from 30° to 3° and a subsequent increase in the system resolution. The internal fixation target was set at 9°. Images of two pairs of adjacent regions of interest were acquired for each subject and photoreceptor densities were determined with a manual counting algorithm. Photoreceptor densities of adjacent pairs were compared to OCT layer thicknesses at the same locations.

Results: AMD patients had on average fewer visible cones than normal controls (3131 vs. 3994 cones/mm²). In addition to the global reduction of detectable cones, there was also variable loss in photoreceptor density with the adjacent regions of interest varying by 9.0% for the normal controls and 22.2% in the AMD patients (p=0.001). Interestingly, there was no significant difference in outer retinal thickness between normal controls and AMD subjects at the locations of imaging (p=0.23), however, there was a significant reduction in outer segment thickness in the AMD group (p=0.011).

Conclusions: While our data is limited, it suggests that the ‘lost’ photoreceptor cells may still be present in subjects with AMD, however their outer segment morphology may be altered.

Commercial Relationships: Marketa Cilkova, None; Adam M. Dubis, None; Esther Papamichael, None; Padraig J. Mulholland, None; Andrew Rider, None; Steven Dakin, None; Adnan Tufail, Novartis (F), Roche (C), Novartis, Heidelberg Engineering (C), Genetech (C), Bayer (C), Allergan (C); Gary S. Rubin, None; Roger S. Anderson, None

Support: Fight for Sight Clinical Fellowship Award

Comparison of 3D Computer-automated Threshold Amsler Grid Testing and Microperimetry in Wet AMD Patients

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Purpose: Comparative analysis of examination results from 3D Computer-automated Threshold Amsler Grid Test (3D-CTAG; Fink & Sadun, JBO 2004) and microperimetry in wet AMD patients.

Methods: Group #1: Wet AMD patients (n=35, 43 eyes). Group #2 (Control): Healthy patients (n=25, 50 eyes). All patients underwent 3D-CTAG testing and microperimetry. 3D-CTAG: Subjects in a dark room were placed on a chin-head-rest in front of an iPad III wearing optical corrections for presbyopia. Indices for 3D-CTAG analysis: Number of scotomas per eye (ND), lowest perceivable contrast level (CL), absolute hill-of-vision volume lost (AVL), and relative volume lost (VLRH). Microperimetry, MAYA, CenterVue, Italy: Tested visual field 20°×20°, 68 points. Indices for microperimetry analysis: Average threshold (AT) in dB, average threshold in choroidal neovascularization (ATCNV) in dB, and percentages of fixation points located within 1° (P1). The following non-parametric statistical methods were used: Shapiro-Wilk test, Mann-Whitney U-test, and Spearman’s rank correlation coefficient.

Results: Result format: Median(25%-quartile;75%-quartile). Group #1: ND=1(1;2), CL=17(11;25)%, AVL=4711(2932.5;6968)%deg², and VLRH=6.8(4.24;10.06)%. AT=19.1(11.45;22.7)dB, ATCNV=15.9(7.61;18.86)dB, and P1=34(27.5;54.5)%. Group #2: ND=0(0;0), AVL=0(0;0), and VLRH=0(0;0). AT=29.1(8.28;30.8) dB and P1=95(93.99)%). A medium correlation between AT and AVL (ρ=0.69, p=0.00001) and a strong correlation between ATCNV and AVL (ρ=0.85, p=0.00001) were determined, i.e., the visual field depressions detected by both methods coincide. The fixation stability (P1) also has a negative correlation with AVL (ρ=0.65, p=0.00095).

Conclusions: Both 3D-CTAG and microperimetry demonstrate functional disorders of the macular area in wet AMD. The average threshold reduction in the CNV area correlates well with the AVL in 3D-CTAG. It seems preferable to use 3D-CTAG in patients with low visual acuity (<6/30) compared to microperimetry because of a more stable fixation. 3D-CTAG testing appears to be less tedious for patients because it takes only 4-5 min. per eye compared to 10-15 min. for microperimetry.
Example visual field defect in wet AMD patient represented as a microperimetry sensitivity map.

Example visual field defect in wet AMD patient from Fig. 1 represented as a 3D surface plot of contrast sensitivity across the tested visual field obtained with 3D-CTAG.

Program Number: 4939 Poster Board Number: A0299
Presentation Time: 11:00 AM–12:45 PM
Swept Source Optical Coherence Tomography Angiography of Asymptomatic Neovascularization in Intermediate Age-Related Macular Degeneration

*Luis Roisman*, 1, 2 Qi Qin Zhanget, 3 Ruikang K. Wang, 3 Giovanni Gregori, 1 Anqi Zhang, 1 Chieh-LI Chen, 1 Lin An, 1 Gillian Robbins, 1 ANDREW MILLER, 1 FANG ZHENG, 1 Philip J. Rosenfeld, 1 Ophthalmology, Bascom Palmer Eye Institute, MIAMI, FL; 2 Ophthalmology, Universidade federal de Sao Paulo, Sao Paulo, Brazil; 3 University of Washington, SEATTLE, WA; 4 Zeiss Meditec, DUBLIN, CA.

**Purpose:** To identify subclinical type 1 neovascularization in asymptomatic eyes with intermediate age-related macular degeneration (iAMD) using swept source optical coherence tomography angiography (SS-OCTA)

**Methods:** Methods: Consecutive patients with asymptomatic iAMD in one eye and neovascular AMD in their fellow eye were enrolled in a prospective OCT study at the Bascom Palmer Eye Institute. They underwent SS-OCTA, fluorescein angiography (FA), and indocyanine green angiography (ICGA). Images from these three angiographic techniques were then compared. Additional patients with intermediate age-related macular degeneration (iAMD) were imaged as well.

**Results:** Results: Eleven consecutive patients with iAMD in one eye and neovascular AMD in their fellow eye were imaged with FA, ICGA, and SS-OCTA between August 2014 and September 2015. Clinical examination of the 11 eyes revealed drusen and pigmentary abnormalities in the central macula and no evidence of macular fluid on routine OCT imaging. Ten of the 11 eyes had no evidence of leakage on FA and one eye had questionable fluorescein leakage. ICGA revealed the presence of central macular plaques in three of the 11 asymptomatic eyes with iAMD, and SS-OCTA was able to unambiguously identify type 1 neovascularization corresponding to the plaques in all three eyes. No additional foci of neovascularization were identified in the remaining eight asymptomatic eyes with iAMD. To determine the true prevalence of type 1 CNV in asymptomatic eyes with iAMD, we have imaged 103 patients with non-exudative AMD in one eye and exudative AMD in their fellow eye. Additional examples of type 1 neovascularization in these asymptomatic eyes with iAMD will be shown.

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Conclusions: Conclusions: SS-OMAG identified type 1 neovascularization corresponding to ICGA plaques in asymptomatic eyes with iAMD. The ability of OCTA to provide non-invasive, fast, detailed, depth-resolved identification of non-exudative neovascular lesions in eyes with iAMD suggests the need for a new classification system that distinguishes between neovascular and non-vascular iAMD.

Commercial Relationships: Luiz Roisman, Carl Zeiss (R); Qinqin Zhang, None; Ruikang K. Wang, None; Giovanni Gregori, ZEISS MEDITEC (R); Anqi Zhang, None; Chieh-Li Chen, None; Lin An; gillian robbins, ZEISS MEDITEC (R); ANDREW MILLER, ZEISS MEDITEC (R); FANG ZHENG, ZEISS MEDITEC (R); Philip J. Rosenfeld, ZEISS MEDITEC (R)

Support: Carl Zeiss Travel Funding

Program Number: 4940 Poster Board Number: A0300
Presentation Time: 11:00 AM–12:45 PM

Choroidal structure in eyes with drusen and reticular pseudodrusen by binarization of optical coherence tomographic images

Federico Corvi1, 2, Eric H. Souied3, Vittorio Capuano2, Eliana Costanzo2, Lucia Benatti1, Lea Querques1, Francesco Bandello1, Giuseppe Querques1, 2, 3
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Purpose: To compare the luminal and stromal area of the choroid in eyes with drusen and reticular pseudodrusen (RPD) and to investigate their change over 24 months.

Methods: Images of optical coherence tomography were converted to binary images. The cross-sectional total choroidal area, luminal area, and stromal area of the choroid were measured in eyes with drusen, RPD, and control subjects at baseline examination and after 24 months.

Results: A total of 18 eyes of 18 subjects for each group (drusen, RPD and control subjects) were included in the study. In eyes with drusen we found reduction of mean total choroidal area (p=0.0005), luminal area (p=0.003) and stromal area (p=0.007) from baseline to month-24; no change of ratio between luminal-stromal area and the choroidal area was recorded (p=0.1 and p=0.1, respectively). Similarly, in eyes with RPD we found reduction of mean total choroidal area (p=0.0001), luminal area (p=0.0001) and stromal area (p=0.0002) from baseline to month-24; no change of ratio between luminal-stromal area and the choroidal area was recorded (p=0.1 and p=0.1, respectively). Mean luminal, stromal and total choroidal area were reduced in eyes with RPD, as compared to eyes with drusen and controls at both baseline and month-24 (p=0.05 for all). In eyes with RPD the stromal area was more represented, as we found lower mean ratio of luminal and total choroidal area compared with eyes with drusen and controls at both baseline and month-24 (p=0.05 for all).

Conclusions: Mean total choroidal, luminal and stromal area reduce over 24 months in a similar manner in eyes with drusen and RPD (no changes in mean luminal-stromal ratio). Mean choroidal luminal, stromal and area are more reduced in eyes with RPD, as compared to eyes with drusen and controls. The stromal area was more represented in eyes with RPD suggesting a possible role in the pathogenesis and disease progression.

Commercial Relationships: Federico Corvi, None; Eric H. Souied, Bausch and Lomb (C), Ophthotech (C), Allergan (C), Bayer (C), Novartis (C), Alcon (C), Alimera (C); Vittorio Capuano, None; Eliana Costanzo, None; Lucia Benatti, None; Lea Querques, None; Francesco Bandello, Farmila-Thea (C), Allergan (C), Alimera (C), Hoffman-Laroche (C), Bayer (C), Schering-Pharma (C), Novartis (C), Genetech (C), Novagali-Pharma (C), Sanofi-Aventis (C); Giuseppe Querques, Ophthotech (C), Novartis (C), Alcon (C), Alimera (C), Bausch and Lomb (C), Allergan (C), Bayer (C)

Program Number: 4941 Poster Board Number: A0301
Presentation Time: 11:00 AM–12:45 PM

Longitudinal analysis of drusen volume in intermediate age-related macular degeneration using different SD-OCT scan patterns

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Purpose: Dynamic changes of drusen volume have been discussed as a disease marker in eyes with intermediate age-related macular degeneration (AMD). The aim of this study was to evaluate two different scan patterns of optical coherence tomography (OCT) for the assessment of the natural course of drusen volume over four years in the context of a prospective, longitudinal natural history study.

Methods: Thirty-eight eyes with intermediate AMD of 38 patients (mean age 70 ± 6.1 years, range 51-82 years) that did not show any conversion to late stage AMD in the study eye over 4 years were included in the current analysis. Annual multimodal imaging included acquisition of two different raster scan patterns (field size 20°x15°): A. 19 B-scans (i.e. distance approx. 240 µm) and B. 145 B-scans (30 µm). Automatic segmentation of Bruch’s membrane and the retinal pigment epithelium was manually corrected as indicated in each individual B-scan.

Results: The mean drusen volume at baseline within the five inner subfields of the Early Treatment in Diabetic Retinopathy Study grid was 0.21 ± 0.10 mm3 for scan pattern A and 0.20 ± 0.07 mm3 for scan pattern B. The mean change from baseline was 0.02 ± 0.04 mm3 and -0.001 ± 0.09 mm3 at year 1, 0.05 ± 0.09 mm3 and 0.03 ± 0.11 mm3 at year 2, 0.03 ± 0.08 mm3 and 0.04 ± 0.14 mm3 at year 3 and -0.003 ± 0.10 mm3 and 0.05 ± 0.17 mm3 at year 4, respectively (p<0.05 at all four years). Statistical analysis revealed no significant difference between scan pattern A and B for the assessment of change in drusen volume over time (p = 0.21).

Conclusions: Eyes with intermediate AMD and no conversion to late AMD stages on average show relatively small changes of drusen volume over time. The assessed drusen volume based in 19 vs. 145 B-scans did not differ significantly. Further longitudinal analysis also including eyes with intermediate AMD with conversion to late-AMD are required to further investigate the quantification of drusen over time volume as a marker for disease progression.

Commercial Relationships: Sarah Thiele, Optos (F), Carl Zeiss Meditec (F), Heidelberg Engineering (F); Jennifer Nadal; Rui Hua, None; Monika Fleckenstein, Heidelberg Engineering (R), US20140303013 A1 pending (P), Merz (C), Bayer (R), Heidelberg Engineering (F), Genentech (F), Carl Zeiss Meditec (F), Genentech (R), Novartis (R), Optos (F); Matthias Schmidt, None; Frank G. Holz, Optos (F), Heidelberg Engineering (C), Acucela (C), Boehringer Ingelheim (C), Roche (C), Acucela (F), Heidelberg Engineering (R), Bayer Healthcare (F), Allergan (C), Alcon (F), Alcon (C), Novartis (C), Allergan (F), Carl Zeiss Meditec (F), Genentech (F), Novartis (F), Merz (C), Heidelberg Engineering (F), Bayer Healthcare (C), Genentech (C); Steffen Schmitz-Valckenberg, Alcon (C), Novartis (C), Bayer (F), Allergan (F), Alcon (F), Optos (F), Roche (F), Bayer (R), Heidelberg Engineering (F), Formycon (F), Heidelberg Engineering (R), Carl Zeiss Meditec (F), Genentech (F), Novartis (F)
Non-Exudative AMD: Artifact versus Reality

Andrew R. Miller, Fang Zheng, Karen B. Schaal, Luiz Roisman, Andrew D. Legarretta, William J. Feuer, Philip J. Rosenfeld, Giovanni Gregori, Bascom Palmer Eye Institute, Miami, FL.

**Purpose:** To validate the performance of a fully automated choroidal segmentation algorithm and to analyze the relationship between the patterns of choroidal thickness and choroidal blood vessel distribution in eyes with dry AMD imaged using widefield swept-source OCT (SS-OCT).

**Methods:** Patients were enrolled in a prospective OCT study at Bascom Palmer Eye Institute. Eyes with a diagnosis of dry age-related macular degeneration (AMD) were imaged using a prototype 100-kHz SS-OCT instrument (Carl Zeiss Meditec, Dublin, CA) with a central wavelength of 1,050 nm. We used an OCT cube scan pattern (512x512 A-scans) covering a 12x12mm retinal area. Autofluorescence (AF) images (Heidelberg Spectralis) were also acquired. The eyes were partitioned into 3 groups based on the assessment of (presence/absence/inconclusive) of reticular pseudodrusen (RPD) on both the AF images and the OCT images. RPD on the OCT images were assessed by examining en face slabs with boundaries from 35 to 55 µm above the RPE. Five eyes were randomly chosen from each of the three groups. The boundaries of the choroid were manually segmented in a total of 15 scans from 15 eyes and compared with the results of the automated algorithm.

**Results:** Pointwise choroidal thickness maps were automatically generated and compared to manually generated choroidal thickness maps over the entire scan area. The average difference between the two maps was 13.7 microns. Although subfoveal choroidal thickness is typically thinner in eyes with RPD compared with eyes without RPD, we found the specific thickness patterns varied significantly from eye to eye. In particular, choroidal thickness appeared to correlate with the geographic distribution of the large choroid vessels.

**Conclusions:** When applied to widefield SS-OCT scans, our fully automated choroidal segmentation algorithm was shown to be relatively close pointwise to the manually drawn boundaries and is quite able to capture the different patterns of choroidal thickness over a wide area.

**Commercial Relationships:** Andrew R. Miller, None; Fang Zheng, None; Karen B. Schaal, None; Luiz Roisman, None; Andrew D. Legarretta, None; William J. Feuer, None; Philip J. Rosenfeld, Carl Zeiss Meditec Inc. (F), Carl Zeiss Meditec Inc. (R); Giovanni Gregori, Carl Zeiss Meditec Inc. (F), Carl Zeiss Meditec Inc. (P)

Quantitative analysis of Pigment Epithelium Detachment response to anti-VEGF treatment in patients with Wet Age-Related Macular Degeneration

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**Purpose:** The aim of the present work is to assess response of PEDs to anti-VEGF treatment by means of modern, customised image analysis tools that can provide quantifiable measures of response to treatment and thus may offer clues to guide management decision tailored to the individual needs of each patient.

**Methods:** Consecutive patients from Manchester Royal Eye Hospital with Wet AMD associated with a PED were recruited retrospectively. A balanced sample of treatment-naive patients on either aflibercept or ranibizumab was identified. A minimum PED height of 50 microns was defined for inclusion. Data recorded included: Best-corrected visual acuity (BCVA), CMT, presence of SRF/IRF, maximum PED height, PED horizontal dimension, PED vertical dimension, PED surface area, PED volume and PED content reflectivity by means of customised image analysis software. The same data were recorded at baseline, after three months (three injections of either anti-VEGF agent) and at the end of year one of treatment. A stepwise linear regression analysis was used to identify associations between change in BCVA and PED metrics and all baseline parameters.

**Results:** 102 consecutive patients were included into the study, 50 on ranibizumab and 52 patients aflibercept. Change in BCVA
Success of novel treatments to restore visual function such as retinal prostheses and stem cells assume that the cortex remains responsive and topographically aligned to reestablished inputs. In a prospective observational study we tested the hypothesis that the visual cortex is able to re-establish function following anti-VEGF therapy for neovascular age-related macular degeneration (nAMD).

**Purpose:**
Success of novel treatments to restore visual function such as retinal prostheses and stem cells assume that the cortex remains responsive and topographically aligned to reestablished inputs. In a prospective observational study we tested the hypothesis that the visual cortex was able to re-establish function following anti-VEGF therapy for neovascular age-related macular degeneration (nAMD).

**Methods:**
10 participants with nAMD undergoing routine anti-VEGF NHS treatment underwent ETDRS visual acuity, Zeiss cirrus SD-OCT and functional Magnetic resonance imaging (fMRI) before (visit 1) and after 3 monthly initiation treatments (visits 2–4). Functional MRI data were acquired on a General Sigma HD Excite 3T MRI scanner. Gradient recalled echo-pulse sequences were used to measure T2-weighted blood oxygen level-dependent (BOLD) data (vector mean projected amplitude). Based on anatomical criteria two regions of interest, 5 mm in diameter were chosen in each hemisphere from each participant. One was in the posterior occipital pole (PO) retinotopically representing the macula region and the second in the mid-calcarine (MC) representing a peripheral location. The BOLD response (BR) from the PO was controlled for the expected variance in intersession response by correcting it by the PO activity. The MC was chosen for analysis since it was able to re-establish function following anti-VEGF therapy for nAMD.

**Results:**
The mean CR response increased over time (Figure 2). The correlation between the treated eye VA and CRT was -0.473 (p=0.002), between the CR and VA was 0.236 (p=0.142), and between CR and CRT was -0.410 (p=0.009). These results were driven by one outlier and once excluded all correlations missed statistical significance.

**Conclusions:**
Although individual cases showed an increase in cortical activity, response was highly variable. Further work is required to confirm the hypothesis that the visual cortex is able to re-establish function following anti-VEGF therapy for nAMD.

<table>
<thead>
<tr>
<th>Mean (SD) BR</th>
<th>Mean (SD)</th>
<th>Mean (SD)</th>
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Table 1. Treated and untreated mean and standard deviation (SD) for BR.

![Figure 1. Mean CR factor (y-axis) at visit 1 to visit 4 (x-axis).](image)

**Figure 1.** Mean CR factor (y-axis) at visit 1 to visit 4 (x-axis).
to their known melanin concentration. Porcine and human RPE samples were peeled off from formalin-fixed eyeballs and tested on the calibrated system. Broadband micro-ring ultrasonic transducer was used in PA detection to ensure sufficient axial resolution to locate the 10-µm cell monolayer and minimize influence from the choroidal melanin, which is of little pathological interest. We measured the melanin concentration in pig and human RPE and monitored light-induced melanin loss in pig RPE.

**Results:** While the RPE melanin concentrations are comparable between pig and human, more melanin is found in the pig choroid. The RPE melanin loss can be caused by light illumination and the loss rate increases with higher power.

**Conclusions:** PAM is capable of quantifying the RPE melanin concentration and its variation noninvasively with the help of broadband micro-ring transducer.

Measurement of the RPE melanin concentration by PAM. (a)-(d) PAM images of pig RPE, pig choroid, human RPE and human choroid. (e) Comparison of ocular melanin distribution between pig and human. (f) Quantification of light-induced melanin loss.

**Commercial Relationships:** Xiaofu Shu, Hao Li, None; Biqin Dong, None; Hao F. Zhang, None

**Support:** NIH Grant 1R01EY019951, 1R24EY022883, and 1DP5DK108248; NSF Grant CBET-1055379

**Program Number:** 4947
**Poster Board Number:** A0307
**Presentation Time:** 11:00 AM–12:45 PM

**Cone Photoreceptor Imaging and OCT Angiography in AMD Geographic Atrophy**

Jia Qin1, Nicholas Rinella2, Daniel M. Schwartz2, Michael Deiner4, Kyle C. McDermott2, Shane Griffin, Panagiota Loumou4, John S. Werner2, Austin Roorda2, Jacques L. Duncan1.

1Ophthalmology, University of California San Francisco, San Francisco, CA; 2Ophthalmology & Vision Science, University of California Davis, Sacramento, CA; 3School of Optometry and Vision Science graduate program, University of California Berkeley, Berkeley, CA.

**Purpose:** The purpose of this study was to visualize and quantify cone photoreceptor and choriocapillaris changes at the edge of geographic atrophy (GA) in patients with age-related macular degeneration (AMD).

**Methods:** Cone photoreceptors and choriocapillaris were imaged using confocal adaptive optics scanning laser ophthalmoscopy (AOSLO) and optical coherence tomography-angiography (OCT-A). Cone photoreceptor and choriocapillaris images from 3 normal subjects were compared with 2 patients with AMD and non-foveal GA. The AOSLO cone mosaic was superimposed upon OCT-A microvasculature images using blood vessels as landmarks. Regions of interest (ROIs) extending 200 µm x 200 µm, were selected in the superimposed cone mosaic and microvasculature images acquired from the same eye. Regions of interest were selected at the edge of well-defined areas of GA and in areas without GA in 2 AMD patients, and at comparable eccentricities in 3 normal subjects. Cone spacing was calculated and choriocapillaris perfusion was assessed in each of the ROIs.

**Results:** Confocal AOSLO images showed irregular cone packing and areas where cones were not visible at the edge of GA in the AMD patients. Cone spacing increased mildly at the edge of GA in the AMD patients compared with normal eyes. Choriocapillaris perfusion in the ROIs at the edge of GA was reduced, but not completely absent, compared with ROIs at similar eccentricities in regions without GA and in normal eyes.

**Conclusions:** Cone photoreceptor spacing measures were abnormal at the edge of GA. Vascular perfusion of the choriocapillaris at the edge of the GA appeared reduced compared with areas without GA, and normal eyes. The abilities of AOSLO and OCT-A to noninvasively visualize alterations in photoreceptor and choriocapillaris structure make them promising tools for assessing AMD with GA. Cone photoreceptor spacing and choriocapillaris perfusion changes can be distinguished and assessed in AMD patients with GA and normal eyes. The combination of AOSLO and OCT-A imaging and evaluation may be useful for elucidating disease development and progression.

**Commercial Relationships:** Jia Qin, None; Nicholas Rinella, None; Daniel M. Schwartz, None; Michael Deiner, None; Kyle C. McDermott, None; Shane Griffin, None; Panagiota Loumou, None; John S. Werner, None; Austin Roorda, University of Rochester, University of Houston (P); Jacques L. Duncan, None


**Clinical Trial:** NCT00254605

**Program Number:** 4948
**Poster Board Number:** A0308
**Presentation Time:** 11:00 AM–12:45 PM

Assessing the function-morphology ratio of choroidal neovascularization and pigment epithelium detachment in age-related macular degeneration using OCT-angiography

Christoph R. Clemens, Peter Heiduschka, Florian Alten, Nicole Eter. Department of Ophthalmology, University of Muenster, Muenster, Germany.

**Purpose:** The architecture and the vascular characteristics of a vascularized pigment epithelium detachment (vPED) in age-related macular degeneration (AMD) are the most relevant factors regarding the risk of retinal pigment epithelium (RPE) tear development. Based on fluorescence angiographic (FA) data, previous studies described the morphologic proportions of choroidal neovascularization (CNV) and PED lesion as particularly relevant for the likelihood of tear development. The aim of our study was to extend the morphologic
CNV/PED ratio by incorporating functional optical coherence tomography angiography (OCT-A) imaging in the vPED analysis.

**Methods:** Multimodal imaging was performed in twelve eyes of ten patients (71.3 ± 7.6 years) with a vPED lesion due to AMD including structural OCT, FA, indocyanin green angiography and OCT-A.

Based on OCT-A imaging, the perfusion index (PFI) in the CNV area as well as the morphologic CNV/PED ratio (mR) were assessed resulting in a functional CNV/PED ratio (IR) = PFI/mR.

**Results:** Mean PED lesion size was 6.47 mm², mean CNV lesion size was 4.03 mm². The mean mR was 0.65 ± 0.26 and functional measurements showed a PFI of 73.8 ± 17.1. Both values were negatively correlated (p=0.04). The mean IR was 134 ± 61. Lesions with a mR < 0.5 showed a mean IR of 174.8 ± 69.6 and lesions with a mR > 0.5 showed a mean IR of 106.8 ± 33.6. mR and IR were negatively correlated (p=0.007).

**Conclusions:** Adding the functional component to the morphologic CNV/PED ratio appears promising with regards to a more sensitive predictability of impending RPE tear development particularly in high-risk vPED patients.

**Commercial Relationships:** Christoph R. Clemens, None; Peter Heiduschka, None; Florian Alten, None; Nicole Eter, None

**Program Number:** 4949 Poster Board Number: A0309
**Presentation Time:** 11:00 AM–12:45 PM
**Correlation between subfoveal choroidal thickness by EDI-OCT and stage of dry related macular degeneration**

Yolanda Villalpando, Abel Ramirez-Estudillo, Arthur Levine, Benito Celis, SERGIO ROJAS, Carla Perez, Adriana Saucedo, Itzel Espinosa, Angeles Hernandez. Retina and Vitreous, Hospital Nuestra Señora de la Luz, DF, Mexico.

**Purpose:** The choroid is the vascular structure with the greatest blood flow in the body of which depends the stability of the photoreceptors and retinal pigment epithelium cells. It has been shown that the decrease in choroidal thickness is correlated with advanced stages of age relatad macular degeneration (AMD). The purpose of the study is to determine the subfoveal choroidal thickness through enhanced depth imaging (EDI OCT) in AMD patients and observe whether there is correlation with the stage of AMD.

**Methods:** A descriptive, transversal and observational study was conducted. Complete eye examination was performed were visual acuity, fundus examination, axial length (AL), EDI OCT and fundus photographs were included. AREDS classification for staging patients was used. Patients with dry AMD and AL ≤ 26mm were enrolled.

Patients with macular involvement by causes other than AMD, renal failure, media opacities and antiangiogenic use were excluded. One way ANOVA was used for correlation between subfoveal choroidal thickness and stage of AMD, considering statistically significant p ≤ 0.05 value.

**Results:** Thirty-two eyes of 23 patients were included, they had a mean age of 78.5 ± 8 years (range 58-88). Patients were divided by stage and subfoveal choroidal thickness and it was found that as AMD progresses there is a significant diminution of subfoveal choroidal thickness.

**Conclusions:** Our results show that there is an inverse relationship between the thickness subfoveal choroidal and severity of dry AMD.

**Commercial Relationships:** Christoph R. Clemens, None; Peter Heiduschka, None; Florian Alten, None; Nicole Eter, None

**Program Number:** 4950 Poster Board Number: A0310
**Presentation Time:** 11:00 AM–12:45 PM
**Relationship between choroidal thickness and area of ellipsoid zone defect in macular telangiectasia type 2 using enhanced-depth imaging SD-OCT**

Daniel Q. Li, Netan Choudhry, John Golding. 1 IMedicine, University of Toronto, Toronto, ON, Canada; 2VRM Toronto, Toronto, ON, Canada.

**Purpose:** Idiopathic macular telangiectasia type 2 (MacTel 2) is associated with both choroidal thickening and outer retinal disruption, but it is unclear if there is a correlation between the extent of these two clinical features. In this retrospective, observational clinical study, we investigate the relationship between choroidal thickness and area of ellipsoid zone defect in MacTel 2 using enhanced-depth imaging (EDI) spectral-domain optical coherence tomography (SD-OCT).

**Methods:** We examined 20 eyes from 10 patients who underwent EDI SD-OCT imaging for MacTel Type 2 between 2012 and 2014 at Herzig Eye Institute, Toronto, Canada. Choroidal thickness measurements were made at the fovea and at 5 points within an interval of 500µm in both directions, nasal and temporal from the fovea, by semi-automated segmentation of B-scan EDI SD-OCT images. Ellipsoid zone defect was defined as diffuse and focal disruptions occurring in the photoreceptor inner segment/outer segment (IS/OS) junction, which appeared as hyporeflective grey shades on C-scan (“en-face”) SD-OCT images. The total area of defect was manually measured by a single observer using built-in software tool. Univariate analysis was used to determine the mean and spread of collected anatomical values. Bivariate linear regression was used to evaluate the association between subfoveal choroidal thickness or average choroidal thickness across the central 1-mm segment and the area of ellipsoid zone defect.

**Results:** Both subfoveal and average central choroidal thicknesses were positively associated with area of ellipsoid zone defect (p < 0.00001). Subfoveal choroidal thickness (µm) ranged from 118 to 523 (mean 319.4 ± SD 91.3), average choroidal thickness (µm) ranged from 122 to 474 (mean 286.2 ± SD 85.3), and area of ellipsoid zone defect (mm²) ranged from 1.53 to 6.53 (mean 3.71 ± SD 1.43).

**Conclusions:** Choroidal thickness correlates with area of ellipsoid zone defect in patients with macular telangiectasia type 2. This information provides another clinical perspective on the pathophysiology of MacTel, and can be considered in new models of its pathogenesis. This study also introduces the value of EDI SD-OCT in assessing quantifiable parameters of MacTel, which may guide future research for a better understanding of this currently idiopathic disease.

**Commercial Relationships:** Daniel Q. Li, None; Netan Choudhry, None; John Golding, None

**Program Number:** 4951 Poster Board Number: A0311
**Presentation Time:** 11:00 AM–12:45 PM
**Morphological and functional evaluation of dome-shaped maculopathy**

Francesca Guidolin, Elisabetta Pilottò, Enrica Convento, Alessandra Bruno, Evelyn Longhin, Edoardo Midena. 1Department of Ophthalmology, University of Padova, Padova, Italy; 2G. B. Bietti Foundation, IRCCS, Rome, Italy.

**Purpose:** To evaluate retinal sensitivity impairment in dome-shaped maculopathy (DSM) and to correlate it to optical coherence tomography (OCT) features.

**Methods:** All referred patients with DSM were consecutively studied by means of enhanced depth imaging spectral-domain OCT (EDI-OCT). Two linear scans centered into the fovea, horizontally
and vertically, were acquired. Subfoveal retinal thickness, bulge height and choroidal thickness were measured by two independent graders. The presence of foveal subretinal fluid (ISRF), extraretinal subretinal fluid (eSRF), pigment epithelium detachment (PED), subretinal pigment and macular schisis were also evaluated. Retinal sensitivity and fixation were studied by means of both mesopic and scotopic microperimetry. Fixation quantification was analyzed using Bivariate Contour Ellipse Area (BCEA).

**Results:** Seven patients with bilateral DSM were studied (14 eyes). DSM was horizontal in 10 eyes (71.42%), vertical in 2 eyes (14.29%) and symmetric in 2 (14.29%). Inter-grader agreement was excellent (ICC= 0.98). Subfoveal retinal thickness was 169.57 ± 64.29 μm, and subfoveal choroidal thickness was 203.57 ± 69.52 μm. Choroid was thinner inferiorly compared to all the other sites (vs superior, p = 0.0049; vs nasal, p = 0.0002; vs temporal, p = 0.0076). Subfoveal retinal thickness was positively related to retinal sensitivity (r = 0.7193), and inversely related to BCEA (r = 0.4526). The presence of ISRF (8/14 eyes, 66.67%), was not related to bulge height (OR = 1). Both ISRF and bulge height were inversely related to retinal sensitivity, both in mesopic (p = 0.0338 and r = 0.5790, respectively) and scotopic microperimetry (p = 0.1005 and r = 0.5874, respectively). The presence of PED (5/14 eyes, 41.67%) significantly determined fixation instability (p = 0.045).

**Conclusions:** Morphological OCT features, that characterize DSM, correlate with retinal dysfunction. The anomalous topographic distribution of choroidal thickness may suggest a role of choroid in the pathogenesis of DSM.

**Commercial Relationships:** Francesca Guidolin, None; Elisabetta Pilotto, None; Enrica Convento, Alessandra Bruno, None; Evelyn Longhin, None; Edoardo Medina, None

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**Program Number:** 4952 **Poster Board Number:** A0312 **Presentation Time:** 11:00 AM – 12:45 PM

**Correlation of morphology and function using spectral domain optical coherent tomography, microperimetry and multifocal ERG in patients with macular telangiectasia type 2**

Anna A. Ledolter, Alessio Montuoro, Markus Ritter, Christian Simader, Ursula Schmidt-Erfurth. Ophthalmology, Medical University of Vienna, Vienna, Austria.

**Purpose:** Macular telangiectasia Type2 (MacTel2) is a progressive neurodegenerative macular disease of still unclear etiology. Functional impact of the degenerative morphological features is of interest for pathogenesis and therapeutic strategies in this disease.

**Methods:** We examined 18 patients (35 eyes) with MacTel2 by spectral domain optical coherent tomography (SD-OCT), multifocal electroretinogram (mERG) and microperimetry (MP). The 61 stimulating points of MP (28°x28° of macula) corresponded to the central 61 of 103 stimulus hexagons of mERG. A custom image viewing and processing software was used to match infrared fundus images of SD-OCT to MP fundus images with the corresponding retinal sensitivity map. The association of retinal sensitivity has been evaluated to following morphological SD-OCT features: photoreceptors IS/OS junction (normal/irregular/lost), external limiting membrane (ELM) (normal/lost); inner retina (normal/layers hyperreflectivity/hyperreflective cavities). mERG responses were calculated as a difference from the age-matched normal subjects, measured in standard deviations (SD), between the subject data and the control data.

**Results:** A total of 2135 sensitivity points were graded for the associated morphology. An intact retinal structure was correlated with a normal retinal function captured by both MP and mERG (Table 1). Loss of photoreceptor IS/OS junction line was associated with very low retinal sensitivity measured by MP and abnormal mERG. Areas with ELM disruption were associated with variable macular sensitivity on MP where the mERG was abnormal (25% under 2SD). Retinal function in the area corresponding to intraretinal cavities was decreased in 25% on both MP and mERG. Irregularity of IS/OS junction line and hyperreflectivity of inner retinal layers was associated with normal retinal function on mERG and slightly reduced on MP.

**Conclusions:** Precise correlation of retinal function with degenerative retinal changes in MacTel2 revealed that loss of photoreceptor IS/OS junction greatly influences retinal function whereas disruption of ELM and degenerative intraretinal cysts have less functional impact.

**Table 1. Retinal function evaluated for morphology in the regions of interest.**

<table>
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<tr>
<th>Morphology</th>
<th>OCT feature</th>
<th>Microperimetry (MP)</th>
<th>Multifocal ERG (mERG)</th>
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<td>Inner retina</td>
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**Oq-Quartile**

**Commercial Relationships:** Anna A. Ledolter, None; Alessio Montuoro, None; Markus Ritter, None; Christian Simader, None; Ursula Schmidt-Erfurth

**Program Number:** 4953 **Poster Board Number:** A0313 **Presentation Time:** 11:00 AM – 12:45 PM

**Short-term choriocapillary changes in patients with central serous chorioretinopathy after photodynamic therapy**

Marco Nassisi, Camilla Alovisi, Carlo Lavia, Federico Grignolo, Chiara M. Eandi. Department of Surgical Science, Eye Clinic, University of Turin, Torino, Italy.

**Purpose:** To investigate the short term effects of photodynamic therapy (PDT) at the level of the choriocapillary in patients with chronic central serous chorioretinopathy (CSC).

**Methods:** IRB approval was obtained for off-label use of verteporfin in CSC. Consecutive patients with chronic CSC (> 6 months) were enrolled. Baseline examination included: Best Corrected Visual Acuity (BCVA) with ETDRS charts, complete slit lamp exam, IOP measurement, fundus biomicroscopy, spectral domain OCT (SD-OCT) with the Enhanced Depth Imaging (EDI) mode (Spectralis, Heidelberg Engineering), OCT angiography (Avanti RTVue XR, Optovue), angiography with fluorescein and green indocyanine (Spectralis, Heidelberg Engineering). Half dose ICG guided PDT was then performed. BCVA, SD-OCT, and angio-OCT were repeated at one hour, one week, and one month after PDT treatment. Changes on choriocapillary morphology were described by analyzing angio-OCT choroid cap images. Changes on central retinal thickness (CRT) and choroidal thickness at the level of the fovea were measured with the spectrals caliper tool.

**Results:** Ten eyes of 10 patients with chronic CSC were enrolled. There were 9 men and the mean age was 53 year old (range 42 – 70 years). The mean BCVA at baseline was 20/50 and improved to 20/40 at 1 week and remained stable at 1 month. CRT decreased from 425 microns at baseline to 325 and 294 microns at one week and one month respectively with complete resolution of subretinal fluid. Similarly, choroidal thickness decreased in all eyes (405, 374, and 351 microns at baseline, one week, and one month, respectively). When analyzed at one week by the mean of the angio-OCT, the choriocapillary morphology showed peculiar...
Clinical characteristics of bilateral central serous chorioretinopathy

Nobuhiro Terao, Tetsuya Yamagishi, Yuto Katoh, Shigeru Kinoshita, Chie Satozono, 1Department of Ophthalmology, Kyoto Prefectural University of Medicine, Kyoto, Japan; 2Department of Frontier Medical Science and Technology for Ophthalmology, Kyoto Prefectural University of Medicine, Kyoto, Japan.

Purpose: To elucidate the clinical characteristics of patients with bilateral central serous chorioretinopathy (CSC).

Methods: This retrospective observational case series involved 128 eyes of 102 patients (19 eyes of 16 females and 109 eyes of 86 males; mean age: 54.3 years) with CSC diagnosed by optical coherence tomography (OCT), fluorescein angiography (FA), and indocyanine green angiography. Patients were divided into two groups as follows: patients with bilateral CSC (b-CSC Group) and those with unilateral CSC (u-CSC Group). Clinical diagnosis of b-CSC was based on the presence of serous retinal detachment (SRD) in at least 1 eye and past or present SRD in the fellow eye. The b-CSC group and u-CSC group were compared in regard to age, sex ratio, spherical equivalent (SE), axial length (AL), best-corrected visual acuity (BCVA), last-visit BCVA, rate of atrophic tract (AT). CSC of chronic phase was defined as cases with symptoms lasting more than 6 months and FA findings of widespread leakage from broad areas of retinal pigment epithelium damage. SCT was measured on enhanced depth imaging-OCT (EDI-OCT) images, and the presence of AT was confirmed based on fundus autofluorescence (FAF) images.

Results: Fifty-two eyes of 26 patients (6 eyes of 3 females) were categorized into b-CSC Group and 76 eyes of 76 patients (13 eyes of 13 females) into u-CSC Group. With statistical significance, the b-CSC Group vs. the u-CSC Group, respectively, tended to show older age (mean age: 59.0 vs. 52.7 years; P=0.014), higher SE (0.01 diopters (D) vs. -1.15D; P=0.001), shorter AL (23.11mm vs. 23.82mm; P=0.017), higher rate of chronic phase (86.5% vs. 67.1%; P=0.013), higher rate of AT on FAF (26.9% vs. 2.6%; P=0.017), and worse last-visit BCVA (logMAR: 0.19 vs. 0.05; P=0.019). No differences existed between the two groups in regard to sex ratio, BCVA at baseline, and SCT on EDI-OCT.

Conclusions: The findings of this study show that patients with b-CSC tend to be older and have shorter AL, higher SE, poor visual prognosis, higher rate of chronic phase, and higher rate of AT on FAF images in comparison with patients with u-CSC. Shorter AL with higher SE may be associated with the pathogenesis of b-CSC. Physicians should regard b-CSC as a severe form of the disease, and earlier therapeutic intervention is strongly recommended.

Clinical Trial: NCT01327911

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Program Number: 4956 Poster Board Number: A0316
Presentation Time: 11:00 AM–12:45 PM
Different branching patterns of choroidal neovascularization (CNV) in AMD using spectral-domain optical coherence tomography angiography (OCTA)

André C. Romano1,2, 1Ophthalmology, UNIFESP, São Paulo, Brazil; 2Henry C. Witelson Ocular Pathology Laboratory, McGill University, Montreal, QC, Canada.

Purpose: Optical coherence tomography angiography (OCTA) is quick and non-invasive, and provides volumetric data with the clinical capability of specifically localizing and delineating pathology along with the ability to show both structural and blood flow information in tandem. The purpose of this study is to describe the different branching patterns of choroidal neovascularization (CNV) using spectral-domain optical coherence tomography angiography (OCTA).

Methods: Patients with neovascular age related macular degeneration were imaged using the spectral-domain optical coherence tomography angiography (OCTA) AngioVue Avanti system (Optovue, Inc, Fremont, CA) between January 2013 and October 2015 at Neovista Eye Center were assessed. Characteristics and patterns of choroidal neovascularization identified by OCTA on a 2 x 2, 3 x 3 mm, 6 x 6 mm and 8 x 8 mm scan were included. Location and thickness of the each slab was manually manipulated to include full extent of the membrane on OCTA.

Results: OCTA demonstrates capillary networks consistent with previous histological studies in AMD. Optical coherence tomography angiography identified the number of vessels feeding the neovascular membranes. OCTA angiography identified the different patterns of choroidal neovascularizations, and showed the extent of the membrane on OCTA.

Commercial Relationships: André C. Romano

Program Number: 4957 Poster Board Number: A0317
Presentation Time: 11:00 AM–12:45 PM
Novel MRI Algorithm Pipeline Suggests Overestimation of Axial Length on IOLMaster Compared to Measurement on MRI

Alexander H. Vu1, Jack Grinband2, Albert Xing1, Quan V. Hoang1

1 Ophthalmology, Harkness Eye Institute, Columbia University Medical Center, New York, NY; 2Radiology, Columbia University Medical Center, New York, NY.

Purpose: Partial coherence interferometry (IOLMaster) is the gold standard in clinical ophthalmology for measuring axial length and thus is critical in evaluating myopic progression. One alternative for standard in clinical ophthalmology for measuring axial length and alignment. To compare axial length measurements in the two measurement modalities, we employed linear regression analysis to determine the slope of the MRI:IOLMaster relationship.

Methods: A prospective study was performed on 22 eyes of 11 young (ages 22 to 28 years) emmetropic volunteers with no known history of ocular disease. All eyes underwent measurement with both IOLMaster and 3D MRI scan (Phillips, 3.0T, fat-suppressed T2-weighted cube, a modified 3D fast-scan echo sequence). Volume renderings of 3D MRI images were generated. To allow for consistent 3D MRI axial length determination, a novel algorithm was developed for a feature-based registration, which included a series of linear transformations, thresholding, voxel normalization, re-sampling and alignment. To compare axial length measurements in the two measurement modalities, we employed linear regression analysis to determine the slope of the MRI:IOLMaster relationship.

Results: Eyes examined ranged in axial length from 21.69 mm to 24.60 mm on IOLMaster and from 21.55 mm to 23.95 mm on MRI. After performing the linear regression, the MRI:IOLMaster relationship slope was determined to be 0.90 ($R^2$ = 0.95, p < 0.0001). An $R^2$ value of 0.95 implies that the axial length measurement by MRI and by IOLMaster are highly correlated. However, since a slope of 1.0 would indicate identical accuracy in measurement, the slope of 0.90 implies that there is a measurement bias that is a result of either an over-estimation by IOLMaster or under-estimation by 3D MRI.

Conclusions: Axial length measurements differ between 3D MRI and IOLMaster, even in a subset of young, emmetropic eyes free from ocular disease. As MRI is not affected by media issues, it may provide a more veridical measure of length, implying the bias observed may be originate from IOLMaster over-estimating length.

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Program Number: 4958 Poster Board Number: A0318
Presentation Time: 11:00 AM–12:45 PM
Evaluation of OCT angiography in detection of Central Serous Chorioretinopathy

Nikolaus Feucht, Mathias M. Maier, C.P. Lohmann, Lukas Reznicek. Bldg 10, CRC, Room 3-2531, Augenklinik Rechts der Isar, Munich, Germany.

Purpose: To evaluate the contribution of Optical Coherence Tomography angiography (OCTa) in patients with acute Central Serous Chorioretinopathy (CSC).

Methods: A consecutive series of 11 eyes of 10 healthy subjects with acute CSC were included. In all subjects, best-corrected visual acuity was obtained followed by a full clinical examination including slit lamp biomicroscopy as well as funduscopy evaluation. All patients underwent fluorescein angiography (FA), indocyanine green angiography (ICGA), optical coherence tomography (OCT) and optical coherence tomography angiography (OCTa). FA and ICGA and OCTa images were evaluated for depicting the serous detachments of the neurosensory retina and the leakage points. OCT images were evaluated by two retina specialists for depicting the serous detachments and retinal pigment epithelium (RPE) detachment as a surrogate parameter for possible leakage according to a standardized grading protocol.

Results: FA images were able to identify the leakage point in every included study eye and serous retinal detachments in 4 out of 11 eyes. ICGA images could identify the leakage point in five out of 11 eyes and serous retinal detachments in five out of 11 eyes due to a visible “demarcation line”. SD-OCT scans revealed RPE detachment in eight out of 11 study eyes and serous retinal detachment in every

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included eye. OCTa images through the inner, medium, outer retina or choriocapillaris could not identify leakage points in any of the included eyes. In four out of 11 eyes, it was possible to detect detached retina adjacent to the leakage point through a visible “contour line” seen in OCTa images of the outer retina. In five out of 11 eyes we observed irregular flow patterns in OCTa images through the choriocapillaris.

**Conclusions:** Non-invasive OCTa contributes little to diagnose acute CSC compared to current invasive (FA and ICGA) as well as non-invasive (OCT) imaging techniques. Detection of leakage points is not reproducible nevertheless we observed a irregular flow patterns in OCTa in five out of 11 eyes in the choriocapillaris layer.

**Commercial Relationships:** Nikolaus Feucht, Mathias M. Maier, None; C.P. Lohmann, None; Lukas Reznicek, None

**Program Number:** 4959 Poster Board Number: A0319
**Presentation Time:** 11:00 AM–12:45 PM
**Reticular pseudodrusen characterization by retromode imaging Daniele De Geronimo, Lea Querques, Maria Cristina Parravano, Antonluca Boninfante, Paola Giorno, Monica Varano, Francesco Bandello, Giuseppe Querques. 1Ophthalmology, IRCCS-G.B.Biotti Foundation, Rome, Italy; 2Ophthalmology, IRCCS San Raffaele Scientific Institute, University Vita-Salute San Raffaele, Milan, Italy.

**Purpose:** Reticular pseudodrusen (RPD), associated with age related macular degeneration (AMD), are suggested to be located internal to the retinal pigment epithelium (RPE), in contrast to conventional drusen. Different stages of RPD have been proposed on Spectral Domain-OCT or in color fundus photographs and infrared reflectance (IR). In this report we evaluated the RPD characteristics on the so-called ‘retromode’ imaging, which rely on the detection of scattered light from the fundus, and classified RPD on the basis of the appearance of the deposits in the outer retina.

**Methods:** Consecutive patients with early AMD with RPD in at least one eye, detected by IR and SD-OCT, but without typical drusen were included. They performed retromode imaging of the fundus with the Nidek F-10 confocal digital ophthalmoscope. We classified the RPD on the basis of the appearance of the deposits on the ‘retromode’ images.

**Results:** Nine eyes of 7 consecutive patients (5 Female/2 Male; mean age 72.1±4.1 years) with early AMD with RPD in at least one eye, but without typical drusen, were included. RPD were identified by means of laterally scattered light of retromode and the deposits have been classified as round, bended and interlacing. In particular, all these different shapes were detected in variable proportions in all eyes when the right aperture was used, and the dark shadows were in the right side.

**Conclusions:** Our study corroborates SD-OCT demonstration that in RPD the deposits accumulate in the outer retina with variable size and shapes. The coexistence in all eyes of different shapes for the deposits may explain the reticular appearance previously claimed by different authors as an exclusive peculiarity of the choroid.

**Commercial Relationships:** Daniele De Geronimo, None; Lea Querques; Maria Cristina Parravano, None; Antonluca Boninfante, None; Paola Giorno, None; Monica Varano, None; Francesco Bandello, None; Giuseppe Querques, None

**Program Number:** 4960 Poster Board Number: A0320
**Presentation Time:** 11:00 AM–12:45 PM
**DYNAMIC FUNCTIONALITY OF RETINAL VESSELS IN EYES WITH CENTRAL SEROUS RETINOPATHY Livia Tomasso, Lucia Benatti, Federico Corvi, Fatemeh Darvizeh, Giovanni Baldin, Adriano Carnevali, Lea Querques, Ilaria Zucchiatti, Francesco Bandello, Giuseppe Querques. IRCCS Ospedale San Raffaele, Milano, Italy.

**Purpose:** To analyze static characteristics and dynamic functionality of retinal vessels in eyes with central serous retinopathy (CSR) by means of Dynamic Vessel Analyzer (DVA).

**Methods:** Patients presenting with CSR and normal subjects (controls) matched for age and sex between May 2015 and November 2015 were enrolled in the study. Participants underwent complete ophthalmologic examination, including optical coherence tomography, dynamic and static retinal vessels analysis.

**Results:** A total of 28 eyes of 28 subjects (14 eyes for each group) were included in the analysis. Dynamic analysis during stimulation by flickering light showed mean venous dilation of 3.1±1.6% in CSR patients and 5.3±2.6% in healthy eyes (p=0.005); mean arterial dilation was 3.2±2.5% and 4.1±1.53%, respectively (p=0.28). Static retinal analysis in CSR patients showed a mean Central Retinal Artery Equivalent (CRAE) of 191±19, a mean Central Retinal Vein Equivalent (CRVE) of 216±18 and a mean arteriovenous ratio (AVR) of 0.88±0.08. In control subjects mean CRAE was 189±16 and mean CRVE 212±19 (p=0.887 and p=0.65 respectively vs respective measurements in CSR) and mean AVR was 0.89±0.04 (p=0.695).

**Conclusions:** Dynamic analysis revealed a reduced retinal venous dilation in response to flicker light stimulation in CSR eyes. The impaired retinal vascular function together with the increased choroidal thickness may help understanding CSR and give insights in its pathogenesis.

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**Program Number:** 4961 Poster Board Number: A0321
**Presentation Time:** 11:00 AM–12:45 PM
**Inner Retinal Layer Thickness in Age-Related Macular Degeneration Patients with Disciform Scar and Geographic Atrophy Abdülhıdır Ağın, Ata Baytaroğlu, Yakup Çevik, Uğur Acar, Gungor Sobaci. 1Department of Ophthalmology, Hacettepe University Faculty of Medicine, Ankara, Turkey; 2Ophthalmology, Ardanah State Hospital, Ardanah, Turkey.

**Purpose:** To define whether the inner retinal layer (IRL) is preserved or not in the late-stage of Age-Related Macular Degeneration (AMD) which is the potential candidate for macular prostheses in the future.

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Methods: Fifty treatment-naïve late-stage AMD patients with disciform scar (AMD-DS, n=28) and geographic atrophy (AMD-GA, n=22), 50 age- and sex-matched controls were enrolled into the study. Spectral Domain Optical Coherence Tomography (SD-OCT, Spectralis, Heidelberg Engineering, Germany) images above quality index (Q) of 25 were included in the study. The IRL, ganglion cell layer (GCL), inner plexiform layer (IPL), inner nuclear layer (INL) and outer retinal layer (ORL); outer plexiform and outer nuclear (OPL-ONL) layers and choroidal thickness (ChT) measurement were compared in between AMD patients and control group. P value of less than 0.05 was considered significant.

Results: The mean ages were 71.70 ± 8.10 years (61 - 89) and 70.10 ± 7.43 years (59 - 78) in AMD patients and control group, respectively (p=0.63). The IPL and GCL values were 27.00 ± 8.62 and 28.10 ± 12.04 µm in AMD-DS patients, 30.33 ± 10.38 µm and 28.93 ± 15.04 µm in AMD-GA patients and 37.60 ± 3.82 µm and 43.27 ± 6.04 µm in control group, respectively. In regard to confidence level of 95% in controls, GCC and IPL values in AMD-DS and AMD-GA patients were significantly less (p<0.05 GCC and p<0.05 IPL for both AMD-DS and AMD-GA group). The mean subfoveal ONL thickness were 71.70 ± 17.73 µm (p=0.044) in AMD-DS patients, 69.54 ± 16.64 µm (p=0.029) in AMD-GA patients and 86.80 ± 15.19 µm in control group. There were statistically significant ChT thinning in AMD-DS patients (106.60 ± 30.11 µm, p=0.02) and AMD-GA patients (134.91 ± 57.20 µm, p=0.001) compared to control group (233.80 ± 68.19). However, we didn’t observe statistically significant differences in INL and OPL values between AMD patients and the control group.

Conclusions: In contrast to AMD-DS patients, preserved INL and OPL seems to favors in much potential benefit from the implant in AMD-GA patients, especially for subretinal implants.

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Presentation Time: 11:00 AM–12:45 PM

Optical coherence tomography angiography in treatment-naïve quiescent choroidal neovascularization
Adriano Carnevali1, Andrea Mazzaferrero2, Federico Corvi3; Maria vittoria Cicinelli1, Eleonora Corbelli1, Vittorio Capuano4, Lea Querques5, Vincenzo Scorcia1, Francesco Bandello6, Giuseppe Querques6. 1U.O. Oculistica, Università Magna Graecia Catanzaro, Catanzaro, Italy; 2IRCCS Ospedale San Raffaele, Milano, Italy; 3Università Paris-Est - Créteil, Paris, France.

Purpose: To describe the optical coherence tomography angiography (OCT-A) features of treatment-naïve “quiescent” choroidal neovascularization (CNV) secondary to age-related macular degeneration (AMD).

Methods: Nine consecutive patients with treatment-naïve quiescent CNV secondary to AMD consecutively presenting between September 2015 and November 2015 at the Retina Service of the Department of Ophthalmology of the University Vita-Salute San Raffaele in Milan were enrolled in the study. Patients underwent multimodal imaging assessment including FA, ICGA, SD-OCT and OCT-A. The size and appearance of quiescent CNV on OCT-A were evaluated. OCT-A was performed through a prototype OCT-A (AngioPlex, CIRRUS HD-OCT models 5000, Carl Zeiss Meditec, Inc., Dublin, USA). The automatic segmentation provided by the machine software was manually adjusted by two expert retinal specialists (G.Q. and F.C.), to ensure correct visualization of the capillary plexuses, outer retinal layers, choriocapillaris layer, and identification of the CNV plane. CNV size was classified as “small” if greatest linear dimension (GLD) was less than 1 mm, “medium” if GLD was between 1 and 2 mm, and “large” if GLD was more than 2 mm. CNV on OCT-A were classified in well circumscribed (seafan-shaped vessels) or poorly circumscribed (long filamentous vessels) on the bases of its appearance and its borders.

Results: Ten eyes of 9 consecutive patients (4 Female / 5 Male; mean age 75.6±9 years) with quiescent CNV secondary to AMD were included in the analysis. All eyes evaluated in this study demonstrated agreement between OCTA and FA, ICGA, and SD-OCT images with respect to treatment-naïve quiescent CNV identification. CNV size on OCT-A was small in 7 eyes (70%), medium in 2 eyes (20%) and large in 1 eye (10%). CNV appeared as well circumscribed in 7 eyes (70%) and poorly circumscribed in 3 eyes (30%).

Conclusions: Using OCTA allows the clinician to visualize CNV noninvasively and may provide a method for identifying even treatment-naïve quiescent CNV and possibly guiding treatment.

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