Morphological variations in naïve-choroidal neovascularization after intravitreal treatment (IVT) with antiVEGF

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Purpose: To describe morphological changes in the naïve choroidal neovascularization (CNV) in patients with AMD, after intravitreal treatment with anti-VEGF (IVT), evaluated with OCTA

Methods: Forty-five eyes were evaluated in 37 patients affected by wet AMD and treated with intravitreal antiVEGF. The morphological characteristics of CNV were assessed by OCT XR Avanti –Optovue before, and 1, 2 and 3 months after injection

Results: Morphological changes of CNV were already observed after the first month and continued to be observed in subsequent months. Major variations concern the reduction of the area of the lesion; and the serious loss of peripheral capillaries with branching vascular plot that constantly increases after each IVT. In 14 patients the appearance of a feeder trunk was observed even after the first injection. In three eyes that have not been subjected to the third injection, we immediately observed a new increase in capillary density.

Conclusions: The OCTA allows us to obtain useful morphological information about the significant variations faced by CNV after treatment with antiVEGF IVT, as well as being a very useful and convenient method of non-invasive investigation.

Variation AOCT of CNV: CNV at T0, T1 CNV one month later but without IVT therapy, T2 after the first IVT, T3 after the second IVT, T4 three months after the second IVT.

Commercial Relationships: Simona Altimari, None; Carmine Luciano Vulcano, None; Alessandro Labate, None; Elisabetta Sterbini, None; Marco Giubilei, None
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**Quantification of flow at baseline and follow-up in uveitic and non-age-related macular degeneration choroidal neovascular membranes (CNVM) using Optical Coherence Tomography-Angiography (OCT-A)**

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**Purpose:** OCT-A is a recent advance in non-invasive imaging utilizing split-spectrum amplitude decorrelation to acquire high-resolution angiographic images. Recent software modifications permit semi-automated quantification of CNVM ‘flow’. We present the use of the AngioAnalytics OCT-A software (Optovue AngioVue) for the quantification of non-age-related macular degeneration (AMD) related-CNV at baseline and follow-up. Absence of the perilesional hypo-intense halo has been reported as a sign of CNVM quiescence in neovascular AMD and we aimed to confirm this in our cohort.

**Methods:** Patients were identified prospectively from the retinal and uveitis service at a tertiary care centre. Only eyes with delineable CNVM on OCT-A were included. Clinical and demographic data, OCT (Topcon) central subfield thickness (CST) and OCT-A scans were collected in all patients. Patients received intravitreal anti-vascular endothelial growth factor therapy, as well as immunosuppression, where indicated. The repeatability of flow measurements between 2 observers were assessed using Bland-Altman analysis.

**Results:** 9 eyes of 9 patients (7 female, 2 male) were identified with an age range: 18-69 years. CNVM occurred secondary to posterior uveitis, myopia and central serous chorioretinopathy (CSCR) in 4, 4 and 1 patient, respectively. 8 CNVM demonstrated evidence of activity, of which follow-up OCT-A data were available for 5 eyes (3 posterior uveitis, 1 myopia, 1 CSCR). Compared with baseline, mean flow within the CNVM reduced significantly from 0.27mm²/100ms to 0.13mm²/100ms following initial treatment (p=0.037). There was an associated significant reduction in CST on OCT 338.4um vs. 239.6um (p=0.044). However, comparing baseline CST with flow for all patients there was no significant correlation detected (r=0.182, p=0.703). The repeatability coefficient for inter-observer measurements was ±10.9% of mean baseline flow values. The perilesional hypo-intense halo was identified in 4 patients at baseline, and persisted or became more obvious with quiescence in all 4 cases.

**Conclusions:** OCT-A provides an additional quantitative parameter for monitoring CNVM treatment response. Inter-observer flow measurements demonstrated good repeatability. The perilesional halo did not consistently disappear with other features of CNVM quiescence in non-AMD CNVM.

**Commercial Relationships:** Tomas Burke, None; Ester Carreno, None; Clare Bailey, None; Richard W. Lee, None; Andrew D. Dick, None; Adam H. Ross, None

**Methods:** This retrospective study included consecutive patients with PCME naïve of treatment and age-matched control eyes, imaged using OCTA (RTVue XR Avanti, Optovue). The diagnostic criteria for PCME were: vision loss after cataract surgery and occurrence of intraretinal cystoid spaces with a central macular thickness of at least 321 µm on postoperative OCT. Qualitative changes in macular capillary plexus were assessed by two independent examiners. Automated flow density acquired by a new prototype AngioVue software (with remove artifact tool) was used to assess the CD in the 3x3 mm angiograms in the superficial capillary plexus (SCP) and deep capillary plexus (DCP) in PCME and control eyes.

**Results:** Eight eyes of 7 patients with PCME were imaged and compared to 8 age-matched control eyes. The first visual symptoms occurred in a mean time of 38.1 ± 22.3 days after the surgery. At initial examination, the pattern of SCP remained nearly normal although the DCP was altered and disorganized. The CD was significantly decreased in both plexus in PCME eyes compared with control eyes (whole en face CD in the SCP: 47.9 ± 3.8% and 52.9 ± 4.0% respectively, p = 0.01; whole en face CD in the DCP: 43.6 ± 7.1% and 54.2 ± 3.2% respectively, p = 0.001). All eyes were treated with dexamethasone and ketorolac drops associated with oral acetazolamide. After resolution of edema, in a mean time of 79.4 ± 35.1 days, DCP architecture recovered in all eyes. The CD increased in both plexus and the difference with control eyes was no longer significant (whole en face CD was 49.8 ± 3.9 % in the SCP and 53.4 ± 6.1% in the DCP; p = 0.23 and 0.6 respectively, compared with control eyes).

**Conclusions:** This first OCTA study of capillaries changes in PCME showed that in the acute phase, the DCP was mainly altered and disorganized with a significant decrease of CD compared to healthy control eyes. After macular edema resolution under topical and systemic therapy, the pattern of DCP recovered and its CD returned to normal.

**Commercial Relationships:** Aude Couturier; Dan Chetrit, None; Sophie Bonnin, None; Valerie Mane, None; Alain Gaudric, None; Ramin Tadayoni, None

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**Optical Coherence Tomography Angiography in Central Serous Chorioretinopathy Treated with Eplerenone or Photodynamic Therapy**

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**Purpose:** To correlate function and structural optical coherence tomography (OCT) to optical coherence tomography angiography (OCT-A) measures in patients affected by central serous chorioretinopathy (CSCR) and to describe their changes after treatments (i.e. oral eplerenone, half-fluence photodynamic therapy [PDT]).

**Methods:** Twenty eyes of 16 consecutive patients with treatment-naïve CSCR undergoing either eplerenone or PDT were enrolled in this prospective, observational study. All patients underwent structural OCT and OCT-A at baseline and after therapy at months 1 and 3.

**Results:** Eleven eyes of 9 patients and 9 eyes of 7 patients underwent eplerenone or PDT treatment, respectively. Central macular thickness (CMT) and subretinal fluid (SRF) correlated to fovea avascular zone (FAZ) area (r = 0.74 and r = 0.71, p = 0.01) and vessel density (r = 0.77 and r = 0.68, p = 0.01) at deep capillary plexus (DCP). CMT (p = 0.001), SRF (p = 0.0005), CFST (p = 0.0016), FAZ area at DCP

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

**Pseudophakic Cystoid Macular Edema Imaged by Optical Coherence Tomography Angiography**

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**Purpose:** To study macular capillary changes and capillary density (CD) using optical coherence tomography angiography (OCTA) in pseudophakic cystoid macular edema (PCME) before treatment and after resolution of the edema.

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Using a superficial slab on OCTA, PVD of capillaries

The study of retinal vessel density is crucial in evaluating disease severity and progression especially in retinal diseases such as diabetic retinopathy. Unfortunately, not all optical coherence tomography angiography (OCTA) machines have the capability of measuring vessel density. Hence, our study aims to describe a novel technique of evaluating retinal vessel density using OCTA images.

**Program Number:** 1647 **Poster Board Number:** A0078
**Presentation Time:** 11:00 AM–12:45 PM

**Perfused Vessel Density of Peripapillary Capillaries vs. Major Vessels in Primary Open Angle Glaucoma (POAG) Using OCT Angiography**

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**Purpose:** To evaluate peripapillary capillary perfused vessel density (PVD) in comparison to major vessel PVD in optical coherence tomography angiography (OCTA) images.

**Methods:** 4.5x4.5mm optic disc OCTA scans of 10 healthy eyes and 27 eyes from patients with POAG were analyzed using custom software. Two OCTA layers were extracted from each scan: a slab extending from the vitreous to 50μm below the inner limiting membrane (ILM; superficial layer) and a layer extending from the ILM to the posterior boundary of the retinal nerve fiber layer (RNFL; RNFL layer). For each layer, two regions of interest (ROI) were defined: (1) an annulus with an inner diameter of 1.95mm and outer diameter of 3.45mm centered over the optic disc and (2) the entire image excluding a circle with a diameter of 1.95mm centered over the optic disc (Scripsema, IOVS 2016). Capillaries and major vessels were extracted using local and global thresholding, respectively. Capillary PVD was defined as the capillary area divided by the corresponding ROI area excluding the major vessel area. Major vessel PVD was defined as the major vessel area divided by the corresponding ROI area. Kruskal-Wallis tests and post-hoc Dunn tests with Holm correction were performed to assess statistical significance among disease stages for each parameter.

**Results:** Consistent with a prior study, annulus and global capillary PVD decreased from control to severe POAG in the RNFL layer (Scripsema, IOVS 2016), with significant differences between control and mild POAG in global capillary PVD (15.9% difference, p<0.05). In the superficial layer, major vessel PVD increased from control to severe POAG in both the annulus and global ROI and capillary PVD decreased as in the RNFL layer. Major vessel PVD was not significantly different among groups in the RNFL layer. For all parameters, there were significant differences in the following comparisons: control vs. moderate, control vs. severe, and mild vs. severe (Fig 1).

**Conclusions:** Using a superficial slab on OCTA, PVD of capillaries and major vessels both appear to correlate with stage of disease. This type of image analysis may yield more information about the natural history of glaucomatous vascular changes and serve as a tool for diagnosing and staging POAG.

![Fig 1. Annual ROI PVD from the superficial and RNFL layers in controls and the 3 stages of POAG.](image-url)
Purpose: The purpose of this study was to investigate the macular flow density as assessed by optical coherence tomography angiography (OCTA) in eyes with primary open-angle glaucoma (POAG) and age-matched healthy control eyes.

Methods: The macular flow density was evaluated using the OCTA (Heidelberg Engineering Spectralis 2 OCT-A) centered on the macula in 30 perimetric POAG eyes (age 73.3 ± 5.5 years) and 30 age-matched healthy control eyes. A custom image analysis approach measured the pixel density after binarization in 5 sectors defined by the ETDRS study (central sector: 1 mm diameter, 4 sectors: 3.5 mm diameter; for comparison see attached OCTA image with ETDRS sectors). For statistical analysis, one eye was chosen randomly and compared to the healthy control eye using parametric paired t-test.

Results: The macular flow density was significantly altered in the central (p = 0.0167), inferior (p = 0.0258) and nasal (p = 0.0438) sector, while the superior and temporal sector showed no significant difference.

Conclusions: We found a decreased macular microvasculature of the retina determined by Heidelberg Engineering OCTA in POAG patients. These findings suggest that the perfusion is altered in POAG. However, it remains unclear whether this decrease in perfusion is causal to the retinal nerve fiber layer degeneration or secondary to its loss.

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OCT angiography evaluation of peripapillary vessel density in eyes treated with plaque radiotherapy for uveal melanoma
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Purpose: To study peripapillary retinal capillary circulation in eyes treated with I-125 plaque radiotherapy for uveal melanoma using OCT angiography (OCTA).

Methods: Cross-sectional study of 16 subjects treated with I-125 plaque radiotherapy one to nine years prior to imaging with OCTA. Subjects were prescribed 85Gy to the tumor apex over 100 hours using I-125 plaque brachytherapy. All subjects had clinically apparent radiation retinopathy and/or radiation optic neuropathy at the time of OCTA imaging. Seven were male and nine were female, with ages ranging from 37 to 81 years. The visual acuities in the irradiated eyes ranged from 20/20 to counting fingers, while visual acuities in the untreated fellow eye were 20/30 or better. Peripapillary retinal capillary circulation was measured by Angio Vue OCTA (Optovue Avanti RTVue XR) in both eyes. 4.5x4.5 mm optic disc scans were obtained. The peripapillary vessel density (PPVD) was calculated for the inner retina (inner limiting membrane to outer plexiform layer) in treated eyes and compared to fellow eyes. The relationship of the PPVD to the calculated dose to the optic nerve was evaluated.

Results: The PPVD as measured by OCTA was significantly lower in treated eyes (52.9% +/- 22.4%) than in fellow eyes which did not receive radiation (73.3% +/- 13.7%, p = 0.004). Every subject was not evaluated pre-radiotherapy, but in those that were (14 of 16), no significant difference was seen between PPVD in eyes with tumor and the fellow eye prior to radiation. A representative OCTA of the peripapillary region in an eye is shown in Figure 1. There was a linear correlation between radiation dose (D50, the dose to 50% of the disc) and the PPVD (Pearson’s; r = -0.528, P = 0.043) as shown in Figure 2.

Conclusions: Radiation optic neuropathy is a significant cause of morbidity in patients undergoing radiotherapy for uveal melanoma. OCTA provides a measure of the capillary changes that are occurring following radiation, and may serve as a quantitative endpoint to address visual prognosis in individual patients.

Evaluation of a larger series of patients is warranted to further evaluate OCTA as a clinically significant endpoint.

Program Number: 1651 Poster Board Number: A0082
Presentation Time: 11:00 AM–12:45 PM

OCT-Angiography Quantification of Peripapillary Retinal Vessel Density In Myopes with and Without Tilted Discs and Emmetropes
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Purpose: To examine the effect of myopia and optic disc tilt on peripapillary perfused vessel density (PVD) as measured by optical coherence tomography angiography (OCTA). High myopia and tilted optic discs may be associated with visual field defects presumed secondary to mechanical stress on optic nerve fibers. Peripapillary retinal perfusion may play a role. This study is the first to investigate the effect of myopic and optic disc tilt on peripapillary PVD as measured by OCTA.

Methods: Emmetropic control and myopic (myopia ≥ -1.0 D) eyes were imaged using the Optovue Avanti XR OCT system™ (Fremont, CA) to obtain OCT volumetric images of the optic disc (4.5 mm x 4.5 mm) The Split-Spectrum Amplitude Decorrelation Angiography Tomography (SSADA) was used to create a 3-dimensional map of perfused vessels in the peripapillary retinal nerve fiber layer (RNFL). The Optovue AngioAnalytics software™ was used to calculate the PVD as the percent area of perfused vasculature within the RNFL divided into six peripapillary segments and one inside disc segment. A custom algorithm was used to generate a color-coded density map of perfused radial peripapillary vessels. Average perfusion density values in emmetropes vs. myopes were compared in the peripapillary segments. Statistical analysis was performed in SPSS Software © (Version 24, IBM Corporation, Armonk, NY). Student t-tests were used to compare group differences in PVD; a multiple regression model was used to quantify the variance accounted for by disc tilt and refractive error.

Results: PVD in 36 emmetropic and 28 myopic eyes (6 with tilted discs) were analyzed. Myopic eyes demonstrated lower PVD in overall peripapillary ring, nasal, temporal, and inferotemporal sectors. The inside disc sector of myopic eyes demonstrated significantly higher PVD than emmetropic eyes. Multiple regression analysis found that disc tilt, and not refractive error, predicted variance of PVD in the peripapillary radial, nasal, and inside disc sectors.

Conclusions: Myopic eyes have statistically significant decreases in peripapillary PVD compared with emmetropic eyes, as measured by OCTA. The presence of optic disc tilt may be more predictive of decreased PVD than myopic refractive status alone.

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Presentation Time: 11:00 AM–12:45 PM
Optical coherence tomography angiography parameters in diabetic patients with no diabetic retinopathy


Purpose: To evaluate the foveal avascular zone (FAZ) and capillary density (CD) of diabetic eyes with no diabetic retinopathy (DR) obtained by optical coherence tomography angiography (OCTA).

Methods: Case-control observational study. 64 eye of 34 patients with diabetes mellitus and no DR and 37 eyes of 22 age-matched healthy controls were included. All patients underwent OCTA scans (AngioVue, Avanti OCT, Optovue). FAZ area and CD in the superficial and deep capillary plexus layers were measured manually using ImageJ and Adobe Photoshop software, respectively.

Results: The superficial and deep FAZ areas were significantly correlated with best corrected visual acuity (BCVA) (P < 0.03). HbA1C > 7 was associated with larger superficial FAZ area in the DM group (P = 0.03), but only reached borderline significance in the deep FAZ area (P = 0.06). Age was inversely correlated with the superficial and deep capillary density (P < 0.005). After adjusting for BCVA, median superficial and deep FAZ areas were significantly larger in diabetic eyes (superficial 0.27 mm² [interquartile range (IQR), 0.20 – 0.35 mm²], deep 0.33 mm² [IQR, 0.27 – 0.39 mm²]) than in controls (superficial 0.23 mm² [IQR, 0.21 – 0.29 mm²], P = 0.009), deep 0.29 mm² [IQR, 0.22 – 0.34 mm², P = 0.006]). Median superficial and deep CD were not significantly different between DM group and controls (P > 0.05). No correlation was found between FAZ area or CD and diabetes duration, smoking, hypertension or hyperlipidemia.

Conclusions: Significant early changes in FAZ area, but not in capillary density, obtained by OCTA were found in diabetic patients with no DR compared to controls. FAZ area was correlated with BCVA and HbA1C level while CD was inversely correlated with age.

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Program Number: 1653 Poster Board Number: A0084
Presentation Time: 11:00 AM–12:45 PM
Quantitative spectral-domain optical coherence tomography angiography (OCTA) of Diabetic Retinopathy (DR) Severity

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Purpose: To quantify and compare capillary density and morphology in macular 3x3 and 6x6mm OCTA scans of subjects with DR.

Methods: Multicenter, retrospective, cross-sectional study of adult subjects with and without DR. Retinal microvasculature was assessed with a commercially available OCTA (Cirrus AngioPlex) and correlated with clinical exam. A custom MATLAB program was used to calculate indices of capillary density and morphology from segmented and non-segmented OCTA images using both 3x3 and 6x6mm scan patterns. Microvascular density was quantified as vessel skeleton density (VSD) and vessel area density (VAD), and vessel complexity (VCI) while morphology was quantified as vessel diameter (VD), vessel diameter index (VDI), and vessel perimeter index (VPI). All statistical analysis was done using SAS (SAS Institute Inc.). Pairwise comparisons were computed for the non-segmented (NSR), superficial (SRL), and deep retinal layers (DRL) in both 3x3 and 6x6 mm scans comparing successively worse stages of DR severity. Correlation coefficients with p-values were used to determine the direction and magnitude of correlation between OCTA measures and DR severity.

Results: Sixty-four eyes with DR and 18 healthy eyes from 50 subjects were studied. NSR images showed that VSD and VCI were significantly lower for mild NPDR than normal (p<0.05) as well as for all comparisons between successively more severe DR (p<0.05). Comparisons among SRL images showed that VDI, VD, VAD, VSD, and VCI were significantly different in mild or moderate NPDR compared to normals (p<0.05) and VDI and VD were significantly different in advanced DR (p<0.05). Density and morphology parameters in the DRL were not consistently and significantly different. Spearman’s correlation showed that VDI, VD, VAD, VSD, VPI and VCI were all significantly correlated with DR severity (p<0.001). VDI and VD were positively correlated and VAD, VSD, VPI, and VCI were negatively correlated. Significant change in vessel morphology parameters was generally found in 3x3mm of SRL.
Conclusions: Vascular changes in DR can be objectively characterized with OCTA parameters. In general, decreasing capillary density (VAD, VSD, VPI and VCI), and increasing vascular caliber (VD and VDI) were associated with worsening DR. Changes in morphology could mainly be detected using the 3x3mm scans.

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Presentation Time: 11:00 AM–12:45 PM

Agreement between OCT-Leakage and Fluorescein Angiography to identify sites of alteration of the Blood-Retinal Barrier in Diabetics

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Purpose: To compare the location of the sites of lower reflectivity, as determined by OCT-Leakage using Spectral Domain Optical Coherence Tomography (SD-OCT), with sites of fluorescein leakage identified by Fluorescein Angiography (FA) in eyes with diabetic retinopathy.

Methods: Fifty-two eyes from 28 patients with diabetes type 2 and presence of non-proliferative diabetic retinopathy were imaged with FA and SD-OCT (AngioPlex, Carl Zeiss Meditec, Inc.). All FA images were analyzed by 2 experienced graders, and the areas surrounding well-defined sites of leakage were outlined by the graders. The SD-OCT scans were processed using OCT-Leakage proprietary software and semi-automated segmentation. Both procedures were performed without access to the clinical data.

Results: In eyes that were classified as having well-defined sites of leakage on FA, OCT-Leakage showed a sensitivity of 95.9% (91.4% - 100.0%) and a specificity of 75.4% (61.7% - 89.2%) regarding agreement between these sites of alteration of the Blood-Retinal Barrier (BRB). The areas of abnormal extracellular fluid increase were larger than the areas of fluorescein leakage and included the well-defined leakage sites identified by FA. OCT-Leakage identified localized increases in extracellular space, mainly in the Inner Nuclear, Outer Plexiform or Outer Nuclear Layers, even in eyes without leakage on FA.

Conclusions: OCT-Leakage performed using SD-OCT was found to better identify abnormal retinal fluid than did FA and showed good sensitivity and specificity in comparison with FA for identification of sites of alterations of the BRB.

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Clinical Trial: NCT02391558
Conclusions: It is possible to detect avascular regions from OCT angiography images. The avascular map and quantitative results have potential to be a useful for DR diagnosis and monitoring.

Methods: Between November, 2014 and March, 2016, a total of 173 eyes were imaged on the same day with both Avanti RTVue XR optical coherence tomography angiography (Optovue Inc., Fremont, CA) with superficial retinal, deep retinal, outer retinal, and choriocapillaris automated segmentation and Spectralis SD-OCT (Heidelberg Engineering Inc., Heidelberg, Germany) with macular 30 degree, 25-line horizontal raster image acquisition scan patterns. Scans were read by two independent graders and interobserver differences were reconciled by an independent third grader. Sensitivity of fluid detection for the en face scans was determined by using a combination of Avanti 304-line macular cube and Spectralis 25-line raster scans as a gold standard.

Results: A total of 244 en face and 25-line radial SD-OCT scans were interpreted (mean: 1.41 scans/eye). 168 scans (68.9%) had confirmed fluid on SD-OCT. The en face scan pattern fluid detection sensitivity was 93.5% and specificity was 47.4%. Inter-rater reliability for fluid detection was 78.7% for the en face scans and 91.0% for the SD-OCT scans.

Conclusions: The en face SD-OCT scanning protocol alone with automated segmentation is highly sensitive, but not specific in detecting the presence of intraretinal and subretinal fluid in DME. Positive en face scan findings should be correlated with additional OCT scan protocols to guide clinical decision making.

Commercial Relationships: Nathan Cutler, None; Abtin Shahlaee, None; Murtaza K. Adam, None; Jason Hsu, None

Program Number: 1657 Poster Board Number: A0088
Presentation Time: 11:00 AM–12:45 PM

Diabetic Choroidopathy: choroidal vessel density and volume in diabetic retinopathy with swept-source optical coherence tomography
Jay Wang1, Ines Lains2, Joana Providencia3,4, Grayson Armstrong2, Katherine E. Talcott1, Pedro Giñó1,3, Joao Heitor Marques1,2, Joao Figueira1,2, Deeba Husain2, Ivana K. Kim2,3, Joan W. Miller1, Rufino Silva2,3, John B. Miller1, Ophthalmology, Massachusetts Eye and Ear Infirmary, Boston, MA; 2Faculty of Medicine, University of Coimbra, Coimbra, Portugal; 3Association for Innovation and Biomedical Research on Light, Coimbra, Portugal.

Purpose: To compare choroidal vascular density and volume in eyes with different stages of diabetic retinopathy against controls, using en face swept-source optical coherence tomography (SS-OCT).

Methods: Multicenter, prospective, cross-sectional study. We recruited diabetic and age-matched non-diabetic subjects. Diabetic eyes were divided into 4 groups: no diabetic retinopathy (No DR), non-proliferative DR (NPDR), NPDR with macular edema (NPDR + DME), and proliferative DR (PDR). All underwent complete ophthalmologic exam and imaging using SS-OCT (3D horizontal volume, 12 mm x 9 mm). En face images of the choroidal vasculature were obtained (using Bruch’s membrane as reference for flattening) and converted to binary images on ImageJ. Choroidal vascular density was then calculated as a percent area occupied by choroidal vessels in the central macular region (a 6-mm diameter circle centered on the fovea) as well as throughout the posterior pole (12 mm x 9 mm scan). Choroidal thickness was also obtained using SS-OCT automated software. The central macular choroidal vascular volume was calculated by multiplying the average choroidal vascular density by macular area and choroidal thickness. Multilevel mixed linear models were performed for analyses.

Results: We included 143 diabetic eyes (n = 27 no DR, n = 47 NPDR, n = 51 NPDR + DME, and n = 18 PDR), and 64 non-diabetic control eyes. Choroidal vascular densities of the central macula were significantly lower in eyes with NPDR + DME (28% ± 6.1%, β=-0.02, p=0.045) and eyes with PDR (26.4% ±
5.1%, ß = -0.04, p=0.039) compared to controls (30.9% ± 7.2%), even when controlled for age. Similar statistically significant results were also observed for the wider posterior pole images (21.6% ± 3.2%, ß = -0.015, p=0.009 and 20.5% ± 2.2%, ß = -0.023, p=0.006 for NPDR+DME and PDR, respectively, when compared to controls (23.3% ± 3.4%). The central macular choroidal vascular volume was significantly lower in eyes with PDR (0.015 mm³ ± 0.005 mm³, ß = -0.01, p=0.02) compared to control (0.023 mm³ ± 0.01 mm³).

**Conclusions:** Choroidal vessel density and volume is significantly reduced in more advanced stages of diabetic retinopathy. New imaging modalities should allow us to further explore the contributions of choroidal vessel disease in diabetic eye disease pathogenesis, prognosis, and response to treatment.

**Commercial Relationships:** Jay Wang, None; Ines Lains, Allergan (R); Joana Providencia, None; Grayson Armstrong, None; Katherine E. Talcott, None; Pedro Gil, None; Joao Heitor Marques, None; Joao Figueira, None; Deeba Husain, None; Ivana K. Kim, None; Joan W. Miller, KalVista Pharmaceuticals Ltd. (C), Valeant Pharmaceuticals (P), Alcon (C), Amgen, Inc (C), ONL Therapeutics, LLC (P), Maculogix, Inc. (C); Rufino Silva, Alimera (C), Allergan (C), THEA (C), Novartis (C), Alcon (C), Bayer (C); John B. Miller, Allergan (C)

**Program Number:** 1658 Poster Board Number: A0089

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

**Anatomical Location-Specific Normative Quantification of Macular Nonperfusion in Diabetic Retinopathy using Optical Coherence Tomography Angiography (OCTA)**

**Purpose:** To evaluate a novel normative-based approach to mapping and quantifying extent of macular nonperfusion in different stages of diabetic retinopathy (DR) using OCTA.

**Methods:** 19 controls and 45 diabetic eyes (15 no retinopathy - NoDR, 15 nonproliferative diabetic retinopathy - NPDR; and 15 proliferative diabetic retinopathy - PDR) were imaged using a commercial SD-OCT system (Avanti RTVue-XR; Optovue). Registered and averaged OCTA images created from 10 sequential 3x3 mm foveal OCTA scans using ImageJ were obtained for each subject (Moet al, ARVO imaging conference 2016) (Fig A1 & B1). All nonperfused perifoveal areas were automatically delineated on the averaged OCTA images using custom software. An eccentricity-specific normative database based upon the control group was used to identify all nonperfused areas that were at least 2 standard deviations (SD) greater than the norm. These regions were classified according to their sizes: 2-3.9, 4-7.9, or ≥8 SDs greater than the mean of the control group. Percentage of nonperfused perifoveal area was computed as the percentage occupied by the total nonperfused area (at least 2 SD greater than the normative means) divided by the area within the 300 µm region of interest extending from the FAZ margin (Fig A2 & B2). Values between groups were compared using Kruskal-Wallis and post hoc Mann-Whitney U tests.

**Results:** The mean±SD of the percentage of nonperfused areas were 4±4%, 5±4%, 20±10%, and 3±11% in the control, noDR, NPDR, and PDR groups respectively. While there were no significant differences between the control and NoDR groups, percentage of nonperfused area differed significantly between all other groups in terms of nonperfused areas of each different size (2-3.9, 4-7.9, and ≥8 SDs), at the 300 µm eccentricity from the FAZ margin (p<0.05).

**Conclusions:** We have demonstrated a novel technique of automated standard deviation mapping which can quantify the degree of anatomical location-specific nonperfusion on OCTA scans in patients with DR. This technique is sensitive to both focal and global defects which may prove useful for earlier diabetic retinopathy detection and severity grading.

**Commercial Relationships:** Richard B. Rosen, Optovue (C), Guardian Health (I), Clarity (C), Allergan (C), NanoRetina (C), OD-OS (C), Regeneron (C), Genentech (F), Carl Zeiss (C), Opticology (I), Ocatra Therapeutics (ACT) (C); Brian Krawitz, None; Erika Philips, None; Richard Bavier, None; Shelley Mo, None; Richard Weitz, None; Joseph Carroll, None; Toco Chui, None

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

**Diabetic retino-choroidopathy: automated morphofunctional assessment**

**Purpose:** To perform a fully automated quantitative assessment of retinal and choroidal microvasculature in eyes with diabetic maculopathy (DM) using optical coherence tomography angiography.
Retrospective case series of 48 eyes of 48 patients with diabetic retinopathy (DR) included in this study. It has been reported that the detection rates of microaneurysms (MAs) in diabetic retinopathy (DR) using optical coherence tomography angiography (OCTA) and to identify potential compensatory mechanisms secondary to focal vascular impairment.

Methods: Retrospective case series of 48 eyes of 48 patients with DM (19 females, mean age 66.2 ± 9.4 years) and 47 eyes of 47 age-matched controls evaluated by Spectralis HRA-OCT2 (Heidelberg Engineering, Heidelberg, Germany). The Full-spectrum probabilistic-correlation angiography (FS-PDA) generated optical coherence tomography angiograms of the superficial (SCP) and deep (DCP) capillaryplexuses and of the choriocapillaris (CC) layer. A fully automated micro-structural analysis, obtained by a custom built software (AngioOCTTool™) provided data on FAZ metrics and SCP, DCP or CC vessel density. A comparative analysis between different vascular layers was performed; the obtained data were also compared with those of healthy subjects.

Results: A statistically significant difference (p<0.05) in FAZ surface values was shown between the SCP and DCP both in diabetic and healthy subjects, while no differences were reported for vascular densities. A negative linear correlation in terms of vessel density was reported between CC and both SCP and DCP in diabetic patients (Spearman’s coefficient of rank correlation); at the reverse a positive linear correlation between the same parameters was noticed in healthy subjects. Capillary density values were significantly lower (p<0.05) in all retinal vascular layers and choriocapillaris of DM patients compared with healthy subjects.

Conclusions: A fully automated quantitative OCT-A approach is a useful imaging system for detecting diabetic-induced focal vascular impairment both in retinal and choroidal layers. Retinal and choroidal vascular networks, although distinct entities, seem functionally interconnected: varying the degree of perfusion may be a mutual compensatory mechanism in response to an ischemic injury.

Commercial Relationships: Marco Lupidi, Allergan (R); Carlo Cagini, None; Florence Coscas, None; Fiore Tito, None; Massimo Nicolò, None; Felice Cardillo Piccolino, None; Gabriel J. Coscas, Heidelberg Engineering (C)

Evaluating microaneurysms in diabetic retinopathy using different types of optical coherence tomography angiography

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Purpose: Previous studies have reported that the detection rates of microaneurysms (MAs) in diabetic retinopathy (DR) using optical coherence tomography angiography (OCTA) are rather low (41–62%). Using two different types of OCTA devices, spectral-domain (SD) and swept-source (SS) OCT, we evaluated the detection rates of MAs in DR in eyes with and without macular edema.

Methods: Fifty-three eyes of 32 patients with DR were enrolled. Macular OCTA images (3 × 3 mm) were obtained using two OCT devices: SD-OCTA, RTVue XR Avanti (Optovue, Fremont, CA) and SS-OCTA, DRI OCT Triton (Topcon, Tokyo, Japan). Fluorescein angiography (FA) also was performed in all patients. MAs were defined as hyperfluorescent spots seen in early- and/or late-phase FA images, and the rates of detection of all MAs using each OCTA device were evaluated. In 14 eyes with macular edema, we also defined “culprit MAs” located in edematous regions (retinal thickness 350 μm or greater) with leakage on late-phase FA images. The detection rates of the culprit MAs were compared to that of all MAs. Two observers independently counted the MAs seen with both OCTA devices, and the interclass correlation coefficients (ICCs) were calculated.

Results: The detection rates of all MAs using SD-OCTA and SS-OCTA, respectively, were 67.9±14.7% and 68.3±15.4%, the difference of which did not reach significance (p=0.35). The ICCs for the counting of the MAs using SD-OCTA and SS-OCTA, respectively, were 0.984 and 0.983. In eyes with macular edema, the detection rates of all MAs versus that of the culprit MAs were 69.0±13.4% versus 83.1±6.1% using SD-OCTA and 72.1±12.1% versus 86.7±8.2% using SS-OCTA. The detection rate of the culprit MAs was significantly (p<0.01) higher than that of all MAs with both OCTA devices.

Conclusions: Both OCTA devices (SD-OCTA and SS-OCTA) almost equally detected the MAs in the eyes with DR. Culprit MAs were detected to a greater degree using both OCTA devices than all MAs. The results suggest that OCTA is useful to evaluate clinically active MAs, which are a major cause of diabetic macular edema.

Commercial Relationships: Akihiro Ishibazawa, None; Tomoko Mase, None; Kosuke Shimizu, None; Young-Seok Song, None; Akitoshi Yoshida, Tomey (P), Nidek (P), Topcon (P)

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Presentation Time: 11:00 AM–12:45 PM

Spatial pattern of retinal capillary dropout in diabetic retinopathy: evaluation using OCT angiography

Yoshihiro Kaizu, Shintaro Nakao, Takehito Hayami, Munee Yamaguchi, Iori Wada, Kohta Fujitawa, Shigeo Yoshida, Tatsuro Ishibashi, Koh-hei Sonoda. Ophthalmology, Kyushu University, Fukuoka, Japan; Intelligent Mechanical Systems, Graduate School of Natural Science and Technology, Okayama University, Okayama, Japan.

Purpose: It has been reported that foveal avascular zone (FAZ) could be enlarged during the progression of diabetic retinopathy. Our purpose in this study was to evaluate the retinal capillary dropout of macular area excepting FAZ enlargement in patients with diabetic retinopathy using optical coherence tomography angiography (OCTA).

Methods: This retrospective case control study included diabetic patients (18 NDR eyes, 19 NPDR eyes, 4 PDR eyes) and 28 healthy control subjects who underwent OCTA examination (RTVue XR Avanti: Optovue Inc, Fremont, California, USA). Retinal capillary densities of the whole 3x3 mm area as well as four divided areas (superior, inferior, lateral, nasal) excepting FAZ area were measured in 3x3 mm OCT angioflow images centered on the fovea using NI Vision Builder (National Instruments, Texas, USA).

Results: Retinal capillary densities of the whole 3x3 mm superficial OCTA images in healthy control, NDR, NPDR and PDR eyes were 45.6%, 39.7%, 37.7% and 34.2%, respectively. These of deep OCTA images were 59.7%, 51.6%, 42.8% and 34.2%, respectively. Retinal capillary densities of superficial as well as deep OCTA image in diabetic eye was significantly lower than those of healthy eyes (p<0.05, p<0.01, respectively). In superficial and deep OCTA images, there were no significant differences among the four areas (superior, inferior, lateral, nasal) in healthy, NDR, NPDR, and PDR eyes, respectively.

Conclusions: Retinal capillary dropout could be caused independently of FAZ enlargement and spatially evenly in the macular area of diabetic eyes.

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

**Relationship between internal reflectivity of diabetic microaneurysms on SD-OCT and detection on OCT Angiography**

**Daniele De Geronimo**, Maria Cristina Parravano, Fabio Scarinci, Lea Querques, Gianni Virgili, Joseph Simonett, Monica Varano, Francesco Bandello, Giuseppe Querques

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**Purpose:** To correlate the appearance of microaneurysms (MAs) on structural SD-OCT with their detection on OCT angiography (OCT-A) in patients with non proliferative diabetic retinopathy (NPDR).

**Methods:** Observational cross-sectional clinical study. Sixteen patients with mild, moderate or severe NPDR without diabetic macular edema underwent SD-OCT and OCT-A on the same day. Two observers blinded to patient groupings evaluated reflectivity of MAs on structural SD-OCT scans and their visualization at the level of superficial capillary plexus (SCP) and deep capillary plexus (DCP) on OCT-A.

**Results:** The study included one hundred and thirty-five MAs detectable on OCT-A; 56.3% (n 76) were visible only in the DCP, 6.7% (n 9) only in the SCP, 21.5% (n 29) were visible in both plexuses (mixed); finally 15.6% (n 21) were not visible on any OCT-A images. Compared to MAs with hyper reflectivity or moderate reflectivity, MAs with hypo reflectivity on structural SD-OCT were significantly less likely to be detected on OCT-A (OR: 4.6; 95%CI: 1.5-14.0, p = 0.008; and OR: 4.2, 95%CI 1.2-14.2, p = 0.022, respectively). Compared to non-visible MAs, superficial (OR: 1.7, 95% CI: 0.4 – 8.4), mixed (OR: 2.5; 95% CI: 0.8-7.8) and deep (OR: 3.6; 95% CI: 1.3-9.7) MAs were increasingly more likely to be more reflective (test for trend p<0.011), though only the OR of deep MAs reached significance when position was a categorical variable (p=0.013).

**Conclusions:** MAs that appear hyporeflective on structural SD-OCT have a lower detection rate on OCTA images. This relationship between the internal reflectivity of MAs on structural SD-OCT and their visualization on the OCT-A images may help further understand the different pattern of blood flow dynamics in MAs.

**Commercial Relationships:** Daniele De Geronimo, None; Maria Cristina Parravano, None; Fabio Scarinci, None; Lea Querques, None; Gianni Virgili, None; Joseph Simonett, None; Monica Varano, None; Francesco Bandello, None; Giuseppe Querques, None

**Program Number:** 1663 | **Poster Board Number:** A0994

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

**Quantification of changes in foveal capillary architecture caused by idiopathic epiretinal membrane using OCT-Angiography**

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

**Purpose:** Idiopathic epiretinal membrane exerts vertical and tangential forces on the retina. The latter are dragging the retina from its original position, which can be clearly appreciated when looking at the vascular displacement. In this prospective observational study we quantified the extent and depth of distortion of the foveal capillary architecture due to traction of idiopathic epiretinal membrane (ERM) using optical coherence tomography angiography (OCT-A).

**Methods:** Multimodal imaging including OCT-A (Angiovue, Optovue) was performed in 26 eyes with idiopathic ERM (71.2 years ± 5.8). Best corrected visual acuity (BCVA), OCT-A vessel density of the foveal (VDFo) and parafoveal (VDP) region were assessed. Based on 6x6mm2 OCT-A images, a macular vessel density ratio (MVR=VDF/VDP) was calculated for the superficial (s), deep (d) and full-thickness (f) slabs to assess a depth-resolved, non-invasive evaluation of foveal distortion. The data were subdivided in a group with mild (BCVA < 0.4 logMar) and severe (BCVA > 0.4 logMar) VA reduction due to ERM. Data was compared to age-matched healthy controls.

**Results:** In all three slabs, MVR was significantly smaller in the control group in comparison with the ERM group: MVRs: 0.64 ± 0.11 vs 0.82 ± 0.11 (p<0.01); MVRd: 0.61 ± 0.08 vs 0.74 ± 0.17 (p<0.01); MVRf: 0.69 ± 0.16 vs 0.81 ± 0.11 (p<0.01). In mild BCVA reduction patients, MVR was significantly higher only in the superficial slab: MVRs: 0.64 ± 0.11 vs 0.74 ± 0.11 (p=0.022); MVRd: 0.61 ± 0.08 vs 0.69 ± 0.13 (p=0.11); MVRf: 0.69 ± 0.16 vs 0.75 ± 0.11 (p=0.13). Whereas in severe BCVA reduction patients, MVR was significantly higher in all slabs: MVRs: 0.64 ± 0.11 vs 0.88 ± 0.08 (p<0.01); MVRd: 0.61 ± 0.08 vs 0.80 ± 0.17 (p < 0.01); MVRf: 0.69 ± 0.16 vs 0.86 ± 0.10 (p<0.01).

**Conclusions:** Assessing MVR using OCT-A may serve as a tool to quantify the extent and depth of distortion of the foveal capillary architecture due to traction of ERM. BCVA reduction appears to be associated with a greater extent and depth of distortion.

[A] Exemplary optical coherence tomography angiography (OCT-A) en-face image of a control subject with a superimposed EDTRS grid with close-up of foveal area [B] and corresponding SD-OCT image [C]. [D] Exemplary OCT-A image of an epiretinal membrane (ERM) patient with a superimposed EDTRS grid with close-up of foveal area [E] and corresponding SD-OCT image [F].

**Commercial Relationships:** Pieter Nelis, None; Florian Alten, None; Christoph R. Clemens, None; Peter Heiduschka, None; Nicole Eter, Bayer (F), Alimera (R), Bayer (R), Allergan (R), Roche (C), Allergan (F), Allergan (C), Alimera Sciences (C), Novartis (F), Heidelberg Engineering (R), Novartis (R), Bayer (C), Novartis (C)

**Program Number:** 1664 | **Poster Board Number:** A0995

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

**Abnormalities in Superficial and Deep Capillary Plexus of Fellow Eye of Patients Affected by Idiopathic Epiretinal Membrane in Contralateral Eye**

Andrea M. Coppe, Giuliana Lapucci, Marta Gilardi, Roberto Gattegna, Pamela Cosimi, Guido Ripandelli.

Ophthalmology, GB Foundation Study Ophth IRCCS, Rome, Italy.

**Purpose:** To detect by means of angio-OCT defects in the superficial (SCP) and deep capillary plexus (DCP) of the fellow eye (FE) in patients affected by idiopathic epiretinal membrane (IERM) in the contralateral eye (CoE)

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Methods: Fourteen FE of 14 patients with IERM in the CoE, mean age 68.80±5.27 years, 11 F and 4M, were studied. The control group consisted of 14 eyes from 14 normal, age matched subjects. All subjects had ametropia <3D and underwent clinical examination including VA evaluation using ETDRS chart and slit-lamp biomicroscopy with +90D lens. The macula was analyzed with the SD angio-OCT RTVue XR (Optovue Inc.) using the Cross Line scan to confirm the diagnosis and the Angio Retina [6.0] scan to evaluate the blood flow (BF) in the 6×6 mm area around the fixation point, measuring the BF in SCP and DCP. The software release (Beta ver. 2015.100.0.35 for Clinical) quantified the BF as a percentage of the area analyzed. A grid centered on the fixation point identified 3 areas: central 1 mm (Fovea [F]), 3 mm (WholeMacula [WM]) and between 1 and 3 mm from the center (Parafovea [PF]). Data collected underwent to unpaired T-test assuming unequal variance. A level of p<0.05 was accepted as statistically significant.

Results: The following are the results of the comparison of BF in homologous areas between the patients and controls group.

SCP - WM: BF in FE (46.10±5.45%) was reduced vs CE (49.92±3.38%), p=0.035; F: BF in FE (36.70±5.48%) was increased vs CE (30.26±5.20%), p=0.024; PF: BF in FE was reduced (47.13±7.20%) vs CE (52.24±4.14%), p=0.031.

DCP - WM: BF in FE (49.49±7.19%) was reduced vs CE (55.37±3.85%), p=0.013; F: no difference in BF between groups (FE: 31.86±12.93% vs. CE: 32.56±6.58%), p=0.858; PF: BF in FE (54.17±6.44%) was reduced vs CE (58.94±4.18%), p=0.029.

Conclusions: A paravascular reduction of BF is found in both SCP and DCP of FE, whereas an increase of BF is found in the foveal SCP. It is possible to hypothesize that a retinal defect could precede and, possibly, be involved in the development of the vitreoretinal modifications occurring in IERM eyes; this findings could also be consistent with our previous report (poster #4242, ARVO Meeting 2016) in which we found a selective cellular loss in the perifoveal ganglion cell layer of FE eyes with unilateral IERM.

Commercial Relationships: Andrea M. Coppe, None; Giuliana Lapucci, None; Marta Gilardi, None; Roberto Gattegna, None; Pamela Cosini, None; Guido Ripandelli, None.

Program Number: 1665 Poster Board Number: A0096
Presentation Time: 11:00 AM–12:45 PM

Segmented Swept Source OCT Angiography Assessment of the Foveal Avascular Zone Ratio in Ultra-Wide-Field Imaged Non-Proliferative and Proliferative Diabetic Retinopathy: New Biomarker of Prognosis

Francesco Stringa, Emmanouil Tsamis, Soon Ch‘ng, Goncalo Bento, Yvonne D’Souza, Assad Jalil, Paulo Eduardo Stanga, Manchester Vision Regeneration (MVR) Lab at NIHR/Wellcome Trust Manchester Clinical Research Facility and Manchester Royal Eye Hospital, Manchester Academic Health Science Centre, Central Manchester University Hospital NHS Foundation Trust, Manchester, United Kingdom; 1Division of Pharmacy & Optometry, School of Health Sciences, Faculty of Biology, Medicine & Health, Manchester Academic Health Science Centre, University of Manchester, Manchester, United Kingdom; 2Division of Evolution & Genomic Sciences, School of Biological Sciences, Faculty of Biology, Medicine and Health, Manchester Academic Health Science Centre, University of Manchester, Manchester, United Kingdom.

Purpose: Segmented Swept-Source OCT Angiography (SS-OCTA) imaging of the foveal avascular zone (FAZ) and the paravascular vasculature shows microvascular changes that can be correlated with the severity of diabetic retinopathy (DR). We aim to assess whether alterations in the paravascular area of FAZ can be interpreted as a clinical biomarker of disease progression.

Methods: Observational and retrospective study of diabetic patients diagnosed with Non-Proliferative (NPDR) and Proliferative (PDR) DR between January and October 2016. All eyes were imaged on Optos California® (Optos®, UK) and the retinopathy classified by two independent observers into three groups: mild/moderate NPDR, severe NPDR and PDR. SS-OCTA (Triton Plus®, Topcon Corp., Japan) images were acquired using the 6 mm × 6 mm fovea-centred cubes scanning protocol. Surface Area (SA) was measured using the Topcon IMAGEnet® (version 1.19) proprietary software after automated segmentation of the FAZ into superficial vascular (SVP) (SVP-FAZ) and deep vascular plexus (DVP) (DVP-FAZ). Eyes with Clinically Significant Macular Oedema (CSMO) and with previous panretinal photocoagulation (PRP) were excluded. The difference and ratio between SAs in SVP-FAZ and DVP-FAZ in each group were analysed.

Results: Five (PRP) and ten (CSMO) eyes were excluded in the statistical analysis. Imaging results from seventy-four eyes (36 patients, 15 females and 21 males, mean age was 60.3 years (±11.65, range 35-83)) were included in this study. In all eyes, the SA of DVP-FAZ was larger than that of SVP-FAZ. Mild/moderate NPDR graded eyes showed the smallest SA of FAZ in both DVP and SVP (p<0.01), whereas PDR eyes showed the largest FAZ area in both plexuses (p<0.01). The ratio of SAs of SVP-FAZ over DVP-FAZ (rFAZ) was significantly lower in severe NPDR eyes vs. mild/moderate NPDR and PDR eyes (p<0.01).

Conclusions: The SA of FAZ in both plexuses is correlated with DR severity, increasing with severity of retinopathy. Capillary rarefaction in DVP compared to that in SVP is more evident in severe NPDR than in the other groups. The enlargement of SA of SVP-FAZ may indicate further enlargement of the SA of SVP-FAZ and progression to PDR. Therefore rFAZ could serve as a prognostic tool for the monitoring of DR.

Commercial Relationships: Francesco Stringa, None; Emmanouil Tsamis, None; Soon Ch‘ng, None; Goncalo Bento, None; Yvonne D’Souza, None; Assad Jalil, None; Paulo Eduardo Stanga, Topcon Corporation (F), Optos (R), Optos (F), Optos (C), Topcon Corporation (C), Topcon Corporation (R).

Program Number: 1666 Poster Board Number: A0097
Presentation Time: 11:00 AM–12:45 PM

Evaluation of foveal avascular zone in diabetic patients with or without macular edema by swept source optical coherence tomography angiography

Don-II Ham, Sung Min Kim, Mingui Kong, Samsung Medical Center, Ophthal, Sungkyunkwan Univ Sch of Med, Seoul, Korea (the Republic of).

Purpose: To reveal the meaningful change in superficial and deep foveal avascular zone (FAZ) of diabetic patients by using optical coherence tomography angiography (OCTA).

Methods: This is a retrospective, cross-sectional study which included 75 eyes of 62 patients who had undergone OCTA of macular area. Patients were divided into three groups for analysis; diabetic patients with central macular edema (DME+), diabetic patients without central macular edema (DME-), and normal control group. Swept source OCTA within 3 x 3 mm zone of macula was performed for all patients. By using commercially available ImageJ software, superficial and deep FAZ area was measured.

Results: Mean superficial FAZ (sFAZ) area among three groups showed no significant differences (p=0.136). However, mean deep FAZ (dFAZ) area among three groups showed significant differences.

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(p=0.000) and it was the largest in DME+ group (0.764 ± 0.293mm²) and the smallest in normal controls (0.444 ± 0.145mm²).

**Conclusions:** Compared to normal controls, dFAZ enlargement was significant in diabetic patients and it was more prominent in DME+ group. On the other hand, sFAZ showed no statistical significance in their size differences among three groups. In evaluation of diabetic retinopathy, enlargement of dFAZ might be more important than the change in sFAZ.

**Commercial Relationships:** Don-Il Ham, None; Sung Min Kim, None; Mingui Kong, None

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

**Swept-Source OCT-Angiography of the Anomalous Foveal Avascular Zone**

**Collier Jiang**, **Netan Choudhry** 1, 2, 1Faculty of Medicine, University of Toronto, Toronto, ON, Canada; 2Herzig Eye Institute, Toronto, ON, Canada; 3Department of Ophthalmology & Vision Sciences, University of Toronto, Toronto, ON, Canada.

**Purpose:** To analyze anomalous appearing (vascularized) foveal avascular zones (FAZ) using swept-source OCT-angiography (SS-OCTA) and compare these findings to the contour of the corresponding foveal pit using swept-source OCT (SS-OCT).

**Methods:** 14 eyes with anomalous FAZs from 10 patients were identified using SS-OCTA (Topcon Triton; Tokyo Japan). Patient demographic, visual acuity and ophthalmological diagnoses were obtained from medical records. SS-OCT imaging was used to characterize the foveal contour and identify the presence of fovea plana. Each of the vascular layers in the retina (superficial capillary plexus (SCP), deep capillary plexus (DCP) and choriocapillaris) were evaluated for both affected and unaffected eyes using the 3.0mm x 3.0mm strategy. Depth-decoded images were examined to identify anastomosis between the SCP and DCP in all eyes.

**Results:** 6 out of 10 patients had an anomalous FAZ findings in only 1 eye, while the remaining 4 patients had bilaterally anomalous FAZ presentations. The FAZ was absent in all 14 eyes at the level of the SCP. 5 eyes demonstrated complete vascularization of the FAZ at the DCP in addition to the SCP. The choriocapillaris was normal in all eyes. 50%(7) of eyes with a vascularized FAZ demonstrated a fovea plana configuration on SS-OCT, while 50%(7) had a normally developed pit. 4 of 10 patients had anomalous FAZ presentations bilaterally, and 2 patients with single eye involvement had a partial FAZ in their uninvolved eye. Mean ETDRS BCVA was 0.20 ± 0.14 logMAR units for anomalous FAZ eyes, and 0.20 ± 0.15 logMAR units for uninvolved eyes for patients with single eye involvement.

**Conclusions:** The FAZ is a key anatomical landmark which can be imaged successfully using SS-OCT-angiography. Vascularization of the FAZ is uncommon and can be found in eyes with a fovea plana configuration and is not necessarily associated with worse vision. The SCP and DCP can both be involved in an anomalous vascularized FAZ configuration.

(A) Color fundus photographs and (B) Swept-source OCT images of the right and left eyes respectively. Inset of (B) demonstrates the absence of a defined foveal pit.
Swept-source OCT angiogram of the (A) superficial capillary plexus, (B) deep capillary plexus, and (C) choriocapillaris of the right and left eyes respectively. (A) and (B) demonstrate anomalous foveal vascularization and the absence of a foveal avascular zone.

**Commercial Relationships:** Collier Jiang, None; Netan Choudhry, Topcon (C)

**Program Number:** 1669 **Poster Board Number:** A0100
**Presentation Time:** 11:00 AM – 12:45 PM
**Repeatability of FAZ Area and Vessel Density Analysis with Projection Artifacts Removal on Optical Coherence Tomography Angiography (OCT-A) in Normal, Glaucoma and Retina Eyes**

Yulia Wolfson, Yi-Sing Hsiao, Jing Tian, Kelly A. Soules, Ben K. Jang, Qienyuan Zhou. Optovue, Inc., Fremont, CA.

**Purpose:** To evaluate repeatability of the automated macular superficial plexus vessel density (SPVD), deep plexus vessel density (DPVD), parafoveal 300 µm ring vessel density (FD-300) and foveal avascular zone (FAZ) area parameters of OCT-A scans with AngioAnalytics software for AngioVue® (Optovue, Inc., Fremont, CA), and to estimate the effect of projection artifacts removal (PAR) on DPVD in 3 study groups.

**Methods:** Up to 3 consecutive fovea-centered 3X3 mm (304X304 A-scans) OCT-A scans per eye were acquired from 15 normal (N), 16 glaucoma (G), and 13 retina (R) subjects (one eye per subject) through IRB-approved protocol. Automatically generated vessel density parameters before and after PAR (Fig. 1) were exported and analyzed for distribution and repeatability.

**Results:** Total of 42, 40 and 24 qualified scans were analyzed for N, G and R groups, following exclusion of scans with motion or segmentation artifacts.

Whole image (WI) vessel density (VD), foveal 1 mm diameter zone (FZ) VD, FD-300 and FAZ area were evaluated for distribution and repeatability, including superficial plexus vessel density (SPVD) and deep plexus vessel density (DPVD) with and without PAR for WI and FZ areas (Fig. 1) – Table 1 summarizes the results.

SPVD was significantly higher than DPVD with PAR in N and R groups (p=0.0002 and 0.0007 correspondingly), while no significant difference was detected in G group (p=0.64). In all groups WI DPVD with PAR was significantly lower than without PAR (p<0.0001 for all groups). For FZ no significant difference was found for DPVD with and without PAR in N and G groups (p=0.25 and 0.1 correspondingly), while in R group the DPVD with PAR compared to without PAR was significant (p=0.0087).

**Conclusions:** AngioAnalytics OCT-A software provides repeatable readings of FAZ area and vessel density parameters. Application of PAR noticeably affects DPVD in N, G and R eyes, resulting in significantly lower DPVD values than without PAR, implicating the necessity of PAR for deep vasculature plexus evaluation.

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**Fig. 1** Enface deep plexus OCT-A (upper), OCT b-scan (middle) with overlaid OCT-A flow signal in red and vessels density image (lower) of the same scan without (left) and with PAR (right).

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EVALUATION OF THE FOVEAL AVASCULAR ZONE IN CHILDREN WITH TYPE 1 DIABETES USING OPTICAL COHERENCE TOMOGRAPHY WITH ANGIOGRAPHY (OCTA)

Kim Duong1, 2, Manan Shah, Radhika Ragam, Bernard Szirth. 1SUNY College of Optometry, Springfield, VA; 2Rutgers New Jersey Medical School, New Brunswick, NJ.

Purpose: Previous studies have shown changes in the foveal avascular zone (FAZ) using optical coherence tomography with angiography (OCTA) in adults with Type 2 diabetes mellitus (DM). We evaluated the FAZ area using OCTA in children with Type 1 DM in this retrospective clinical study as a screening and recommendation follow-up tool for children with DM.

Methods: Data including visual acuity, automated blood pressure, optical coherence tomography (OCT), OCTA, and color and autofluorescence digital retinal images were collected from children with Type 1 DM. Subjects were grouped based on age, gender, duration of diabetes and HbA1c level. The AngioVue OCTA system (Optovue, Inc., Fremont, CA, USA) was used to measure the FAZ area. Two-sample t-tests were calculated to determine the difference in FAZ area among patients of different ages, gender, and duration of diabetes.

Results: This study included 101 children with Type 1 DM with an average HbA1c of 7.62 ± 1.24, average duration of diabetes of 6.15 ± 3.86 years (range 1.0-17.0 years), mean systolic blood pressure of 107 ± 14.68, mean diastolic blood pressure of 66.81 ± 9.18, and an average FAZ area of 0.25mm² ± 0.11 mm². No significant difference in FAZ area was found among the different age groups, duration of diabetes, or HbA1c level (p>0.05). Males (0.22 mm²) were found to have a smaller FAZ area than females (0.27 mm²) (p = 0.02).

Conclusions: The current recommendations for diabetic screenings are 5 years after diagnosis of Type 1 DM or at the start of age 10. Our study proposes a baseline screening at the time of diagnosis using imaging technologies including OCTA, color and autofluorescence retinal images, along with visual acuity and blood pressure. The FAZ may demonstrate early changes associated with macular edema. While our data does not support a significant correlation between FAZ area and age, duration of diabetes and level of HbA1c, OCTA may still be a beneficial screening tool that will allow clinicians to track longitudinal changes in the FAZ area if screened at time of diagnosis. The significant difference in FAZ area between genders needs to be further investigated especially in longer duration subjects with Type 1 DM.

Commercial Relationships: Kim Duong, None; Manan Shah, None; Radhika Ragam, None; Bernard Szirth, None

Program Number: 1671 Poster Board Number: A0102
Presentation Time: 11:00 AM–12:45 PM

DIFFERENCE OF FOVEAL AVASCULAR ZONE OF NORMAL EYE IN THREE DIFFERENT OCT ANGIOGRAPHY MACHINES


Purpose: To compare foveal avascular zone (FAZ) measurements of different three commercially available optical coherence tomography-angiography (OCT-A) machines.

Methods: In a cross-sectional prospective non-interventional study of 27 healthy volunteers, fovea-centered 3×3mm OCT-A scans obtained by three machines: DRI-OCT Triton; TOPCON (Triton), RS3000 Advance; NIDEK (RS3000) and CIRRUS HD-OCT model 5000; ZEISS (CIRRUS). FAZ in the superficial and deep plexus layers...
were measured by two masked graders. The interrater, interlayer, and intermachine agreements were assessed. **Results:** In each machine, intrarater correlation coefficient was higher than 0.964 (P<0.001). Interrater correlation was also higher than 0.987 (P<0.001). For superficial FAZ, intermachine correlation coefficient (95% confidence interval) was 0.920 (0.803-0.965) for Triton versus RS3000, 0.899 (0.575-0.965) for RS3000 versus CIRRUS and 0.963 (0.913-0.983) for CIRRUS versus Triton (P<0.001). For deep FAZ, intermachine correlation coefficient was 0.813 (0.633-0.910) for Triton versus RS3000, 0.694 (0.369-0.857) for RS3000 versus CIRRUS and 0.679 (0.153-0.872) for CIRRUS versus Triton (P<0.001). The average of superficial FAZ was 0.264 ± 0.071 mm² with Triton, 0.278 ± 0.072 mm² with RS3000 and 0.257 ± 0.066 mm² with CIRRUS. There was a significant difference between any of two of three machines. Brand-Altman analysis revealed the existence of systemic error between machines. In deep FAZ, the average FAZ was 0.617 ± 0.175 mm² with Triton, 0.646 ± 0.178 mm² with RS3000 and 0.719 ± 0.175 mm² with CIRRUS. There was a significant difference between RS3000 versus CIRRUS or CIRRUS versus Triton. **Conclusions:** FAZ measured with three commercially available OCT-A machines showed excellent reproducibility and repeatability in healthy eyes, indicating that they are clinically interchangeable to a certain extent. However, the absolute value of FAZ was significantly different between machines. This information should be remembered in research or mass screening using FAZ. **Commercial Relationships:** Alessandro Arrigo, Carlo La Spina, None; Adriano Carnevali, None; alessandro marchese, None; Riccardo Sacconi, None; Alessandro Rabiolo, None; Lea Querques, None; Maria Vittoria Cicinelli, None; Giuseppe Querques, Zeiss (C), Bayer Shering-Pharma (C), Heidelberg (C), Allergan Inc (C), Alimera Sciences (C), Novartis (C); Francesco Bandello, Hoffmann-La Roche (C), C, Alimera Sciences (C), Sanofi-Aventis (C), Allergan Inc (C), Genentech (C), Thrombogenetics (C), Bayer Shering-Pharma (C), Zeiss (C), Novartis (C), NovagaliPharma (C), Bausch and Lomb (C), Farmila-Thea (C), Alcon (C) **Program Number:** 1673 **Poster Board Number:** A0104 **Presentation Time:** 11:00 AM–12:45 PM Optical coherence tomography angiography analysis of the avascular foveal zone in diabetic retinopathy Yu-Qiang Soh, Daniel Ting, Tien Wong, Ian Yeo, Gemmy C. Cheung, Gavin S. Tan. Singapore National Eye Centre, Singapore, Singapore. **Purpose:** Fundus fluorescein angiography (FFA) is currently the gold standard for the diagnosis of macular ischemia, a known complication of diabetic retinopathy (DR). Optical coherence tomography angiography (OCT-A) is a novel and non-invasive method for imaging of the retinal and choroidal vasculature. In contrast to FFA, OCT-A is able to differentiate between the retinal superficial vascular plexus (SVP) and deep vascular plexus (DVP). The purpose of this study is to evaluate the characteristics of foveal avascular zones (FAZ) captured by OCT-A, with reference to FFA, in patients with DR. **Methods:** This is a prospective study involving 22 eyes (11 patients, 8 male) with varying DR severities (5 eyes had no DR; 6 had mild non-proliferative DR (NPDR); 6 had moderate NPDR; 2 had severe NPDR and 3 with proliferative DR). All eyes were imaged using OCT-A (Swept-Source Optical Coherence Tomography Angio™, Topcon Corp, Japan) and FFA (Spectralis® Scanning Laser Angiography, Heidelberg Engineering, Germany) to characterize their FAZ. We compared the FAZ area, maximum horizontal and vertical dimensions, for both superficial vascular plexus (SVP) and deep vascular plexus (DVP), between OCT-A and FFA. **Results:** The mean age and HbA1C was 59.9 ± 11.6 years and 8.01 ± 6.5% respectively. For OCT-A, measurements of FAZ area, horizontal and vertical dimensions were 0.335 ± 0.074 mm², 0.656 ± 0.112 mm² and 0.662 ± 0.087 mm² at the SVP, and 0.277 ± 0.104 mm², 0.605 ± 0.137 mm² and 0.572 ± 0.142 mm² at the DVP, respectively. The corresponding values obtained via FFA were 0.271 ± 0.135 mm², 0.374 ± 0.140 mm² and 0.561 ± 0.154 mm² respectively. On OCTA, FAZ area was significantly larger in the SVP compared to DVP (p = 0.015). Comparing OCT-A to FFA, there were no statistically significantly different differences in FAZ measurements comparing the SVP and FFA, mean area (p = 0.073), horizontal diameter (p = 0.1), vertical diameter (p = 0.551); or comparing DVP with FFA, mean area (p = 0.714), horizontal diameter (p = 0.956) and vertical diameter (p = 0.665). These abstracts are licensed under a Creative Commons Attribution-NonCommercial-No Derivatives 4.0 International License. Go to [http://iovs.arvojournals.org/](http://iovs.arvojournals.org/) to access the versions of record.
Conclusions: OCT-A is comparable to FFA in regard to its ability to accurately characterize the FAZ. Further studies with larger sample sizes are required to confirm our findings.

Commercial Relationships: Yu-Qiang Soh, None; Daniel Ting, None; Tien Wong, None; Ian Yeo, None; Gemmy C. Cheung, None; Gavin S. Tan, None

Program Number: 1674 Poster Board Number: A0105
Presentation Time: 11:00 AM–12:45 PM

Fractal dimension analysis of parafoveal microvascular anatomy using optical coherence tomography angiography in two machines
Kareem Sioufi1, Abtin Shahlaee2, Emil Anthony T. Say1, Sandor Ferenczy1, Jason Hsu1, Carol L. Shields1. 1Oncology Service, Wills Eye Hospital, Philadelphia, PA; 2Retina Service, Wills Eye Hospital, Philadelphia, PA.

Purpose: To evaluate parafoveal microvascular anatomy using fractal dimension (FD) analysis in normal healthy volunteers using two optical coherence tomography angiography (OCTA) machines. FD is a geometrical index of complexity in self-similar structures, which can be applied to the complexity of retinal vascular microanatomy scanned on OCTA.

Methods: Parafoveal 3mm x 3mm OCTA scans were performed in 50 eyes of 25 healthy volunteers using two commercially available machines, Optovue RTVue XR Avanti (OA) (Optovue, Fremont CA, USA) and Zeiss Cirrus HD-OCT 5000 (ZC) (Carl Zeiss Meditec, Inc., Dublin CA, USA). Superficial and deep plexuses were identified by automated segmentation, and skeletonized images of OA and ZC were obtained using ImageJ (National Institutes of Health, Bethesda MD, USA) (Figure 1) and employing identical skeletonization technique for scans from both OA and ZC. FD analysis for all images was achieved on ImageJ using FracLac plugin. Eyes of same patient were analyzed in paired fashion using student t-test, and interclass correlation coefficient (ICC) was calculated between machines. Statistical analyses were performed with SPSS, Version 23 (SPSS, Inc, Chicago, Illinois, USA).

Results: Mean subject age was 33 years and there were 14 (56%) females. By OCT, mean central macular thickness was significantly greater on OA vs. ZC (259 vs. 257 m, p=0.023). By OCTA, both the superficial and deep plexus FD values were significantly different (OA vs. ZC) (1.816±0.0022 vs. 1.800±0.0044 for superficial, p<0.0001) (1.815±0.0034 vs. 1.791±0.0054 for deep, p<0.0001), respectively. Poor correlation between machines was evident in both superficial (ICC=0.083) and deep (ICC=0.072) plexuses. Table 1.

Conclusions: FD analysis of OCTA scans is a novel method for assessment of retinal microvascular anatomy. Eyes imaged on two commercial OCT angiography platforms showed significant differences using FD method which could be related to the concentration of pixels per image and the number of B-scans per machine.

Figure 1. Optical coherence tomography angiography (OCTA) in healthy eyes using two machines; (A) A montage of four OCTA images of the superficial plexus scanned on Optovue RTVue XR Avanti (OA) (Optovue, Fremont, CA, USA) or Zeiss Cirrus HD-OCT 5000 (ZC) (Carl Zeiss Meditec, Inc., Dublin CA, USA) in eyes (B) A skeletonized OCTA image. The deep plexus scanned on OA and ZC were treated in a similar manner (E, F) and (G, H), respectively. We noted (E-H) significantly higher fractal dimensions of the retinal capillary networks scanned with OA compared to ZC.

Table 1. Fractal dimension analysis of parafoveal microvascular anatomy using two optical coherence tomography angiography machines. Outcomes.

<table>
<thead>
<tr>
<th>Features</th>
<th>Optovue Avanti</th>
<th>Zeiss Cirrus</th>
<th>ICC between machines</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial plexus</td>
<td>1.816±0.0022</td>
<td>1.800±0.0044</td>
<td>0.003</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Deep plexus</td>
<td>1.815±0.0034</td>
<td>1.791±0.0054</td>
<td>0.072</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

*paired student’s t-test, inter-class correlation coefficient (ICC)

Commercial Relationships: Kareem Sioufi, Abtin Shahlaee, Emil Anthony T. Say, Sandor Ferenczy, Jason Hsu, Carol L. Shields

Program Number: 1675 Poster Board Number: A0106
Presentation Time: 11:00 AM–12:45 PM

Refinement of fractal analysis methodology of swept-source optical coherence tomography angiography images of normal eyes
Nitish Mehta1, Sarwar Zahid2, Bing Q. Chiu1, Suruchi Bhardwaj1, Edmund Tsui1, Emma Young1, Joshua A. Young2, Jesse J. Jung2.
1Ophthalmology, New York University, New York, NY; 2East Bay Retina Consultants, Inc, Oakland, CA.

Purpose: We aimed to study the effect of image quality and other parameters on fractal dimension (FD) analysis to characterize the retinal vascular branching pattern in normal eyes using swept-source optical coherence tomography angiography (OCTA).

Methods: Macular scans of 3x3, 6x6, 9x9, and 12x12mm sizes of 29 normal eyes were obtained with the investigational Zeiss Plex Elite 9000 (Carl Zeiss Meditec, Inc., Dublin, CA, USA) (Figure 1). The central 3x3mm portions of all images were cropped out for subgroup analysis to account for proportionally different inclusion of the foveal avascular zone (Figure 2). Subgroup analysis was performed using various image resolutions and with various incorporation of vascular elements. Grayscale OCTA images were standardized and binarized using ImageJ (National Institutes of Health, Bethesda, Maryland, USA). Fractal box-counting analyses were performed using Fractalyse (ThéMA, Besançon Cedex, France) and Fraclac ((National Institutes of Health, Bethesda, Maryland, USA). Statistical analysis was achieved with two-tailed Student’s T-test and one-way analysis of variance (ANOVA).

Results: Fractal dimension (FD) and correlation coefficient (CC) were significantly different (p<0.05) between superficial and deep plexuses in all image sizes and types and between the different image sizes for both superficial and deep plexuses. There was a significant difference (p<0.05) between both FD and CC between the original 3x3mm images and the same 3x3mm region of the modified larger images in the subgroup analysis.
Conclusions: Different FD values between image sizes suggest an effect of inclusion of different anatomy. Cropped images remain statistically different suggesting image quality and size also impact analyses. Further studies may determine the optimal image size/quality to develop FD analysis as an OCTA-derived quantitative tool for assessing retinal vascular structure.

Commercial Relationships: Nitish Mehta, None; Sarwar Zahid, None; Bing Q. Chiu, None; Suruchi Bhardwaj, None; Edmund Tsui, None; Emma Young, None; Joshua A. Young, None; Jesse J. Jung, None

Program Number: 1676 Poster Board Number: A0107
Presentation Time: 11:00 AM–12:45 PM

Quantitative OCT-Angiography in Optic Disc Pit
Netan Choudhry1, Bryen Turco1, John Golding1. 1Herzig Eye Institute, Toronto, ON, Canada; 1Ophthalmology & Vision Sciences, University of Toronto, Toronto, ON, Canada.

Purpose: The purpose of this study was to studies to assess the characteristics of retinal vasculature in the region of the optic disc using spectral-domain optical coherence tomography angiography (SD-OCTA) in eyes with congenital optic disc pit(s).

Methods: Six patients (twelve eyes) with unilateral congenital optic disc pit were imaged using spectral-domain OCT-angiography (Optovue Angiovue, Fremont, CA). The installed software applied split-spectrum amplitude-decorrelation angiography (SSADA) algorithms to convert OCT-angiography data to quantitative capillary perfusion density (CPD) values and qualitative vascular perfusion maps. Normal and optic disc pit CPDs were compared at the superficial & deep capillary plexus as well as the choriocapillaris within the confines of various scan regions.

Results: Affected eyes of all patients with unilateral ODP had reduced CPD values localized to the pit region at the radial peripapillary layer relative to normal contralateral eyes. Reduced CPD values were also noted at the nerve head layer. Vascular perfusion maps demonstrated the abnormal flow signals corresponding to the CPD values specific to each microvascular layer analyzed.

Conclusions: The retinal capillary density in the radial peripapillary region is reduced in eyes with optic disc pit(s). OCT-angiography is a useful tool for analyzing the abnormal retinal vascular changes in optic disc pit. The abnormal vasculature in ODP may contribute to some of the vision loss observed in this condition.
Optical Coherence Tomography Angiography in Glaucoma

Jeffrey Ma, Peter L. Nesper, Anupama Anchala, Amani A. Fawzi. Ophthalmology, Northwestern University, Chicago, IL.

Purpose: There is increasing evidence that vascular changes and insufficient blood flow to the optic nerve contribute to the pathogenesis of glaucoma. Optical coherence tomography angiography (OCTA) is a novel noninvasive imaging modality that can assess microvascular structure and function. Previous OCTA studies have demonstrated decreased peripapillary vascular flow and vessel density in glaucomatous eyes compared with control eyes. In this study, we used OCTA to evaluate macular changes in vessel density and inner retinal thickness in glaucomatous eyes.

Methods: We acquired 3 x 3 mm macular OCTA scans (RTVue XR Avanti, Optovue Inc., Fremont, CA) of patients with primary open angle glaucoma (POAG), normal tension glaucoma (NTG), glaucoma suspect, or normal eyes. Parafoveal vessel density and inner retinal thickness (internal limiting membrane to inner plexiform layer) were measured.

Results: We found a significant decrease in mean parafoveal vessel density in both POAG eyes (48.4±1.0%, N=18 eyes, P<0.05) and NTG eyes (45.6±1.1%, N=6 eyes, P<0.001) compared with normal eyes (51.3±0.6%, N=22 eyes). In eyes of glaucoma suspect patients, there was notably a greater parafoveal vessel density (51.3±0.6%, N=22 eyes, P<0.05) and NTG eyes (97.3±2.5%, P<0.0001) but not glaucoma suspect eyes (120.6±2.5% P=0.20) compared with normal eyes (116.1±1.7%). Mean ages of the subject groups were 65.9 years for POAG, 69.0 years for NTG, 40.3 years for glaucoma suspects, and 64.9 years for normal controls.

Commercial Relationships: Chieh-Li Chen, None; Priscilla Nobrega, None; Joanne C. Wen, None; Raghu C. Mudumbai, None; Shivali Menda, None; Murray A. Johnstone, None; Philip P. Chen, None; Ruikang K. Wang, Carl Zeiss Meditec (R), Carl Zeiss Meditec (C), Carl Zeiss Meditec (P), Carl Zeiss Meditec (F)

Support: NEI R01EY024158, Carl Zeiss Meditec Inc., Research to Prevent Blindness

Program Number: 1678 Poster Board Number: A0109
Presentation Time: 11:00 AM–12:45 PM

Optical Coherence Tomography Angiography in Glaucoma

Jeffrey Ma, Peter L. Nesper, Anupama Anchala, Amani A. Fawzi. Ophthalmology, Northwestern University, Chicago, IL.

Purpose: There is increasing evidence that vascular changes and insufficient blood flow to the optic nerve contribute to the pathogenesis of glaucoma. Optical coherence tomography angiography (OCTA) is a novel noninvasive imaging modality that can assess microvascular structure and function. Previous OCTA studies have demonstrated decreased peripapillary vascular flow and vessel density in glaucomatous eyes compared with control eyes. In this study, we used OCTA to evaluate macular changes in vessel density and inner retinal thickness in glaucomatous eyes.

Methods: We acquired 3 x 3 mm macular OCTA scans (RTVue XR Avanti, Optovue Inc., Fremont, CA) of patients with primary open angle glaucoma (POAG), normal tension glaucoma (NTG), glaucoma suspect, or normal eyes. Parafoveal vessel density and inner retinal thickness (internal limiting membrane to inner plexiform layer) were measured.

Results: We found a significant decrease in mean parafoveal vessel density in both POAG eyes (48.4±1.0%, N=18 eyes, P<0.05) and NTG eyes (45.6±1.1%, N=6 eyes, P<0.001) compared with normal eyes (51.3±0.6%, N=22 eyes). In eyes of glaucoma suspect patients, there was notably a greater parafoveal vessel density (51.3±0.6%, N=22 eyes, P<0.05) compared with normal eyes. We also found a significant decrease in inner retinal thickness in POAG eyes (105.3±2.5µm, P<0.005) and NTG eyes (97.3±4.5µm, P<0.0001) but not glaucoma suspect eyes (120.6±2.5µm P=0.20) compared with normal eyes (116.1±1.7µm). Mean ages of the subject groups were 65.9 years for POAG, 69.0 years for NTG, 40.3 years for glaucoma suspects, and 64.9 years for normal controls.

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**Coauthors:** Minhaj Nur Alam, None; Peter L. Nesper, None; Anupama Anchala, None; Amani A. Fawzi, None

**Program Number:** A0110

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

**Automatic classification of sickle cell retinopathy using quantitative features in optical coherence tomography angiography**

Minhaj Nur Alam\(^1\), Damber Thapa\(^1\), Jennifer I. Lim\(^2\), Dingcai Cao\(^2\), Xincheng Yao\(^1,2\).

\(^1\)Department of Bioengineering, University of Illinois at Chicago, Chicago, IL; \(^2\)Department of Ophthalmology and Visual Science, University of Illinois at Chicago, Chicago, IL.

**Purpose:** Automatic detection and quantitative classification are desirable for effective diagnosis of sickle cell retinopathy (SCR). This study is to explore automatic detection and classification of SCR by characterizing features in optical coherence tomography angiography (OCTA) images.

**Methods:** OCTA images of 35 sickle cell disease (SCD) patients (12 males and 23 females; 35 African Americans) and 14 control subjects (11 males, 3 female, 5 African Americans) were used. The mean age was 40 years (range 24 to 64) for the patients and 37 years (range 25 to 71) for the controls. OCTA images of both eyes were analyzed, so the database consisted of 70 SCD and 28 control eyes. Seven feature vectors, including blood vessel density, vascular tortuosity, diameter, vessel perimeter index, foveal avascular zone (FAZ) area, contour irregularity of FAZ, and parafoveal avascular density were calculated from the OCTA images. Three classifiers, i.e., support vector machine, k-nearest neighbor algorithm and discriminant analysis, were used to classify the OCTA images. For SCR vs. control classification, the algorithms used a random 50% of OCTA images as a training set and the rest (50%) of the images as test set in each simulation. For interstage classification (mild vs. severe) among SCR patients, 95% of the data were used randomly to train the classifier to predict the rest of the 5% data correctly. Sensitivity, specificity, and accuracy were calculated to examine the performance of the algorithms.

**Results:** For SCR vs. control case, all three classifiers perform well with an average accuracy of 98% using the optimized feature vectors. For inter-stage classification, support vector machine shows better performance compared to the other classifiers. Table 1 shows the performance of each classifier in terms of sensitivity, specificity, and accuracy. Among all 3 classifiers, support vector machine shows the best performance with 100% sensitivity, 100% specificity and 100% accuracy for SCR vs. control classification and 97% sensitivity, 98% specificity and 97% accuracy for inter-stage classification.

**Conclusions:** The automated classification algorithm with quantitative feature vectors can successfully predict SCR and identify the stage by analyzing OCTA images. This shows the effectiveness of the feature vectors calculated from OCTA images for automatic classification of SCR.

**Commercial Relationships:** Jeffrey Ma, None; Peter L. Nesper, None; Anupama Anchala, None; Amani A. Fawzi, None

**Program Number:** A0111

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

**Spectral-Domain Optical Coherence Tomography and Optical Coherence Tomography Angiography in Sickle Cell Retinopathy**

Laura Dell’Arbi\(^1\), Lorenzo Riva\(^1\), Alessandro Invernizzi\(^1\), Andrea Aretti\(^1\), Giulio Barteselli\(^1\), Eleonora Benatti\(^1\), Claudia Mainetti\(^1\), Elena Tabacchi\(^1\), Francesco Viola\(^1\), Laura Dell’Arbi\(^1\), Lorenzo Riva\(^1\), Alessandro Invernizzi\(^1\), Andrea Aretti\(^1\), Giulio Barteselli\(^1\), Eleonora Benatti\(^1\), Claudia Mainetti\(^1\), Elena Tabacchi\(^1\), Francesco Viola\(^1\).

\(^1\)Università degli Studi di Milano, Milan, Italy; \(^2\)Eye Clinic, Luigi Sacco Hospital, Milan, Italy; \(^3\)Genentech, Inc, San Francisco, CA.

**Purpose:** To determine and quantify central and temporal retinal and choroidal vascular abnormalities using spectral domain optical coherence tomography (SD-OCT) and optical coherence tomography angiography (OCTA) in patients with sickle cell disease (SCD).

**Methods:** Forty-six eyes of 23 consecutive patients with electrophoretic confirmation of SCD were analyzed. Centrally and temporally centered SD-OCT (Spectralis, Heidelberg Engineering) and OCTA (Avanti RTVue XR; Optovue Inc) were performed. An age and sex-matched control group of healthy patients was also recruited. SD-OCT scanning protocol included 31 B-scans, spaced 240 microns apart and covering a 30° x 25° area. SCD eyes were divided into 2 groups based on the presence of visible macular thinning areas, defined as thinning associated with loss of definition of inner retinal layers on OCT scans and identified as blue patchy areas on retinal thickness color-coded map.

**Results:** Nineteen out of 46 eyes (41.3%) were noted to have patchy areas of macular thinning on SD-OCT. In comparison to healthy controls, OCTA in SCD subjects showed foveal avascular zone enlargement in both the superficial (SCP) and the deep (DCP) capillary plexus (p<0.0001, p=0.0171).

In SCD eyes, vessel density was significantly lower in the DCP (p<0.0001), both in central and temporal scans. Central SCP and DCP flow area (p=0.0012, p=0.0003) and temporal DCP flow area were reduced (p<0.0255) in SCD patients. In comparison to controls, the flow area in non-patchy eyes was diminished both in SCP and DCP but only in the central scans (p=0.0003, p=0.0004), while the flow area in patchy eyes was reduced only in the DCP both centrally and temporally (p=0.0022, p=0.0073). Choriocapillaris abnormalities were significant in both areas in SCD subjects (p<0.0001, p=0.0129).

**Conclusions:** In our study, SCD microangiopathy involved both SCP, DCP and choriocapillaris. In comparison to controls, patchy eyes showed deep vascular abnormalities involving both central and temporal macula. Considering that perfusion defects in non-patchy eyes were limited to the central macula, deep temporal retinal hypoperfusion could cause patchy areas of macular thickening that are frequently observed temporal to the fovea in SCD eyes. Possible

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**Support:**

**Commercial Relationships:**

**Program Number:** A0112

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

**Spectral-Domain Optical Coherence Tomography and Optical Coherence Tomography Angiography in Sickle Cell Retinopathy**

Laura Dell’Arbi\(^1\), Lorenzo Riva\(^1\), Alessandro Invernizzi\(^1\), Andrea Aretti\(^1\), Giulio Barteselli\(^1\), Eleonora Benatti\(^1\), Claudia Mainetti\(^1\), Elena Tabacchi\(^1\), Francesco Viola\(^1\).

\(^1\)Università degli Studi di Milano, Milan, Italy; \(^2\)Eye Clinic, Luigi Sacco Hospital, Milan, Italy; \(^3\)Genentech, Inc, San Francisco, CA.

**Purpose:** To determine and quantify central and temporal retinal and choroidal vascular abnormalities using spectral domain optical coherence tomography (SD-OCT) and optical coherence tomography angiography (OCTA) in patients with sickle cell disease (SCD).

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**Conclusions:** In our study, SCD microangiopathy involved both SCP, DCP and choriocapillaris. In comparison to controls, patchy eyes showed deep vascular abnormalities involving both central and temporal macula. Considering that perfusion defects in non-patchy eyes were limited to the central macula, deep temporal retinal hypoperfusion could cause patchy areas of macular thickening that are frequently observed temporal to the fovea in SCD eyes. Possible
further studies could correlate SD-OCT retinal segmentation with OCTA findings.

**Commercial Relationships:** Laura Dell’Arti, None; Lorenzo Riva, None; Alessandro Invernizzi, None; Andrea Aretti, None; Giulio Barteselli, Genentech (E); Eleonora Benatti, None; Claudia Mainetti, None; Elena Tabacchi, None; Francesco Viola, Bayer (C), Novartis (C)

**Program Number:** 1681 Poster Board Number: A0112
**Presentation Time:** 11:00 AM–12:45 PM
**Analysis of the foveal microvasculature in sickle cell disease using optical coherence tomography angiography**
azzeddine Mokrane, Franck Fajnkuchen, Lise Qu Knafo, Audrey Giocanti. Ophthalmology department, Avicenne Hospital, Bobigny, France.

**Purpose:** Ischemic microangiopathy is well known in sickle cell disease (SCD) using fluorescein angiography. We performed a prospective observational clinical study, to assess the size of foveal avascular zone (FAZ) and explore the perifovea microvasculature changes in the superficial (SCP) and deep capillary plexi (DCP), using optical coherence tomography angiography (OCT-A).

**Methods:** We included in a prospective study all consecutive patients with electrophoretic confirmation of SCD. OCTA swept source scans (Triton Plus, Topcon, Tokyo, Japan) with a scanning area of 3 x 3 mm, and an ultra wide field (UWF) retinography (California, Optos, Fife, Scotland) were recorded for all patients. For OCTA analysis, preset parameters were used to segment the SCP and DCP. The size of the FAZ in SCP and DCP was manually measured by 2 independent examiners. The number of vascular branching points was automatically assessed based on the vascular skeletonization with Image J software. Eyes were staged based on the Goldberg classification of SCD retinopathy using ultra-wide field imaging (UWF). Our primary endpoint was to compare the FAZ size in SCD patients (HbSS and HbSC) to control. Our secondary endpoints were the number of branching points, the central retinal thickness (CRT), and the Goldberg classification compared between all groups.

**Results:** 46 eyes of 24 consecutive patients were included in HbSS genotype group (n=27), in HbSC genotype group (n=19) and 15 eyes of 8 healthy subjects in a control group. The FAZ measured in the DCP was significantly larger in both HbSC (p = 0.0001) and HbSS (p = 0.0004) group compared to control. There was no significant difference for FAZ size in the SCP, for CRT, and for number of superficial vascular branching points between both genotypes. There was less branching points in HbSc (p=0.034) and HbSS (p=0.0014) than in the control group. The Goldberg stage was significantly higher in the HbSC than in the HbSS group (2.21 vs 1.22, p = 0.0062), and no other significant difference was found between SCD groups.

**Conclusions:** OCTA provides useful information about macular microvasculature and structural alterations associated in SCD retinopathy. Ischemic abnormalities seem to be more predominant in the DCP in case of SCD retinopathy.

**Commercial Relationships:** azzeddine Mokrane, None; Franck Fajnkuchen, None; Lise Qu Knafo, None; Audrey Giocanti, None

**Program Number:** 1682 Poster Board Number: A0113
**Presentation Time:** 11:00 AM–12:45 PM
**Assessment of Macular Perfusion in Multiple Evanescent White Dot Syndrome Using Optical Coherence Tomography Angiography**
Abtin Shahlaee, Jayanth Sridhar, Nika Bagheri, Wasim Samara, James P Dunn, Sonia Mehta, Retina Service, Wills Eye Hospital, Philadelphia, PA; Retina, Bascom Palmer Eye Institute, Miami, FL.

**Purpose:** Optical coherence tomography angiography (OCT-A) enables non-invasive depth-resolved evaluation of macular perfusion. This study aims to assess macular blood flow across various retinal and choroidal layers in the setting of multiple evanescent white dot syndrome (MEWDS).

**Methods:** Consecutive case series with comparison of affected eyes to fellow eyes using OCT-A (RTVue-XR Avanti, Optovue) measured macular vascular density.

**Results:** Five eyes with MEWDS and 5 fellow eyes were examined. The mean overall macular vascular density was lower in eyes with MEWDS compared to fellow eyes in both the deep capillary plexus (58.9% versus 61.5%, respectively; P = 0.042) and choriocapillaris (66.5% versus 68.3%, respectively; P = 0.043). The mean overall vascular density was similar in the superficial capillary plexus (54.0% versus 55.1%, respectively; P=0.500).

**Conclusions:** Quantitative OCT-A measurements non-invasively demonstrated significantly reduced deep capillary plexus and choriocapillaris perfusion in eyes with MEWDS when compared to fellow eyes. This offers further insight into the potential pathophysiologic processes involved in this disorder.

**Commercial Relationships:** Abtin Shahlaee, None; Jayanth Sridhar, None; Nika Bagheri, None; Wasim Samara, None; James P. Dunn, None; Sonia Mehta, None

**Program Number:** 1683 Poster Board Number: A0114
**Presentation Time:** 11:00 AM–12:45 PM
**OCT angiography - new insights into an Ocular Syphilis outbreak in Brazil**
Isabel M. Borelli, Claudio Zett Lobos, Gabriel Costa de Andrade, Cristina Muccioli. Ophthalmology, Universidade Federal de São Paulo, São Paulo, Brazil.

**Purpose:** The characteristics of ocular syphilis may mimic many ocular diseases and have been well described clinically, as well as with fluorescein angiography (FA), indocyanine green angiography and optical coherence tomography (OCT) findings. OCT angiography (OCT-A) is a novel and non-invasive technique for imaging retinal microvasculature by detecting changes, with respect to time, in reflectivity related to blood flow. This study aims to report the OCT-A features of ocular syphilis.

**Methods:** In this prospective interventional case series study, 20 patients with ocular syphilis attended at the Ophthalmology Department of Federal University of Sao Paulo from March to October 2016. The diagnostic was based on clinical evaluation and results of both non-treponemal and treponemal serological exams. The patients underwent multimodal imaging, including OCT-A (Optovue RTVue XR AvantiR) and were treated with ceftriaxone (2 - 4 g daily IV for 14 days). Patients whose compliance with therapy or follow-up could not be ensured were excluded, likewise those with features obscuring the OCT A image. We herein describe the clinical manifestations, ancillary examination outcomes and new insights into ocular syphilis detected by OCT-A.

**Results:** The diagnosis of ocular syphilis was made in 20 patients - 12 male and 8 female (average 45,60 years). 12 patients with low follow up compliance (10) and media opacities (2) were excluded, therefore, data for 16 eyes of 8 patients were analyzed. The symptoms, clinical presentation and 1 month outcomes are described in TABLE 1. The OCT-A features found include nonperfusion area of the superficial and deep retina plexus and choriocapillaris, hyperreflective dots on En Face OCT, flow density changes and perfioveal capillary arcade disruption in patients 1, 4 (FIGURE 1,2) and 6.

**Conclusions:** The OCT-A findings correlate with the hiperreflective dots noted on B-Scan and En face OCT, corroborating the theory...
that ischemia of the choriocapillaris may lead to the accumulation of subretinal metabolic residues (hiperreflective dots on En Face OCT) associated with low vision with improvement after specific treatment for syphilis. OCT-A seems to have the potential to increase our understanding of the ocular syphilis pathogenesis, although, further studies are needed to determine this reliability.

Conclusions: SSADA based OCTA can offer significant additional information then FA and OCT. It can also provide the blood flow information in each of the four segmented tissue slabs to help the researchers understand the pathophysiology of the posterior uveitis better.

Optical Coherence Tomography Angiography in Pars Planitis Daniela Meizner, Vidal Soberon, Guillermo Salcedo Villanueva. Asociación para Evitar la Ceguera, Mexico, Mexico.

Purpose: To report and compare the visualization of retinal vasculature findings using Optical Coherence Tomography Angiography (OCTA) versus Fluorescein Angiography (FA) in patients with Pars Planitis (PP).

Methods: We performed a retrospective, observational and descriptive study in which seventeen eyes of nine patients with PP and clear optic media were included. Patients were recruited for FA and OCTA imaging. Results from the two imaging modalities were analyzed and compared by two retina experts using MAC OS X 10.11 image editor. Adherent to the declaration of Helsinki, IRB approved.

Results: Seventeen eyes of nine patients were included. Mean patient age was 19.2(± 6.85) years, 55% of patients were female (n=5). The FA showed changes in eyes with active inflammation; 6 eyes (35.29%) showed vascular leakage, 2 eyes (11.76%) showed cystic coherence tomography (OCT) images of 31 involved eyes to detect the findings of each disease.

Vascular looping, remodeling, focal dilatation and capillary drop out in both superficial and deep retinal slabs in birdshot chorioidopathy
FA is a sensitive diagnostic tool to identify inflammation in patients with PP. OCTA does not show differences in patients with active or inactive PP when compared to FA.

**Conclusions:** FA is a sensitive diagnostic tool to identify inflammation in patients with PP. OCTA does not show differences in patients with active or inactive PP when compared to FA findings.

**Commercial Relationships:** Daniela Meizner, None; Vidal Soberon, None; Guillermo Salcedo Villanueva, None

**Program Number:** 1687 Poster Board Number: A0118

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

**Assessment Of Subclinical Microvascular Flow Characteristics In Anerysmal Retinal Vasculitis Using Optical Coherence Tomography Angiography**

**J Emanuel Carvalho, Dilraj S. Grewal, Dhanes Thomas. Medical Retina, Moorfields Eye Hospital, London, United Kingdom.**

**Purpose:** Microvascular flow abnormalities in retinal vasculitis may not be detected on fluorescein angiography due to obscured visualization from leakage. Using optical coherence tomography (OCT) angiography, we evaluated the presence of microvascular flow abnormalities in eyes with aneurysmal retinal vasculitis.

**Methods:** We reviewed 4 eyes of 3 patients with perinuclear antineutrophil cytoplasmic autoantibody (p-ANCA) associated retinal vasculitis, biopsy-proven eosinophilic granulomatosis with polyangiitis (EGPA) associated with retinal vasculitis, and idiopathic retinal vasculitis, aneurysms, and neuroretinitis (IRVAN, N = 2 eyes). Fluorescein angiogram-directed OCT angiography imaging (Zeiss AngioPlex, Carl Zeiss Meditech) of the areas of aneurysms (N=10) using 3 x 3 and 6 x 6 mm scan sections was performed.

**Results:** In both p-ANCA and EGPA vasculitis eyes, superficial and deep capillary level perfusion abnormalities were seen in regions adjacent to all 6 aneurysmal dilations imaged. In none of these 6 areas, were capillary perfusion abnormalities detected using fluorescein angiography. Four of the 6 areas were also associated with surrounding intraretinal cystic fluid on OCT. Sub-internal limiting membrane aneurysmal outpouchings were confirmed on OCT in all 6 areas. The inner choroid in these areas showed loss of detail and a diffuse increase in reflectivity. In both eyes of the patient with IRVAN, scanned 3 years after being treated with a course of oral steroids, no microvascular abnormalities were detected in all 4 aneurysmal areas imaged.

**Conclusions:** Widespread subclinical capillary perfusion abnormalities develop in both the superficial plexus and deep vascular plexus in regions adjacent to inflammatory aneurysmal dilations, which are not detected using fluorescein angiography. The spectrum of these perfusion abnormalities suggests that early treatment of milder disease may potentially prevent the development of these microvascular abnormalities. It is also possible that immunoglobulin (Ig) E and mast cell-mediated damage in EGPA and IgG mediated cytotoxic hypersensitivity and vascular endothelial cell damage in p-ANCA vasculitis has a greater severity of perivascular inflammatory damage than IRVAN. OCT angiography allows recognition of these subclinical microvascular abnormalities and thus may serve as a non-invasive tool to monitor progression.

**Commercial Relationships:** J Emanuel Carvalho; Dilraj S. Grewal, None; Dhanes Thomas, None

**Program Number:** 1687 Poster Board Number: A0118

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

**Optical Coherence Tomography Angiography in Serpiginous Chorioiditis**

**Daniela Montorio1, 2, Elisabetta Misericocchi1, Giulio Modorati1, Stefano Mercuri1, Alessandro RabiolI1, Riccardo Sacconi1, 3, Adriano Carnevali4, Lea Querques1, Giuseppe Querques1, Francesco Bandello1. 1Department of Ophthalmology, IRCCS San Raffaele Scientific Institute, University Vita-Salute San Raffaele, Milan, Italy, Milan, Italy, Italy; 2Eye Clinic, Department of Neurosciences, Reproductive Sciences and Dentistry, University of Naples Federico II, Napoli, Italy; 3Department of Ophthalmology, University of Verona, University hospital of Verona, Verona, Italy, Verona, Italy; 4Department of Ophthalmology, University of “Magna Graecia”, Catanzaro, Italy, Catanzaro, Italy.

**Purpose:** To analyze vessel density of the whole choroid in Serpiginous Chorioiditis (SC) using optical coherence tomography angiography (OCT-A).

**Methods:** Observational study. Nineteen eyes of 11 patients affected by Serpiginous Chorioiditis were recruited. All patients underwent SD-OCT (Spectralis Heidelberg Retinal Angiograph + OCT; Heidelberg Engineering, Heidelberg, Germany) and OCT-A (AngioPlex Elite 9000 SS-OCT, Carl Zeiss Meditech, Inc., Dublin, USA). Quantification of vessel density of whole choroid was performed by means analysis of binarized 6x6 mm OCT-A images. Four different regions of the retina were chosen for investigation: unaffected area, inner border of the lesion, outer border of the lesion and affected retina. Border regions were defined as portion of retina within 30 µm from the dividing limit between affected and unaffected area.

**Results:** Nineteen eyes of 11 Caucasian patients (3 males, 27.3%), with a mean age of 60.72 years ± 6.80 were enrolled. The whole choroid showed statistically significant reduction of vessel density in affected areas (0.235 ± 0.13) compared to unaffected areas (0.756 ± 0.14) (p <0.001), and between inner borders (0.330 ± 0.13) and outer borders (0.659 ± 0.13) of affected areas (p <0.001).

Statistically significant differences in vessel density were detected between affected areas (0.235 ± 0.13) and inner borders (0.330 ± 0.13) and between unaffected areas (0.756 ± 0.14) and outer borders of the lesion (0.659 ± 0.13) (p=0.038). Also the differences between affected areas (0.235 ± 0.13) and outer borders (0.659 ± 0.13), between unaffected areas (0.756 ± 0.14) and inner borders (0.330 ± 0.13) were statistically significant (p<0.001).

**Conclusions:** OCT-A demonstrated progressive loss of the whole choroid from the inner border of affected areas to unaffected areas in eyes with Serpiginous Chorioiditis.

**Commercial Relationships:** Daniela Montorio; Elisabetta Misericocchi, None; Giulio Modorati, None; Stefano Mercuri, None; Alessandro RabiolI, None; Riccardo Sacconi, None; Adriano Carnevali, None; Lea Querques, None; Giuseppe Querques, None; Francesco Bandello, Farmila-Thea (C), Alcon (C), Novartis (C), NovagaliPharma (C), Bausch and Lomb (C), Allergan Inc (C), Genentech (C), Thrombogenetics (C), Bayer Shering-Pharma (C), Zeiss (C), Hoffmann-La Roche (C), Sanofi-Aventis (C), Alimera Sciences (C)
Program Number: 1688 Poster Board Number: A0119
Presentation Time: 11:00 AM–12:45 PM
OCT angiography findings in Autosomal Dominant Drusen patients
Giulia Caminiti, Rita Serra, Claudio Iovino, Enrico Peiretti.
Eye Clinic, University Of Cagliari, Cagliari, Italy.
Purpose: To evaluate optical coherence tomography angiography (OCT-A) findings in eyes with Autosomal Dominant Drusen.
Methods: 12 eyes of 6 patients (3 men and 3 women) with a clinical diagnosis of Autosomal Dominant Drusen underwent a complete ophthalmological examination including color fundus picture, fundus autofluorescence (FAF), fluorescein angiography (FA) and indocyanine green angiography (ICGA); enhanced-depth imaging optical coherence tomography (EDI-OCT) (HRA+OCT Spectralis Heidelberg), and OCT-A using AngioVue technologies (Optovue Inc). BCVA was also evaluated and any visual complain was recorded.
Results: The mean age of the patients was 51 years. BCVA ranged from 1.77 LogMAR and 0 LogMAR (mean value 0.27 logMAR) and visual complaints were referred in 4 patients. On FAF, 6 eyes (50%) showed the presence of some area of hypoa autofluorescence suggestive for geographic atrophy (GA) corresponding to some alteration of the ellipsoid/RPE zone on SD-OCT. In all eyes, choriocapillaris segmentation of OCT-A revealed different degrees of choriocapillaris impairment. Particularly, choriocapillaris was classed as rarediffed in 8 eyes (66.6%) and absent in 4 eyes (33.3%). One eye showed the presence of a neovascular network on OCT-A better highlighted in the choriocapillaris segmentation.
Conclusions: OCT-A appears to be a valid instrument in order to follow the patients affected by Autosomal Dominant Drusen especially in the early stages of the disease before any visual complain.
Commercial Relationships: Giulia Caminiti, None; Rita Serra, None; Claudio Iovino, None; Enrico Peiretti, None

Program Number: 1689 Poster Board Number: A0120
Presentation Time: 11:00 AM–12:45 PM
Follow-up of patients with PCV in CSCR treated with PDT or IVT of ANTI-VEGF; better ICGA or OCT-A?
Enrico Peiretti, CLAUDIO IOVINO, Rita Serra, Giulia Caminiti.
Odontostomatol & Surgical Science, Azienda Ospedaliera universitaria S. Giovanni di D, Cagliari, Italy.
Purpose: Chronic central serous chorioretinopathy (CSCR) may predispose to the development of choroidal neovascularization (CNV) and polyovoidal choroidal vasculopathy (PCV) could be present. The aim of the study is to evaluate OCT angiography (OCT-A) and indocyanine green angiography (ICGA) features in patients with Chronic CSCR complicated by PCV, before and after treatments.
Methods: Eight eyes of 7 consecutive patients diagnosed as PCV in chronic CSCR on the basis of multimodal imaging were enrolled. Patients were classified in 2 groups: the first group included 4 eyes treated with photodynamic therapy (PDT), the second group included 4 eyes treated with intravitreal injection (IVT) of anti-VEGF (Bexacizumab, Ranibizumab, Afibercept). OCT-A and ICGA were performed before and after treatment, in order to understand the effect of such therapies on the vascular networks. The fixed follow-up schedule was after 3 months for PDT group and after 1 month for the IVT group.
Results: At the baseline, in the whole series of patients, ICGA was able to detect 100% of the PCV and the data were confirmed by SD OCT analysis. Manual choriocapillaris segmentation of OCT-A showed the presence of PCV in 62% of the cases. After therapy, the first group (PDT treatment) showed that the polytomic lesions were not detectable either by ICGA as well as on OCT-A analysis in 75% of the eyes. In the second group (IVT of anti-VEGF), 75% of the eyes revealed the presence of PCV after treatment on ICGA while on OCT-A in 50% of the eyes was very difficult to detect the presence of the aneurysmatic dilatations characteristic of PCV.
Conclusions: OCT-A can be considered a valuable tool in order to detect the PCV in CSCR but is debatable its use in the follow up of Photodynamic therapy and IVT of anti-VEGF.
Commercial Relationships: Enrico Peiretti, None;
CLAUDIO IOVINO, None; Rita Serra, None; Giulia Caminiti, None

Program Number: 1690 Poster Board Number: A0121
Presentation Time: 11:00 AM–12:45 PM
High Correlation between OCTA and OCT Measurements in Patients with Optic Atrophy
Ali Shariati1, Yin Shen2, Zhongdi Chu1, Matthew Powers3, Ruikang K. Wang1, Yaping J. Liao1.
1Ophthalmology, Stanford School of Medicine, Stanford, CA; 2Wuhan University, Wuhan, China; 3Bioengineering, Washington University, Seattle, WA.
Purpose: Non-invasive retinal imaging such as optical coherence tomography (OCT) is routinely used in evaluation of patients with vision loss, and optical coherence tomography angiography (OCTA) is a new imaging modality that is beginning to be used clinically. In this study, we measured OCT and OCTA in patients with optic atrophy and age-matched controls and determined whether there is OCT-OCTA correlation.
Methods: We recruited patients with vision loss from a single institution using approved protocol and performed a retrospective, cross-sectional study in 28 patients with optic atrophy (mean age 58 ± 3 yrs, range 17-92 yrs) and 18 age-matched controls (mean age 52 ± 5 yrs, range 19-92 yrs). Inclusion criteria for those with optic atrophy include stable vision loss for >6 months, no other cause of vision loss, and Humphrey visual field mean deviation worse than -5 dB. Patients with optic atrophy included non-arteritic and arteritic anterior ischemic optic neuropathy, optic neuritis, cancer, and others. Control subjects included those with no known history or exam findings of optic nerve or retinal issues. We quantified changes in retinal vasculature using custom-written Matlab programs. Statistical analyses performed included Mann-Whitney test and regression analysis.
Results: Compared with age-matched controls, those with optic atrophy had significantly lower vessel area density at the optic disc (0.3370 ± 0.0087, ctrl: 0.4297±0.0074, P<0.0001) and macula (atrophy:0.3436±0.0071, ctrl:0.3876±0.0086, P<0.0018). Similarly, those with optic atrophy had significantly thinner OCT retinal nerve fiber layer (RNFL) thickness (atrophy:61±1 μm, ctrl:91±1 μm, P<0.0001) and macular ganglion cell complex (atrophy:58±2 μm, ctrl: 80±1 μm, P<0.0001). Regression analysis revealed significant correlation between OCTA disc vessel density and OCT RNFL thickness (R²=0.4913, P<0.0001) and between OCTA macular vessel density and OCT macular ganglion cell complex thickness (R²=0.2152, P=0.0003). There was also significant correlation between OCTA disc and macular vessel densities (R²=0.362, P<0.0001) and RNFL and macular GCC thickness (R²=0.8239, P<0.0001).
Conclusions: In patients with optic atrophy, there was significant thinning of the OCT RNFL and macular ganglion cell complex compared with age-matched controls, and these changes were significantly correlated with a decrease in both optic disc and macular vessel density on OCTA.
Commercial Relationships: Ali Shariati, None; Yin Shen, None; Zhongdi Chu, None; Matthew Powers, None; Ruikang K. Wang, None; Yaping J. Liao, None

Program Number: 1691 Poster Board Number: A0122
Presentation Time: 11:00 AM–12:45 PM

Optical Coherence Tomography Angiography (OCTA) after Plaque and Proton Beam Radiotherapy for Uveal Melanoma

Edward L. Randerson1, Clinton Warren2, Rachel E. Linderman3, Margaret R. Strampe4, 5, Irina Sparks3, Hannah Russell1, Katie McKenney6, Joseph Carroll7, 8, William Wirostko1.
1Ophthalmology & Visual Sciences, Medical College of Wisconsin, Milwaukee, WI; 2Cell Biology, Neurobiology, and Anatomy, Medical College of Wisconsin, Milwaukee, WI; 3Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI; 4University of Minnesota Medical School, Minneapolis, MN.

Purpose: Uveal melanoma is the most common primary intraocular tumor in adults and is a potentially life-threatening malignancy. Focal radiation therapy has been widely utilized to reduce tumor growth and can induce varying degrees of radiation retinopathy.1,2 We conducted a prospective study using OCTA to analyze the parafoveal superficial capillary plexus following radiation for uveal melanoma.

Methods: 21 subjects were imaged using the OCTA RTVUe XR 100 Avanti (OptoVue, Inc., Fremont, CA). 3x3mm scans were averaged to improve signal-to-noise ratio.1 Axial lengths and SD-OCT imaging facilitated lateral scaling and comparison analysis. Boundaries of the foveal avascular zone (FAZ) were delineated manually in ImageJ (NIH, Bethesda, MD) by two masked observers. FAZ area and acircularity were determined using MATLAB (Mathworks, Natick, MA).4,5

Results: OCTA qualitatively demonstrated areas of reduced capillary density in post-radiation eyes (Fig 1). Quantitative analysis was precluded by fixation errors and image artifact in 48% of subjects; 11 were included for analysis (8 plaque, 3 proton beam). Patients were imaged at a mean of 30.1±26.7 months following radiation with an average tumor height of 2.8±1.5mm and radiation dose of 25.9±35.8 Gy at the fovea. The average FAZ area for the irradiated and nonirradiated eyes was 260±132 µm² and 176±85 µm², respectively (p=0.10). Comparing the acircularity of irradiated to nonirradiated eyes revealed a mean of 1.37±0.23 and 1.28±0.19, respectively (p=0.34). Irradiated metrics were compared to a previously obtained normative database of 232 eyes with a mean FAZ area of 250±104 µm² (p=0.81), and a mean acircularity of 1.21±0.13 (p=0.045).

Conclusions: OCTA can be utilized to qualitatively assess for early signs of radiation retinopathy; however, obtaining reliable images for quantitative analysis can be challenging. Irradiated eyes demonstrated no significant difference in FAZ area, but the acircularity was significantly increased compared to our normative database. Additional imaging and future analysis of intercapillary spacing and vascular density is needed.

1Weis PMID:26966414
2Gündüz PMID:10326957
3Schneider PMID:22930834
4Wilk PMID:27887888
5Tam PMID:22039250

Fig 1: Averaged 3-frame OCTA image acquired 36 months post-proton beam with parafoveal capillary dropout, scale bar = 500µm.

Commercial Relationships: Edward L. Randerson, None; Clinton Warren, None; Rachel E. Linderman, None; Margaret R. Strampe, None; Irina Sparks, None; Hannah Russell, None; Katie McKenney, None; Joseph Carroll, OptoVue (F); William Wirostko, None

Support: NIH Grant P30EY001931 and Thomas M. Aaberg, Sr. Retina Research Fund

Program Number: 1692 Poster Board Number: A0123
Presentation Time: 11:00 AM–12:45 PM

Intra- and Peripapillary Capillary Density After Plaque Radiotherapy for Choroidal Melanoma: Analysis of Eyes Without Radiation Papillopathy

Ocular Oncology Service, Wills Eye Hospital, Philadelphia, PA.

Purpose: To study the intra- and peripapillary capillary density (CD) using optical coherence tomography angiography (OCTA) in eyes treated with plaque radiotherapy for choroidal melanoma.

Methods: Five patients treated with plaque radiotherapy for unilateral choroidal melanoma without radiation papillopathy or retinopathy clinically and by optical coherence tomography (OCT) were imaged with OCTA. Comparison of optic nerve head (ONH) and radial peripapillary capillary (RPC) level CDs between irradiated and fellow non-irradiated eyes was performed for regions [whole image, inside disc/intrapapillary, and peripapillary] and quadrants [nasal, inferior nasal, inferior temporal, superior temporal, superior nasal, and temporal] as defined by preset parameters on the AngioVue software [version 2016.1.0.26] (Figure 1).

Results: Overall, imaging was performed at mean 14 months after radiation. Mean age was 65 years (median: 61, range: 54-78), all were Caucasians (5/5, 100%), and majority were female (3/5, 60%). One patient had diabetes mellitus, 4 had controlled hypertension, and none had glaucoma. Tumor was located superiorly (3/5, 60%), temporal (1/5, 20%), and in the macula (1/5, 20%). Mean radiation dose to optic disc and foveola were 32 Gy (median: 29, range: 22-49), and 37 (median: 32, range: 12-69) Gy, respectively. By OCT,
mean central macular thickness between irradiated eyes and fellow non-irradiated eyes was 257 um vs 229 um (p=0.25), respectively. OCTA analysis by region showed there was significant decrease in whole image (p=0.01 and p=0.03), intrapapillary (p=0.01 and p=0.02), and peripapillary (p=0.01 and p=0.02) CD of irritated eyes in both ONH and RPC, respectively (Table 1). Analysis by quadrant showed only significant CD reduction in the inferotemporal quadrant in ONH (p=0.02), and inferonasal quadrant in RPC (p=0.03) (Table 1).

Conclusions: OCTA allows quantitative analysis of ONH and RPC CD. There appears to be significant reduction in intrapapillary and peripapillary CD in irritated eyes even before clinical or OCT evidence of radiation papillopathy and maculopathy.

Program Number: 1693 Poster Board Number: A0124
Presentation Time: 11:00 AM–12:45 PM

Swept-source Optical Coherence Tomography Angiography features of Choroidal Nevomelanocytic lesions

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Purpose: This is an institutional, consecutive, case series describing the features observed on optical coherence tomography angiography (OCT-A) of choroidal nevomelanocytic lesions. The purpose of this work is to:
- Assess the anatomical alterations in retino-choroidal layers imaged via OCT-A associated with presence of choroidal nevomelanocytic lesions
- Investigate the potential of OCT-A to contribute diagnostic and prognostic information.

Methods: Consecutive patients referred with choroidal nevomelanocytic lesions to a tertiary academic ophthalmology centre underwent swept-source OCT-A by means of the DRI Triton OCT-A (Topcon Corporation, Tokyo, Japan). A scan centred on the lesion was obtained on each case. En-face structural OCT of the choriocapillaris with flow reversal was also performed. Two experienced specialists in chorio-retinal disease undertook qualitative assessment of obtained images.

Results: 45 consecutive cases of choroidal nevomelanocytic lesions underwent OCTA imaging. Of those, 25 had adequate imaging quality for further analysis. 15 represented flat choroidal nevi without suspicious features and 10 cases were choroidal nevi showing elevation on OCT. The latter cases had an average thickness of the nevus of 256 microns measured on OCT. The superficial and deep capillary plexuses appeared undisturbed in all cases. The outer retinal layer appeared normal in all cases of flat choroidal nevi. In the cases of choroidal nevus with mild elevation, the outer retinal layer appeared more susceptible to projection artifacts from overlying retinal vasculature. The choriocapillaris layer showed fading of the normal homogenous vascular mosaic corresponding to the area of the nevus. The corresponding area appeared increasingly darker with increasing thickness of the choroidal nevus. On en-face reverse flow OCT centered on the choroid, even the faintest and thinnest nevi could be visualized in striking detail allowing very precise delineation of the nevus and measurement of lateral dimensions.

Conclusions: OCT-A presents characteristic changes in the outer retinal and choriocapillaris layers in cases of choroidal nevi. Reverse en-face structural OCT of choroidal nevi may be optimally suited for visualization of small, faint lesion, allowing accurate, detailed measurement of lateral dimensions in all cases.

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Irradiated Eye, n=5</th>
<th>Non-irradiated Eye, n=5</th>
<th>*P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal strength, mean (median, range)</td>
<td>66 (61.58-69)</td>
<td>48 (46-60.75)</td>
<td>0.09</td>
</tr>
<tr>
<td>Capillarity density, mean (median, range), %</td>
<td>50 (52.43-58)</td>
<td>38 (57, 53-61)</td>
<td>0.06</td>
</tr>
<tr>
<td>Optic nerve head</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Quadrants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasal</td>
<td>50 (52, 43-58)</td>
<td>38 (57, 53-61)</td>
<td>0.06</td>
</tr>
<tr>
<td>Inferior nasal</td>
<td>50 (52, 43-66)</td>
<td>44 (62, 60-68)</td>
<td>0.06</td>
</tr>
<tr>
<td>Inferior temporal</td>
<td>56 (57, 52-62)</td>
<td>63 (62, 60-65)</td>
<td>0.02</td>
</tr>
<tr>
<td>Superior temporal</td>
<td>56 (57, 43-64)</td>
<td>61 (59, 53-67)</td>
<td>0.44</td>
</tr>
<tr>
<td>Superior nasal</td>
<td>51 (54, 36-57)</td>
<td>56 (49, 49-66)</td>
<td>0.10</td>
</tr>
<tr>
<td>Temporal</td>
<td>56 (53, 48-66)</td>
<td>61 (60, 57-63)</td>
<td>0.15</td>
</tr>
<tr>
<td>Regions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole image</td>
<td>50 (48, 44-55)</td>
<td>55 (54, 50-59)</td>
<td>0.81</td>
</tr>
<tr>
<td>Inside disc</td>
<td>50 (48, 47-54)</td>
<td>54 (54, 51-61)</td>
<td>0.81</td>
</tr>
<tr>
<td>Peripapillary</td>
<td>54 (53, 50-60)</td>
<td>49 (46, 56-60)</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Radial peripapillary capillary Quadrants | | | |
| Nasal | 49 (50, 41-59) | 57 (55, 54-61) | 0.07 |
| Inferior nasal | 51 (51, 43-69) | 65 (63, 58-68) | 0.03 |
| Inferior temporal | 50 (59, 53-67) | 61 (61, 60-69) | 0.07 |
| Superior temporal | 58 (60, 40-69) | 63 (62, 66-68) | 0.52 |
| Superior nasal | 63 (55, 43-59) | 58 (60, 54-64) | 0.17 |
| Temporal | 59 (57, 53-65) | 62 (61, 59-66) | 0.13 |
| Regions | | | |
| Whole image | 48 (48, 42-55) | 53 (51, 50-57) | 0.83 |
| Inside disc | 39 (40, 21-49) | 48 (48, 36-55) | 0.82 |
| Peripapillary | 53 (53, 51-62) | 61 (49, 58-64) | 0.82 |

* All p-values were compared to fellow eyes using paired t-test.
Patients with choroidal melanoma underwent a complete ophthalmic evaluation, including best corrected visual acuity, color fundus photography, B-scan ultrasound, fluorescein angiography (FA), indocyanine green angiography (ICGA) and swept source OCT-A with Zeiss prototype (PLEX Elite, Swept-Source OCT model 9000, Carl Zeiss Meditec, Inc, Dublin, CA).

**Purpose:** To describe the imaging features of choroidal melanoma using swept source optical coherence tomography angiography (OCT-A) and evaluate its ability to display tumor intrinsic vasculature.

**Methods:** Patients with choroidal melanoma underwent a complete ophthalmic evaluation, including best corrected visual acuity, color fundus photography, B-scan ultrasound, fluorescein angiography (FA), indocyanine green angiography (ICGA) and swept source OCT-A with Zeiss prototype (PLEX Elite, Swept-Source OCT model 9000, Carl Zeiss Meditec, Inc, Dublin, CA).

**Results:** Twenty-two eyes of 22 consecutive patients with choroidal melanoma were included in the study; 11 cases (50%) were treatment naive. Three lesions (14%) were located at the macula, 14 (63%) between the macula and equator and 5 (23%) between the equator and the ora serrata. The mean tumor base and thickness were respectively 10.3 mm (range 5-15 mm) and 4.5 mm (range 1.5-8.9 mm). Seventeen lesions (77%) were dome shaped whereas 5 (23%) showed a mushroom configuration. Thirteen lesions (59%) were pigmented, 5 (23%) partially pigmented and 4 (18%) amelanotic. An exudative retinal detachment was detected in 13 eyes (59%). FA and ICGA disclosed intrinsic microvasculature of the tumor respectively in 4 (20%) and 22 (100%) cases whereas OCT-A detected microvasculature of choroidal melanoma in all cases. Specifically, intrinsic vasculature could be recognized in 14 eyes (64%) using the automated choroid segmentation, 16 eyes (73%) using the automated whole eye segmentation and in 22 eyes (100%) with fine manual adjustments of segmentation lines.

**Conclusions:** Swept source OCT-A represents a valid imaging technique in evaluating patients affected by choroidal melanomas. In our series OCT-A disclosed the intrinsic microvasculature of the tumor in all cases despite their size and position.
**Results:** The Superficial Capillary Network (SCN) shows a smaller Foveal Avascular Zone and is identified in healthy eyes in a slab comprised between 51.5±7.6 µm and 93.4±8.0 µm from the ILM in the parafovea region. The Deep Capillary Network (DCN) is located deep in the retina in the slab located between 105±11.0 µm and 190±15.2 µm from the ILM in the parafovea region. The larger vessels are mainly located superficial to these capillary networks in a slab close to the ILM. There are interconnecting capillaries between both capillary networks mainly perpendicular and crossing the retina between the SCN and DCN slabs that could be interpreted as an additional network.

**Conclusions:** Custom segmentation allows improved characterization of the retinal capillary networks and their location. Clear identification of the superficial and deep capillary networks in healthy eyes is fundamental for improved understanding of retinal vascular disease and its progression.

**Program Number:** 1697
**Poster Board Number:** A0128
**Presentation Time:** 11:00 AM–12:45 PM

Comparing measurements of the superficial vasculature using Optovue AngioVue and Zeiss Angioplex

**Purpose:** Optical coherence tomography angiography (OCT-A) permits non-invasive visualization of the retinal vasculature. Here, we compared measurements of the superficial vasculature using two commercially-available OCT-A devices.

**Methods:** Twenty subjects with no known ocular diseases were imaged using Zeiss Angioplex (Carl Zeiss Meditec Inc., Jena, Germany) and Optovue AngioVue (Optovue, Fremont, CA). One 3x3mm foveal image of the right eye was taken with each device. We first manually marked the boundaries of the foveal avascular zone (FAZ). From these measurements, we then calculated both the area and acircularity. The FAZ areas and acircularities were compared between devices using paired t-tests. Each image was then scaled to the same size, registered to each other using rigid body registration, and skeletonized by ImageJ (NIH, Bethesda, MD). Using AnalyzeSkeleton in ImageJ, capillary endpoints and mean vessel length were compared between devices using Wilcoxon matched-pairs signed ranks test or paired t-test respectively.

**Results:** There was a small but significant difference when comparing FAZ area (Angioplex: 0.245±0.101mm², AngioVue: 0.254±0.102mm²; p = 0.0244), though there were cases where the shape of the FAZ was remarkably different (Figure 1). Larger differences were seen in FAZ acircularity (Angioplex: 1.26±0.153, AngioVue: 1.19±0.117; p = 0.0060) as well as measures of image quality such as average vessel length (Angioplex: 11.52±0.832, AngioVue: 12.28±1.245; p = 0.0283) and capillary endpoints (Angioplex: 2719.0±513.63, AngioVue: 2145.2±347.78; p <0.0001).

**Conclusions:** Just as with conventional measurements of retinal thickness, data collected across different devices should not necessarily be combined. Our results also show that Optovue AngioVue images have fewer capillary endpoints when compared to Zeiss’s Angioplex images as well as with longer average vessel length, consistent with the subjectively higher image quality (e.g., fewer eye movement artifacts and better vessel contrast) observed using AngioVue. More work is needed to assess whether these differences extend to eyes with retinal pathology.

1. Wilt PMID: 27887888
2. Tan PMID: 22039250
3. Arganda-Carreras PMID: 20232465

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Swept Source OCT Angiography of Polypoidal Choroidal Vasculopathy using Boundary Layer Specific Segmentation

**Background:** Swept source optical coherence tomography angiography (SS-OCTA) has been a non-invasive tool to identify the polypoidal choroidal vasculopathy (PCV) that is indocyanine green angiography (ICGA). Efforts to image PCV with OCTA have been limited by poor image quality, inability to image polyps, and the difficulty of capturing the entire PCV complex on a single en face image. Herein, we define the segmentation boundaries to obtain en face images of the PCV complex.

**Purpose:** The gold standard for the identification of polyps and branching vascular networks (BVNs) in polypoidal choroidal vasculopathy (PCV) is indocyanine green angiography (ICGA). Swept source OCTA has been limited by poor image quality, inability to image polyps, and the difficulty of capturing the entire PCV complex on a single en face image. Herein, we define the segmentation boundaries to obtain en face images of the PCV complex, which we follow after anti vascular endothelial growth factor (VEGF) therapy.

**Methods:** Patients with PCV were enrolled in a prospective study at Bascom Palmer Eye Institute. Patients underwent imaging with a SS-OCTA instrument (PlexElite 9000, Carl Zeiss Meditec Inc., Dublin, CA). *En face* slabs for both structure and flow imaging were produced using boundary layers from the retinal pigment epithelium (RPE) to the RPE-fit layer, roughly following Bruch’s membrane. These layers were established using the Custom Segmentation option. The position and thickness of the slab were manually adjusted to optimize the signal to noise for viewing of the PCV complex. The automated segmentation was manually corrected when necessary. Two visualization algorithms were employed: the MAX algorithm utilizes the greatest flow signal for each A-scan in the slab, while the SUM algorithm adds the flow signals in the slab. *En face* and cross-sectional scans with and without flow were reviewed to determine whether all polyps could be identified. SS-OCTA images were compared with ICGA images when available.

**Results:** Three eyes of two patients were imaged. Two eyes were treated with anti-VEGF therapy. In all eyes, the polyps and connecting BVNs were visualized using a single slab configuration. The MAX algorithm clearly displayed the BVNs, and the SUM algorithm identified both the polyps and the BVNs. On B-scan, polyps could be identified by their flow signature within the RPE detachments. ICGA was available in one case, and the PCV complex appeared identical using both SS-OCTA and ICGA imaging.

**Conclusions:** SS-OCTA combined with a custom boundary identification strategy for the *en face* and cross-sectional viewing of flow images detected polyps and the BVNs associated with PCV. Additional patients are being recruited to validate this SS-OCTA imaging strategy against ICGA imaging.

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**Figure 1.** FZ segmentation results for two subjects showing the differences in FZ shapes obtained with the different devices.

**Commercial Relationships:** Gregory Stein, None; Fang Zheng, None; Ann Q. Tran, None; Joao R. Dias, None; Elie Motulsky, None; Giovanni Gregori, Philip J. Rosenfeld, None; Carl Zeiss Meditec (F), Carl Zeiss Meditec (R), Carl Zeiss Meditec (C); Fight For Sight (R), Optovue (F)

**Support:** R01EY024969, P30EY001931, Fight For Sight
To evaluate the reproducibility and repeatability, each subject was scanned three times on each instrument and using three different instruments, giving a total of 9 scans per eye. The variance of measurements for each eye was calculated, the variances for all individuals were averaged, and the square root was taken. The resultant value was divided by the average of measurements among all eyes to determine the coefficient of repeatability (CR).

**Results:** Vessel perfusions among all normal subjects were found between 0.349 and 0.412 (average: 0.46, standard deviation: 0.028) with CR of 0.92%. Flux index among all normal subjects were found between 0.343 and 0.519 (average: 0.38, standard deviation: 0.011) with CR of 1.28%. Both metrics were calculated over the entire annulus region.

**Conclusions:** Our results suggest that the RNFL microvasculature quantification (i.e., vessel perfusion and blood flux index) using AngioPlex OCT Angiography are repeatable and reproducible with variances less than 2% for normal subjects. These findings are crucial for glaucoma disease management using OCTA.

**Fig. 1.** A representative image of peripapillary RNFL angiography. Quantifications were performed in the area between the two red circles.

**Commercial Relationships:** Yuan Liu, Carl Zeiss Meditec, Inc. (E); Ali Fard, Carl Zeiss Meditec, Inc. (E); Homayoun Bagherinia, Carl Zeiss Meditec, Inc. (E); Mary K. Durbin, Carl Zeiss Meditec, Inc. (E); Jochen Straub, Carl Zeiss Meditec, Inc. (E)

**Program Number:** 1700  **Poster Board Number:** A0131  **Presentation Time:** 11:00 AM–12:45 PM  **Comparison between wide angle OCT angiography and ultra-wide field fluorescein angiography on the detection of non-perfusion area**

Osamu Sawada, Yusuke Ichiyama, Yuka Ito, Masashi Kakinoki, Tomoko Sawada, Yoshitsugu Saishin, Masahito Ohji. Ophthalmology, Shiga University of Medical Science, Otsu, Japan.

**Purpose:** Fluorescein angiography is valuable for the detection of non-perfusion area (NPA), but it is an invasive test. While OCT angiography (OCT-A) is a non-invasive test, the angle was narrow to detect NPA. We compared wide angle OCT angiography with ultra-wide field FA on the detection of NPA.

**Methods:** Patients with diabetic retinopathy (age ≥ 20 years, type 1 or type 2 diabetes mellitus) underwent nonsteered ultra-wide field FA using the Optos® panoramic 200Tx imaging system and wide angle OCT-A with 12.0x12.0-mm fields of five visual fixations (center, superotemporal, inferotemporal, superonasal, inferonasal) using PLEX Elite 9000®. We counted the numbers of the eyes of positive or false negative with OCT-A among eyes with positive NPA in FA and false positive or negative with OCT-A among eyes with NPA negative with FA. We calculated the sensitivity and the specificity for the detection of NPA by OCT-A.

**Results:** We evaluated twenty three eyes out of 13 patients (mean age, 59.9 years old; female/male, 5/8) with diabetic retinopathy. The number of true positive was 20 eyes; false negative, one eye; false positive, one eye; and true negative, one eye on the detection of NPA by OCT-A. The sensitivity for the detection of NPA by OCT-A was 0.95 and the specificity was 0.5.

**Conclusions:** Because the wide angle OCT-A with a 12x12 mm field has high sensitivity for the detection of NPA, it could replace FA.

**Commercial Relationships:** Osamu Sawada, Santen (R), Bayer (F), Bayer (R), Novartis (R), Kowasouyaku (R); Yusuke Ichiyama, Topcon (R), Zeiss (R); Yuka Ito, None; Masashi Kakinoki, None; Tomoko Sawada, Novartis (R), Bayer (R), Santen (R), Allagan (R); Yoshitsugu Saishin, Pfizer (R), Novartis (R), Bayer (R); Masahito Ohji, Santen (R), Zeiss (R), Novartis (R), Senjyu (F), Otsuka (F), Bayer (F), Alcon Japan (F), Allagan (C), Santen (F), Bayer (R), Alcon Japan (C), Otsuka (R), Kowa (R), Bayer (C), Novartis (C), Senjyu (R), Alcon Japan (R), Pfizer (F), Pfizer (R), Santen (C), Novartis (F)

**Support:** None