Evolution of vitreoretinal separation in normal subjects as described by wide-angle montage imaging of optical coherence tomography

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Purpose: Posterior vitreous detachment (PVD) plays an important role in several vitreoretinal interface disorders. Historically, observations of PVD using optical coherence tomography (OCT) were limited to the macular region. The purpose of this study is to describe the morphology of the vitreoretinal interface, from the macula to the periphery, in normal subjects, using montaged OCT images.

Methods: The design of this study is a prospective, consecutive interventional case series. All investigations adhered to the tenets of the Declaration of Helsinki. Recruited were 70 healthy eyes of 50 normal subjects, ranging from 21 to 75 years (48.9 ± 18.3 [mean ± SD]). Montaged images of horizontal and vertical OCT scans through the fovea, were obtained in each subject as previously described.

Results: Based on the montaged OCT images, the PVD was classified into the following 5 stages: stage 0, no PVD (0 eye); stage 1, focal PVD limited to paramacular, peripheral or from paramacular to peripheral zones (48 eyes, 45.2 ± 18.5 years [mean ± SD]); stage 2, perifoveal PVD expanding to the periphery (8 eyes, 53.7 ± 14.6 years); stage 3, near-complete PVD with persistent vitreopapillary adhesion alone (2 eyes, 59.5 ± 0.5 years); stage 4, complete PVD (12 eyes, 66.7 ± 8.5 years). Initiation of vitreous separation often occurred in a superior quadrant in 94% of stage one PVDs.

Conclusions: Using wide-angle montage OCT we have successfully imaged the vitreoretinal interface from the macula to the periphery and documented the longitudinal development of age-related PVD. Whereas prior work suggests that PVD originates in the perifoveal region, our observations clearly demonstrate more peripheral points of initiation. Our findings also show that PVD is usually initiated superiorly but that other quadrants may also be involved. Initiation of PVD is observable even in the second decade of life, much younger than previously appreciated. Following initiation, PVDs generally progress slowly and move posteriorly to the perifoveal region and anteriorly to the periphery.
Ocular morphometry from wide-field, whole eye OCT compared to MRI and PCI

Purpose: Ocular morphometry (or biometry) is an important part of clinical care, such as cataract surgical planning, and in research where eye shape from MRI has been correlated with pathological myopia. While widely used in ophthalmology, optical coherence tomography’s use in ocular morphometry has generally been limited due to technical and optical constraints in imaging the eye as a whole. We describe here the development of a “whole eye” OCT system that overcomes these constraints to simultaneously image full views of the anterior chamber and 50° on the retina (macula + optic nerve) and provide ocular morphometry.

Methods: A tabletop 200kHz swept source (λc=1045nm; Axsun, Inc.) OCT system with a polarization encoded, dual channel sample arm was developed to simultaneously image both the anterior and posterior eye in a single volume (Fig. A-E). Four subjects (N = 8 eyes) were consented under an IRB approved protocol to have “whole eye” OCT volumes, and for comparison, also have PCI (LenStar, Haag-Streit) and MRI (1mm T1; MR 750 3.0 T, GE, Inc.). For morphometric analysis, OCT images were segmented, corrected for subject and system optical distortions, and oriented correctly in a virtual space (Fig. F). Retinal curvature (Rc) and axial length (AL) from OCT were compared to MRI and PCI respectively. Non-parametric Wilcoxon sign rank test was used for statistical analysis.

Results: Curvature measured by whole eye OCT (Rc = 11.49±0.59mm) compared to MRI (Rc = 11.11±0.33mm) was not statistically significantly different (ΔRc = -0.38±0.62mm, p = 0.219). Axial length measured by whole eye OCT (AL = 23.13±0.87mm) compared to PCI (AL = 23.19±0.76mm) was also not statistically different (ΔAL = 0.06±0.288, p = 0.557).

Conclusions: We demonstrated a wide-field, whole eye OCT system capable of simultaneously providing quantitative morphometric analysis of ocular tissue within a single volume acquisition that is not statistically significantly different from MRI and PCI. This has

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Purpose: To demonstrate the usability of fundus autofluorescence (FAF) images acquired using a prototype widefield (WF) slit-scanning ophthalmoscope (SSO) (ZEISS, Dublin, CA), imaging over a 90° field of view (FOV) as measured from the cornea.

Methods: A prototype WF SSO was used to acquire 90° FAF images on 8 undilated eyes from 6 subjects with and without ocular disease, as well as True Color images for comparison. FAF is dye-less fluorescence imaging using either blue (FAF-Blue) or green (FAF-Green) illumination, which captures the natural autofluorescence of lipofuscin that accumulates in the retinal pigment epithelium (RPE). Image quality was evaluated by a licensed optometrist. Images were graded as unusable if image artifacts disrupted the ability to evaluate the central 45 degree field of view.

Results: Of the 16 non-mydriatic FAF images acquired, 81% (13/16) were usable. The 19% (3/16) of unusable FAF images occurred because the subjects’ pupil diameters were smaller than 2.5mm, the system’s limit. FAF-Blue, FAF-Green, and True Color images, each spanning a 90° FOV, are presented for a subject with a history of trauma in the left eye secondary to a car accident and status post multiple ocular surgeries (Figure 1). Both FAF images show an area of hypofluorescence superior to the optic disc, corresponding to a region of dead RPE cells. This area is not seen on the True Color image as True Color imaging does not provide functional information on the status of RPE cells. An area of peripapillary atrophy encircling the optic disc can be seen in the True Color image, and a corresponding region of hypofluorescence is present in both FAF images. Finally, accumulation of lipofuscin can be seen in the region inferior nasal to the macula as an area of hyperfluorescence in both FAF-Blue and FAF-Green images.

Conclusions: The prototype widefield slit-scanning ophthalmoscope is capable of acquiring 90° FAF-Blue and FAF-Green images on undilated eyes. These images provide functional information regarding the presence of dead RPE cells, missing RPE cells, and the accumulation of lipofuscin.

Commercial Relationships: Mary K. Durbin, Carl Zeiss Meditec, Inc. (E); Jennifer Luu, Carl Zeiss Meditec, Inc. (E); Conor Leahy, Carl Zeiss Meditec, Inc. (E); Robert Sprowl, Carl Zeiss Meditec, Inc. (E); T K. Brock, Carl Zeiss Meditec, Inc. (E)

Program Number: 5449 Poster Board Number: B0606
Presentation Time: 8:30 AM–10:15 AM
Usability of Widefield Slit-Scanning Ophthalmoscopes for Fundus Autofluorescence Imaging

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Program Number: 5450 Poster Board Number: B0607

Impact of Ultrawide Field Retinal Imaging (UWFI) on the Rapid Assessment of Avoidable Blindness and Diabetic Retinopathy(RAAB-DR) Survey
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1Optos (F); 2University of the Philippines, Philippine Eye Research Institute, Manila, Philippines; 3Ophthalmology, Harvard Medical School, Boston, MA; 3Beetham Eye Institute, Joslin Diabetes Center, Boston, MA.

Purpose: To evaluate the feasibility and benefit of implementing UWFI within the efficient and cost-effective survey method of RAAB-DR used to estimate prevalence and causes of visual impairment (VI) in Central Luzon, Philippines

Methods: The RAAB-DR methodology estimates the prevalence of blindness, diabetes mellitus (DM) and DR in a defined geographic area. Community clusters (N=35) each with 50 subjects >=50 yrs old were selected by probability proportionate to size sampling for entry into this cross-sectional population-based survey. Participants received visual acuity (VA) screening and VI diagnosis by a study certified ophthalmologist. Subjects were classified as having DM if they had a previous diagnosis, were receiving DM treatment or had HbA1c >=6.5%. DM subjects were further assessed for DR by dilated biomicroscopy (direct and indirect). All subjects had nonmydriatic UWFI (2x stereo 200° images; eye; Daytona, Optos plc, Scotland, UK). Retinal images were evaluated by Joslin Vision Network protocol at a centralized reading center. Main outcome measures were prevalence and primary causes of VI (<20/40), prevalence of DR based on UWFI, and agreement between UWFI and dilated biomicroscopy for DR severity.

Results: 1750 individuals were identified and 1440 (82.3%) evaluated. VA was >=20/40 in 1090 (75.1%). The 3 top causes of VA <20/40 were untreated cataracts (n=219, 62%), refractive error (n=181, 23%) and posterior segment disease (n=27, 8%). UWFI was done in 1358 subjects (94.3%), with ungradable images in 22 (1.6%). Non-DR posterior segment disease was identified in 341 (23.7%) and DM found in 377 (26.1%) subjects. DR severity distribution (by UWFI) was: no DR=69.5%, mild non-proliferative DR (NPDR)=11.1%, moderate NPDR=9.3%, severe NPDR=2.7%, proliferative DR=5.0%, DME=5.6% and ungradable=2.4%. Linear-weighted DR severity agreement between UWFI and dilated biomicroscopic exam was substantial (k=0.64; 95% CI:0.56-0.72), with exact agreement in 75.8% and within 1-step in 95.4%. UWFI identified more severe disease in 17.8%.

Conclusions: Relatively high rates of DM and DR are found in this diverse low-to-middle income population. As the first RAAB-DR survey to use UWFI, our study demonstrates that UWFI can be readily incorporated, has substantial agreement with biomicroscopy and appears to improve the ability to identify DR and non-DR retinal disease in such population-based surveys.

Commercial Relationships: Gary L. Yau, Paolo S. Silva, Optos (F); Leo D. Cubillan, None; Karlo M. Claudio, None; Kevin M. Panggat, None; Migil G. Ledesma, None; Maria A. Villano, None; Joanne C. Macenas, None; Cloyd M. Pitoc, None; Carisa M. Paraz, None; Jennifer K. Sun, None; Lloyd P. Aiello, Optos (R), Optos (F)

Support: Lions International
Assessing retinal vascular biomarkers for Alzheimer’s disease using ultra-widefield imaging (UWFI)

Lajos Csicsyk, Erin Flynn, Enrico Pellegrini, Giorgos Papanastasiou, Tom MacGillivray, Craig Ritchie, Tunde Peto, Imre Lengyel.

Centre for Experimental Medicine, Queen’s University Belfast, Belfast, United Kingdom; 2Centre for Clinical Brain Sciences, The University of Edinburgh, Edinburgh, United Kingdom; 3Queen’s University Belfast, Belfast, United Kingdom; 4NIHR Biomedical Research Centre, Moorfields Eye Hospital NHS Foundation Trust and UCL Institute of Ophthalmology, London, United Kingdom; 5School of Medicine and Health Sciences, The George Washington University, Washington, DC; 6Clinical Research Imaging Centre, University of Edinburgh, Edinburgh, United Kingdom; 7Centre for Dementia Prevention, University of Edinburgh, Edinburgh, United Kingdom.

Purpose: Pathological changes in the eye have been reported in a range of neurodegenerative diseases including changes in retinal vascular parameters (RVPs). The purpose of this study was to assess whether there are measurable RVP changes associated with Alzheimer’s disease (AD) using UWFI and whether any progression related changes can be detected during a 2 year period.

Methods: UWFI images were acquired of 20 healthy controls (HC; (MMSE=28) and 13 participants with AD (MMSE=26) using an OPTOS TX 200 scanning laser ophthalmoscope at baseline (BL) and after a two-year follow-up (FU). The study had full local Ethical Committee approval. Images were analysed using previously developed segmentation and analysis algorithms for UWFI to measure several different RVPs including arterial and venular branching, vessel width gradient (WG), fractal dimensions (FD) of the vascular network patterns and vessel tortuosity. Analysis was carried out either on the whole image or in a circular zone (Zone C) centred on the optic disc (OD) stretching from 0.5 ODDs to 2 ODDs from the OD boundary. The image and zone was further divided into four quadrants centred on the OD. Statistical analysis was carried out in GraphPad Prism (version 7.0, 2016) using a paired and unpaired t-test where appropriate; here results with p<0.05 were reported.

Results: In total, 78 images were included in the analysis (46 HC and 32 AD). There was no significant difference in age between HC and AD (77.7±7.2 vs. 71.3±10.2; p>0.1). At BL there was decreased arterial FD (HC=1.3±0.02; AD=1.2±0.02; P<0.05) and increased arterial WG (HC=3.86x10^{-3}±1.39x10^{-3}; AD=8.43x10^{-3}±1.72x10^{-3}; p<0.05) at the infero-nasal quadrant on the entire image as well as in Zone C. There was an increase in venular WG in superior-nasal quadrant (HC=4.55x10^{-3}±6.03x10^{-4}; AD=9.93x10^{-3}±1.77x10^{-3}; p<0.01) and also when all quadrant were considered together (HC=5.85x10^{-3}±3.23x10^{-4}; AD=8.01x10^{-3}±7.08x10^{-4}; p<0.01) on the entire image as well as in Zone C. From BL to FU our analysis could not detect progression in any of the RVPs.

Conclusions: Our preliminary data suggests that retinal vascular biomarkers measured on UWFI can distinguish between HC and AD at baseline but might not be sensitive enough to detect progression during a 2 year period. Larger participant numbers and longer FU period might be needed to detect progression of RVPs.

Commercial Relationships: Lajos Csicsyk, Erin Flynn, None; Enrico Pellegrini, None; Giorgos Papanastasiou, None; Tom MacGillivray, None; Craig Ritchie, None; Tunde Peto, None; Imre Lengyel, OPTOS Pte (E)

Support: OPTOS Pte unrestricted grant; The Bill Brown Charitable Trust
Program Number: 5454  Poster Board Number: B0611  
Presentation Time: 8:30 AM–10:15 AM  

**Image Quality Comparison Between Non-Mydriatic and Mydriatic High-resolution True-Color Widefield Fundus Images**


**Purpose:** To compare the color, resolution, contrast, and field of view of high-resolution true-color widefield fundus images, captured using a prototype widefield slit-scanning ophthalmoscope (ZEISS, Dublin, CA), imaging the same eyes undilated (non-mydriatic) and after dilation (mydriatic).

**Methods:** We captured high-resolution true-color widefield fundus images of the same eyes before and after dilation. We first imaged the eyes with a naturally dark-adapted pupil. After dilating the eyes using cycloplegic eye drops, we imaged the same eyes again. Pupil diameter (PD) was measured and recorded prior to each acquisition using a PD ruler. Images were visually compared by a clinical expert with respect to color, resolution, contrast, and field of view.

**Results:** We captured images on 6 eyes of 6 normal healthy subjects. The sample included eyes with natural lens (phakic) and artificial lens (pseudophakic). We were able to capture images of all eyes. Visual comparison of the images with undilated and dilated pupils showed no significant difference in color or resolution. Resolution was evaluated in the central retinal field of view and in the periphery. The achieved field of view was identical. The images captured with dilated pupils had slightly higher contrast than the images of the same eyes captured with undilated pupils. Figure 1 shows an example of an undilated eye. Figure 2 shows an image captured of the same eye after dilation.

**Conclusions:** All images taken before and after dilation were found to be clinically useful. No significant differences in color, resolution, or field of view were found when comparing non-mydriatic and mydriatic images captured with the widefield slit-scanning ophthalmoscope prototype. Images of eyes with dilated pupils have slightly higher contrast. The prototype provides clinically useful true-color high-resolution widefield fundus images when imaging undilated or dilated eyes.

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**Commercial Relationships:** Jochen Straub, Carl Zeiss Meditec, Inc (E); Conor Leahy, Carl Zeiss Meditec, Inc (E); Jennifer Luu, Carl Zeiss Meditec, Inc (E); Jeff Schmidt, Carl Zeiss Meditec, Inc (E); Mary K. Durbin, Carl Zeiss Meditec, Inc (E)
Comparison of Nonmydriatic Eye Images Acquired Using a Widefield 90° Slit-Scanning Ophthalmoscope and Standard 45° Commercial Fundus Cameras


**Purpose:** Studies have shown an increase in the rate of unusable images acquired by standard commercial nonmydriatic fundus cameras for subjects >50 years of age. This study compares the quality and field of view (FOV) of images acquired on nonmydriatic eyes of subjects >50 years old with and without ocular disease using a prototype widefield (WF) slit-scanning ophthalmoscope (SSO) (ZEISS, Jena, Germany) and two standard commercial nonmydriatic fundus cameras.

**Methods:** Eighteen (18) nonmydriatic eyes of 9 subjects over 50 years of age were imaged using a ZEISS prototype WF SSO with the macula centered. The system acquires 90° FOV images as measured from the cornea. Comparison 45° FOV images were acquired using standard commercial nonmydriatic fundus cameras, VISUCAM® 524 (ZEISS, Jena, Germany) and VISUCAM®PRO NM (ZEISS, Jena, Germany). Eight subjects had type 2 diabetes, 2 eyes had cataracts, and 2 eyes were pseudophakic. Image quality was evaluated by a licensed optometrist. Images were graded as unusable if 1) image artifacts disrupted the ability to evaluate the central 45° FOV or 2) the size of a subject’s pupil prevented the acquisition of a 45° FOV. Evidence of pathology observable in the outer 45° of the WF SSO images was recorded.

**Results:** Of the nonmydriatic eye images acquired using the prototype WF SSO, 100% (18/18) had usable image quality. Only 67% (12/18) of the nonmydriatic eye images acquired using VISUCAM 524 and VISUCAM®PRO NM had usable image quality, with the rest graded as unusable because the pupil size was too small. Only a small pupil mode 30° FOV image could be acquired using VISUCAM 524 and VISUCAM®PRO NM. For one nonmydriatic eye image, a hemorrhage was observable in the outer 45° of the WF SSO image. Neither VISUCAM 524 nor VISUCAM®PRO NM captured this hemorrhage as it was located outside the 45° FOV.

**Conclusions:** The ZEISS WF SSO is able to acquire high-quality, WF images of nonmydriatic eyes in subjects >50 years old. Though additional testing is required, the Zeiss WF SSO appears to perform at least as well as the standard 45° fundus cameras when evaluating subjects with diabetes, and may provide additional diagnostic information when pathology lies outside the 45° FOV.

**Table 1 - Summary of usable image area for WF SSO, VISUCAM 524, and VISUCAM®PRO NM.**

<table>
<thead>
<tr>
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<th>WF SSO</th>
<th>VISUCAM 524</th>
<th>VISUCAM®PRO NM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of eyes</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Average usable area (mm²)</td>
<td>327</td>
<td>68.5</td>
<td>60.6</td>
</tr>
<tr>
<td>Standard deviation of usable area (mm²)</td>
<td>139</td>
<td>44.9</td>
<td>47.2</td>
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Figure 1 - Comparison of usable image area in 18 eyes (9 subjects) for WF SSO, VISUCAM 524, and VISUCAM®PRO NM.

**Program Number:** 5455 Poster Board Number: B0612

**Presentation Time:** 8:30 AM–10:15 AM

**Program Number:** 5456 Poster Board Number: B0613

**Presentation Time:** 8:30 AM–10:15 AM

Comparison of Usable Image Area Acquired on Nonmydriatic Eyes Using a Widefield Slit-Scanning Ophthalmoscope and Commercial Fundus Cameras


**Purpose:** To compare the usable image area acquired on nonmydriatic eyes of subjects with and without ocular disease using a prototype widefield (WF) slit-scanning ophthalmoscope (SSO) (ZEISS, Dublin, CA) and two standard commercial nonmydriatic fundus cameras, VISUCAM® 524 (ZEISS, Jena, Germany) and VISUCAM®PRO NM (ZEISS, Jena, Germany).

**Methods:** Eighteen (18) nonmydriatic eyes of 9 subjects over 50 years of age were imaged using a ZEISS prototype WF SSO with the macula centered. The system acquires images that subtend a 90° FOV as measured from the cornea. Comparison images were acquired using standard commercial nonmydriatic fundus cameras, VISUCAM 524 and VISUCAM®PRO NM. Both VISUCAM 524 and VISUCAM®PRO NM acquire images that subtend a 45° FOV. Eight (8) subjects had type 2 diabetes mellitus, 2 eyes had cataracts, and 2 eyes were pseudophakic. The usable image area was evaluated by an expert grader. Regions determined to be poor/ unusable in image quality were marked and the remaining portion of the image was defined as usable. For the WF SSO system, the known image distortion was used to convert from area in pixels to area in mm². VISUCAM 524 and VISUCAM®PRO NM were assumed to be distortion free when converting from pixels to area in mm².

**Results:** The usable image area for each device is summarized in Table 1 and Figure 1. For all 18 eyes, the average usable area for WF SSO was 327 mm², for VISUCAM 524 was 68.5 mm², and for VISUCAM®PRO NM was 60.6 mm².

**Conclusions:** The ZEISS WF SSO provides a larger usable image area than both VISUCAM 524 and VISUCAM®PRO NM for nonmydriatic eyes.

**Table 1 - Summary of usable image area for WF SSO, VISUCAM 524, and VISUCAM®PRO NM.**

**Commercial Relationships:** Nathan D. Shemonski, Carl Zeiss Meditec, Inc. (E); Jennifer Luu, Carl Zeiss Meditec, Inc. (E); Abouzar Eslami, Carl Zeiss Meditec, Inc. (E); Gary C. Lee, Carl Zeiss Meditec, Inc. (E); Conor Leahy, Carl Zeiss Meditec, Inc. (E); T K. Brock, Carl Zeiss Meditec, Inc. (E)
Program Number: 5457 Poster Board Number: B0614
Presentation Time: 8:30 AM–10:15 AM

Imaging of Pseudophakic Eyes Using a Widefield Slit-Scanning Ophthalmoscope

Purpose: To evaluate the performance of a prototype widefield (90°) slit-scanning ophthalmoscope in undilated imaging of pseudophakic eyes.

Methods: True Color 90° fundus images were acquired on undilated (nonmydriatic) eyes of pseudophakic subjects using a prototype widefield (WF) slit-scanning ophthalmoscope (SSO) (ZEISS, Dublin, CA) and commercial fundus cameras. Differences in the imaging between the various fundus imagers were evaluated, with a particular focus on the ability to avoid artifacts associated with reflexes from the intraocular lens (IOL).

Results: Initial True Color images acquired from the prototype WF SSO are presented for an undilated, pseudophakic subject (Figure 1a). The WF images were found to be impervious to IOL artifacts, while careful patient alignment was required to avoid IOL artifacts with the commercial fundus camera (Figure 1b).

Conclusions: The prototype WF SSO is capable of acquiring true color 90° fundus images in undilated, pseudophakic eyes without the need for careful patient alignment to avoid IOL artifacts, in contrast to the commercial fundus camera. Further improvement in reflex minimization in the prototype is expected, along with comparison to additional commercial fundus imagers.

Figure 1a:
Image of nonmydriatic Pseudophakic Eye 1 acquired using a prototype WF SSO.

Figure 1b:
Image of nonmydriatic Pseudophakic Eye 2 acquired using a commercial fundus camera. (Right) IOL artifact is visible in image, but (Left) IOL artifact can be avoided with careful patient alignment.

Commercial Relationships: Matthew J. Everett, Jennifer Luu, Carl Zeiss Meditec, Inc. (E); T. K. Brock, Carl Zeiss Meditec, Inc. (E); Conor Leahy, Carl Zeiss Meditec, Inc. (E); Jeff Schmidt, Carl Zeiss Meditec, Inc. (E)

Program Number: 5458 Poster Board Number: B0615
Presentation Time: 8:30 AM–10:15 AM

Revisiting oral fluorescein angiography with an ultra-wide field scanning laser ophthalmoscope; a case series from clinical practice
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Purpose: Intravenous fluorescein angiography (IV FA) is considered the gold standard in visualizing retinal vasculature. However, the complications of injection combined with potentially adverse side effects limit more widespread use in general practice. In the past, oral fluorescein angiography (OFA) has been examined as a potential alternative, but poor image quality and late phase only angiography were limiting factors. Recent advancements in modern laser based fundus photography systems have the potential to increase the clinical usefulness of OFA.

Methods: Retrospective analysis of 25 patients that received OFA was conducted. Age range: 25-91 years. Weight range: 150-330 lbs. Exclusions: pregnant or breast feeding patients and those with phenylketonuria or soy allergy. Patients were dilated with 1% tropicamide. After obtaining informed consent, weight and blood pressure readings, patients were given the option of sugar free liquid versus capsular formulations of sodium fluorescein (NaF), at a dose of 25-30 mg/kg, based on previous literature. After NaF, patients were photographed via ultra-wide field laser scanning ophthalmoscope (UWF-SLO) every 2 min for 30 min.

Results: Time from ingestion to first observable fluorescein ranged from 2-12 min. Eighty five percent of the patients showed observable fluorescence at 8 min, with a max at 15-22 min. Choroidal flush was not observed in OFA. Early, mid and late phases were observed in 90% of patients. Capsular formulation increased time in all phases. Patients weighing over 250 lbs showed decreased contrast on angiogram. There were no allergic reactions. Most common complaint was temporary dysgeusia.

Conclusions: OFA is a simple and effective alternative to IV FA. Longer transit times allow for bilateral panning UWF-SLO photos to be obtained by even a novice photographer. Costs are similar but OFA does not require a nurse or physician for administration. Elimination of needles, infectious waste and potential for injury, along with
painless administration and low incidence of allergic reaction make OFA appealing. To our knowledge this is the first time a sugar free mix has been used for OFA. While variations in contrast relative to weight need optimization, this preliminary study demonstrates that OFA is a good in office diagnostic tool and has potential to be used as a screening tool.

Comparison of OFA (1) vs. IV FA (2).

Commercial Relationships: Nicole Lemanski, Brian Lemanski, Nidek (F)

Program Number: 5459 Poster Board Number: B0616
Presentation Time: 8:30 AM–10:15 AM

Choroidal vascular abnormalities by UWF ICGA in central serous chorioretinopathy
Min Sagong¹, Donghyoun Noh¹, Jano V. Hemert², Junyeop Lee¹, Jang Hwan Ahn¹, Jehwi Jeon¹, Junhyuk Son¹, Sooncheol Cha¹.
¹Department of Ophthalmology, Yeungnam University College of Medicine, Daegu, Korea (the Republic of); ²Optos Plc, Dunfermline, United Kingdom.

Purpose: To evaluate vortex vein engorgement and choroidal vascular hyperpermeability in patients with central serous chorioretinopathy (CSC) using ultra-widefield indocyanine green angiography (UWF ICGA).

Methods: Twenty two patients with unilateral (19 patients) or bilateral (3 patients) CSC were consecutively included and imaged by UWF autofluorescence, fluorescein angiography and ICGA, and spectral domain optical coherence tomography (OCT). The number of quadrant of vortex vein engorgement was evaluated in the early phase of ICGA, which was classified as effective if the dilated choroidal vessels affect the macula. The area of choroidal vascular hyperpermeability was quantified in the late phase using by stereographic projection method. And they were correlated with clinical findings and OCT features.

Results: In all affected eyes, choroidal hyperpermeability from dilated choroidal vessels was observed in association with 1 or more engorged vortex vein. Affected eyes showed significantly greater choroidal hyperpermeability area ($P < 0.001$) and thicker subfoveal choroidal thickness ($P = 0.022$) compared with unaffected eyes although both eyes in the patients with unilateral CSC demonstrated symmetry of vortex congestion (78.1%). The choroidal vascular hyperpermeability was significantly correlated with subfoveal choroidal thickness ($P=0.012$, $\rho=0.493$) and the height of subretinal fluid ($P=0.012$, $\rho=0.514$). The number of quadrant of the effective vortex vein engorgement was correlated with subfoveal choroidal thickness ($P=0.010$, $\rho=0.505$).

Conclusions: UWF ICGA could demonstrate vortex vein engorgement and choroidal vascular hyperpermeability, suggesting outflow congestion as a potential contributor to the pathogenesis of CSC. And they may serve as diagnostic clues or even predictors of disease course.

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