Title: **OCT-A: A New Clinical Tool to Aid in the Diagnosis & Management of Retinal Vascular Diseases**

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**Abstract:** OCT-A is a new, noninvasive method for imaging the retinal and choroidal microvasculature. This poster will review the OCT-A as an adjunctive clinical tool for the optometrist, utilizing three case studies of asymptomatic, longstanding BRVO.

I. **Case History (Patient 1)**

- **Demographics:** 53 year old white male
- **Chief Compliant:** Presents for evaluation of gradual, painless, decreased vision right eye
- **Ocular History:**
  - (+) Hypermature cataract OD
  - 1st exam at University Eye Center: denies other previous ocular disease diagnoses or complications
- **Medical History:**
  - (+) Rheumatoid arthritis: history of prednisone and methotrexate use (d/c due to side effects)
  - (+) Heavy tobacco smoker
  - (+) History of fluctuating, elevated blood pressure levels: has not been diagnosed or treated for hypertension to date
- **Current Medications:** none

II. **Case History (Patient 2)**

- **Demographics:** 66 year old black female
- **Chief Compliant:** Presents for 6 month doctor-directed follow up
- **Ocular History:**
  - (+) Stage 2 Hypertensive Retinopathy
    - Arteriolar attenuation with venous tortuosity first noted ~3 years ago
  - (+) History of suspicion for occlusive disease OS with Carotid Doppler performed ~3 years ago: unremarkable
  - (+) ECCE OU: ~2 years ago
  - (+) History of rebound iritis s/p CE OS
  - (+) PVD OU
  - (+) ERM OU
- **Medical History:**
  - (+) HTN >20 years with history of fluctuating, uncontrolled blood pressure
  - (+) Hyperlipidemia
  - (+) Rheumatoid arthritis: d/c meds as per PCP due to increase in blood pressure
  - (+) Unknown thyroid condition
- **Current Medications:**
  - Hydrochlorothiazide 12.5 mg po QD
  - Prinivil 5 mg po QD
**Case History (Patient 3)**
- **Demographics:** 83 year old Hispanic female
- **Chief Complaint:** Presents for evaluation of decreased, distorted vision OS>OD
- **Ocular History:**
  - (+) Lamellar macular hole OS
  - (+) ECCE with PCO OU
  - (+) BRVO inferior temporal to macula OS (10 years ago)
  - (+) Gliosed macroaneurysm superior temporal to macula OD (6 years ago)
  - (+) Pseudoexfoliative material OU with normotensive IOPs, (-) GL changes
  - (+) Degenerative myopia OU
  - (+) Right superior oblique palsy with longstanding history of intermittent horizontal and vertical diplopia
- **Medical History:**
  - (+) Carotid artery disease (~5 years ago)
  - (+) Uncontrolled, fluctuating blood pressure levels without diagnosis of HTN
  - (+) Crohn’s Disease
  - (+) Arthritis
  - (+) Osteoporosis
  - (+) Tinnitus
  - (+) Longstanding history of vertigo and dizziness
    - Multiple MRIs (> = 5) with (+) ventricular colloid cyst noted and possible history of silent stroke
- **Current Medications:** Humira, Simvastatin, Ranitidine, Cartia XT

**II. Pertinent findings (Patient 1)**
- **Clinical:**
  - BCVA: LP OD, 20/25 OS
  - Pupils: PERRL (-) APD
  - EOMs: Full, smooth, and comitant OU
  - CVF: unable OD, full to finger count OS
  - Tonometry (Goldmann): 17/16
- **Physical:**
  - OD: unable to assess secondary to hypermature cataract
  - OS: Normal vitreous; ONH: 0.40 R with healthy, pink, and well-defined rim tissue; Grade 0 ERM; collateral vessels superior nasal to ONH, isolated dot hemorrhage superior nasally, venous dilation and arteriolar attenuation
- **Other:**
  - B-scan: (-) RD, mass, or other abnormalities OD
  - Blood pressure x 3 (in-office): 158/100, 175/112, 161/110
  - OCT-A OS only: collateral vessels and capillary ischemia along superior temporal arcades on superficial and deep layer scans indicative of previous BRVO, possible wedge defect inferior temporally (Note: area of collaterals superior nasal to ONH not imaged)
- **Pending:** Fundus photos and FA
**Pertinent findings (Patient 2)**

- **Clinical:**
  - BCVA: 20/20 OD, 20/20- OS
  - Pupils: PERRL (-) APD
  - EOMs: Full, smooth, and comitant OU
  - CVF: full to finger count OD/OS
  - Tonometry (Goldmann): 16/16

- **Physical:**
  - DFE + Fundus Photos:
    - OD: Normal vitreous; ONH: 0.25 R with healthy, pink, and well-defined rim tissue; (+) ERM, (+) lamellar hole; (+) AV nicking superior to ONH with venous engorgement and tortuosity, arteriolar attenuation, (+) ghost vessel superior temporally with collateral vessels crossing horizontal raphe
    - OS: Normal vitreous; ONH: 0.25 R with healthy, pink, and well-defined rim tissue; (+) ERM, (+) lamellar hole OS>OD; (+) AV nicking with venous engorgement and tortuosity, arteriolar attenuation

- **Other:**
  - Blood pressure (in-office): 131/90
  - OCT-A OD: collateral vessels and capillary ischemia superior temporally at region of ghost vessel (superficial and deep layers)

**Pertinent findings (Patient 3)**

- **Clinical:**
  - BCVA: 20/40 OD, 20/30+ OS
  - Pupils: OD: 7-6 mm, OS 4-3 mm, surgically induced irregular pupils with minimal reactivity OU, (-) APD
  - EOMs: Full, smooth, and comitant OU, habitual head tilt to left with elevation deficit OS when head straightened out
  - CVF: full to finger count OD/OS
  - Lens: PCIOL with PCO OS>OD
  - Tonometry (Goldmann): 14/14

- **Physical:**
  - DFE + Fundus Photos:
    - OD: PVD; ONH: 0.40 R with healthy, pink, and well-defined rim tissue; normal macula; abnormal vascular looping with fibrotic tissue along superior temporal arcade
    - OS: PVD; ONH: 0.45 R with healthy, pink, and well-defined rim tissue; (+) lamellar hole; (+) collateral vessels, telangiectatic anastomoses inferior temporal to macula

- **Other:**
  - Blood pressure (in-office): 139/67
  - OCT-A:
    - OD: abnormal vascular looping with ischemia superior temporal to macula in region of previous gliosed macroaneurysm
    - OS: collateral vessels with retinal ischemia inferior temporal to macula (superficial and deep layers)
  - Fluorescein angiography imaging performed at diagnosis and visual fields available
III. Differential diagnoses
- Primary: Branch Retinal Vein Occlusion
- Others: Hypertensive Retinopathy, Diabetic Retinopathy, Retinal angiomatous proliferation (Patient 3), Subretinal neovascularization (Patient 3)

IV. Diagnosis and Discussion
- General
  - Retinal vein occlusions are the second most common retinal vascular diseases after diabetic retinopathy and one of the major causes of vision loss or impairment. Branch retinal vein occlusion (BRVO) is an acute cause of visual impairment secondary to thrombotic events, external compression, or vessel wall pathology.
  - Common findings with BRVO include dilated and tortuous veins, narrowing and sheathing of the adjacent artery, retinal neovascularization, cotton wool spots, retinal edema, and/or vitreal hemorrhaging.
  - Optical Coherence Tomography Angiography (OCTA) is a new, non-invasive imaging system that generates both structural and vascular flow images of the retina and choroid. Relative to fluorescein angiography (FA), it is a quick diagnostic tool that utilizes split-spectrum amplitude decorrelation angiography (SSADA) to provide three-dimensional scans. The SSADA uses motion contrast to detect blood flow by comparing consecutive B-scans.
  - OCTA studies with BRVO have revealed that there is a decrease in capillary density with foveal avascular zone enlargement, areas of capillary non-perfusion, and microvascular abnormalities in both superficial and deep vascular layers. Microvascular abnormalities include microaneurysms, telangiectatic vessels, and anastomoses. Another common finding on the OCTA is vascular congestion at the boundary between healthy and nonperfused retina at the deep vascular layer. Further findings include areas of intraretinal edema, retinal atrophy, as well as shunt vessels.
  - An advantage of the OCTA versus the gold standards, fluorescein angiography and ICGA, is that the OCTA has better resolution of the deep capillary network. The OCTA also allows for separation of the retinal layers in order to more precisely identify the layers involved in a lesion. Pathologic regions detected on the OCTA can then be compared with the corresponding B-scans, which will allow for better understanding of retinal vascular disease processes going forward.
  - Preliminary studies have shown that the OCTA, along with SD-OCT, could be just as efficacious as an FA in the evaluation and management of macular complications secondary to BRVO. Agreement has also been shown between FA and OCT-A in assessing areas of nonperfusion.
  - Current limitations of the OCTA are the presence of image artifacts, decorrelation due to bulk motion and background noise, its inability to show active leakage or real time flow, as well as a small field of view relative to FA. Over time, as the software is able to acquire images at a faster speed, the field of view may be increased with greater resolution of the images. However, it is important to keep in mind that the faster the time between subsequent scans, the less likely the OCTA will be able to pick up on regions of slow blood flow.

- Case Study
  - In Patients 1 and 2, an old, subtle, asymptomatic BRVO was detected inadvertently upon examination and confirmed with OCTA analysis. In Patient 3, the OCTA scan was conducted to compare with FA imaging in a longstanding BRVO patient.
V. Treatment and Management

- General
  - Initial follow up period for BRVO: Q1-2 months. Once stable, Q3-12 months.
    - Important to monitor for subsequent macular edema
      i. Treatment: intravitreal anti-VEGF injections
    - Patients with retinal neovascularization may be treated with PRP in the region of ischemia. In preliminary studies, it is evident that OCTA is as reliable for detecting areas of capillary nonperfusion as an FA.³
  - Standard of care: perform IVFA. However, OCTA may be a new alternative to patients who have frequent follow up visits or have an adverse reaction to IVFA.
  - Clinical pearls: It is important to check blood pressure on patients with suspected systemic disease and refer for treatment of the underlying disease or comorbidities.

- Case Study
  - Patient 1: RTC 2 months for FA with retinal specialist OU post ECCE OD. RTC STAT if changes in vision OS.
  - Patient 2: RTC 6 months for doctor-directed follow up with DFE.
  - Patient 3: RTC 6 months for doctor-directed follow up with DFE. Continue care in Neuro clinic as directed for management of diplopia.

VI. Conclusion

- Although the three patients analyzed in this poster have asymptomatic, old BRVOs that do not need active treatment or aggressive monitoring at this time, the presence of their retinal diseases is indicative of serious, underlying vascular disease processes. The optometrist plays a vital role in the care and management of the overall health and well-being of such patients by addressing the need for further care through their primary care provider or specialists. In this case series, Patient 1 was referred to his primary care provider to address and initiate treatment for his longstanding, uncontrolled blood pressure. Patients 2 and 3 were already being regularly monitored by their PCPs for the underlying systemic conditions.
- The OCTA may serve as an aid to confirm the diagnosis of subtle retinal findings, such as the two asymptomatic, previously undiagnosed BRVO patients. It is a relatively inexpensive and quick procedure for patients who may require frequent follow up exams and may serve as a useful adjunctive tool for the optometrist to have at his/her disposal.
- The utilization of the OCTA instead of fluorescein or indocyanine green angiography also eliminates the risk of possible allergic reactions to the injected dye. These reactions range from common symptoms of nausea and vomiting to the rare side effect of anaphylaxis.
- Detection of flow compromise early in retinal disease processes may help prevent significant vision loss through earlier intervention and treatment.
- Although this poster looks at the analysis of OCTA in patients with BRVO, the new technology may also be used to detect and monitor changes associated with diabetic retinopathy, AMD, sickle cell disease, myopic choroidal neovascularization, as well as glaucoma.¹²³
- There are still many limitations to this device. It is important to keep in mind that at present, there is limited information on the usefulness of the OCTA in everyday practice, as well as a normative database to analyze the results.
References:


