STATE BOARD OF OPTOMETRY
2450 DEL PASO ROAD, SUITE 105, SACRAMENTO, CA 95834
P (916) 575-7170 F (916) 575-7292 www.optometry .ca.gov

Continuing Education Course Approval Checklist

Title: 2017 Spring Education Symposium - An Introduction to Fundus Auto-Fluorescence (FAF)

Provider Name: Marshall B Ketchum University c/o Dr. John Lee

☑Completed Application
Open to all Optometrists? ☑Yes ☐No
Maintain Record Agreement? ☑Yes ☐No

☑Correct Application Fee

☑Detailed Course Summary

☑Detailed Course Outline

☑PowerPoint and/or other Presentation Materials

☑Advertising (optional)

☑CV for EACH Course Instructor

☑License Verification for Each Course Instructor
Disciplinary History? ☐Yes ☑No

AAOS

ASIAN AMERICAN OPTOMETRIC SOCIETY
PRESENTS

2017 Spring Education Symposium

Sheraton Cerritos Hotel - 12725 Center Ct Dr S, Cerritos, CA 90703
Sunday, April 2, 2017

5 HOURS OF CONTINUING EDUCATION

Agenda:

8:00am – 8:10am	**Welcome** Andy Kongsakul, O.D. President, AAOS
8:10am – 9:00am (1 Hour CE)	**10 LASIK Myth Busters** **SMILE – Small Incision Lenticule Extraction** Tom Tooma, MD, NVision Eye Centers
9:00am – 9:20am *(20 min)*	*Break*
9:20am – 11:00am (2 Hours CE)	**Topography Guided LASIK** Franklin Lusby, MD, NVision Eye Centers **Choosing Premium Lenses in Highly Aberrated Corneas** **Understanding New Extended Depth of Focus IOLs** Sheri Rowen, MD, NVision Eye Centers
11:00pm – 11:20pm *(20 min)*	*Break*
11:20am – 12:10pm (1 Hour CE)	**An Introduction to Fundus Auto-Fluorescence (FAF)** Raman Bhakhri, OD, Marshall B Ketchum University
12:10pm – 1:00pm (1 Hour CE)	**Updates on Hydroxychloroquine Retinpathy** Tina Zheng, OD, Marshall B Ketchum University

CALIFORNIA STATE BOARD OF OPTOMETRY

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CONTINUING EDUCATION COURSE APPROVAL APPLICATION

Board Use Only			
Receipt #	Payor ID	Beneficiary ID	Amount
1-2916	541455	488477	50

$50 Mandatory Fee

Pursuant to California Code of Regulations (CCR) § 1536, the Board will approve continuing education (CE) courses after receiving the applicable fee, the requested information below and it has been determined that the course meets criteria specified in CCR § 1536(g).

In addition to the information requested below, please attach a copy of the course schedule, a detailed course outline and presentation materials (e.g., PowerPoint presentation). Applications must be submitted 45 days prior to the course presentation date.

Please type or print clearly.

Course Title	**Course Presentation Date**
An Introduction to Fundus Auto-Fluorescence	04/02/2017 11:20Am - 12:00Pm

Course Provider Contact Information

Provider Name

John (First) Lee (Last) Howard (Middle)

Provider Mailing Address

Street 2575 Yorba Linda Blvd **City** Fullerton **State** CA **Zip** 92831

Provider Email Address jlee@ketchum.edu

Will the proposed course be open to all California licensed optometrists?	☑ YES ☐ NO
Do you agree to maintain and furnish to the Board and/or attending licensee such records of course content and attendance as the Board requires, for a period of at least three years from the date of course presentation?	☑ YES ☐ NO

Course Instructor Information

Please provide the information below and attach the curriculum vitae for each instructor or lecturer involved in the course. If there are more instructors in the course, please provide the requested information on a separate sheet of paper.

Instructor Name

Raman (First) Bhakhri (Last) (Middle)

License Number 14547	**License Type** Optometrist
Phone Number (714) 449-7401	**Email Address** rbhakhri@ketchum.edu

I declare under penalty of perjury under the laws of the State of California that all the information submitted on this form and on any accompanying attachments submitted is true and correct.

Signature of Course Provider — *Date* 2/14/2017

SUMMARY – An Introduction to Fundus Auto-Fluorescence

Raman Bhakhri, OD

Fundus Auto-Fluorescence (FAF) is an underappreciated tool used in providing the best care to our patients. While OCTs are the "hot toys" going into optometrists' offices, the FAF is a great technology that is getting overlooked. Clinical conditions such as age related macular degeneration, central serous retinopathy, plaquenil toxicity and others are better evaluated and treated with this technology. This lecture will go into the technology itself, the use of it in clinical practice and cases in which this technology made a difference in taking better care of the patient than without it.

An Introduction to Fundus Auto-Fluorescence

Introduction:

- What is FAF: FAF provides a topographic map of accumulated lipofuscin within the retinal pigment epithelium (RPE)
- Represents a non-invasive means of identifying pathologic changes that cannot be visualized with normal fundus photography, fluorescein angiography, or optical coherence tomography (OCT).

How does it work: imaging lipofuscin

- In RPE cells, due to incomplete degradation of photoreceptor outer segments by lysosomes, the undigested material is termed lipofuscin.

Different Imaging Modalities

- Fundus Camera: (single flash, very bright, low contrast, low resolution, cheaper)
- cSLO: (higher contrast, continuous scanning, expensive)
- Wide field: (cheaper, wide field, less contrast, lids/eyelashes)

Interpretation:

- Around the central macular area, the FAF signal is lessened due to luteal pigment.
- Blood vessels are black due to absorption of light by blood
- Normal retina is grey in color
- Optic nerve head is black
    - Absence of RPE and therefore no lipofuscin
    - Hyper auto fluorescence: accumulation of lipofuscin or other ocular fluorophores due to RPE dysfunction
    - Will glow white
    - Hypo auto fluorescence: absence of RPE secondary to atrophy or tearing and blockage of the RPE by overlying fluid or vitreous opacities
    - Will look black

Clinical Applications:

- AMD
- CSC (central serous retinopathy)
- Plaquenil toxicity
- Choroidal Nevi / melanomas
- ONH Drusen
- Macular / retinal dystrophies

AMD:

- Dry AMD: Intro
- Benefits
- Clinical Implications: Can be predictive of transition to Wet AMD

Geographic Atrophy:

- Introduction of junctional zone, can predict progression based on appearance

Plaquenil Toxicity:

- Intro, Pathophysiology
- FAF interpretation

Central Serous:

- Intro, Pathophysiology
- FAF interpretation

Stargardt maculopathy:

- Intro, Pathophysiology
- FAF interpretation

RP:

- Intro, Pathophysiology
- FAF interpretation

Optic Disc Drusen:

- Intro, Pathophysiology
- FAF interpretation

Choroidal melanoma/nevi

- Intro, Pathophysiology
- FAF interpretation

AN INTRODUCTION TO FUNDUS AUTO-FLUORESCENCE (FAF)

Roman Bhakhri O.D., F.A.A.O.
Assistant Professor
Southern California College of Optometry

- Goals:
  - Facilitate understanding of the scientific basis of FAF
  - Interpreting FAF findings
  - Clinical cases

WHAT IS FUNDUS AUTO FLUORESCENCE?

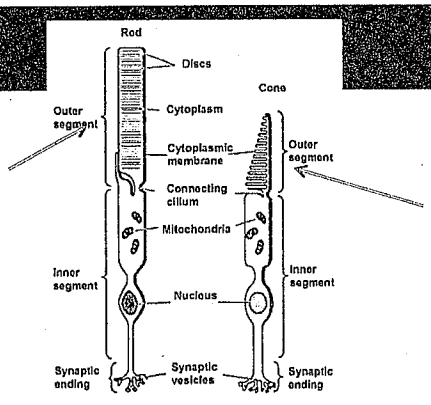
- FAF provides a topographic map of accumulated lipofuscin within the retinal pigment epithelium (RPE)
- Represents a non-invasive means of identifying pathologic changes that cannot be visualized with normal fundus photography, fluorescein angiography, or optical coherence tomography (OCT).

LIPOFUSCIN

- RPE digests tips of the photoreceptor outer segments every day. This digestive material contains fatty acids and by products of the visual cycle.
- In RPE cells, due to incomplete degradation of photoreceptor outer segments by lysosomes, the undigested material is termed lipofuscin.
- Lipofuscin accumulation part of normal aging process

LIPOFUSCIN

- Once formed, the RPE cell has no means to either degrade or transport LF into the extracellular space via exocytosis
- LF trapped in the cytoplasmic space
- Lipofuscin is not a single compound, composed of different molecules.
  - Best known component is A2E
- Excessive accumulation thought to be due to disease process.



AUTO-FLUORESCENCE

- LF is a fluorophore: chemical compound that can re-emit light upon light excitation
- Broad spectrum of excitation (300-600nm) and emission (480-800nm).
- Excited by wavelengths in the green and blue portion of the color spectrum.

BENEFITS

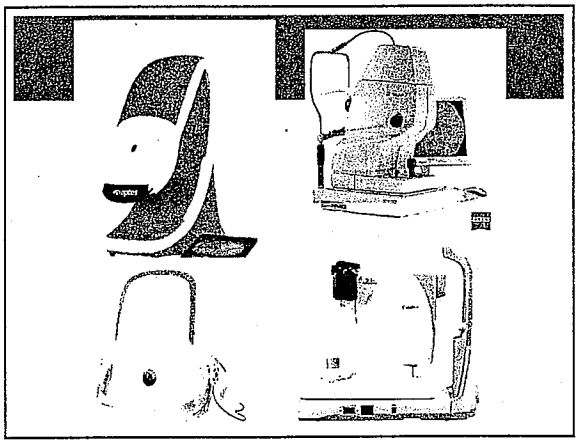
- Documentation
- Diagnostic Modality (especially for conditions that are not visible through traditional means)
- Detect structural abnormalities
- Predict functional deficits

IMAGING MODALITIES

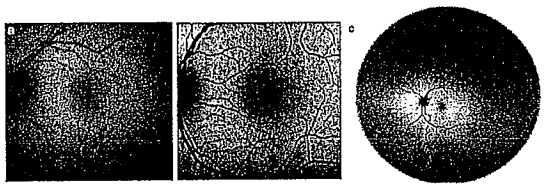
Fundus Camera: (single flash, very bright, low contrast, low resolution, cheaper)
- Topcon TRC
- Zeiss Visucam
- Canon CR2

cSLO: (higher contrast, continuous scanning, expensive)
- Heidelberg Spectralis
- Nidek F-10

Wide field: (cheaper, wide field, less contrast, lids/eyelashes)
- Daytona
- California



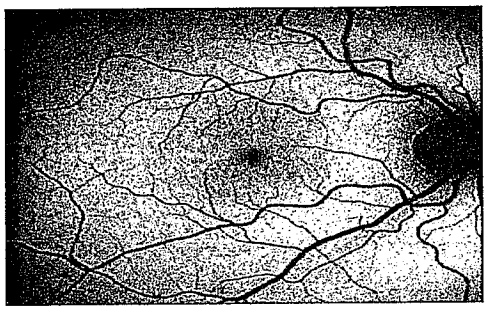
COMPARISON



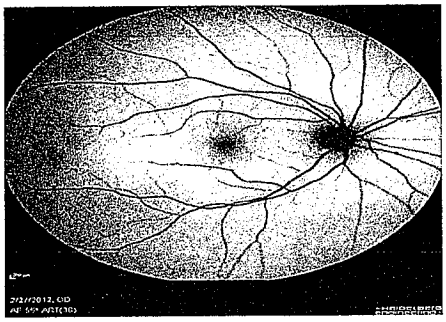
NORMAL FUNDUS

- Around the central macular area, the FAF signal is lessened due to luteal pigment.
- Blood vessels are black due to absorption of light by blood
- Normal retina is grey in color
- Optic nerve head is black
  - Absence of RPE and therefore no lipofuscin

A NORMAL FUNDUS



A NORMAL FUNDUS



INTERPRETATION

- Hyper auto fluorescence: accumulation of lipofuscin or other ocular fluorophores due to RPE dysfunction
  - Will glow
- Hypo auto fluorescence: absence of RPE secondary to atrophy or tearing and blockage of the RPE by overlying fluid or vitreous opacities
  - Will look **black**

CLINICAL APPLICATIONS

- AMD
- CSC (central serous retinopathy)
- Plaquenil toxicity
- Choroidal Nevi / melanomas
- ONH Drusen
- Macular / retinal dystrophies

EARLY DRY AMD

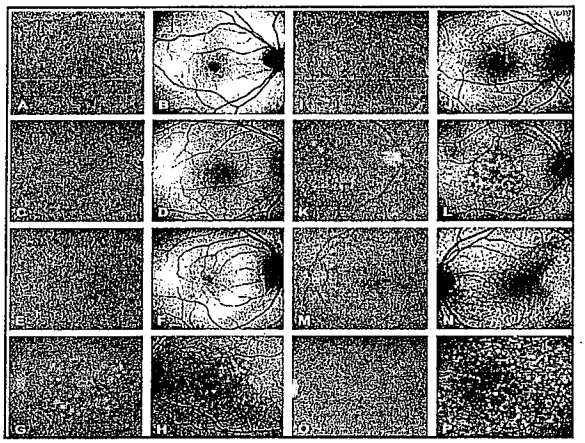
- Characterized by drusen, focal hypo/hyper pigmentation
  - Patients may be asymptomatic
- Early AMD-wide variety of FAF patterns that are "invisible" to conventional cameras.
- FAF provides higher contrast than normal fundus photos, allowing for easier visualization of areas of RPE loss
  - Images of atrophy can be used to monitor for progression

WHY FAF?

- Early AMD patients, changes in auto fluorescent signals are not always related to fundus images and not visible on fluorescein angiograms
- Findings:
- Hyperpigmentation
  - increases in FAF signals due to melano-lipofuscin
- Hypo- and depigmentation
  - loss of FAF signals dependent on the degenerated or lack of RPE.
- FAF signals related to drusen can be normal, increased, or decreased relative to background autofluorescence.
  - Therefore, not possible to identify drusen among other autofluorescent images. Fundoscopic images need to be viewed concurrently

FUNDUS AUTO FLUORESCENCE STUDY GROUP: AUTO FLUORESCENCE PATTERNS

1) Normal pattern
2) Minimal change pattern
3) Focal increase pattern
4) Patchy pattern
5) Linear pattern
6) Lacelike pattern
7) Reticular pattern
8) Speckled pattern

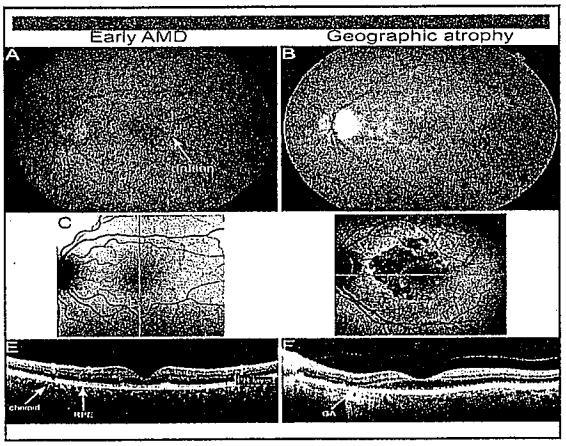


CONCLUSIONS

- In transition to exudative AMD, the so-called patchy FAF pattern was found to be the most frequently associated pattern.
  - suggests that the patchy FAF pattern in early AMD may represent a high-risk marker for progression to advanced AMD.
- Another study: patchy and linear patterns were found to be the most risky patterns in transition to wet AMD

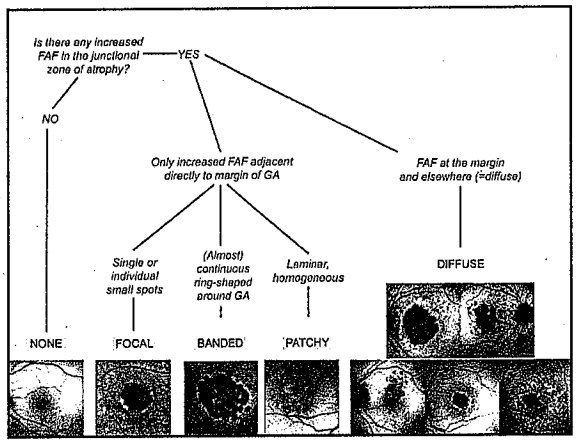
GEOGRAPHIC ATROPHY (GA)

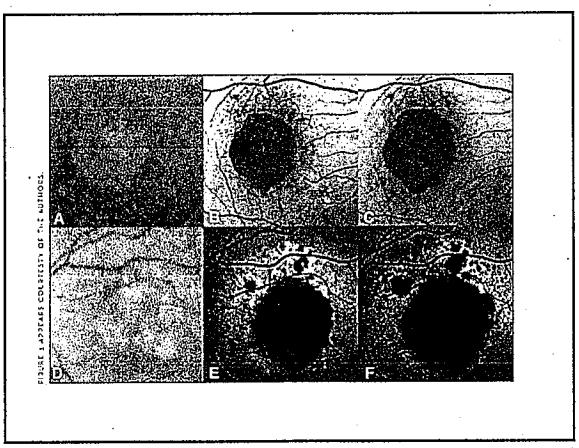
- Geographic atrophy indicates the late stage of AMD
- Can be a single or multiple areas of atrophy
- Sharply demarcated atrophic area with visible underlying choroidal vasculature
  - FAF finding: Since lipofuscin not found in absence of RPE, decreased FAF-will look black



FAF AND THE JUNCTIONAL ZONE

- Junctional zone: Increased amounts of lipofuscin in areas surrounding GA
  - help predict risk of progression.
- Increases in FAF seen in GA are caused by an increase in lipofuscin in the RPE. The increase in lipofuscin generally precedes cellular death; therefore, an increase in FAF represents an incipient area of atrophy.





TAKE HOME POINT

- The more hyper-autofluorescent the FAF signal is at the junctional zone, more likely there will be GA progression.
- This is especially true when the auto fluorescent signal expands in a diffuse pattern beyond the area of GA
- Interestingly, FAF patterns described by FAM study group demonstrate stronger impact on GA progression than other risk factors—including age, history of smoking, atrophy size at baseline and systemic disease

Type	Progression
No abnormalities	0.38mm2
Focal	0.81mm2
Diffuse	1.77mm2

PLAQUENIL TOXICITY

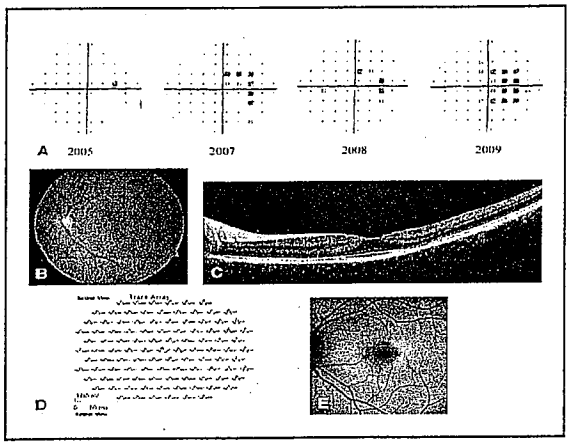
- Chloroquine (CQ) and hydroxychloroquine (HCQ) have been used for in the treatment and prophylaxis of malaria as well as in the management of systemic lupus erythematosus, rheumatoid arthritis, and other dermatologic and rheumatologic diseases.
- Affinity for melanin-rich tissue, including the RPE, and both drugs may affect the metabolism of photoreceptors.
- Accumulation of these medications in the RPE may account for long-term toxicity, which may progress for several months after the medication has been discontinued.

PLAQUENIL TOXICITY

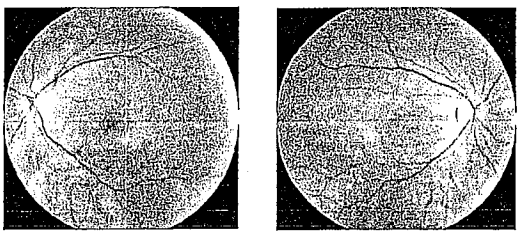
- Signs:
  - Ophthalmoscopy may reveal granular pigmentary alterations, often in the form of a bull's eye maculopathy, with a circle of RPE atrophy surrounding but sparing the central fovea.
- Symptoms
  - blurred vision
  - photophobia
  - paracentral scotomas

PLAQUENIL TOXICITY

- Methods not recommended for early detection:
  - Fundus photos
  - Full field ERG and EOG
  - Color Vision
  - 24-2 VF and Amsler grid
  - FA
  - Time Domain OCT
- New Guidelines:
  - DFE
  - 10-2 visual field perimetry
  - spectral domain optical coherence tomography (SD-OCT)
  - fundus autofluorescence
  - multifocal electroretinogram (mfERG).

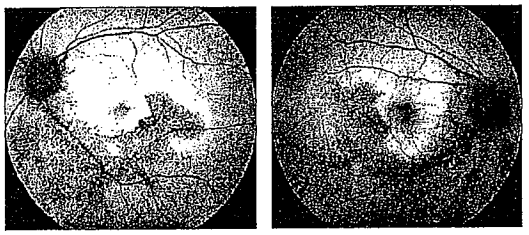


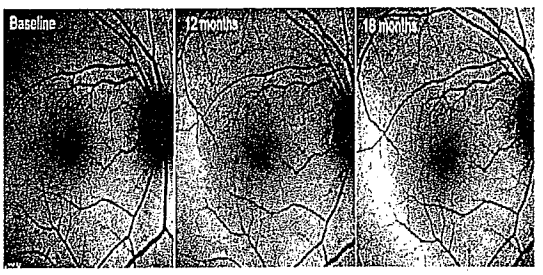
PLAQUENIL TOXICITY 20/20 VA?



http://www.westcoastretina.com/WestCoastRetina/july-2010.html

PLAQUENIL TOXICITY





Dong Hoon Lee, Ronald B. Melles, Soo Geun Joe, Joo Yong Lee, Juna-Gone Kim, Chang-Keun Lee, Bin Yoo, Bon San Koo, Jae Taek Kim, Michael F. Marmor, Young Hee Yoon
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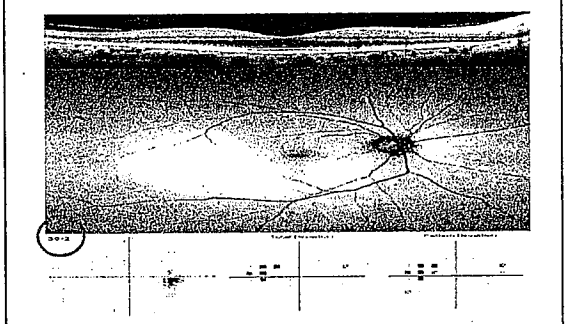

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CENTRAL SEROUS CHORIORETINOPATHY (CSC)

- idiopathic flat retinal detachment within the macula young and middle-aged adults between 20 to 50 years of age
- Primarily male patients (male: female ratio about 10:1) are affected and typically a type-A behavior in these patients can be observed.
- emotional stress frequently accompanies the visual disturbances
- Also associated with:
  - vasoconstrictive agents
  - endogenous hyper cortisol
  - systemic corticosteroid use

CENTRAL SEROUS CHORIORETINOPATHY (CSC)

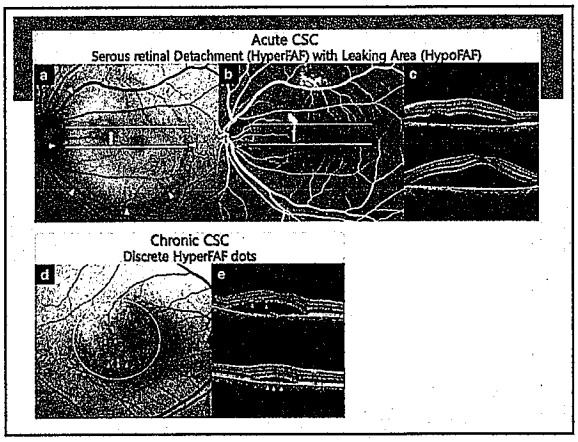
- Signs:
  - shallow, round, and serous detachment of the neurosensory retina
  - small detachments of the retinal pigment epithelium (RPE)
- Symptoms:
  - blurred vision
    - visual acuity in the range of 20/20 to 20/200, with an average presenting visual acuity of 20/30
  - scotoma
  - micropsia
  - metamorphopsia

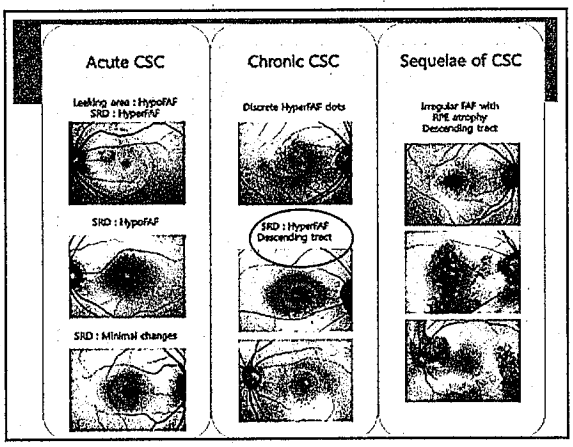
CENTRAL SEROUS CHORIORETINOPATHY (CSC)

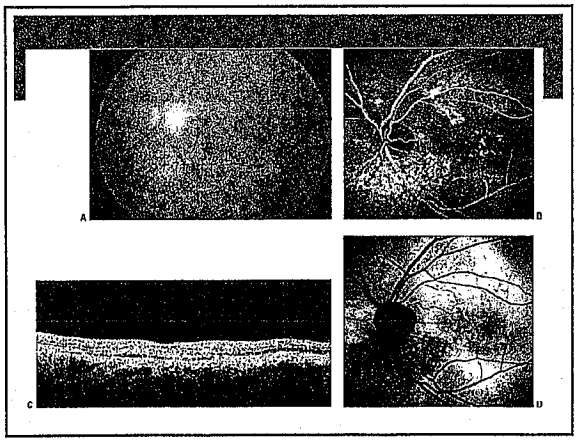
- Pathophysiology
  - Widely accepted that the origin of the subretinal fluid is the choroid. Because of a defect in the RPE layer, choroidal fluid enters the subretinal space and leads to the detachment of the neurosensory layer
  - permeability of the choriocapillaris is the primary cause of damage to the overlying RPE leading to distinct breaks and subsequent neurosensory detachment

CENTRAL SEROUS CHORIORETINOPATHY (CSC)

- Treatment:
  - The long-term visual prognosis for most patients is excellent and improvement can be achieved without treatment.
    - 20% to 30% of patients will have one or more recurrences
    - 5% will develop choroidal neovascularization or chronic detachment with cystoid macular edema from this condition
  - Retinal laser
  - PDT
  - Avastin



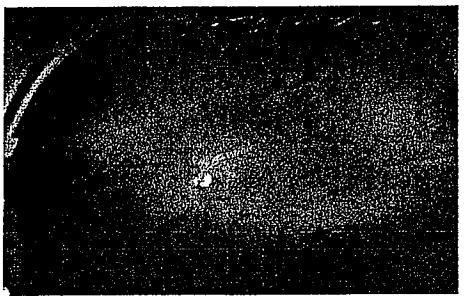


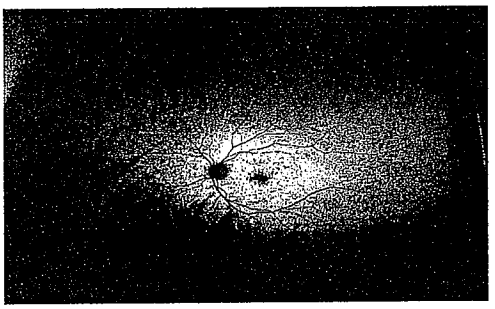


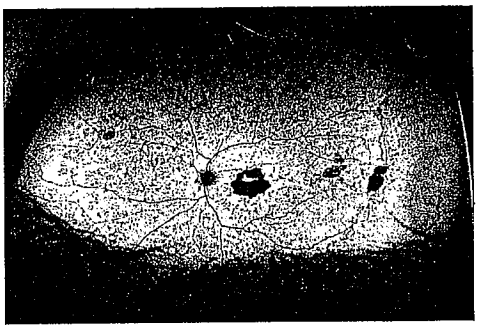
STARGARDT DISEASE

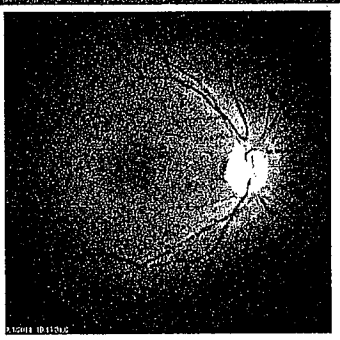
- Most common inherited macular dystrophy
- Variability in age of onset, acuity, retinal appearance, and severity.
- ABCA4 gene mutation is cause of condition
  - Responsible for transport of retinoids
  - All-trans-retinal accumulates, and lipofusicin builds, rpe and photoreceptor damage
- Signs:
  - Normal
  - RPE mottling
  - Bulls eye appearance/beaten bronze
  - Pisciform flecks
- Symptoms:
  - Decreased VA, central scotoma

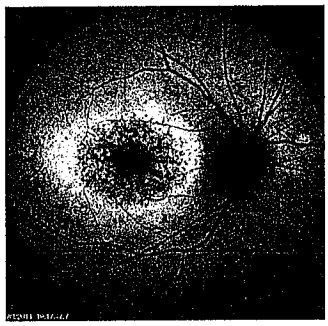
STARGARDT DISEASE











RETINITIS PIGMENTOSA

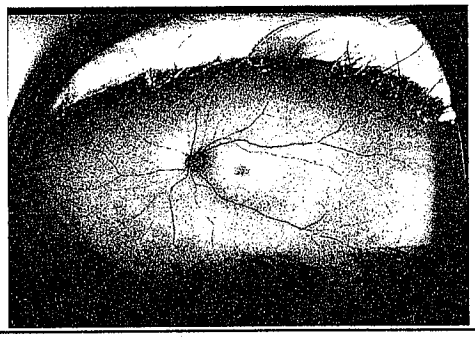
- Group of conditions with rod dysfunction and then cone function
- AD,AR, X-linked, mitochondrial, digenic
  - Gene mapping
- Symptoms:
  - Night vision problems
  - Visual field restriction
  - Decreased acuity
- Signs:
  - Bone spicules(photoreceptor death lead to pigment migration)
  - Blood vessel attenuation
  - Disc pallor
  - Foveal lesions
  - PSC's

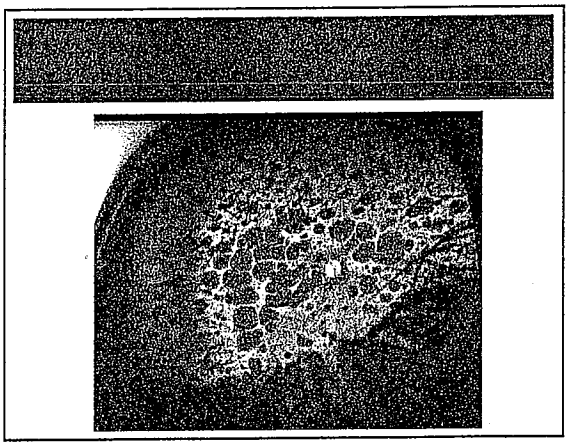
FAF FINDINGS

- Early: Hyper auto fluorescent parafoveal ring not visible on fundus exam
  - corresponds to outer segment dysfunction and lipofuscin production
  - Size of ring correlates with visual function
- Late: Varying presentations:
  - Islands of preserved/non preserved retina
  - Central retinal atrophy
- Abnormal fundus auto fluorescence precedes loss of retinal function and is helpful for monitoring disease progression

RP VARIANT: USHERS

USHERS





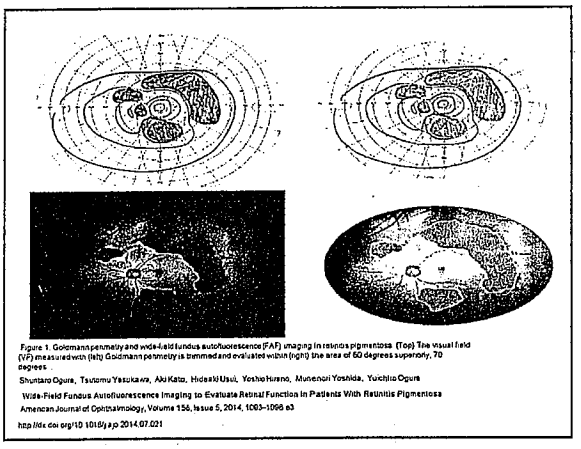


Figure 1. Goldmann perimetry and wide-field fundus autofluorescence (FAF) imaging in retinitis pigmentosa. (Top) The visual field (VF) measured with (left) Goldmann perimetry is trimmed and evaluated within (right) the area of 60 degrees superiorly, 70 degrees.

Shuntaro Ogura, Tsutomu Yasukawa, Aki Kato, Hideaki Usui, Yoshio Hirano, Munenori Yoshida, Yuichiro Ogura

Wide-Field Fundus Autofluorescence Imaging to Evaluate Retinal Function in Patients With Retinitis Pigmentosa

American Journal of Ophthalmology, Volume 156, Issue 5, 2014, 1063–1066.e3

http://dx.doi.org/10.1016/j.ajo.2014.07.021

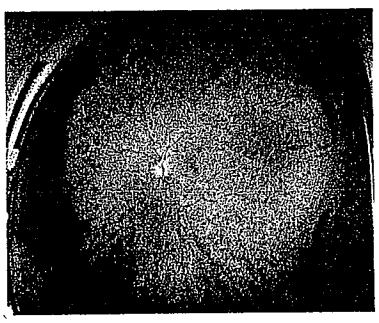
OPTIC DISC DRUSEN

- They are typically buried early in life and generally become superficial, and therefore visible, later in childhood, at the average age of 12 years.
  - Autofluorescence of drusen depends on it's depth
    - deep buried drusen may be difficult to assess using FAF.
- Complications:
  - visual field defects
  - hemorrhages
  - choroidal neovascular membrane
  - nonarteritic anterior ischemic optic neuropathy
  - retinal vascular occlusions

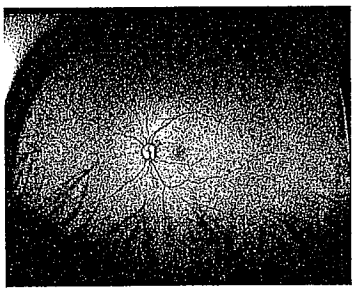
OPTIC DISC DRUSEN

- The calcific properties of drusen have inherent auto fluorescent ability, thus ONHD will hyper fluoresce on FAF.
- Research shows this method is effective in diagnosing ONHD in pediatric patients.
  - Misdiagnosing drusen as true disc edema may lead to an invasive and unnecessary workup for elevated intracranial pressure
- Ultrasound B is considered the most reliable method for detecting ONHD. It permits buried drusen to be detected, even in uncooperative children or in patients with media opacity
  - B-scan availability???

DISC DRUSEN

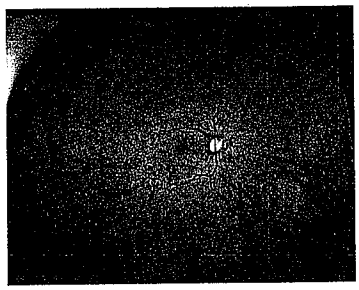


DISC DRUSEN

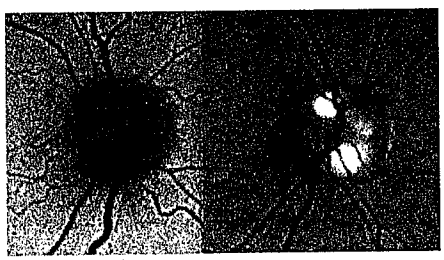


DISC DRUSEN

DISC DRUSEN



BURIED DRUSEN



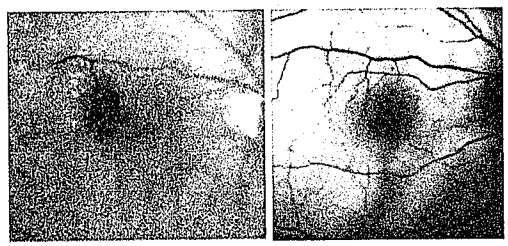
CHOROIDAL NEVUS VS MELANOMA

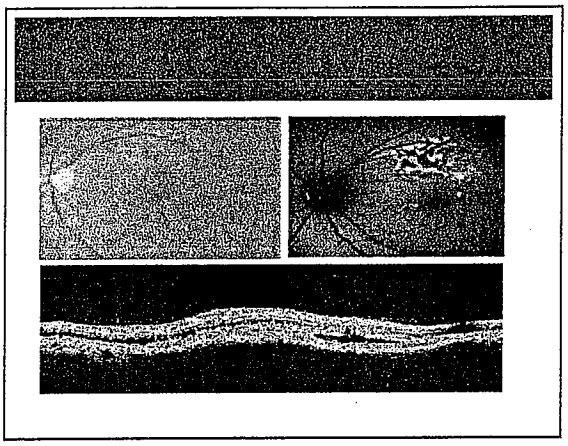
- Choroidal nevi are benign melanocytic lesions of the posterior uvea.
  - In the United States, their prevalence ranges from 4.6 percent to 7.9 percent in Caucasians.
  - By comparison, choroidal melanoma is rare, manifesting in approximately six in 1 million Caucasian individuals.
- Metastasis of and death from choroidal melanoma have been shown to correlate with increasing basal diameter and increasing thickness of the lesion.
- Early detection is important.
- In addition, making the correct diagnosis of choroidal nevi in a timely fashion protects patients against the visually damaging effects of unnecessary treatment.

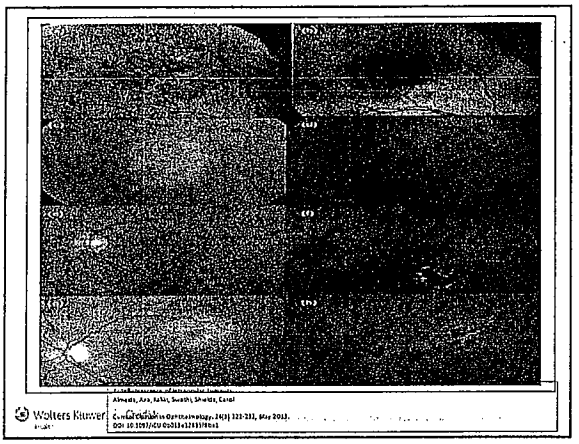
TFSOM USHH

- To Find Small Ocular Melanoma Using Helpful Hints Daily" (TFSOM-UHHD)
- This stands for
  - *Thickness* greater than 2 mm
  - subretinal *Fluid*,
  - *Symptoms*
  - *Orange* pigment present,
  - *Margin* within 3 mm of the optic disc,
  - *Ultrasonographic hollowness* (versus solid/flat)
  - absence of *halo* (A halo refers to a pigmented choroidal nevus surrounded by a circular band of depigmentation.)
  - absence of *drusen*

CHOROIDAL NEVUS VS MELANOMA







CHOROIDAL NEVUS VS MELANOMA

- Patients who have one or two risk factors for malignant transformation should be monitored every four to six months.
- Three or more suspicious features should be referred management alternatives and possible treatment due to their increased risk of developing melanoma
- The presence of three or more of these risk factors is correlated with more than 50% chance for tumor growth
  - strongly suggestive of a small choroidal melanoma rather than nevus

TAKE HOME POINTS

- A great adjunct type of testing
  - Easy to perform
- Always try to correlate to fundus appearance, signs, and symptoms
- Not useful for every disease....

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- CE Lecture, My Favorite Retinal Cases, Asian American Optometric Society — May 2015
- CE Lecture, Select Low Vision Topics, MBKU/UCLA Program — Jan 2015
- Gyrate Like Atrophy in an ornithine normal patient AAO Ellerbrock Grand Rounds , Denver, CO Rounds, American Academy of Optometry Meeting Seattle, WA — Nov 2014
- Hereditary Retina 101, Optometry's Meeting Philadelphia, PA — June 2014
- Low Vision Grand Rounds, Optometry's Meeting Philadelphia, PA — June 2014
- CE Lecture, Hereditary Retina, SCCO Ocular Disease Program — Mar 2014
- CE Lecture, Retinitis Pigmentosa, SCCO Ocular Disease Program — Nov 2013
- A Presumed White Dot Syndrome, AAO Ellerbrock Grand Rounds, American Academy of Optometry Meeting Seattle, WA — Oct 2013
- CE Lecture, White Dot Syndromes, SCCO Ocular Disease Program Part 1 — Mar 2012
- Development of Mobile Device and PC-based Vision Testing, Assessment and Education: A Survey of Smart Phone Usage In Low Vision Patients. *Envision Conference.* — Sept 2012
- Grand Rounds Lecturer at ICO: Presented clinical case studies to fourth year students and faculty at ICO. Topics included Idiopathic Intracranial Hypertension, Progressive Outer Retinal Necrosis, and Multiple Evanescent White Dot Syndrome. — Sept 2011-Mar 2012

Research:

- Co-investigator: Maestro NDB II: "Topcon 3D OCT-1 Maestro Reference Database Study II — May-June 2015

Licensure:

- California License — Oct 2012-present
- Illinois License (inactive) — Mar 2011-present

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- Ittner EA, **Bhakhri R**, Newman T. Necrotising herpetic retinopathies: a review and progressive outer retinal necrosis case report. Clinical & experimental optometry : journal of the Australian Optometrical Association. 2016;99(1):24-9.

- **Bhakhri R**. Spectral domain optical coherence tomography and auto-fluorescence findings in adult-onset vitelliform dystrophy. Clinical & experimental optometry : journal of the Australian Optometrical Association. Dec 30 2014. [Epub ahead of print]

- **Bhakhri R**. Ischemic Optic Neuropathy. California Optometry. 2014;41(1):44-50.

- **Bhakhri R**. Clinical findings and management of multiple evanescent white dot syndrome. Optometry and vision science: official publication of the American Academy of Optometry. 2013 Oct;90(10):e263-8. PubMed PMID: 23939295. Epub 2013/08/14. eng.

- Chun R, **Bhakhri R**, Coalter J, Jay WM. Smartphone Usage in Patients with Optic Atrophy. Neuro-Ophthalmology. 2012;36(5):193-5.

- **Bhakhri R**, Cymbor, M. Intravitreal bevacizumab holds promise for treating neovascular glaucoma. Primary Care Optometry News. 2010 April:10.

Presentations:

• An Introduction to Fundus Auto Fluorescence, SCCO	Jan 2017
• The Somewhat, Kind Of, Sort Of White Dot Syndromes AAO Meeting, Anaheim, CA	Nov 2016
• CE Lecture, Retina Grand Rounds, OCOS	Oct 2016
• CE Lecture, Unique Ocular Disease Cases, SCCO Ocular Disease Program	July 2016
• What is Low Vision? Laguna Woods Community Center	April 2016
• CE Lecture, Optic Neuropathy Pearls, SCCO Ocular Disease Program	Mar 2016
• CE Lecture, Infectious Retina, SCCO Ocular Disease Program	Mar 2016
• CE Lecture, Disease Grand Rounds South Bay Optometric Society, Torrance, CA	Feb 2016
• CE Lecture, Hereditary Retina Grand Rounds South Bay Optometric Society, Torrance, CA	Feb 2016
• The Somewhat, Kind Of, Sort Of White Dot Syndromes AAO Meeting, New Orleans, LA	Oct 2015
• Low Vision Technology Grand Rounds AAO Meeting, New Orleans, LA	Oct 2015
• Adaptive Low Vision Technology AAO Meeting, New Orleans, LA	Oct 2015
• CE Lecture, A Potpourri of Cases, SCCO Ocular Disease Program	July 2015
• Low Vision Lecture, Department of Rehabilitation	May 2015

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• Orange Country Optometric Society (OCOS)	2012-present
• American Academy of Optometry(AAO)	2011-present
• British Columbia Association of Optometrists (BCAO)	2010-2011
• Canadian Association of Optometrists (CAO)	2010-2011
• American Optometric Association (AOA)	2006-present

Posters:

- **Bhakhri R** et al. Reversal of white spots and night blindness: a case of Vitamin A deficiency. Optom Vis Sci 2016;93:E-abstract 165298.
- **Bhakhri R**, Sawamura M. Pituitary macroadenoma in a monocular patient: correlating structural loss to functional loss. Optom Vis Sci 2016;93:E-abstract 165297 .
- Plaumann, M, **Bhakhri R**. Using Optical Coherence Tomograhpy to Diagnose and Monitor Commotio Retinae in the Pediatric Population. Optom Vis Sci 2016;93:E-abstract 165041.
- **Bhakhri R,** Yoshinaga P, Romeo, S. Adult Onset Stargardt Disease with Foveal Preservation. Optom Vis Sci 2015;92:E-abstract 155308.
- **Bhakhri R**. Tapatel Retinal Sheen Imaging in an X-Linked Retinitis Pigmentosa Carrier. Optom Vis Sci 2015;92:E-abstract 155306.
- Han S, **Bhakhri R,** Chen A. Torpedo Maculopathy. Optom Vis Sci 2015;92:E-abstract 155215.
- Comer G, **Bhakhri R**. Fundus Auto Fluorescence in the Evaluation of Retinitis Pigmentosa: Structure to Function Correlation. Optom Vis Sci 2014;91:E-abstract 145312.
- **Bhakhri R**, Ittner, E. A Case of Progressive Outer Retinal Necrosis. Optometry 2012. 83(7): E-abstract 54.
- **Bhakhri R**, Chun R, Coalter JD, Jay WJ. A Survey of Smart Phone Usage in Low Vision Patients. Investigative Ophthalmology and Visual Science 2012; 53: ARVO E-abstract 4421.

Publications:

- **Bhakhri R**, Ridder WH, 3rd. Gyrate Atrophy-Like Phenotype: Normal Plasma Ornithine and Retinal Crystals. Optometry and vision science : official publication of the American Academy of Optometry. 2016;93(9):1173-80.
- **Bhakhri R**. X-Linked Retinitis Pigmentosa. California Optometry. December 2015.

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- Dr. Jack Thomas Memorial Scholarship from the British Columbia Association of Optometrists — 2007
- Beta Sigma Kappa Honors Society Member at the PCO — 2006-2010

Certifications/Workshops:

- AOA Research Camp, Ohio State University — 2014
- Summer Institute for Faculty Development — 2013
- Fundamental of Leadership, Part 1, American Academy of Optometry Meeting — 2012
- Optometric Glaucoma Society Residents Meeting — 2012
- Certified in the management of the Implantable Miniature Telescope with CentraSight — 2011

Professional Service:

- AAO Website Task Force — 2016
- SCCO Student Scholarship and Program committee — 2016-present
- Vice Chair of AAO Faculty Student Committee — 2016-present
  - SCCO Liaison (2014-present)
- Delegate, COA House of Delegates — 2016
- Volunteer with Care Harbor Los Angeles — 2015
- MBKU Physician's Assistant Interviewer — 2015-present
- SCCO Faculty Council Executive Committee, Director — 2014-present
- SCCO Faculty Merit Committee — 2013-2016
- SCCO Residency Advisor/Mentor — 2013-present
- Optometry and Vision Science (OVS) Article Reviewer — 2013-present
- SCCO Admissions Committee — 2012-present
  - Chair (2014-2016)
- Council on Optometric Education (COPE) Reviewer — 2012-present
- California Optometric Association Journal Article Reviewer — 2012-present
- SCCO Admissions Interviewer — 2012-present
- Volunteer with Opening Eyes at OC/World Games Special Olympics — 2012-present
- Volunteer with Opening Eyes at Penn State Special Olympics — 2009

Memberships and Associations:

- Diplomate of the American Board of Optometry (ABO) — 2013-present
- Fellow of the American Academy of Optometry — 2012-present
- California Optometric Association (COA) — 2012-present

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with occupational therapists and psychologists. Low vision services also performed at the Illinois School for the Visually Impaired in conjunction with local Lions Clubs..

Teaching Experience:

Clinical Integration of Basic Sciences (CIBS 510) — Aug 2014-present
- Facilitated lab sections and encouraged problem based learning to first years students.

Ocular Disease Diagnosis & Management II (CLS 762) — Oct 2013-present
- Lectured to third years students on hereditary and peripheral retinal conditions

Low Vision Rehabilitation at SCCO (CLS 774) — Nov 2012-present
- Instructor of record — Nov 2014-present
- Taught low vision course to third years students. Topics included near and distance devices/optics/magnification, visual field rehabilitation, lighting and contrast, and grand rounds cases.

Low Vision Rehabilitation Lab Course at SCCO (CLS 774) — Nov 2012- present
- Instructor of record — Nov 2014-present
- Instructed third year students on how to perform low vision exams. Lab work also included how to take proper case histories, select appropriate low vision devices, and provide appropriate rehabilitation services.

Low Vision Laboratory at ICO (CLE 367: Low Vision) — Nov 2011-July 2012
- Instructed third year students on how to perform low vision exams. Lab work also included how to take proper case histories, select appropriate low vision devices, and provide appropriate rehabilitation services.

Honors/Awards:

- Elected to hood SCCO Classes of 2014, 2015, and 2016 during Graduation Ceremony — 2014-2016
- SCCO Professor of the Quarter, Winter — 2014-2016
- SCCO Staff Doctor of the Year — 2013, 2016
- Runner up for the American Optometric Association (AOA) Contact Lens and Cornea Section (CLCS) CLCS Student-Resident Photo Contest Travel Grant — 2012
- Clinical honors for externship at the Palo Alto Veterans Hospital — 2010
- Clinical honors for externship at Nittany Eye Associates — 2009
- Clinical honors for externship at the William Feinbloom Vision Rehab Center, — 2009
- Dr. Harry Kaplan Scholarship from the PCO — 2007

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Education:

O.D.	Pennsylvania College of Optometry (PCO) at Salus University Elkins Park, PA; Summa Cum Laude Class Rank of 10/154, GPA 3.82/4.00 at the PCO	2006-2010
B.Sc	Pennsylvania College of Optometry at Salus University Elkins Park, PA	2007
B.Sc	University of Alberta, Edmonton, AB-Major: Biology Minor: Chemistry	2003-2006
	Okanagan University College, Penticton, BC-Major Biology Minor: Chemistry	2002-2003

Professional Work Experience:

Southern California College of Optometry (SCCO), Fullerton, CA — Sept 2012-present

- Assistant professor in low vision and ocular disease. Duties include teaching low vision course and laboratory. Responsibilities also include precepting of third and fourth year students in school and community clinics.

Envision Optometry, Abbotsford, BC — Sept 2010-June 2011

- Primary care optometrist: Provided primary eye care in a corporate setting with an emphasis on contact lens fittings.

Ellwood Eye Clinic, Abbotsford, BC — Sept 2010-June 2011

- Primary care optometrist: Provided primary eye care, pediatric, and contact lens services in a private practice. Work also included co-management with ophthalmologists in the pre and post-operative care of surgical cases including cornea, cataracts, glaucoma and retina.

Waterfront Eyecare, Penticton, BC — May 2007-July 2007

- Optometric Technician: Preformed pre testing on patients. Dispensed glasses as well as performing adjustments.

Residency:

Illinois College of Optometry (ICO), Chicago, IL — July 2011-July 2012

- Provided care to patients in cornea, glaucoma, retina, neuro-optometry, urgent care, electro-physiology, and primary care services. Supervised students in advanced care clinics.

Spectrios Institute for Low Vision, Wheaton, IL — July 2011-July 2012

- Performed comprehensive low vision exams. Work included low vision exams for children through the Seeing is Believing Program in conjunction with local Lions Clubs.

Chicago Lighthouse for the Blind, Chicago, IL — July 2011-July 2012

- Performed comprehensive low vision exams in conjunction