



RESIDENT/FELLOW RESEARCH DAY


Department of Ophthalmology and Visual Sciences

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Roy J. and Lucille A. Carver
College of Medicine
University of Iowa Hospitals and Clinics
Iowa City, Iowa

Hybrid: In-Person/Virtual Meeting

Friday, May 21, 2021



Vertical C/D Ratio	0.60	0.45
Cup Volume	0.228 mm ³	0.114 mm ³

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Alanna K. Tisdale, M.D., M.P.H.

OCULOPLASTIC SURGERY

Brittany A. Simmons, M.D.

PEDIATRIC OPHTHALMOLOGY

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VITREORETINAL DISEASE

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Timothy M. Boyce, M.D.
Razek Georges Coussa, M.D.
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Tyler S. Quist, M.D.
Alexis K. Warren, M.D.
Caroline W. Wilson, M.D.

SECOND-YEAR RESIDENTS

Karam A. Alawa, M.D.
Justine L. Cheng, M.D.
Salma A. Dawoud, M.D.
Ryan J. Diel, M.D.
David A. Ramirez, M.D.

FIRST-YEAR RESIDENTS

Matthew G. Field, M.D., Ph.D.
Zachary Q. Mortensen, M.D., M.B.A.
Tirth J. Shah, M.D.
Margaret R. Strampe, M.D.
Caroline Y. Yu, M.D.

PRELIM RESIDENTS-INTERNAL MEDICINE

Aaron D. Dotson, M.D.
Andrew S. Goldstein, M.D.
Tina Hendricks, M.D.
Mahsaw Motlagh, M.D.
Sean M. Rodriguez, M.D.

Pathogenic Mutations Promote Oxidative Damage in Fuchs' Endothelial Corneal Dystrophy

Matthew G. Field, MD, PhD

Primary Supervisor: Mark A. Greiner, MD

Co-authors: Jessica M. Skeie, PhD, Aliasgar Salem, PhD

Purpose: Fuchs endothelial corneal dystrophy (FECD) affects 6.1 million Americans over 40 years of age and is the leading indication for corneal transplant surgery in the U.S. This condition can be diagnosed early, but there is no available therapy to prevent disease progression. Over 70% of FECD cases have been linked to either the accumulation of trinucleotide repeats in intron 2 of the TCF4 gene (late onset) or abnormal collagen production due to a point mutation in the COL8A2 gene (early onset). Oxidative stress and mitochondrial dysfunction have been implicated in disease pathogenesis, but the role TCF4 and COL8A2 alterations play in promoting these alterations is poorly understood. Our goal is to study the molecular alterations induced by these mutations in corneal endothelial cells (CECs) in order to develop early therapeutic targets.

Methods: CECs with the TCF4 repeat (F35T) were generous gifts from Dr. Albert Jun (Johns Hopkins, Baltimore, MD, USA). Wildtype CECs (B4G12) were obtained from DSMZ (Leibniz Institute, DSMZ-German Collection of Microorganisms and Cell Cultures). Wildtype CECs with doxycycline-inducible expression of the TCF4 repeat or the COL8A2 mutation were created to study early changes related to the genetic alterations. Mitochondrial superoxide ($O_2^{\bullet-}$) free radicals were quantified using MitoROS 580 dye and a TECAN plate reader, and mitochondrial membrane potential (MMP) was quantified using JC-1 dye and a TECAN plate reader. qPCR was used to study gene expression under various conditions.

Results: F35T CECs (N=8) have 15.7-fold higher mitochondrial $O_2^{\bullet-}$ than B4G12 controls (N=12) as measured by MitoROS 580 dye. F35T CECs (N=9) also have a 3-fold lower mitochondrial membrane potential (MMP) than B4G12 CECs (N=9) as measured by JC-1 aggregate:monomer ratio. We have successfully established the first CEC line with doxycycline-inducible expression of the COL8A2 mutation. Induction of COL8A2 induces oxidative changes, including increased expression of the antioxidant superoxide dismutase 2 (SOD2).

Conclusions: Oxidative stress and mitochondrial dysfunction markers are increased in FECD. Establishment of model CECs lines that can induce the TCF4 repeat and COL8A2 mutation will help elucidate the early molecular changes caused by these alterations in order to better study disease pathogenesis and develop novel therapeutics.

Examining the Relationship Between Injector Lumen Diameter and Exposed Endothelial Surface Area and Tissue Conformation of DMEK Tissue Scrolls

Yong Kam, MD

Primary Supervisor(s): Mark Greiner, MD, Jennifer Ling, MD, Christopher Sales, MD, MPH

Co-author: Gregory Schmidt, BS, CEBT

Purpose: The relationship between Descemet membrane endothelial keratoplasty (DMEK) tissue and injector devices is important to understand, particularly as options for tissue insertion expand. We hypothesize that the outer endothelial surface area of a DMEK scroll, which is exposed to trauma during tissue injection, is reduced when the internal diameter (ID) of the distal tube is narrowed.

Methods: DMEK tissues not suitable for transplantation (n=2, 8.0mm diameter) were loaded into either a Straiko or LEITR modified Jones tube (Gunther Weiss). Tissues were ejected from the proximal to the distal end of each tube, and images were captured using optical coherence tomography (OCT, Optovue RTVue) with the tissue positioned at the distal tube. The ID at the narrowest distal tube, as well as the DMEK scroll diameter as it passed through this point, were measured using ImageJ software. Using the measured diameter of the DMEK scrolls, we calculated the outer scroll surface area assuming that DMEK tissue forms a uniform cylinder.

Results: The narrowest ID measured at the distal end of the Straiko and LEITR tubes was 1,200 μ m (mean, 1,237 μ m \pm 35; n=3) and 860 μ m (mean, 905 μ m \pm 45; n=3), respectively. The diameter of the DMEK scroll at the narrowest ID of the Straiko and LEITR tubes was 1,122 μ m (mean, 1,174 μ m \pm 83; n=3) and 795 μ m (mean, 884 μ m \pm 80; n=3), respectively. The calculated DMEK outer scroll surface area was 27.3mm² for the Straiko and 19.7mm² for the LEITR tube, which represents a 27.8% decrease in exposed endothelial surface area for the LEITR compared to the Straiko tube. Qualitatively, DMEK tissues do not always form a uniform cylindrical conformation in either injector and sometimes form irregular corrugations (Figure 1).

Conclusions: In this series, DMEK tissue scroll diameter decreased in order to conform to the smallest luminal diameter of the injector. Reducing the injector's distal lumen size may result in a significant decrease in endothelial cells potentially exposed to trauma from the injector. However, tissue scroll conformation may be increasingly altered as the lumen narrows. Further studies are needed to assess the impact of lumen diameter on scroll conformation and endothelial cell loss.

Risk Factors for Corneal Transplant Failure Due to Fibrous Downgrowth Among First Time Graft Recipients

David Ramirez, MD

Primary Supervisor: Mark Greiner, MD

Co-authors: Abigail Walling, BA; Christopher Fortenbach, MD, PhD; Lai Jiang, MD; Kendra Frey, MD

Purpose: To define risk factors for graft failure associated with fibrous downgrowth among first-time cornea transplant recipients at a single academic center.

Methods: In this retrospective case-control study, we queried medical records of all patients at a single academic center for a histopathologic diagnosis of fibrous downgrowth between January 1, 2002 and July 17, 2019. We included all patients with complete medical records diagnosed with fibrous downgrowth after a first failed corneal transplant. We matched cases to controls in a 1:3 ratio based on indication for surgery, year of surgery, method of transplantation, sex, and age, and reviewed medical records for past ocular and surgical histories.

Results: 78 eyes (76 patients) met case inclusion criteria and were matched with 234 control eyes. The incidence of fibrous downgrowth was 0.6% per year. The most common keratoplasty indication among cases was pseudophakic corneal edema (32%) and aphakic corneal edema (18%). Cases were more likely to have a history of uveitis (OR 3.09, 95% CI 1.35-7.10; $p=0.006$), retinal detachment (OR 2.17, 95% CI 1.17-4.02; $p=0.013$), trauma (OR 2.08, 95% CI 1.03-4.21, $p=0.038$), and aphakia (OR 2.80, 95% CI 1.57-4.98; $p=0.0003$). Cases were more likely to have had iris derangement (OR 10.57, 5.65-19.76; $p<0.0001$) or retinal surgery (OR 3.00, 95% CI 1.72-5.25; $p<0.0001$). Prior glaucoma drainage device surgery was not a significant risk. Receiver operating characteristic curves demonstrated the best model fit when using 3 predictors: iris derangement, history of uveitis, and history of retinal detachment or retinal surgery. The sensitivity and specificity of this model was 86% and 60%, respectively.

Conclusions: A history of uveitis, history of retinal detachment or retinal surgery, and presence of iris derangement are risk factors for graft failure among first-time keratoplasty recipients with fibrous downgrowth. Patients requiring keratoplasty with these conditions should be monitored closely for graft failure.

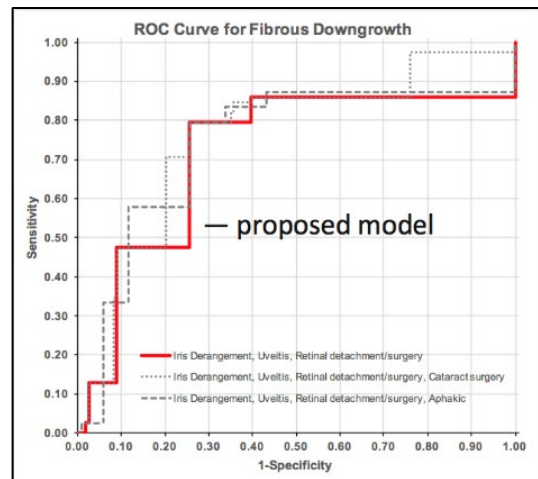


Figure: Receiver operating characteristic curves for 3 selected models. The proposed model is highlighted.

Comparative Long Term Outcomes of Pars Plana Vitrectomy Combined with Anterior Chamber Intraocular Lens versus Intra-scleral Haptic Fixation of Posterior Chamber Intraocular Lens

Alexis Warren, MD

Primary Supervisor: Elliott H. Sohn, MD

Co-authors: Pavlina S. Kemp, MD, Razek Georges Coussa, MDCM, MPhil, MEng, Justine Cheng, MD, H. Culver Boldt, MD, Stephen R. Russell, MD, Thomas A. Oetting, MD, A. Tim Johnson, MD, PhD

Purpose: To evaluate the long-term clinical outcomes in patients with combined pars plana vitrectomy (PPV) with placement of anterior chamber intraocular lens (ACIOL) versus intrascleral haptic fixation (ISHF) using the Agarwal technique with fibrin glue to secure the scleral flap of a posterior chamber intraocular lens (PCIOL).

Methods: We conducted a retrospective consecutive chart review on patients who underwent PPV with concomitant placement of either anterior chamber or ISHF with fibrin glue for aphakia, dislocated IOL or dropped crystalline lens at the University of Iowa. Patients with <32 weeks of follow-up were excluded. Detailed pre-, intra-, and post-operative complications were analyzed using mixed model univariate analysis, and t-test. Post-operative complications included lens subluxation, uveitis-glaucoma-hyphema syndrome, corneal decompensation, hyphema, glaucoma, suprachoroidal hemorrhage, choroidal detachment, cystoid macular edema, vitreous hemorrhage, epiretinal membrane and retinal detachment. Statistical significance was set at $p < 0.05$ for all comparisons.

Results: There were 12 patients in the ACIOL group and 13 patients in the ISHF group. The mean age at time of surgery was 70.4 ± 17.7 years in the ACIOL group and 54.6 ± 21.1 years in the ISHF group ($p = 0.03$). Mean follow-up was 38.2 months (range 8-215 months). The incidence of corneal decompensation was similar in the ACIOL and ISHF lens group which was not statistically significant ($p = 0.93$). There was no difference in the BCVA mean change at the final visit between the two groups ($p = 0.47$). The most common complication in the study cohort was corneal decompensation (32%, $n=8$) followed by cystoid macular edema at (28%, $n=7$).

Conclusions: PPV with concomitant placement of ACIOL or ISHF lenses both result in improvement in BCVA. These procedures are well tolerated and result in similar complication profiles with long-term follow-up.

Smartphone-Based, Head-Mounted Perimetry with the Open Perimetry Interface

Karam Alawa, MD

Primary Supervisor: Michael Wall, MD

Co-authors: Iván Marín-Franch, PhD; Luke Chong, PhD; Andrew Turpin, PhD

Purpose: To develop and implement a smartphone-based, head-mounted perimeter powered by the Open Perimetry Interface (OPI).

Methods: The Iowa OPI is an open-source perimetry software initiative that has been developed for threshold automated perimetry of the full visual field. We updated the OPI R package to support the Google Daydream and other mobile virtual reality (VR) headsets. We then developed an application using the Shiny R package to implement the updated OPI package and communicate with an Android smartphone running an application customized to wirelessly receive and respond to commands from the OPI package. An Android smartphone was calibrated using a luminance meter to determine the relationship between screen

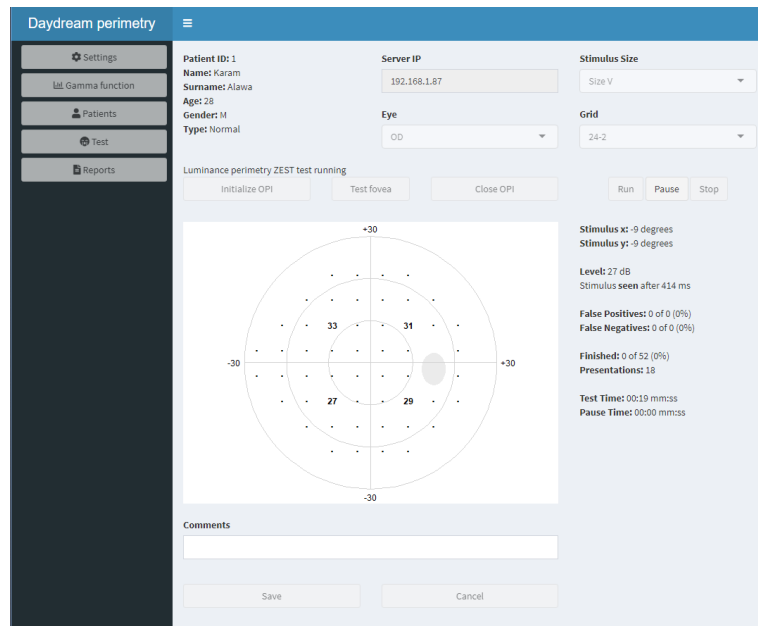


Figure: Graphical user interface for the R Shiny application running a 24-2 visual field threshold test for the right eye.

brightness, grayscale value, and luminance. Three healthy controls were tested on one eye using a 24-2 testing pattern on both the smartphone-based head-mounted perimeter as well as an Octopus 900 running the same version of the OPI.

Results: Each subject successfully completed the test on each device. More data is needed to determine statistical correlation and agreement between the two devices.

Conclusions: Smartphone-based head-mounted perimetry with the OPI is possible, and more work is necessary to compare it to existing perimeters such as the Octopus or Humphrey Field Analyzer, especially in patients with visual field loss. This technology could be especially useful in remote settings or at home where visual field testing is unavailable.

Differences in Clinical Features of Patients with Acute Cerebral Venous Sinus Thrombosis (CVST) and Idiopathic Intracranial Hypertension (IIH)

Alanna Tisdale, MD, MPH

Primary Supervisor: Michael Wall, MD

Co-author: Luis Leal, MD

Purpose: To investigate whether there is a difference in symptoms, visual acuity, eye alignment, or fundus appearance, in patients with CVST and IIH.

Methods: A retrospective chart review was performed, of 2015-2020 University of Iowa neuro-ophthalmology clinic patients. The study included 20 consecutive patients with newly diagnosed IIH and 20 consecutive patients with acute onset CVST. Follow up visits were required for inclusion in the study. Progress notes, fundus photos, OCT results, visual fields, and radiology reports were reviewed to collect data on presenting symptoms, vision, papilledema grades, fundus features, OCT RNFL measurements, and strabismus measurements. Visual acuity and OCT RNFL measurements were also documented from follow up visits. When comparing CVST and IIH patients, Chi Square tests were performed to analyze categorical variable results, and independent samples t tests were performed to evaluate continuous variables.

Results: At presentation, 95% of CVST patients and 10% of IIH patients recalled the date of headache onset. 65% of CVST patients and 20% of IIH patients had disc or peripapillary hemorrhage. 55% of CVST patients and 5% of IIH patients had cotton wool spots on the disc. 65% of CVST patients and 15% of IIH patients had sixth nerve palsies. Among CVST patients, mean papilledema grade was 2.95, and in the IIH group mean papilledema grade was 2.2. Among CVST patients, mean average RNFL was 311, and in the IIH group, mean average RNFL was 173. Statistically significant differences between groups included recall of date of headache onset ($p < 0.0001$), presence of disc or peripapillary hemorrhage ($p=0.004$), disc cotton wool spots ($p=0.001$), 6th nerve palsy ($p=0.001$), mean papilledema grade ($p=0.027$), and mean average RNFL ($p=0.001$). There was not a statistically significant difference in baseline mean visual acuity or change in acuity over time.

Conclusions: Patients with CVST are more likely to recall the date of headache onset, have 6th nerve palsies, disc hemorrhages, disc cotton wool spots, higher baseline RNFL, and higher papilledema grades than their peers with IIH. Patients with CVST appear in general to have a more severe clinical course than IIH patients.

Optical Coherence Tomography in Pediatric Unilateral Optic Nerve Hypoplasia

Justine L. Cheng, MD

Primary Supervisor: Pavlina Kemp, MD

Co-authors: Lindsay De Andrade, MD; Orwa Nasser, MD; Kyungmoo Lee, PHD; Andreas Wahle, PHD

Purpose: To use optical coherence tomography (OCT) to assess the optic nerve and macula retinal layer thicknesses in patients with unilateral optic nerve hypoplasia (ONH) and normals.

Method: Retrospective review identified nine pediatric patients (<18 years) with unilateral ONH and nine age and refraction matched normals with Cirrus OCT optic nerve and macula. Using the Iowa Reference Algorithm, the retinal layer thicknesses were obtained. Student's t-test compared retinal morphology between affected and unaffected eyes, as well as between unaffected eyes and normals. Pearson correlation identified relationships between layer thicknesses and visual acuity.

Results: There was no statistically significant difference between the unaffected, contralateral eyes of patients with clinically unilateral optic nerve hypoplasia, and the eyes of age and refraction-matched normals when comparing central macular thickness and peripapillary retinal nerve fiber layer (RNFL) thickness. Peripapillary RNFL, inner plexiform layer (IPL), inner nuclear layer (INL), and macular RNFL, ganglion cell layer, IPL and INL were all significantly thinner in the affected than the unaffected eyes ($p < 0.039$). Poorer visual acuity was associated with thinner peripapillary INL, peripapillary outer nuclear layer, and macular RNFL, IPL and INL ($r < -0.668$, $p < 0.05$).

Conclusions: OCT may help with diagnosis of ONH through comparison of retinal layer thicknesses, and certain layers may be predictive of visual acuity.

Outcomes of Interventions for Nasolacrimal Duct Obstruction in Patients with Down Syndrome

Heather A. Stiff, MD

Primary Supervisor: Lindsay De Andrade, MD

Co-author: Sara Downes, OD

Purpose: Congenital nasolacrimal duct obstruction (NLDO) is present in 20-30% of patients with Down syndrome compared to 6% of the general population. Down syndrome is considered a risk factor for failure of initial surgical intervention for NLDO. The purpose of this study was to compare the number, type, and outcome of NLDO interventions for patients with Down syndrome and those without Down syndrome.

Methods: Retrospective chart review of patients who presented to the University of Iowa pediatric ophthalmology clinic from January 2009 to December 2018 and underwent surgical intervention for NLDO. Data collected included number and type of intervention, and degree of subjective improvement after each intervention.

Results: There were 208 patients; 15 (7.2%) with Down syndrome and 193 (92.8%) controls. Age at initial intervention was 2.8 years in the Down syndrome group and 1.6 years in controls ($p=.002$). Initial intervention was probing with infracture alone in 8 patients (53%) with Down syndrome and 80 (41%) controls ($p=0.42$). After one intervention, 5 patients with Down syndrome (33%) were “resolved” compared to 141 of controls (78.3%) ($p=.002$). Of the group with Down syndrome, 4 (27%) had two or more interventions compared to 13 (6.7%) in the control group ($p= 0.02$). In patients with Down syndrome who underwent multiple interventions, initial intervention was probing with infracture alone in 1 of 4 patients.

Conclusions: Patients with Down syndrome were less likely to have resolution of symptoms after one intervention, and were more likely to undergo two or more interventions compared to controls. There was no difference in type of initial intervention between the groups, but the group with Down syndrome was significantly older at first intervention.

The True Cause of Spasmus Nutans

Salma Dawoud, MD

Primary Supervisor(s): Alina Dumitrescu, MD; Arlene Drack, MD

Purpose: Spasmus nutans (SN) is a rare, acquired nystagmus presenting with a classic triad of small-amplitude high-frequency nystagmus, head nodding, and torticollis. Historically, SN has been considered a benign self-limited disease, however, there are several case reports of patients presenting with a SN-like nystagmus only to be later diagnosed with an underlying disease. Known SN mimickers include optic nerve and chiasmal gliomas; retinal disease such as congenital stationary night blindness, cone-rod and rod dystrophy; and many other retinal, neurological and systemic diseases. The goal of this study is to identify patients previously diagnosed with SN and determine the extent of retinal and neurological investigation, and if an alternative diagnosis was discovered based on more extensive evaluation.

Methods: An on-going retrospective chart review is being performed on patients diagnosed with SN between January 1, 1960 to January 1, 2021. These charts are being queried for age at time of diagnosis of SN, ocular and neurological work-up including ERG and brain MRI, and final diagnosis.

Results: Our retrospective review is on-going at this time. We have identified four patients who were initially diagnosed with SN, but on further evaluation were discovered to have underlying diagnoses of Beckwith-Wiedemann, chromosome 1q deletion syndrome, and congenital stationary night blindness.

Conclusions: Due to the assumption that SN is a benign disease, SN patients may receive an incomplete retinal and neurological evaluation. We hypothesize that if all of patients diagnosed with SN received a complete evaluation, an underlying disease would be discovered, and that SN is a sign rather than a diagnosis.

Markers for Sebaceous Carcinoma: Enhancing Histologic Analysis

Brittany Simmons, MD

Primary supervisor(s): Robert Mullins, PhD; Erin Shriver, MD; Nasreen Syed, MD

Co-author: Keith Carter, MD

Purpose: Sebaceous carcinoma is a potentially life-threatening condition that often masquerades as benign disease. Heterogeneity of the disease and lack of definitive immunohistologic markers make diagnosis challenging. Treatment relies on complete excision, which is complicated by multifocal and subclinical intraepithelial spread of disease. This study aimed to identify reliable histologic markers for sebaceous carcinoma of the periocular region. Secondly, the investigators will use these markers to visually label diseased tissue in situ to aid in tumor excision, potentially reducing intraoperative excision time and the need for serial excisions. Lectins are ubiquitous carbohydrate-binding proteins involved in cell adhesion, glycoprotein synthesis, and signaling as cell surface receptors, regulating inflammatory reactions and modulating autoimmune processes. Altered cell surface glycoconjugates have been implicated in ocular disease, displaying distinctive lectin and carbohydrate expression in drusen, choroidal neovascularization, and birdshot chorioretinopathy. Our previous work was the first to report differential expression of lectins in normal eyelid tissues. The authors believe that eyelid markers recognized by lectins may be dysregulated in sebaceous carcinoma.

Methods: After IRB approval, paraffin-embedded samples of control eyelids and eyelids with sebaceous carcinoma were collected. Histochemistry with 38 lectins was performed on 2-4 sections each of normal eyelid tissue from 1 patient and sebaceous carcinoma in 1 patient. Specimens were examined with epifluorescence microscopy.

Results: In normal controls, differential lectin binding was observed in epidermal, neuromuscular, and vascular tissues. The majority of lectins bound epidermal cell membranes and extracellular matrix. Lectin expression was preserved in sebaceous cell carcinoma, with a subpopulation of smaller cells fluorescing with lectin binding that was not seen in normal control eyelids.

Conclusions: Lectin histochemistry is a viable approach for identifying cell surface markers in eyelid tissue. There is differential expression of glycoconjugates in normal eyelid control tissues, and this is maintained in sebaceous cell carcinoma. A subpopulation of cells was noted to fluoresce with lectin binding in sebaceous cell carcinoma. Future directions include histochemistry with concurrent lectin and epithelial markers, expansion of testing to confirm reproducible lectin expression patterns specific to sebaceous carcinoma, and ultimately lead to adjunctive intraoperative visualization to aid in tumor resection.

**Tools for Responding to Patient-Initiated Verbal Sexual Harassment:
A Workshop for Trainees and Faculty**

Lauren E. Hock, MD

Primary Supervisor: Erin M. Shriver, MD

Co-Authors: Patrick B. Barlow, PhD; Brittini A. Scruggs, MD, PhD; Thomas A. Oetting, MD, MS; Denise A. Martinez, MD; Michael D. Abramoff, MD, PhD

Purpose: Patients are the most common source of gender-based harassment of resident physicians, yet residents receive little training on how to handle it. Few resources exist for residents wishing to address patient-initiated verbal sexual harassment themselves. The purpose of this study was to assess the effect of a workshop on tools for responding to patient-initiated verbal sexual harassment on resident and faculty preparedness to respond to patient-initiated harassment.

Methods: A 50-minute workshop was developed, taught, and evaluated to prepare residents and faculty to respond to patient-initiated verbal sexual harassment toward themselves and others. The workshop used an interactive lecture and role-play scenarios to teach a tool kit of communication strategies for responding to harassment. Participants completed retrospective pre-post surveys on their ability to meet the learning objectives and their preparedness to respond.

Results: Ninety-one participants (57 trainees, 34 faculty) completed surveys at one of five workshop sessions across multiple departments. Before the workshop, two-thirds (67%) had experienced patient-initiated sexual harassment, and only 28 out of 59 (48%) had ever addressed it. Seventy-five percent of participants had never received training on responding to patient-initiated sexual harassment. After the workshop, participants reported significant improvement in their preparedness to recognize and respond to all forms of patient-initiated verbal sexual harassment ($p < .01$), with the greatest improvements noted in responding to mild forms of verbal sexual harassment, such as comments on appearance or attractiveness or inappropriate jokes ($p < .01$).

Conclusions: This workshop fills a void by preparing residents and faculty to respond to verbal sexual harassment from patients that is not directly observed. Role-play and rehearsal of an individualized response script significantly improved participants' preparedness to respond to harassment toward themselves and others.

Video Based Kinematic Analysis for Objective Assessment of Suturing Performance

Caroline Yu, MD

Primary Supervisor: Chau Pham, MD

Co-author: Erin M. Shriver, MD

Purpose: The aim of this pilot study is to describe and validate an objective assessment tool for suturing performance using software-based video motion analysis in order to facilitate surgical skills training.

Methods: Eight participants of varying experience levels were recorded while performing simple interrupted sutures and simple running sutures. All participants were standardized to identical suture pads, suture types, and instruments, and all recordings were anonymized and obtained via standardized filming procedures. For the purposes of data analysis, participants were grouped by level of surgical experience (novice defined as no formal ophthalmology training, intermediate defined as some ophthalmology training, and expert defined as post-graduate training and above). The recorded videos were analyzed using Kinovea 0.9.4, a 2D motion analysis software, to extract needle driver position, time, path length, and velocity. An independent reviewer graded the videos and static images of the final sutured product using a standardized rubric to generate a dynamic rating and static rating.

Results: There was a statistically significant difference in both total time (interrupted $p=0.012$; running $p=0.003$) and total path length (interrupted $p=0.014$, running $p=0.008$) based on level of participant experience. There was a strong negative correlation between dynamic rating and average time per suture (interrupted $r^2 = 0.883$; running $r^2 = 0.928$), as well as between dynamic rating and total path length (interrupted $r^2 = 0.603$; running $r^2 = 0.638$). Total time was strongly correlated with total path length (interrupted $r^2 = 0.755$; running $r^2 = 0.421$). Secondary analyses showed that experts had a lower median velocity (0 cm/s vs. 0.97 cm/s, $p=0.003$) compared to their trainee counterparts. Notably, there was an inverse correlation between static rating and total time (interrupted $r^2 = 0.928$; running $r^2 = 0.696$). Finally, analysis of trainee suturing performance before and after participation in a suturing educational curriculum showed a statistically significant increase in static rating ($p=0.002$).

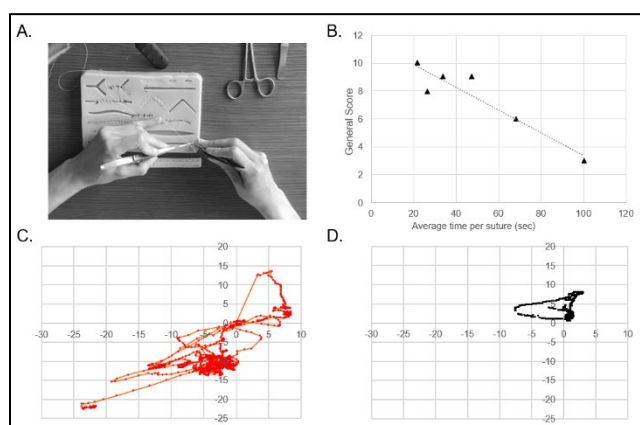


Figure 1 (A) Participants were given standardized suturing tasks that were recorded in a standardized manner. (B) Strong negative correlation between GSR and average time per interrupted suture ($r^2 = 0.883$). (C, D) Representative x-y trajectories of a trainee (C) and an expert (D) performing a simple interrupted stitch.

Conclusions: Software-based kinematic analysis is an effective method to objectively assess suturing performance. Specific measures of instrument motion not only accurately predicted the level of surgical expertise but also improved as a result of practice for trainees. Kinematic analysis can be used to provide objective detailed feedback to trainees and thus improve surgical skills training.

Flipped Ophthalmology Classroom Augmented with Case-Based Learning

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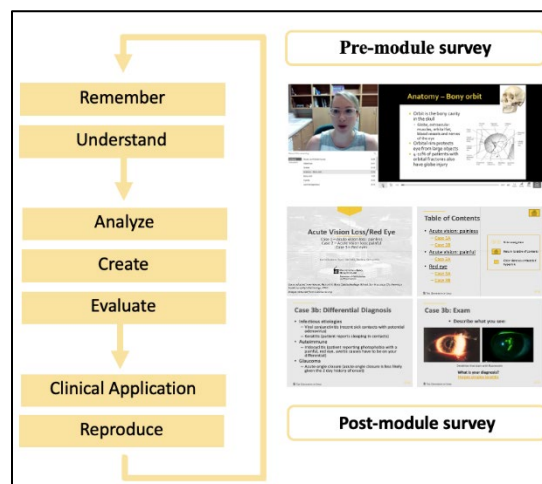
Purpose: The flipped classroom is an effective way to teach ophthalmology to medical students. Nonetheless, there are significant drawbacks to the flipped classroom environment, the most significant of which are concerns of burden and pressure on the part of the learner. The purpose of this study was to examine medical students' perceptions of a case-based flipped classroom style compared to a traditional didactic lecture series, and to evaluate the impact of case-based learning on students' confidence managing common ophthalmic complaints. By allowing students to take advantage of the flipped classroom lecture content before the in-person case-based lecture series, we hypothesized that students would feel more confident during the case-based discussions thereby mitigating feelings of anxiety and burden.

Methods: We created an interactive case-based flipped classroom ophthalmology curriculum. Paired pre-/post-clerkship surveys were distributed to students on the first and last day of the 2-week clerkship. Questions were formatted as statements using a 6-point Likert scale to assess students' prior exposure to a flipped classroom, perceptions of the flipped classroom curriculum, and confidence in evaluating ophthalmic complaints.

Results: Seventy-five students were included in our analysis from July 2019 to March 2020. Pre-clerkship questionnaires revealed no preference for either teaching modality. Wilcoxon signed rank test comparing pre-/post-clerkship data revealed a significant increase in student ratings favoring the case-based flipped classroom model. Students reported significant reductions in pressure to perform, course burden, and overall anxiety; and increased confidence triaging common eye complaints.

Conclusions: Students favor the case-based flipped classroom modality which prioritizes key learning objectives while increasing participation and confidence. Since the implementation of this curriculum, medical students have rated the ophthalmology clerkship the highest among all Carver College of Medicine clerkships in the year 2020. Additionally, the reproducibility and accessibility of standardized prepared video lectures and cases will help other institutions better incorporate ophthalmology into pre-existing rotations. Because this model utilizes electronic lecture delivery and synchronous discussions, this model provides a sustainable and efficacious curriculum that has allowed educators to readily adapt to the post COVID-19 pandemic era. This curriculum has been made freely available to educators around the world at:

<https://eyerounds.org/article/online-ophthalmology-curriculum/index.htm>.



Neutralizing Antibodies to SARS-CoV-2 and the Risk of Infection at a Tertiary Care Center

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Purpose: The novel coronavirus disease of 2019 (COVID19) has resulted in 32 million confirmed cases and over 500 thousand deaths in the United States alone (Johns Hopkins Coronavirus Resource Center). With over ten percent of the population having contracted the virus, the clinical significance of antibodies against the virus following infection remains an area of ongoing research. This study evaluates a cohort of healthcare employees for the presence of antibodies and their subsequent risk of infection.

Methods: University of Iowa Hospitals and Clinics employees were recruited to this prospective cohort study between 6/3/2020 and 3/10/2021. At the time of enrollment, participants completed a questionnaire including questions about symptoms and prior testing for COVID19 infection. A blood sample was obtained and screened for the presence of neutralizing antibodies against the virus responsible for COVID19, SARS-CoV-2. Three months following recruitment, the participants completed a repeat questionnaire regarding infection testing as well as vaccination status.

Results: A total of 328 participants (88% female) were recruited to the study with 17 subjects reporting a prior confirmed infection with SARS-CoV-2. Thirty-six subjects possessed neutralizing antibodies to the virus with 17 individuals having received a vaccine prior to enrollment. Excluding those subjects vaccinated at the time of blood draw, 32% (6/19) of patients with antibodies had no prior documented COVID19 infection although many subjects reported having an influenza-like illness. No participants with antibodies to the virus reported a subsequent confirmed infection during the three months following recruitment.

Conclusions: Despite occupational exposure, evidence of prior SARS-CoV-2 infection was less common among healthcare workers in this study than in the general population. Of those individuals found to have neutralizing antibodies, no subsequent SARS-CoV-2 infections were reported, which may indicate a protective role. As COVID19 continues to take a heavy toll around the world, understanding the impact of prior infection remains an important question in helping mitigate the impact of the virus in the future.

**Outcomes of Patients with Neovascular Age-related Macular Degeneration
During the COVID-19 Pandemic**

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Co-authors: Zachary Mortensen, MD

Purpose: To examine the impact of fixed-interval treatment with anti-vascular endothelial growth factor therapy (VEGF) and reduced imaging on patients with neovascular AMD during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: This was a retrospective analysis of all patients with neovascular AMD at the University of Iowa evaluating the functional and anatomic parameters of the last visit prior to March 25th, 2020 and the first visit after July 1st, 2020. We also examined the cancellation rates of various outpatient clinics and the COVID-19 infection prevalence in our neovascular AMD population.

Results: The difference in mean best corrected visual acuity in logMAR before (0.356 +/- 0.329) and after (0.396 +/- 0.344) the pandemic restriction interval was not found to be statistically significant. The total intraretinal fluid (IRF), subretinal fluid (SRF), and subretinal hyperreflective material (SHRM) on OCT were found to be nearly the same before and after the pandemic. We found that 8 eyes had improvement of IRF, 17 eyes had worsening of IRF, and 24 eyes had stable IRF before and after pandemic restrictions. Additionally, 13 eyes had improvement of SRF, 10 eyes had worsening of SRF, and 34 eyes had stable SRF levels. There was a 12% increase in cancellations in all outpatient specialty clinics for those who were older than 60 years, a 64% increase in cancellations in all outpatient ophthalmology clinics and an 18% increase in cancellations in patients with neovascular AMD. Lastly, of the 189 patients we analyzed, 11 patients tested positive for COVID-19 and 6 of these patients died from COVID-related complications. There were zero patients who were diagnosed with COVID-19 within seven days of their last clinic appointment during the pandemic restriction interval.

Conclusions: Although there were several unfortunate cases of significant vision loss, we found that our patients on average had stable visual acuity and exudative disease while also limited viral exposure during the pandemic.

**Clinical Characteristics and Optical Coherence Tomography in Patients
with *Bartonella Henselae* Neuroretinitis**

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Supervisor: Matthew J. Thurtell, MBBS, MSc

Introduction: To describe and compare the clinical characteristics, visual outcomes, and spectral-domain optical coherence tomography (SD-OCT) findings in patients with *Bartonella Henselae* (*B.Henselae*) neuroretinitis (NR).

Methods: A retrospective review of all patients evaluated in a single academic center between 2005-2020 with serologically proven *B.Henselae* NR. Inclusion criteria included availability of OCT retinal nerve fiber layer (RNFL), total retinal thickness (TRT), and optic disc area at the time of diagnosis. Baseline and follow-up Spectralis and Cirrus SD-OCT optic disc and macula scans were analyzed using a 3-D segmentation algorithm to derive RNFL thickness and TRT. These SD-OCT parameter values were correlated with visual acuity (VA) and visual fields (VF) at baseline and follow-up. Baseline clinical characteristics and treatment of the patients were also collected.

Results: 26 patients and 32 eyes were identified that fulfilled the inclusion criteria. Mean age was 35.7 years (range 7-61 years). Mean follow-up time was 120.1 days range (1-544 days). Simultaneous bilateral involvement occurred in 6 of 26 (23%) patients. Initial acuity was better than 20/60 at baseline in 12/30 (40%) of the affected eye and 6/30 (20%) of the affected eyes at follow-up. Baseline mean RAPD and logMAR VA were 0.9 log units and 1.3 respectively. The most common VF defect was a central/cecocentral scotoma at baseline in 17/24 (70%) and a full visual field in 11/24 (46%) at follow-up. Initial RNFL thickness was 177.3 microns in the affected eye at baseline and 108.59 microns at follow-up. Initial TRT thickness was 361.1 microns in the affected eye at baseline and 279.3 microns at follow-up. Baseline RAPD and logMAR were significantly correlated with logMAR VA at follow-up. There was no significant correlation between initial RNFL thickness, TRT or disk area and final logMAR VA.

Conclusions: This is the first cohort of *B.Henselae* NR in which SD-OCT values were analyzed and correlated with visual outcome. To our knowledge, this is also one of the largest cohorts of *B.Henselae* NR. study did not find a significant association between initial RNFL thickness, TRT or disk area and final logMAR VA. Loss of patients at follow up may contribute to this finding and a larger population study might be warranted to further address this. Furthermore, we found that baseline RAPD and logMAR VA were significantly correlated with logMAR VA at follow-up. These simple clinical findings may serve as a simple prognostication parameter when counseling patients.

Primary Care Providers' Comfort with Autonomous Artificial Intelligence for Diabetic Eye Exams

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Primary Supervisor: Michael D. Abramoff, MD, PhD

Co-authors: Abby Walling, BA; Tirth Shah, MD

Purpose: Autonomous Artificial Intelligence (AI) has demonstrated excellent accuracy in detecting diabetic retinopathy (DR) though AI is not yet widely used in primary care outpatient settings. This study aims to identify concerns primary care providers (PCPs) have with integrating autonomous AI into their clinics for DR screening.

Methods: An anonymous online survey was emailed to 900 Iowan PCPs, including physicians, nurse practitioners, and physician assistants. Their general comfort with AI for DR screening was solicited on a scale from 0-10 (10 being the "very comfortable"). Additionally, participants were asked to indicate how strongly they agreed or disagreed with 11 distinct statements regarding potential concerns with the implementation of autonomous AI into primary care practices for DR screening. The statement topics of potential apprehension for PCP's included their concern for quality of care, lack of knowledge, accuracy, privacy, medical liability, decrease in productivity, systemic healthcare costs, clinicians job loss, personal financial cost, exacerbation of healthcare disparities, and introduction of biases. Participants answered using a 5-scale Likert response matrix. Simple descriptive statistics with sums, means, and ranges were calculated.

Results: 25 responses have been received (2.7% participation rate). 14 (56%) were females with a mean age of 49.7 years (range: 31-71), 19 (76%) were MDs, and 19 (76%) were Family Medicine trained. The mean general comfort level with AI in PCP clinical setting was 7.8 (range: 2-10). The two statements that participants agreed with most were concerns regarding the financial feasibility (52%) and the lack of knowledge about autonomous AI (48%). Participants were most ambivalent regarding their concern for exacerbation of healthcare disparities (48%), diagnostic accuracy (36%), and decrease in productivity (40%). Participants most strongly disagreed that they worried about the effect AI would have on privacy (92%), the quality of care (76%), and potential job loss for clinicians (68%).

Conclusions: While PCPs in Iowa seem moderately comfortable with notion of utilizing autonomous AI to detect DR in their clinics, some concerns remain. The two most popular concerns of PCPs were that their knowledge regarding AI is insufficient, and that the financial costs of autonomous AI implementation may outweigh their clinic's reimbursements.

**Correlation of Features on OCT with Visual Acuity and Gass Lesion Type
in Best Vitelliform Macular Dystrophy**

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Purpose: To correlate structural features seen on optical coherence tomography (OCT) with best corrected visual acuity (BCVA) and Gass lesion type in patients with Best vitelliform macular dystrophy (BVMD).

Methods: This is a retrospective case series of consecutive patients with molecularly-confirmed BEST1-associated BVMD seen at a single academic center. OCT volume scans were reviewed for vitelliform lesion status and presence of a subretinal pillar, focal choroidal excavation (FCE), intraretinal fluid (IRF), or atrophy. These features were then correlated with BCVA and Gass lesion type.

Results: 95 eyes from 48 patients (mean age 38.9 years, range 4-87) were included. The presence of a pillar (24.2%), FCE (20.0%), and atrophy (7.4%) were associated with poor LogMAR VA ($p < 0.05$). Gass type 1 eyes were correlated with good visual acuity (LogMAR < 0.4) whereas type 5 eyes had poor visual acuity (LogMAR > 0.4). Among 65 eyes with longitudinal data (mean 5.1 years of follow-up), 10.8% ($n=7$ eyes) changed from a higher to lower Gass type; of these, 57.1% (4 eyes) had CNV responsive to intravitreal anti-vascular endothelial growth factor (VEGF) treatment.

Conclusion: OCT-based structural features are readily identifiable in BVMD patients and have prognostic importance due to their correlation with BCVA.

Intrafamilial phenotypic variability and zonal distribution of retinal capillary hemangioma in von Hippel-Lindau disease

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Purpose: To evaluate the intrafamilial phenotypic variability of retinal capillary hemangioma (RCH) in families with von Hippel-Lindau (VHL) disease.

Methods: This was a retrospective cohort study of families (2 or more individuals) with the same VHL mutation. Patients with molecularly confirmed VHL evaluated at our institution were identified and records reviewed (n=36). For those individuals with sufficient follow up and imaging (n=27), the number and location of RCHs at the initial and most recent follow up visits were recorded. The location of RCHs was classified using a modified cytomegalovirus retinitis staging system (zones 1, 2, and 3, with subset zones 1a and 1b). The way in which the RCHs were treated and the systemic manifestations of VHL were recorded for each patient. Age-matched comparison of disease severity was performed for three families. Main Outcome Measures were 1) Total number of RCH in each zone, 2) Age-matched phenotypic variability in number and location of RCHs.

Results: Over an average follow up of 155 months, there were 19 (13%) RCHs in zone 1, 82 (58%) in zone 2, and 41 (29%) in zone 3. Intrafamilial phenotypic variation was identified in three families.

Conclusions: Intrafamilial phenotypic variability of RCH exists for families with VHL disease who share the same genetic mutation. A zonal classification system can be used to describe the location of RCH in patients with VHL.

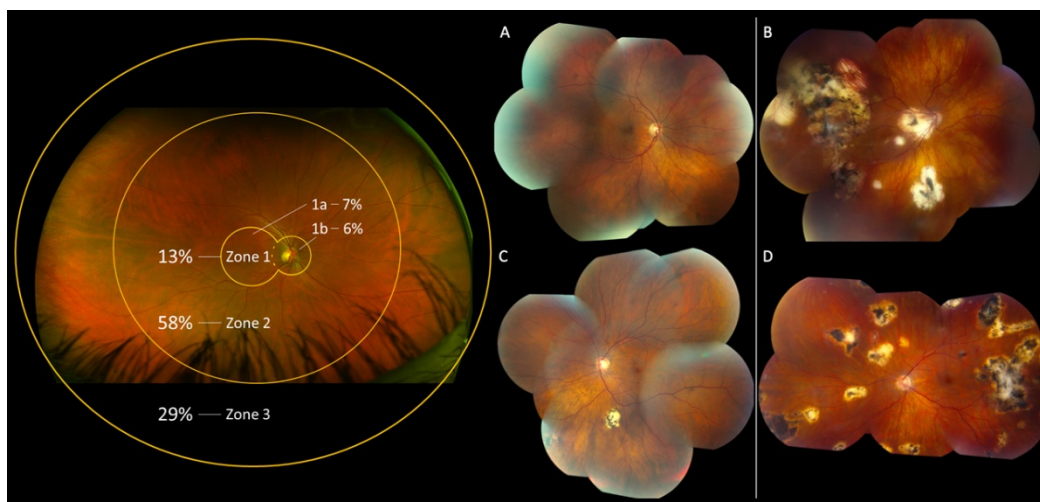


Figure. Zonal distribution pattern for retinal capillary hemangiomas (left side). Within the same families there are mild phenotypes (A, C) compared to severe phenotypes (B, D)

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