

**RESIDENT/FELLOW
RESEARCH DAY**

**Department of Ophthalmology
and Visual Sciences**

**UNIVERSITY OF IOWA
Roy J. and Lucille A. Carver
College of Medicine**



**University of Iowa
Hospitals & Clinics**

Iowa City, Iowa

Papers

Braley Auditorium, 01136 Lower Level Pomerantz Family Pavilion

Friday, March 26, 2010, 8:00 AM-3:30 PM

Posters

Rehabilitation Therapies Gymnasium, 1701 John Pappajohn Pavilion

Thursday, March 25, 2010, 6:00-8:00 PM

Friday, March 26, 2010, 9:40-10:30 AM

RESIDENT/FELLOW RESEARCH DAY - 2010

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Kirk A. Sturridge, M.D.

MOLECULAR OPHTHALMOLOGY

Juan P. Fernandez de Castro, M.D.

NEURO-OPHTHALMOLOGY

Judy Chen, M.D., Ph.D.

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Jill S. Melicher Larson, M.D.

PEDIATRIC OPHTHALMOLOGY

Alina V. Dumitrescu, M.D.

VITREORETINAL DISEASE

Kori A. Elkins, M.D.
Christine N. Kay, M.D.
Rizwan Somani, M.D.
Ryan M. Tarantola, M.D.

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RESIDENTS

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Alex W. Cohen, M.D., Ph.D.
Nandini G. Gandhi, M.D.
A. Brock Roller, M.D.
Lucas J.A. Wendel, M.D.

SECOND-YEAR RESIDENTS

Emily S. Birkholz, M.D.
Jason P. Brinton, M.D.
Leslie T.L. Pham, M.D.
Brian K. Privett, M.D.
Gina M. Rogers, M.D.
Janet Y.M. Tsui, M.D.

FIRST-YEAR RESIDENTS

Priya Gupta, M.D.
Esther S. Hong, M.D.
Shaival S. Shah, M.D.
Matthew S. Ward, M.D.
Christopher E. Watts, M.D.

ORTHOPTICS – TRAINING

Tara L. Bragg, B.A., Second Year
Shemeka Butler, B.S., First Year
Eva Lutz, B.A., Second Year
Dimitra Triantafilou, B.A., First Year

OTHER PRESENTERS

Bhavna Antony, M.S., Research Scholar
Zhihong Hu, M.S., Research Scholar
Kyongmoo Lee, Ph.D., Research Scholar
Li Tang, Ph.D., Research Scholar
George R. Wandling, Jr., B.S., B.A., Medical Student
Xiayu Xu, B.S., Research Scholar

**The University of Iowa
Department of Ophthalmology and Visual Sciences
Resident and Fellow Research Program
would like to recognize**

The William C. and Dorothea Gaedke Charitable Trust

**for their continued support of
resident and fellow research**

Research at The University of Iowa Department of Ophthalmology
and Visual Sciences is supported in part by an unrestricted grant from
Research to Prevent Blindness



**RESIDENT/FELLOW
RESEARCH DAY**

March 25-26, 2010

Department of Ophthalmology
and Visual Sciences

University of Iowa
Roy J. and Lucille A. Carver
College of Medicine

University of Iowa
Hospitals and Clinics

Iowa City, Iowa

OPHTHALMOLOGY RESIDENT/FELLOW RESEARCH DAY SCHEDULE OF EVENTS

Friday, March 26, 2010

7:30 **Registration**, Entry Foyer, Braley Auditorium 01136 PFP

8:00 – 9:45

Papers, Session 1

Braley Auditorium

Moderator: Sudeep Pramanik, M.D.

- 8:00 Welcome: **Michael D. Wagoner**
- 8:10 Introduction of the Moderator
- 8:15 **Emily S. Birkholz**, Michael D. Wagoner, Primary Supervisor 1
Treatment of Ocular Surface Squamous Cell
Intraepithelial Neoplasia With and Without Mitomycin C
- 8:35 **Tara L. Bragg**, Susannah Q. Longmuir, Primary Supervisor 2
Association of Accommodative Insufficiency and Convergence
Insufficiency
- 8:55 **Juan P. Fernandez de Castro**, Edwin M. Stone, Primary Supervisor 3
Induced Pluripotential Cells for Treatment of Blinding
Diseases
- 9:15 **Priya Gupta**, Michael D. Abramoff, Primary Supervisor 4
3-D Textural Analysis of Intraretinal Layers In Macula-
Centered SD-OCT Volumes from Neovascular Age-related
Macular Degeneration Patients

9:40 - 10:30

Break / Posters

Gymnasium, 1701 JPP

10:30 – 12:20

Papers, Session 2

Braley Auditorium

Moderator: David K. Dueker, M.D.

- 10:30 Introduction of Keynote Speaker
- 10:40 **David K. Dueker, M.D.**, Keynote Address
- 11:00 **Esther S. Hong**, Richard C. Allen, Primary Supervisor 5
Predictors for Lid Crease Formation after Frontalis Suspension
Surgery for Myogenic Ptosis
- 11:20 **Eva M. Lutz**, Christine Sindt, Primary Supervisor 6
Stereopsis in Keratoconus Patients
- 11:40 **Jill S. Melicher Larson**, Jeff A. Nerad, Primary Supervisor 7
Orbital Preservation in the Resection of Paranasal Sinus
Tumors with Orbital Involvement

OPHTHALMOLOGY RESIDENT/FELLOW RESEARCH DAY SCHEDULE OF EVENTS

Friday, March 26, 2010

12:00	Matthew P. Rauén, Michael D. Wagoner, Primary Supervisor 8 Donor Rim Culture Results with Keratoplasty: Do the Surgical Procedure and Donor Preparation Technique Impact Culture Results?
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12:30 - 1:30 Buffet Luncheon Atrium Dining Room, 7th Floor, RCP

1:40 – 3:15 Papers, Session 3 Braley Auditorium Moderator: John E. Sutphin, MD
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2:05	Janet Y.M. Tsui, Michael D. Wagoner, Primary Supervisor 10 Phakic Descemet's Stripping Automated Endothelial Keratoplasty: Prevalence and Prognostic Impact of Early Postoperative Cataracts	
2:25	Matthew S. Ward, Michael D. Wagoner, Primary Supervisor 11 Photorefractive Keratectomy Modification of Post-Penetrating Keratoplasty and Lamellar Keratoplasty Refractive Errors	
2:45	Christopher E. Watts, Randy H. Kardon, Supervisor 12 Iris Dysfunction with Alpha-1 Blockers	
3:05	Michael D. Wagoner, Closing Remarks	

3:15 - 3:45 Selection of Leinfelder Awards, Faculty and Guest Panel
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OPHTHALMOLOGY RESIDENT/FELLOW RESEARCH DAY

SCHEDULE OF EVENTS

Thursday, March 25, 2010, 6:00-8:00 PM

Friday, March 26, 2010, 9:45-10:45 AM

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**OPHTHALMOLOGY RESIDENT/FELLOW RESEARCH DAY
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RESIDENT/FELLOW RESEARCH DAY - 2010

Treatment of Ocular Surface Squamous Cell Intraepithelial Neoplasia With and Without Mitomycin C

Emily S. Birkholz, M.D.

Primary Supervisor: Michael D. Wagoner, M.D., Ph.D.

Co-Supervisors: Kenneth M. Goins, M.D.; Anna S. Kitzmann, M.D.;

John E. Sutphin, M.D.



Purpose: To analyze the outcome of excisional biopsy of ocular surface (conjunctival and corneal) squamous cell intraepithelial (*in situ*) neoplasia with and without the use of intraoperative and postoperative adjunctive mitomycin C.

Methods: Retrospective review of every case of histopathologically proven intraepithelial neoplasia that was treated between January 1, 1980 and December 31, 2008 at the University of Iowa Hospitals and Clinics and for whom at least 3 months of follow-up is available.

Results: Thirty-two eyes met the inclusion criteria. Adjunctive therapy was provided with mitomycin C in 17 eyes, including 13 that only had postoperative treatment and 4 that only had intraoperative treatment. The use of adjunctive mitomycin C was significantly associated with a reduced prevalence of recurrence (5.9% vs. 66.7%, ($P = 0.0005$)). When the surgical margins were positive, the use of adjunctive mitomycin C was associated with a reduced prevalence of tumor recurrence (12.5% vs. 55.6%), but this difference was not statistically significant ($P = 0.13$). When surgical margins were negative, the use of adjunctive mitomycin C was significantly associated with a reduced prevalence of recurrence (0% vs. 83.3%; ($P = 0.002$)).

Conclusion: The use of adjunctive mitomycin C is significantly associated with a reduction in the prevalence of postoperative recurrences of ocular surface squamous cell intraepithelial neoplasia. The use of postoperative mitomycin C is recommended even when surgical margins are negative.

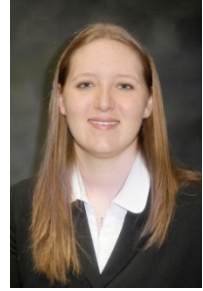
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Association of Accommodative Insufficiency and Convergence Insufficiency

Tara L. Bragg, B.A.

Primary Supervisor: Susannah Q. Longmuir, M.D.

Co-Supervisor: Wanda L. Pfeifer, OC(C), COMT



Purpose: The purpose of this study is to investigate the relationship between convergence insufficiency and accommodative insufficiency looking specifically at the incidence of accommodative insufficiency in convergence insufficiency. We hypothesize that accommodative insufficiency may change in response to convergence insufficiency treatment by orthoptic therapy.

Methods: A retrospective chart review of patients diagnosed with convergence insufficiency at the University of Iowa between January 1960 and October of 2009 will be performed. The incidence of accommodative insufficiency associated with convergence insufficiency will be determined and the response of accommodative amplitudes to orthoptic treatment of convergence insufficiency will be analyzed. Outcome measures included near point of accommodation, convergence amplitudes, and near point of convergence.

Results: Pending

Conclusion: Pending

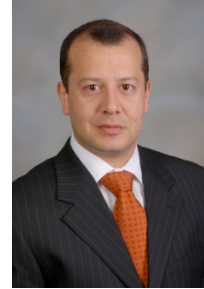
RESIDENT/FELLOW RESEARCH DAY - 2010

Induced Pluripotential Cells for Treatment of Blinding Diseases

Juan P. Fernandez de Castro, M.D.

Primary Supervisor: Edwin M. Stone, M.D., Ph.D.

Co- Supervisors: Markus H. Kuehn, Ph.D.; Robert F. Mullins, Ph.D.



Purpose: Stem cell research is a very promising field but has encountered many ethical dilemmas and the use of human embryos for research has generated great controversy. A method to transform cells from adult tissues into pluripotent stem cells by inserting specific factors was recently developed. The resulting induced pluripotent stem cells (iPSC) have the ability to further differentiate into cells from any of the three germinal layers. In this project human adult fibroblasts, mouse embryonic fibroblasts and mouse adult fibroblasts will be transformed into iPSC. The pluripotent cells will then be differentiated into retinal pigmentary epithelium cells.

Methods: The pluripotency state is achieved by transfecting the cells with a plasmid containing Oct3/4, Sox2, Klf4, and c-Myc using electroporation. Colonies expressing early markers of stem cells like alkaline phosphatase, SSEA-1 and SSEA-4 are further expanded. Colonies consistently expressing pluripotent factors and exhibiting the expected morphology are then challenged to differentiate. The differentiation ability is assessed by the formation of a teratoma *in vivo*, injecting the induced pluripotent stem cells into hind limb muscles of 6-week-old immunocompromised SCID mice. The confirmed pluripotent cells are allowed to grow into embryoid bodies and then committed to differentiate into retinal cells by stepwise treatment with the small molecule factors CKI-7 and SB-431542. The cells are cultivated in knock-out serum replacement (KSR) for a total of 30 days. Differentiated cells can be identified by the typical pigmented cell morphology, the loss of expression of pluripotent markers and the expression of RPE markers ZO-1 and RPE-65.

Human adult fibroblasts, mouse embryonic fibroblasts and mouse adult fibroblasts have been effectively transfected with the plasmid and have expressed early markers of pluripotency. A different cell line of mouse embryonic stem cells has been cultured, proven pluripotent by *in vivo* teratoma formation and differentiated to retinal progenitor cells expressing RPE markers. Mice with provoked RPE defects have been injected subretinally with this cells and their behavior is being analyzed *in vivo* by ERGs and *in vitro* by light microscopy.

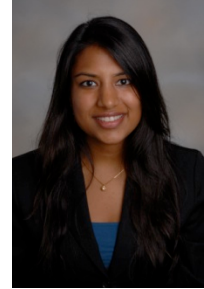
Conclusion: The differentiated retinal cells will be used as models to study inherited blinding conditions. This study helps understand the potential of stem cells and allows the development of transplantation therapies for retinal diseases, the discovery of therapeutic drugs and investigation of the retinal development and disease mechanisms.

3-D Textural Analysis Of Intraretinal Layers In Macula-Centered SD-OCT Volumes From Neovascular Age-related Macular Degeneration Patients

Priya Gupta, M.D.

Primary Supervisor: Michael D. Abramoff, M.D., Ph.D.

Co-Supervisors: Mona Garvin, Ph.D.; Milan Sonka, Ph.D.



Purpose: Currently, the primary quantitative method used in practice to analyze a retinal optical coherence tomography scan is central retinal thickness (CMT). However, texture properties of intraretinal layers provide valuable information regarding the health of the retina as well. The purpose of this study is to quantify these texture properties by Spectral-Domain OCT volumes, and to determine the diagnostic potential of texture analysis in neovascular age-related macular degeneration (AMD).

Methods: 91 macula-centered SD-OCT volumes were obtained from 13 normal (13 scans) and 26 neovascular AMD eyes (78 scans) using Cirrus™ HD-OCT machines. 10 intraretinal layers were automatically segmented, the average thickness with standard deviation (2 features), were determined in each layer and the fluid-filled regions were manually identified then removed from analysis. Next, in each layer 21 texture features were analyzed, broadly be divided into 4 categories: 1) distribution of signal intensity level features, 2) run length features which measure heterogeneity and tonal distribution of intensity level, 3) co-occurrence matrix features which measure the overall spatial relationship of intensity level, and 4) wavelet analysis features which use the principle of de-speckling signal noise to produce quantitative information about changes in horizontal and vertical architecture. The distribution of these features in different regions of the macula was compared in each layer using a Kolmogoroff-Smirnov (K-S) test.

Results: A significant difference was observed between normal and AMD throughout the macula and in most layers for 22 of these 23 features. 4 texture properties had an average K-S statistic (D) greater than 0.4 in all layers and throughout the macula. The thickness of the layers ranked amongst the least discriminant features (average: $D=0.318$, standard deviation: $D=0.263$). Across all features, the largest differences between AMD and normal were detected for the connecting cilia, inner plexiform, and outer segment layers.

Conclusion: 3-D texture analysis of intraretinal layers in macula-centered SD-OCT volumes provides clinically useful metrics, and may be more discriminant than the parameter that is easiest to assess clinically: layer thickness. The next step in this study would be to explore the potential of texture analysis in improving decision-making for treat-and-extend anti-VEGF therapy in neovascular AMD.

Predictors for Lid Crease Formation after Frontalis Suspension Surgery for Myogenic Ptosis

Esther S. Hong, M.D.

Primary Supervisor: Richard C. Allen, M.D., Ph.D.

Co-Supervisors: Keith D. Carter, M.D.; Emily Watterburg, M.D.; Leslie Morrison, M.D.



Purpose: To determine which pre-operative and intra-operative factors influence formation of a lid crease after frontalis suspension surgery in patients with myogenic ptosis.

Methods: This was a non-randomized, retrospective, comparative case series. Patients were identified from the practice of a single individual (RCA). The study was in compliance with the Declaration of Helsinki. The following data was obtained: patient age, diagnosis; pre-operative margin reflex distance (MRD), palpebral fissure height (PF), and levator function (LF); surgical procedure details; and post-operative MRD. Post-operative photographs were reviewed and the lid creases were graded by two reviewers (RCA and KDC) as poor, fair, or good.

Results: 41 patients (81 eyelids) were identified who underwent frontalis suspension surgery using a silicone sling by a single surgeon. Tarsal fixation of the sling and retro-septal placement of the sling was performed in all surgeries. Mean age at the time of surgery was 62.7 years. 39 had a diagnosis of oculopharyngeal muscular dystrophy (OPMD). Pre-operative mean MRD, PF, and LF were 0.20 mm, 5.1 mm, and 10.9 mm, respectively. Mean follow up was 13 months. Post-operative mean MRD was 2.3 mm. The following factors correlated positively with a good lid crease: levator function, conservative concurrent blepharoplasty, preservation of pre-aponeurotic fat, and incorporation of the levator aponeurosis into the skin closure,

Conclusion: The following factors appear to influence favorably the formation of a lid crease in patients with myogenic ptosis who underwent frontalis suspension with a silicone frontalis sling: pre-operative levator function, preservation of skin above the lid crease, preservation of pre-aponeurotic fat, and incorporation of the levator aponeurosis into the skin incision/crease closure.

RESIDENT/FELLOW RESEARCH DAY - 2010

Stereopsis in Keratoconus Patients

Eva Lutz, B.A.

Primary Supervisor: Christine W. Sindt, O.D.

Co-Supervisors: Susannah Q. Longmuir, MD, Wanda L. Pfeifer, OC(C),
COMT, Melissa Madsen, CO



Purpose: Keratoconus is a bilateral asymmetric corneal ectasia where the cornea assumes a conical shape because of thinning and protrusion. Stereoacuity has not been adequately evaluated in the keratoconus population. The progression of keratoconus is asymmetric which results in a difference in vision between the two eyes which can compromise stereoacuity. The purpose of this study is to determine the effect of asymmetric disease on keratoconus stereopsis and to determine the impact on quality of life.

Methods: Patients with a clinical diagnosis of keratoconus and no other ocular disease, and who had been treated with corneal transplantation were enrolled in this study. All patients had their visual acuity and stereoacuity measured using the randot test. They then completed the Visual Function Questionnaire to determine the impact of keratoconus on quality of life which was already standardized for the keratoconus population by the Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Study.

Results: Pending

Conclusion: Pending

Orbital Preservation in the Resection of Paranasal Sinus Tumors with Orbital Involvement

Jill S. Melicher Larson, M.D.

Primary Supervisor: Jeffrey A. Nerad, M.D.

Co-Supervisors: Keith D. Carter, M.D.; Richard C. Allen, M.D., Ph.D.



Purpose: To retrospectively analyze the treatment of patients with paranasal sinus malignancy with orbital extension at the University of Iowa Hospitals and Clinics from 1987 through 2009 with emphasis on the preservation of the eye, primary reconstruction of the orbit and the ideology of congruent margins.

Methods: A retrospective analysis was performed (IRB-01 #200907745) on all patients presenting to the eye clinic with sinus malignancy and orbital extension between 1987 and 2009. We report our experience with clinical evaluation and surgical planning regarding patients with paranasal sinus malignancy with orbital involvement. The medical records of 64 patients were evaluated, 35 (55%) patients underwent orbital reconstruction surgery at the time of tumor excision. Fourteen (22%) patients required unilateral orbital exenteration. One patient underwent orbital exenteration of the right orbit and orbital reconstruction of the left orbit. Fourteen (22%) patients had advanced disease at the time of diagnosis and were treated with palliative chemotherapy and radiation. Tumor type, mean follow-up and site of recurrence were assessed. In the patients undergoing orbital reconstruction (preservation), preoperative and postoperative visual acuity, the presence or absence of diplopia, comfort, tearing and postoperative complication rates were analyzed. Our clinical evaluation, preoperative planning and surgical technique are presented.

Results: Thirty-six patients (36/64) underwent orbital preservation at the time of tumor excision. All patients undergoing primary orbital reconstruction had frozen sections performed on the periorbital at the time of surgical excision prior to reconstruction. One of 36 patients had positive frozen sections of the periorbital and proceeded with orbital reconstruction after refusal of exenteration. Six (6/36) patients developed recurrence of their disease after primary orbital reconstruction, all (6/6) of these patients had known aggressive primary disease and 5/6 had either known distant metastasis or known intracranial involvement at the time of initial surgery. All patients undergoing primary orbital reconstruction that had good preoperative visual acuity maintained a postoperative visual acuity of 20/60 or better, with most patients maintaining 20/20 to 20/25 acuity over time. Few patients had problems with postoperative diplopia, discomfort or epiphora. All patients maintained relatively good cosmesis and there were few postoperative complications.

Conclusion: Orbital preservation surgery can be performed in patients with paranasal sinus malignancy and bony orbital involvement. If bony erosion is present, but frozen sections of the periorbital are negative, orbital preservation surgery should be attempted. In patients where there is known intracranial involvement that cannot be surgically cleared, orbital preservation surgery should be attempted to avoid the disfigurement of exenteration. Our technique allows patients to avoid mutilating facial deformity while maintaining good ocular function and comfort without compromising patient survival.

RESIDENT/FELLOW RESEARCH DAY - 2010

Donor Rim Culture Results with Keratoplasty: Do the Surgical Procedure and Donor Preparation Technique Impact Culture Results?

Matthew P. Rauen, M.D.

Primary Supervisor: Michael D. Wagoner, M.D., Ph.D.

Co-Supervisors: Kenneth M. Goins, M.D.; John E. Sutphin, M.D.



Purpose: To correlate the prevalence of positive donor rim cultures with preoperative tissue manipulation by the operating surgeon or eye bank technicians.

Methods: A retrospective review was conducted of the medical records of all patients treated with penetrating keratoplasty (PKP), lamellar keratoplasty (LKP), deep lamellar endothelial keratoplasty (DLEK), and Descemet's stripping automated endothelial keratoplasty (DSAEK) at University of Iowa Hospitals and Clinics from January 1, 2003, to December 31, 2006. Eyes that did not have donor rim cultures or that underwent keratolimbal allograft transplantation and femtosecond laser-enabled keratoplasty were excluded from the analysis. The cases were divided into 3 groups based upon donor preparation methods. Group 1 included eyes in which no additional manipulation of the donor tissue occurred between recovery and trephination in the operating room ("no precut"); group 2 included eyes in which the surgeon performed additional manipulation of the tissue in the operating room immediately prior to trephination ("surgeon cut"); and group 3 included eyes in which additional manipulation of the tissue was done in the eye bank by certified technical staff at least 1 day prior to trephination ("eye bank precut").

Results: Of 790 keratoplasties that were performed during the study period, 770 met the inclusion criteria. Group 1 included 351 donor rims (314 PKP; 37 LKP). Group 2 included 141 donor rims (113 DLEK; 28 DSAEK). Group 3 included 278 donor rims (all DSAEK). The prevalence of positive bacterial donor rim cultures was 8.3% in group 1, 7.1% in group 2, and 4.0% in group 3. The difference between groups 1 and 3 was statistically significant ($P = 0.03$), whereas the difference between groups 1 and 2 was not ($P = 0.71$). The prevalence of positive fungal donor rim cultures was 2.3% in group 1, 5.7% in group 2, and 2.9% in group 3. The differences between groups 1 and 2 and between groups 1 and 3 were not statistically significant ($P = 0.08$; 0.80, respectively).

Conclusion: Preoperative manipulation of donor tissue is associated with a lower prevalence of positive donor rim bacterial cultures that is statistically significant when done more than 1 day prior to surgery. Conversely, preoperative manipulation in the operating room may be associated with an increased prevalence of positive fungal cultures of the donor rim. From a sterility standpoint, it is safe for properly trained eye bank personnel to precut donor tissue that is used for endothelial keratoplasty.

RESIDENT/FELLOW RESEARCH DAY - 2010

Erythropoietin in Ischemic Eye Disease

Shaival S. Shah, M.D.

Supervisor: Vinit B. Mahajan, M.D., Ph.D.



Purpose: Recent evidence suggests erythropoietin (EPO) and the erythropoietin receptor (EPOR) may play a direct role in the pathogenesis of diabetic retinopathy. Better characterization of the EPO-EPOR signaling system in the ischemic retina may offer a new therapeutic modality for ischemic ophthalmic diseases. This study was performed to identify EPOR mRNA expression in the human diabetic eye.

Methods: Post-mortem retinas were obtained from human eyes with and without diabetic retinopathy. Anti-sense RNA and control sense probes were generated from a human EPOR cDNA template. After *in situ* hybridization, expression patterns of EPOR mRNA were studied with darkfield and phase contrast microscopy.

Results: EPOR antisense RNA probes were validated on human pancreas tissue. In the normal eye, EPOR was expressed in the retinal ganglion cell layer. Minimal expression was observed in the inner and outer nuclear layer. Under conditions of diabetic retinopathy, EPOR expression shifted to photoreceptor cells. Increased expression was also observed in the peripheral retina.

Conclusion: EPOR expression may be a biomarker or contribute to disease mechanisms in diabetic retinopathy. We plan to investigate the role of EPO as a neuroprotective therapeutic intervention for ischemic eye diseases such as anterior ischemic optic neuropathy.

Phakic Descemet's Stripping Automated Endothelial Keratoplasty: Prevalence and Prognostic Impact of Early Postoperative Cataracts

Janet Y.M. Tsui, M.D.

Primary Supervisor: Michael D. Wagoner, M.D., Ph.D.

Co-Supervisors: Kenneth M. Goins, M.D.; John E. Sutphin, M.D.



Purpose: To determine the prevalence and risk factors of visually significant cataracts after phakic Descemet's stripping automated endothelial keratoplasty (DSAEK) and the impact of this complication on the final surgical outcome.

Methods: A retrospective review was conducted of the medical records of all patients treated with DSAEK at University of Iowa Hospitals and Clinics from January 1, 2005, to July 1, 2007. Phakic eyes with corneal decompensation secondary to Fuchs' endothelial dystrophy in which concomitant lens removal was not performed were included in the statistical analysis. The main outcome measure was the development of a visually significant cataract in the first postoperative year. Secondary outcome measures were best spectacle-corrected visual acuity (BSCVA), graft survival, central corneal thickness (CCT), and endothelial cell density (ECD). Eyes with 12 months or more of postoperative follow-up were included in the statistical analysis.

Results: Of 10 eyes that met the inclusion criteria, visually significant cataracts occurred in 4 eyes (40%) in the first postoperative year. Cataract development in 3 eyes was associated with a preoperative shallow anterior chamber (<2.80 mm) and the postoperative development of pupillary block with elevated intraocular pressure. In 1 eye, cataract development was associated with a prolonged course of anterior uveitis and aggressive topical steroid therapy. There was a significant difference in the mean anterior chamber depth between eyes that did and did not develop cataracts ($P = 0.005$). Cataract surgery was associated with initial improvement in BSCVA in 4 eyes (mean, 20/30), but sustained improvement was not achieved in 1 eye that had developed late-onset endothelial graft failure. During the first 2 postoperative years, the mean BSCVA was worse at all follow-up intervals in eyes that developed cataracts. However, the differences between the 2 groups were not statistically significant after 6 (20/41 vs. 20/27; $P = 0.06$), 12 (20/47 vs. 20/28; $P = 0.08$), or 24 months (20/35 vs. 20/24; $P = 0.19$). No significant differences between the 2 groups were detected with respect to the mean change in CCT or ECD at any postoperative interval.

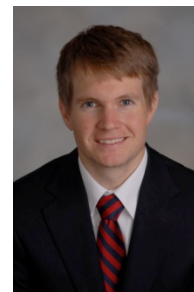
Conclusion: The development of cataracts is relatively common after phakic DSAEK, especially in eyes with shallow anterior chambers.

Photorefractive Keratectomy Modification of Post-Penetrating Keratoplasty and Lamellar Keratoplasty Refractive Errors

Matthew S. Ward, M.D.

Primary Supervisor: Michael D. Wagoner, M.D., Ph.D.

Co-Supervisors: Kenneth M. Goins, M.D.; Anna Kitzmann, M.D.;
John E. Sutphin, M.D.



Purpose: To study the efficacy, predictability, and safety of photorefractive keratectomy (PRK) modification of post-penetrating keratoplasty (PKP) and lamellar keratoplasty (LKP) refractive errors.

Methods: A retrospective chart review was conducted of all patients who underwent primary PRK modification of post-PKP and LKP refractive errors from January 1, 2004, to January 1, 2009, and had at least 3 months of follow-up. Outcome measures of efficacy were the maximum improvement in uncorrected visual acuity (UCVA) and best spectacle-corrected visual acuity (BSCVA). Predictability outcome measures included the obtained percentages of attempted spherical correction and astigmatic correction, as well as the stability of visual acuity and refractive correction. Safety outcome measures were postoperative complications and loss of more than 1 line of BSCVA.

Results: Of the 21 eyes that met the inclusion criteria for this study, 19 eyes had PKP and 2 had LKP. The mean attempted spherical and cylindrical corrections were -6.20 and $+4.58$ diopters (D), respectively. Compared with preoperative values, there were statistically significant postoperative improvement in the best obtained mean UCVA (20/283 vs. 20/53, respectively; $P < 0.001$) and the mean BSCVA (20/49 vs. 20/30, respectively; $P = 0.04$), as well as an increase in the percentage of eyes that obtained a BSCVA of 20/30 or better (38% vs. 41%, respectively; $P = 0.01$). Maximum visual improvement was obtained in 38% of eyes after 1 month, 71% of eyes after 3 months, and 100% of eyes after 6 months. After 1 month, the mean spherical and astigmatic errors had been reduced by 95.1% ($P < 0.001$) and 72.2% ($P < 0.001$), respectively, of the targeted correction. No significant changes in the refractive error were detected between 1 and 12 months. There were no sight-threatening postoperative complications. One eye (4.8%) experienced the loss of 2 lines of BSCVA.

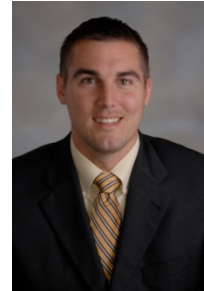
Conclusion: Our findings indicate that PRK is an effective, predictable, and safe method for reducing post-PKP and LKP refractive errors.

RESIDENT/FELLOW RESEARCH DAY - 2010

Iris Dysfunction with Alpha-1 Blockers

Christopher E. Watts, M.D.

Supervisor: Randy H. Kardon, M.D., Ph.D.



Purpose: Intra-operative Floppy Iris Syndrome (IFIS) is a condition that has been identified recently in men taking medications such as Flomax (an Alpha-1 antagonist) for BPH. In our study, we hope to implement and study these patients using a newly developed handheld computerized instrument which captures the pupillary response to both light and dark environments. This instrument quantifies maximum pupillary dilation and constriction, as well as analyzing respective dilation and constriction velocities with corresponding waveform analysis. Previous research utilizing anterior segment OCT has shown thinning of the iris dilator muscle in patients taking Alpha-1 antagonists. Our study would be the first to evaluate the function of the pupil using a device that can be readily and easily used in clinic. Such an evaluation would lead to a better understanding of IFIS, as well as offer a new tool for evaluation of these patients by Ophthalmologists. Improved understanding and pre-operative evaluation will allow Ophthalmologists to be better prepared to identify potential complications of IFIS, leading to better outcomes and management of these surgical patients.

Methods: In our study, patients already scheduled to undergo cataract surgery at both the UIHC and VA hospital will receive pre-operative pupillary waveform analysis using our handheld pupillometer. This evaluation will coincide with their pre-operative evaluation and clinic visit prior to their cataract surgery. Intra-operatively during cataract surgery, these same patients will be graded on a scale designed to evaluate severity of IFIS. This intra-operative scoring system will be correlated to their pre-op measurements using pupillometry. In comparing pre-op pupillary wave form analysis and subsequent presence/severity of IFIS, we hope to better understand the effect Flomax and other alpha-1 antagonists have on pupil function. As an additional benefit, our handheld pupillometer might offer a reliable and efficient pre-operative prediction of IFIS prior to patients receiving cataract surgery.

Results: Pending

Conclusion: Pending

POSTER 1

Automated Method for the Flattening of Optical Coherence Tomography Images

Bhavna Antony, M.S.

Primary Supervisor: Michael D. Abramoff, M.D., Ph.D.

Co-Supervisor: Mona Garvin, Ph.D.

Purpose: The retinal surfaces obtained from the OCT scanners are far from flat, and show different forms of distortions in the B-scan and C-scan slices. These artifacts are thought to be the result of a number of factors such as the corneal curvature, motion of the eye and the positioning of the camera. Flattening the dataset makes visualization easier by bringing the dataset into a more consistent shape, which also allows for the efficient truncation of the dataset. Here, we present a quantitative comparison of two automated methods that eliminate distortions characteristic to optical coherence tomography images.

Methods: First, the retinal surfaces are detected through an automated 3-D graph-theoretic approach. A surface is then selected and used to determine the flattening plane through two consecutive thin-plate spline fits. The first spline-fit uses a smoothing regularization term and an equal number of control points in both axial directions to approximate the distortion seen in B-scans. For the second spline-fit, a smaller regularization term and a larger number of points in the direction of the slice acquisition is used to approximate the rippling seen in C-scans. In both stages, points within the neural canal are avoided using a circular mask to approximate the region. This two-stage approach is compared with the method that uses a single spline-fit. The method is quantitatively validated using depth maps of the optic nerve head constructed from fundus photographs (Tang 2010, SPIE) taken at two slightly different angles. Since the depth images approximate the shape of the optic nerve head, they can be compared with the top surface of the flattened dataset. The normalized depth map is registered to the OCT dataset and the mean unsigned difference is computed within valid areas of the depth map (excluding the neural canal).

Results: Over 30 glaucomatous datasets, the mean unsigned difference between the depth maps and the top surface from the datasets flattened (which are also normalized consistently) by the two-spline flattening approach was significantly smaller than the single spline-fit (0.215 ± 0.056 and 0.127 ± 0.039 , respectively; $p < 0.001$).

Conclusion: Although various methods exist for flattening OCT datasets, thus far none have been quantitatively validated. The presented two-spline flattening method was compared quantitatively with a single-spline approach and found to be more robust.

POSTER 2

Anti-gamma-enolase Autoimmune Retinopathy Presenting in Early Childhood

Jason P. Brinton, M.D.

Supervisor: James C. Folk, M.D.

Co-Supervisors: Audrey C. Ko, B.S.; Jasmine Hernandez, B.S.; Jason P.; Elizabeth A. Faidley, B.A., B.S.; Sarah A. Mugge; Marilyn B. Mets, M.D.; Randy H. Kardon, M.D., Ph.D.; Robert F. Mullins, Ph.D.; Edwin M. Stone, M.D., Ph.D.



Purpose: The fundus appearance of patients affected with autoimmune retinopathy (AIR) can resemble that of individuals affected with a heritable retinal degeneration. We present the clinical, molecular and serologic findings of a case in which AIR and early onset heritable retinal degeneration were both considered in the differential diagnosis.

Methods: A three-year-old female patient presented with clinical findings suggestive of a childhood onset retinal degeneration. DNA and serum samples were collected. The coding regions of 11 genes known to be associated with Leber congenital amaurosis were sequenced. The patient's serum reactivity to soluble and insoluble fractions of human retinal protein was compared to normal controls (n = 32), patients with inflammatory eye disease (n = 82), and patients with molecularly confirmed retinal degenerations (n = 11). Two-dimensional gel electrophoresis and mass spectrometry were used to identify a protein that corresponded to a reactive band on western blot.

Results: No plausible disease-causing mutations were identified in any of the retinal disease genes tested. However, the patient's serum showed reactivity to a single retinal antigen of approximately 47kDa. Two-dimensional gel electrophoresis and mass spectrometry revealed the major reactive species to be neuron-specific enolase (NSE, also known as gamma enolase). Screening of the coding sequence of the gene that encodes NSE (*ENO2*) in the patient revealed a normal sequence. Autoantibodies targeting NSE were not observed in any normal controls or inflammatory eye disease patients. However, anti-NSE activity was found in one 7 year old female with molecularly confirmed Leber congenital amaurosis caused by missense mutations in *CRB1* (Cys195Phe and Gly750Asp).

Conclusion: Infection or inflammation within the retina early in life may lead to an autoimmune phenocopy of early-onset inherited retinal degeneration. This patient's clinical and laboratory findings coupled with the recently discovered role of anti-NSE antibodies in canine AIR, suggest that autoantibodies targeting NSE are involved in the pathogenesis of her disease

POSTER 3

Penetrating Keratoplasty versus Deep Anterior Lamellar Keratoplasty for Keratoconus

Alex W. Cohen, M.D., Ph.D.

Primary Supervisor: Michael D. Wagoner, M.D., Ph.D.

Co-Supervisors: Kenneth M. Goins, M.D.; John E. Sutphin, M.D.

Statistical Assistance: George R. Wandling, Jr., B.A., B.S.



Purpose: To compare the outcome of penetrating keratoplasty (PKP) and deep anterior lamellar keratoplasty (DALK) in the surgical management of keratoconus (KC).

Methods: A retrospective review was conducted of the medical records of all patients treated with PKP or DALK for KC at University of Iowa Hospitals and Clinics from January 1, 2000, to December 31, 2006. The main outcome measures (graft survival, complications, and visual outcome) were evaluated during the first 24 postoperative months. Cases with a minimum follow-up of 6 months were included in the statistical analysis.

Results: Of 41 eyes that met the inclusion criteria, 30 eyes were treated with PKP and 11 eyes were treated with DALK. No cases of late-onset endothelial failure were found in either group. Endothelial rejection occurred in 4 (13.3%) eyes after PKP. Visually significant interface haze occurred in the early postoperative course in 2 (18.2%) eyes after DALK. At the most recent examination, the mean best spectacle-corrected visual acuity (BSCVA) was 20/28 for the PKP group and 20/29 for the DALK group ($P = 0.77$). The percentage of eyes that achieved BSCVA of 20/25 or better was higher in the PKP group than in the DALK group (77.3% vs. 45.5%, respectively), but this difference was not statistically significant ($P = 0.72$).

Conclusion: Treatment of KC with PKP or DALK is associated with similar visual outcomes, graft survival, and prevalence of vision-compromising complications during the first 2 postoperative years.

POSTER 4

Femtosecond Laser (IntraLase) versus the Manual Microkeratome (Moria ALTK) in Dissection of the Donor Lenticule for Descemet's Stripping Automated Endothelial Keratoplasty: Pilot Study in Eyebank Eyes

Nandini G. Gandhi, M.D.

Primary Supervisor: Kenneth M. Goins, M.D.

Co-Supervisors: Greg Schmidt, Rob Mullins, Ph.D.



Purpose: The purpose of this study was to perform an in vitro analysis of the safety and efficacy of preparing the donor lenticule with the IntraLase laser at the 60 kHz frequency as compared to the Moria microkeratome.

Methods: Eight corneoscleral buttons supplied by the Iowa Lions Eye Bank were assigned for dissection to either the femtosecond laser group or to the manual microkeratome group. Four specimens underwent dissection with the IntraLase femtosecond laser at a firing rate of 60 kHz. A spiral pattern for dissection was used to dissect the 9.0 mm lenticules to a depth of 400 microns, and the line and spot separation was set at 4 microns. Four specimen were dissected by the manual microkeratome (Moria ALTK) using the 300 micron head. Endothelial cell density and ultrasonic pachymetry measurement of the corneal cap and stromal bed were performed before the dissection and immediately after the dissection. Endothelial cell density was re-measured at 24 and 48 hours. The cut surfaces of the lenticules from each group were examined with scanning electron microscopy and photographed using a Hitachi S-4800 scanning electron microscope (Toronto, Ontario, Canada). The comparison of measurements obtained after dissection in both groups was performed via the Student t-test, where $p < 0.05$ was considered statistically significant.

Results: There were no intraoperative complications during the dissection of any of the eight lenticules in either the IntraLase or the Moria group. The mean preoperative pachymetry was comparable in both groups ($p = 0.15$). There was no statistically significant difference between the mean corneal cap thickness ($p = 0.42$) or posterior stromal bed ($p = 0.37$) between the two groups. There was a statistically significant difference between the intended cap thickness and the actual obtained cap thickness between the two groups ($p = 0.01$). There was no statistically significant difference in endothelial cell density between the two groups preoperatively ($p = 0.72$); there was likewise no statistically significant difference in the endothelial cell counts between the groups at 24 hours ($p = 0.50$) and 48 hours ($p = 0.62$) postoperatively. There was no statistically significant change in the endothelial cell counts in either group from pre-operative measurements to measurements taken 48 hours after dissection. Scanning electron microscopy demonstrated that the microkeratome consistently produced lenticules that had a smoother surface than those cut with the femtosecond laser.

Conclusion: Dissecting the donor lenticule with the 60 kHz IntraLase laser is a safe and effective method of dissection, but there are some limitations with respect to the smoothness of the lenticule dissected. An optimization of the femtosecond laser protocol by incorporating multiple ablations and utilizing a raster rather than a spiral pattern may contribute to the fashioning of a smoother donor lenticule.

POSTER 5

Circularity Comparison of the Clinical Optic Disc and Automatically Segmented Neural Canal Opening in SD-OCT Images

Zhihong Hu, M.S.

Primary Supervisor: Mona Garvin, Ph.D.

Co-Supervisor: Michael D. Abramoff, M.D., Ph.D.

Purpose: The neural canal opening (NCO), visible in 3-D SD-OCT, is a promising stable reference structure for monitoring glaucomatous progression. The purpose of this study is to investigate the hypothesis that the NCO segmented in SD-OCT tends to be more “circular” or “round” than the disc margin delineated on the stereo fundus photographs. This may be the case particularly in those eyes in which the optic nerves appear “tilted.”

Methods: 68 SD-OCT volumes centered at the optic nerve head (ONH) of 34 patients with glaucoma were obtained from Cirrus™ HD-OCT. The corresponding fundus photographs (Nidek 3Dx) were also obtained. Four intraretinal surfaces were segmented in the original raw OCT images and the OCT images were flattened based on the surface segmentation. From each flattened image, the NCO was automatically segmented using a graph-theoretic approach. Manual planimetry was performed by glaucoma experts to delineate a reference standard (RS) for the disc margins on the fundus images. The circularity ratio or isoperimetric quotient was used to evaluate the circularity of the NCO and optic disc. The 68 scans were divided into two groups, i.e., the more circular group and the less circular group based on the average of the optic disc circularity ratio of the RS. The area correlations of the NCO and optic disc were computed. The relationship of the circularity ratio and area correlation was investigated.

Results: The circularity comparison of NCO of the algorithm and optic disc of the RS.

		68 scans	Less circular group	More circular group
Circul. ratio	NCO of algor.	0.909 ± 0.011 *	0.906 ± 0.011	0.912 ± 0.010
	Optic disc of RS	0.889 ± 0.017 *	0.873 ± 0.013	0.902 ± 0.007
Area correl. of NCO and optic disc of RS (95% CI)**		0.77 (0.64 to 0.85)	0.75 (0.55 to 0.87)	0.86 (0.74 to 0.92)

* Paired t-test of the circularity ratio of the NCO and optic disc for the 68 scans: $p < 0.0001$

** CI: confidence interval

Conclusion: The investigation demonstrates that the NCO in SD-OCT images is significantly more circular than the optic disc on fundus images. The more circular group has greater area correlation between NCO and optic disc than the less circular group.

POSTER 6

3-D Segmentation of Retinal Blood Vessels in Spectral-Domain OCT Volumes of the Optic Nerve Head

Kyongmoo (Kit) Lee, Ph.D.

Primary Supervisor: Milan Sonka, Ph.D.

Co-Supervisor: Michael D. Abramoff, M.D., Ph.D.

Purpose: To develop and evaluate a method that can automatically detect 3-D retinal blood vessels from spectral-domain OCT scans centered on the optic nerve head (ONH).

Methods: 30 ONH-centered OCT scans ($200 \times 200 \times 1024$ voxels, $6 \times 6 \times 2$ mm³) were obtained from both eyes of 15 normal subjects using CirrusTM HD-OCT machine (Carl Zeiss Meditec, Inc., Dublin, CA). The method utilized a fast multiscale 3-D graph search to segment retinal surfaces as well as a triangular mesh-based 3-D graph search to detect retinal blood vessels. To validate the proposed method, computer segmentation results were compared with the markers which a retinal specialist put at the center of retinal blood vessels in 10 randomly selected B-scan images for each isotropic OCT volume.

Results: The mean unsigned error of the computer segmentations compared with the independent standard obtained from a retinal specialist was calculated in 3-D as 0.10 ± 0.07 mm (3.4 ± 2.5 voxels).

Conclusion: The contribution of this study is the development of a fully automated method for 3-D segmentation of retinal blood vessels from spectral-domain OCT scans.

POSTER 7

**Treatment of Epithelial Basement Membrane Dystrophy
With Manual Superficial Keratectomy**

Leslie T.L. Pham, M.D.

Primary Supervisor: Michael D. Wagoner, M.D., Ph.D.

Co-Supervisors: Kenneth M. Goins, M.D; John E. Sutphin, M.D.



Purpose: The aim of this study is to evaluate the efficacy of manual superficial keratectomy (SK) in the treatment of symptomatic epithelial basement membrane dystrophy (EBMD).

Methods: A retrospective review of the medical records of every patient treated with manual SK at University of Iowa Hospitals and Clinics (UHC) from January 1, 1998, to December 31, 2007, was conducted. The indications for surgical intervention were decreased vision and/or recurrent corneal epithelial erosions. Outcome measures included best spectacle-corrected visual acuity (BSCVA), elimination of recurrent erosions, and recurrence of symptomatic EBMD. Cases for which more than 3 months of postoperative follow-up were available were included in the statistical analysis. Eyes that had been treated with either manual SK or phototherapeutic keratectomy (PTK) prior to referral to UHC were excluded from the statistical analysis.

Results: Of 20 patients (14 men; 6 women), 22 eyes met the inclusion criteria. The mean follow-up after surgery was 43.6 months (range, 3.0-115.2 months). Among 20 eyes with decreased vision, improvement was detected in BSCVA from a mean preoperative logMAR acuity of 0.313 (Snellen equivalent 20/41) to a best postoperative acuity of 0.038 (20/22) and a final acuity of 0.079 (20/24). No eyes experienced recurrence of visually significant EBMD. A BSCVA of 20/20 or better was achieved in 12 (60.0%) eyes, and the same result was achieved at the most recent examination in 10 (50.0%) eyes. All 15 (100.0%) eyes with recurrent erosions had complete resolution of symptoms during the first 6 postoperative months. Between 6 and 60 months after initial treatment, 3 (20.0%) eyes experienced recurrent erosions. Among these, 2 eyes were successfully treated with a course of bandage soft contact lens therapy, and 1 eye was successfully treated with excimer laser PTK. No surgical complications resulted from any of the manual SK procedures.

Conclusion: Manual SK is a safe and effective therapeutic modality for the treatment of impaired vision and/or recurrent erosions caused by EBMD.

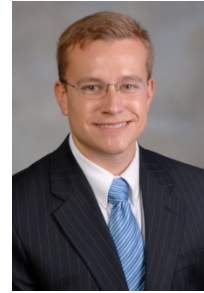
POSTER 8

Use of the EYESi Surgical Simulator as a Valid Model for Capsulorhexis Training

Brian K. Privett, M.D.

Primary Supervisor: Emily C. Greenlee, M.D.

Co-Supervisors: Thomas A. Oetting, M.D., Gina Rogers, M.D.



Purpose: To compare medical students and residents to experienced cataract surgeons on the EYESi surgical simulator's (VRmagic) capsulorhexis training module.

Methods: Sixteen medical students and residents at the University of Iowa and 7 experienced cataract surgeons participated. Each participant completed 4 trials on the EYESi capsulorhexis module.

Results: The experienced surgeons achieved significantly better total scores on both the easy ($P = 0.004$) and medium ($P = 0.000007$) levels of the capsulorhexis module. Experienced surgeons achieved significantly better scores on all parameters at the medium level with better centering ($P = 0.001$), less corneal injury ($P = 0.02$), fewer spikes ($P = 0.03$), less time operating without a red reflex ($P = 0.0005$), better roundness of the capsulorhexis ($P = 0.003$), and in less time ($P = 0.008$).

Conclusion: The EYESi surgical simulator capsulorhexis module showed significant ($P < 0.05$) construct validity.

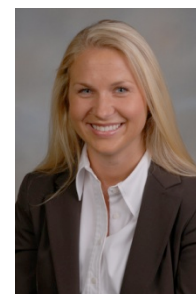
POSTER 9

The Impact of a Structured Surgical Curriculum on Ophthalmic Resident Cataract Surgery Complication Rate

Gina M. Rogers, M.D.

Primary Supervisor: Thomas A. Oetting, M.D.

Co-Supervisors: Andrew G. Lee M.D.; Constance Grignon, M.D.; Emily Greenlee, M.D.; A. Tim Johnson, M.D., Ph.D.; Hilary A. Beaver, M.D.; Keith D. Carter, M.D.



Purpose: To investigate if a more structured surgical curriculum: wet lab/virtual simulator, “backing into cases,” formative feedback, and deliberate practice of the capsulorhexis, introduced early in residency training of ophthalmology residents has an effect on senior resident cataract surgery complication rate.

Methods: Quality assurance data from 1832 phacoemulsification cases performed by third year ophthalmology residents from one program at one training site over the academic years of 1998-2008 was studied. The primary outcome measure was a sentinel event defined as a posterior capsular tear (with or without vitreous loss) or vitreous loss (from any cause). Data was analyzed between two groups: one prior to the enhanced curriculum and one training with the curriculum changes. Data was further analyzed within the each group depending on the amount of surgical experience of the resident prior to the rotation at the studied site.

Results: Sentinel complication rate prior to curriculum changes (Group 1, 1998-2003) was 7.17% and with the enhanced curriculum (Group 2, 2004-2008) was 3.77%; $p=0.008$. One academic year, 2003-2004 was excluded as it did not clearly fall into either group. Within Group 1, residents with less than 60 cases prior to the rotation at the studied site had a sentinel complication rate of 8.47% and with greater than 60 cases a rate of 6.40%. In Group 2, the complication rate with less than 60 cases of experience was 5.49% and with greater than 60 cases was 2.64%.

Conclusion: We appreciate that there are limitations of our study including small sample size, data analyzed from only one center, and confounding variables. However, the majority (>95%) were staffed by one attending and the surgical procedures and equipment were fairly stable during the period included in the analysis. It seems that the most significant change was the addition of the new elements to the early surgical curriculum that led to a quantitative reduction sentinel complication rate thus improving patient safety. The enhancement of the junior resident curriculum seems to have hastened the surgical learning curve as the experienced residents from the 1998-2003 group still had more sentinel complications than the less experienced residents from the group from 2004-2008 with the enhanced curriculum.

POSTER 10

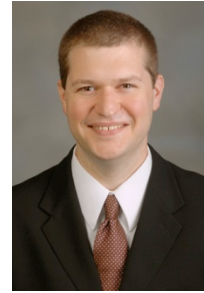
Effects of Vitrectomy and Age-related Macular Degeneration

A. Brock Roller, M.D.

Primary Supervisor: James C. Folk, M.D.

Co-Supervisors: Vinit B. Mahajan, M.D., Ph.D.; H. Culver Boldt, M.D.;

Michael D. Abramoff, M.D., Ph.D.; Stephen R. Russell, M.D.



Purpose: To determine whether vitrectomy alters the long-term progression of age-related macular degeneration (AMD).

Methods: The charts and photographs of subjects with Age-Related Eye Disease Study category 3 AMD in both eyes who previously underwent vitrectomy surgery for an epiretinal membrane or macular hole were retrospectively reviewed in this retrospective case-control study. Subjects were excluded if they had had a vitrectomy in both eyes, had <2 years of follow-up, had previous choroidal neovascularization (CNV), retinal detachment, diabetic retinopathy, angioid streaks, high myopia, vascular occlusions, or extensive macular scarring in either eye, or insufficient hospital records or photographs to determine the extent of AMD. Clinical notes throughout the follow-up interval were reviewed. Two vitreoretinal specialists independently graded pre- and post-vitrectomy fundus photographs of all eyes in a masked fashion. The main outcome measures were the development or progression of geographic atrophy of the retinal pigment epithelium and the development of CNV.

Results: Forty-four eyes of 22 patients with AMD who underwent vitrectomy in 1 eye were included in the study. The progression of AMD at follow-up in the 22 eyes that underwent vitrectomy was compared with the 22 fellow, nonvitrectomized eyes. The average follow up interval was 5.5 years (range, 2–15). Choroidal neovascularization developed in 5 control eyes and in 2 vitrectomized eyes, and atrophy developed in 7 control and 4 vitrectomized eyes. The difference between vitrectomized eyes and fellow eyes for the combined end points of RPE geographic atrophy or CNV was significant ($P = 0.02$).

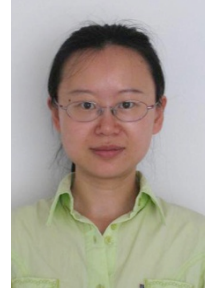
Conclusion: In this pilot study, we did not detect that vitrectomy increased the progression of AMD. In fact, it was associated with a reduced progression to geographic atrophy or CNV. Additional studies are needed to confirm or refute this association.

POSTER 11

Automated Measurement of Optic Nerve Head Shape from Stereo Color Photographs of the Optic Disc: Validation with SD-OCT

Li Tang, Ph.D.

Supervisor: Michael D. Abràmoff, M.D., Ph.D.



Purpose: Spectral domain optical coherence tomography (SD OCT) can provide highly reliable estimates of the shape of the optic nerve head (ONH), which is useful for diagnosing and managing glaucoma and other optic neuropathies. Stereo color photographs are a lower cost, widely used imaging modality that has lacked objective assessment. We validated our automatic algorithm for computing depth maps from stereo color images of the optic disc by comparing them to SD OCT images obtained on the same day.

Methods: 30 pairs of fixed-base stereo color photographs and SD OCT images of the ONH were obtained from both eyes of patients with glaucoma. Dense correspondences between stereo images were found automatically using a scale space based approach in the presence of spatially-varying reflectance, limited illumination, noise, and low contrast or density of the features, which are commonly observed in stereo optic disc photographs. Horizontal disparities between these correspondences formed the disparity map reflecting detailed structures of the ONH, such as cup size, cup depth, neuroretinal rim slope and curvature of the retinal nerve fiber layer (RNFL). For performance evaluation purposes, surfaces of the retinal layer were detected in the raw OCT volume using 3D segmentation. Depth information was recorded as intensities and registered with the reference stereo images to provide the ground truth. The method was validated quantitatively by comparing the same shape obtained from SD OCT images.

Results: The root mean squared (RMS) difference between normalized structures was 0.1592 (95% CI 0.1264 - 0.1920).

Conclusion: Automatically computed depth maps from stereo color images of the optic disc faithfully reproduce the shape of the ONH as confirmed by comparing them to SD OCT images. Stereo color imaging of the ONH combined with automated depth mapping is a low cost alternative for SD OCT that has potential for more cost-effective diagnosis and management of glaucoma and other optic neuropathies.

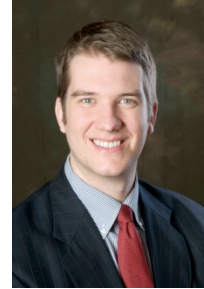
POSTER 12

**Glaucoma Therapy Escalation After Keratoplasty:
Penetrating Keratoplasty Versus Descemet's Stripping
Automated Endothelial Keratoplasty**

George R. Wandling, Jr., B.S., B.A.

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Purpose: To determine the prevalence of escalation of glaucoma therapy after keratoplasty (penetrating keratoplasty [PKP] vs. Descemet's stripping automated endothelial keratoplasty [DSAEK]) and the impact of this complication on graft survival and visual acuity,

Methods: A retrospective review was conducted of the medical records of all patients who underwent keratoplasty to treat corneal endothelial decompensation at University of Iowa Hospitals and Clinics from January 1, 2003, to December 31, 2006. Eyes that had satisfactory control of intraocular pressure (IOP) prior to surgical intervention and a preoperative diagnosis of either phakic corneal edema or pseudophakic corneal edema with a posterior chamber intraocular lens were included in the statistical analysis. The main outcome measure was a sustained requirement for escalation of topical medical therapy or the need for surgical intervention to maintain comparable postoperative IOP. Secondary outcome measures were graft survival and best spectacle-corrected visual acuity (BSCVA). Eyes with 6 or more months of follow-up were included in the statistical analysis.

Results: Among 105 eyes that met the inclusion criteria, escalation of glaucoma therapy occurred in 9 (23.7%) of 38 eyes after PKP and in 16 (23.9%) of 67 eyes after DSAEK during a mean follow-up period of 30.6 ± 8.6 months and 29.9 ± 7.3 months, respectively. Glaucoma therapy escalation was more likely to occur in eyes with pseudophakic corneal edema than in those with phakic corneal edema after PKP (35.0% vs. 11.1%; $P = 0.13$) or DSAEK (40.0% vs. 6.3%; $P = 0.001$). Escalation of glaucoma therapy was associated with a significant decrease in the 3-year Kaplan-Meier probability of graft survival after DSAEK ($P = 0.0004$) but not after PKP ($P = 0.51$). Glaucoma therapy escalation was not associated with a significant decrease in mean BSCVA at any point in the postoperative course after PKP; however, it was associated with significantly decreased vision 3 years after DSAEK (20/124 vs. 20/35; $P = 0.042$).

Conclusion: Escalation of glaucoma therapy is common after PKP and DSAEK. Although the prevalence of this complication is comparable for these two procedures, the adverse impact on graft survival and vision is more pronounced after DSAEK.

POSTER 13

**Descemet's Stripping Automated Endothelial Keratoplasty:
Forceps versus Suture Pull-through Insertion Techniques**

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Co-Supervisors: Kenneth M. Goins, M.D.; John E. Sutphin, M.D.



Purpose: To compare the outcome of forceps and suture pull-through insertion techniques in Descemet's stripping automated endothelial keratoplasty (DSAEK).

Methods: A retrospective review was conducted of the medical records of all patients treated with DSAEK at University of Iowa Hospitals and Clinics from January 1, 2005, to July 1, 2007. The main outcome measures (endothelial cell attrition, graft survival, and visual acuity) were evaluated postoperatively at 1, 3, 6, 12, and 24 months.

Results: Of 179 DSAEK procedures carried out during the study period, the forceps insertion technique was used in 143 cases, and the suture pull-through technique was performed in 36 cases. The mean follow-up was 17.4 ± 9.5 months and 19.1 ± 11.0 months for the forceps and suture pull-through insertion techniques, respectively. No significant differences were detected in endothelial cell attrition, graft survival, or visual acuity between the 2 study groups at any postoperative time interval. At 24 months postoperatively, the forceps insertion and suture pull-through groups had a mean endothelial cell attrition of $45.3\% \pm 19.9\%$ and $44.5\% \pm 17.9\%$, respectively. At the most recent examination, 136 (95.1%) forceps insertion and 34 (94.4%) suture pull-through insertion grafts were clear. The mean logMAR vision values were 0.163 ± 0.017 (Snellen equivalent 20/29) in the forceps insertion group and 0.192 ± 0.035 (Snellen equivalent 20/31) in the suture pull-through group.

Conclusion: No differences were detected in postoperative endothelial cell attrition, graft survival, or visual outcome between the forceps and suture pull-through insertion techniques when performing DSAEK.

POSTER 14

Simultaneous Automatic Detection of Optic Disc and Fovea on Fundus Photographs

Xiayu Xu, B.S.

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Purpose: Automated localization of the optic disc and fovea are important for automated analysis of fundus images. Our group has previously developed separate methods for localization of these structures. However, automatic simultaneous detection of the optic disc and fovea on a color fundus photograph has many theoretical advantages.

Methods: We introduce an enhancement and correction step, which allows the detection result of one structure to facilitate the detection of the other one. In the first step of the method, a set of features are extracted from the color fundus image, and the relationship between the feature set and a distance variable d is established during training phase. Then for a test image, the same set of features is measured and the distance to the optic disc and fovea can be estimated using k -nearest-neighbor regression. A probability image with every pixel labeled a probability of within an optic disc or a fovea is generated during this step. In the second step of the method, a second k -nearest-neighbor regression is applied on the probability image. Information like intensity, distance and angle between the two structures are extracted and trained. Then for a test image, detected high likelihood regions from the first step can be enhanced only if they satisfy the trained relationship. The detected regions that do not get support from the other detected structure will be suppressed. A 150 color fundus images from the left eye were used to train the system, 100 images for the training in the first step and 50 images for the training in the second step. 50 color fundus images from the left eye with early diabetic retinopathy were used to test the system.

Results: For the 50 test images, 100% of the images have a detected optic disc location and fovea location within 50 pixels from the true locations. The distance error for the optic disc is 9.8 ± 8.3 pixels. The distance error for the fovea is 13.7 ± 6.6 pixels.

Conclusion: This is a fully automatic method to detect the optic disc and fovea simultaneously with excellent performance. We are currently expanding validation on larger datasets.

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