

VISION

2015
Duke Eye Center

STATE OF THE ART

Hudson Building opens
its doors to a
new era of eye care





02



08



26

VISION

2015 VOLUME 31, NUMBER 1

COVER STORY

- 02** Hudson Building
- 08** First Sight: Larry Hester
- 12** The Eye Center by the Numbers
- 14** In Memorial: David L. Epstein, MD, MMM
- 16** Eye Cancers
- 18** Low Vision
- 20** Eye Imaging
- 22** New Chair
- 26** Diagnosing Alzheimer's
- 30** Social Media Color Craze

- 01** Message from the Chair
- 23** New Faculty
- 24** News and Awards
- 32** Administration, Faculty and Staff

contents

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From our Chair, Edward G. Buckley, MD



Over the past three decades that I have been on the faculty at Duke Eye Center I have watched us become one of the leading eye institutions in the world. As David Epstein said at the groundbreaking for the Albert Eye Research Institute (AERI) in 2005, "This reputation has been earned through the relentless pursuit of cutting edge scientific research, the collaboration of our research and clinical faculty, an outstanding education program that draws trainees from around the world, and a commitment to providing the best and most innovative care available." It's still true today!

Like the advances in research made possible by the AERI, the Hudson Building promises to have a similar transformative effect. Through Bill Hudson and David Epstein's focused determination, the Duke Eye Center family is poised to achieve even more. The pieces are falling into place. The new clinical space will enable us to expand our programs and establish new ones. The fourth floor will house faculty, trainees, and some research efforts. By relocating faculty out of the AERI we will be able to expand our wet laboratory capabilities as well. And we will have some unclaimed space to grow into in the future. It just could not be better.

We have the facilities. We have the people. We have the desire. And all of this has been made possible by the generous support we have received from donations large and small for which we are eternally grateful. It is now time for us to deliver!

I must confess, I envisioned watching the next chapter in our history from the sidelines. But life has its twists,

**"Sail away from
safe harbor.
Catch the
trade winds
in your sail.
Explore. Dream.
Discover."**

Mark Twain



JIM WALLACE

and I have found myself at the center gearing up for another exciting ride. I am honored to be able to help this department and its supporters chase dreams and realize its potential. What a fantastic group we are!

Below my e-mail signature is the following quote from Mark Twain:

"Twenty years from now you will be more disappointed by the things you didn't do, than by the ones you did. So throw off the bowlines. Sail away from safe harbor. Catch the trade winds in your sail. Explore. Dream. Discover."

It is with this spirit that I embark on this new journey with you. I can't wait to see where it takes us.

Sincerely,

Edward G. Buckley, MD

Chair, Department of Ophthalmology
Vice Dean of Medical Education,
Duke University School of Medicine

The opening of the new Hudson Building at Duke Eye Center signals the

DAWN OF A NEW ERA

in world-class eye care

On June 29, 2015, when the first patients arrive at the spectacular new Hudson Building, they will be stepping into the future of world-class eye care at Duke Eye Center. Passing the stunning Duke-stone tower, these patients will come through the curved, covered drop-off and then cross the threshold of the welcoming automatic glass doors to enter the building's two-story lobby. For these first patients, and the ones to follow, this will be the entrance literally and figuratively to a new era of vision care and sight restoration for years to come.



No detail has been left out to create an exceptional experience for patients. Whether traveling from across the globe, the country, or the state, patients will be able to get everything done in one day—the exam, imaging, physician meetings, and their customized treatment plan, whether that includes injection, laser, or rehabilitation.

Edward G. Buckley, MD, chair of the Department of Ophthalmology, says he is delighted that the Hudson

Building will be able to serve glaucoma, retina, low-vision, and cornea patients under one roof. "This building is dedicated to delivering the latest and most inspired clinical care in the world and signals a momentous transformation of the eye center," Buckley says. "It allows us to provide state-of-the-art care and optimize patient flow so we can help more patients comfortably."

The Hudson Building is opening at a critical time, as demand for vision services is growing at an unprecedented rate. Blindness or low vision now affects 3.3 million Americans ages 40 and up and is projected to reach 5.5 million by 2020, according to the National Eye Institute. Age-related macular degeneration, glaucoma, and cataracts are the most common eye diseases in Americans ages 40 and older.

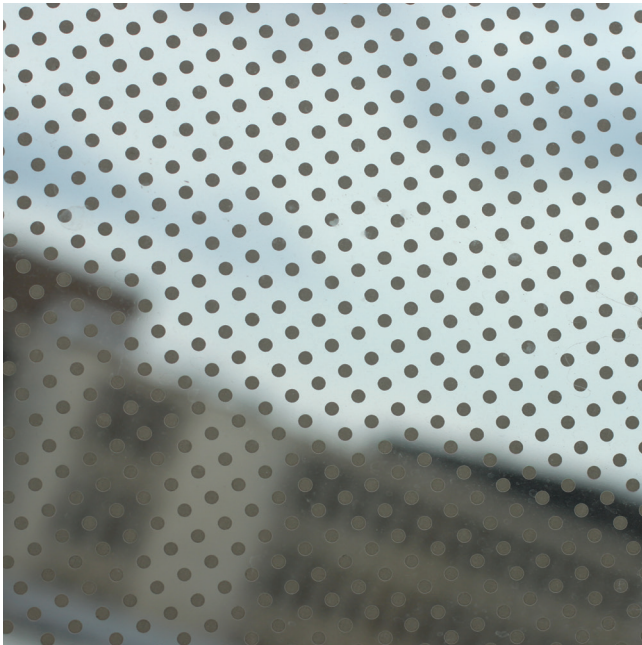
With influence from the global architectural firm HOK and low-vision consultant Chris Downey, RA, the Hudson Building's design enhances all aspects of a patient's visit.

BY SUSAN POULOS

Top row: Screen material on the large windows prevents glare. Duke stone accents the entire building.

Middle row: The entrance to the Hudson Building. Way-finding signage includes Braille and raised letters.

Bottom row: A large window at the entrance provides a flood of natural light. Doors leading from the waiting rooms to treatment rooms have two-foot letters for better visibility.



“Every color, every texture, the contrast of the floors, the walls, furniture, and the lighting methods are designed so each patient—regardless of the level of vision impairment—will be comfortable and able to move with ease,” according to Diane B. Whitaker, OD, chief of the Vision Rehabilitation Center and a principal behind the creation of the Hudson Building.



“Because of this new building and the people involved, I’m confident that before long Duke Eye Center will be a world leader in restoring sight to people who are blind.”

WILLIAM HUDSON

William Hudson, is the president of Durham-based LC Industries and chair of Duke Eye Center’s advisory board.

LC Industries is the nation’s largest employer of people who are blind, LC Industries operates in 14 states, including eight manufacturing facilities that produce well over 2,000 items. With two distribution centers and 31 retail stores operating on military bases, LC Industries serves all branches of the armed forces.

LC Industries employs more than 400 persons who are blind, who provide \$300 million in products and services to federal, state, and commercial markets. LC Industries has operations in 37 locations.

IT ALL STARTED WITH AN IMPORTANT CONVERSATION

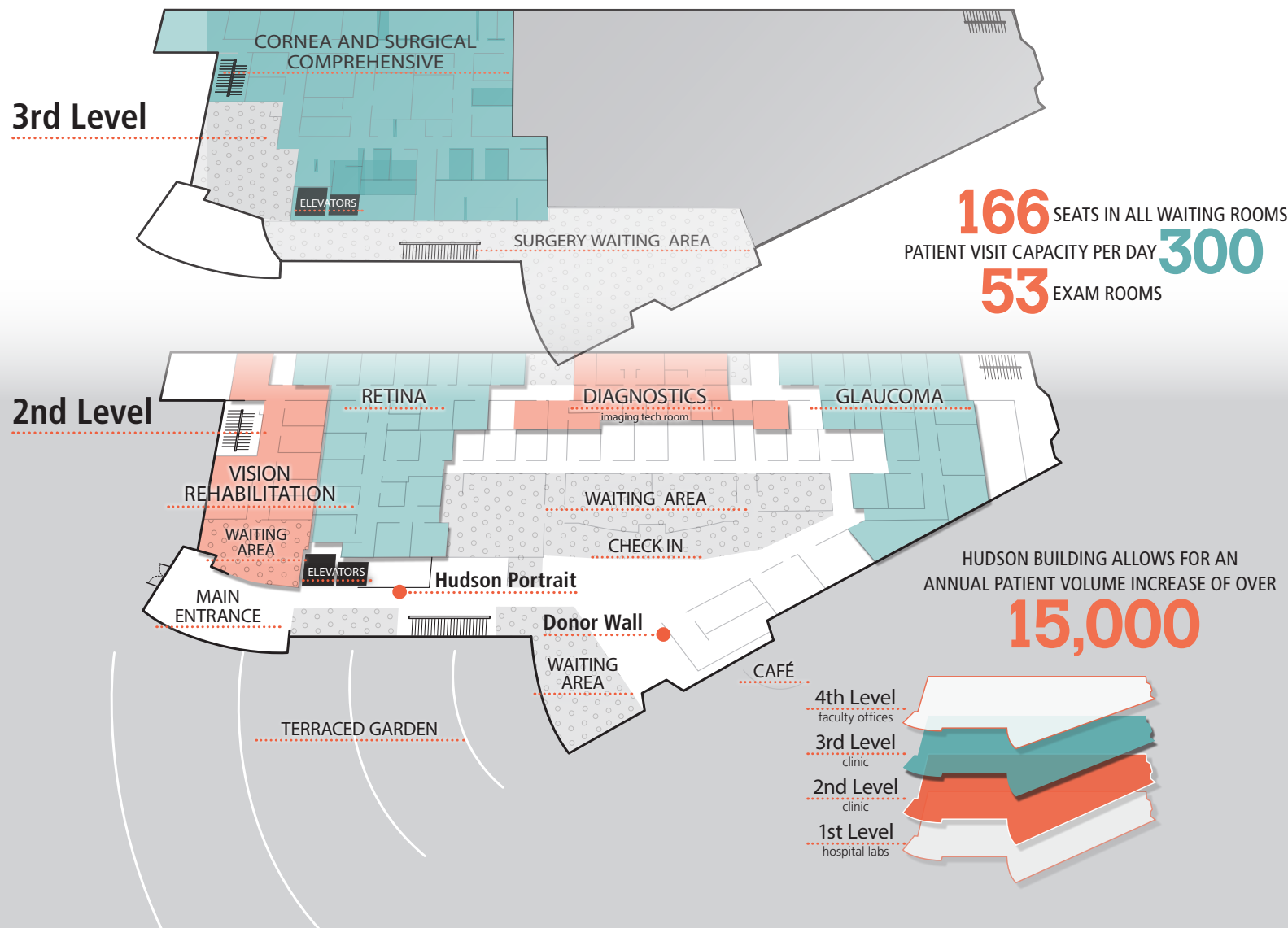
“What started six years ago as a conversation between me and Dr. Whitaker about building a satellite low-vision clinic in the LC Industries facility in RTP to help our vision-impaired employees led to a conversation with Dr. David Epstein, then chair of the Department of Ophthalmology,” recalls William Hudson, president of Durham-based LC Industries and chair of Duke Eye Center’s advisory board. LC Industries (LCI) is the largest employer of visually impaired people in the United States. “LCI provides jobs for the visually impaired, and we provide educational opportunities,” Hudson notes, “but we don’t know how to conduct research on eye diseases or offer vision care. Here’s where Duke Eye Center comes in.”

“Dr. Whitaker and I proposed to Drs. Epstein, Allingham, and Carlson this low-vision clinic to be funded by LCI and staffed by Duke’s ophthalmologic experts,” Hudson continues. “The conversation evolved to LCI being the primary benefactor of a new, state-of-the-art clinical eye-care pavilion. I remember driving back to my office after this meeting thinking, I’m not sure how this happened, but how wonderful for LCI to collaborate with Duke Eye Center in making an unbelievably positive impact on people who are blind.”

In 2009, the LCI board approved the proposal to give \$12 million to Duke Eye Center, one of the largest donations in Duke’s history, and later LCI pledged another \$4 million to the creation of the new building. Over the next five years, Hudson and Epstein—along with dozens of people who stepped forward with a vision, a passion, and a commitment to improve the quality of life of people with eye disease, low vision, and a loss of vision—spent countless hours making this dream come true.

“Never once did Dr. Epstein or I think it wouldn’t happen—it just took longer than we thought it would,” Hudson says. “Because of this new building and the people involved, I’m confident that before long Duke Eye Center will be a world leader in restoring sight to people who are blind.”

Epstein, who chaired the Department of Ophthalmology for 22 years, had an intense passion and desire to address all vision-threatening and blinding diseases that affect people of all ages.



Instrumental in leading the charge to get the Hudson Building constructed, he died unexpectedly last year. Although he didn't live to see the building completed, he avidly watched the foundation being built, one that he was instrumental in creating.

"This building is far more than bricks and mortar; it embodies the dream and intention of the people who, under the leadership of David, collaborated to make this vision come true," reflects R. Rand Allingham, MD, chief of Duke Eye Center's glaucoma service and a longtime colleague of Epstein. "I'm sure David will be smiling down on all of us when the doors open and the first patients arrive. This is an extraordinary accomplishment."

Prominently positioned within the new building is the Visual Rehabilitation Center, the realization of Whitaker's nearly nine-year objective to create a center for comprehensive low-vision rehabilitation. In this new space, patients will receive evaluation and unique, personalized training along with occupational therapy to allow them to maintain or restore activities of daily living such as

shopping, cooking, managing finances, driving, using the phone or a computer, managing medication, and participating in recreational activities. "The goal of the low-vision rehabilitation service is to empower and equip each individual with vision loss with the tools and techniques needed to maintain the highest level of functional independence without compromising safety," states Whitaker.

"The Hudson Building provides a launch pad to take us into the future and provide comprehensive patient-centric care," Whitaker notes. "It also allows us more space to pursue research to promote new technologies and techniques to better serve a growing vision-impaired population."

SHORTER, MORE PLEASANT WAITS FOR IMPECCABLE TREATMENTS

Patients not visiting the Visual Rehabilitation Center stop first at the centralized registration kiosk, where they check in and receive a pager that guides them through their visit. Patients can also choose to check in electronically using

Duke's HealthView patient portal. Varying levels of brightness and contrast to the lighting in the numerous and comfortable waiting areas play to the diverse needs of patients. Color-coded floor tiles and matching wall borders create easy-to-navigate pathways that augment the electronic signage.

Before the opening of the Hudson Building, approximately 55 physicians saw more than 80,000 patients annually at the Wadsworth Building, which was built over 40 years ago to accommodate only eight clinicians and 20,000 patients each year. The tight quarters and long wait times made the patient experience wanting, so the Hudson Building has been clearly needed, Center physicians agree.

With more and better space in the Hudson Building, patients and their families can expect shorter wait times which are crucial to the quality of care at Duke Eye Center. While waiting, they can avail themselves of the patient education centers that provide information on various eye conditions, diseases, and treatments.

Those patients visiting the centralized diagnostic suite, which includes Duke Eye Imaging's state-of-the-art ophthalmologic photography and imaging, will have an experience designed entirely around them. The images taken there will be instantly transmitted to the patient's ophthalmologist. Depending on their needs, patients will go either to the retina or glaucoma suites on the same floor, where treatment, exam, and consultation rooms are arranged in close proximity. Patients requiring cornea or surgical treatment will take the elevator or stairs to the third floor to receive sight-saving treatments and therapies.

“The Hudson Building provides a launch pad to take us into the future and provide comprehensive patient-centric care.”

Diane B. Whitaker, OD

Patients can check out and make their next appointments in their exam rooms, reducing the number of stops required during their visit. Depending on their condition, patients may receive an injection or laser treatment.

“The Hudson Building is the manifestation of our central philosophy and goals of translating research into advanced, cutting-edge vision care, matched with a deep compassion and love for humanity,” says Allingham. “It’s a clinical, patient-centric building that provides easier access to the diagnostic evaluations and treatments our patients need. It’s a venue where physicians can continue to create the vision-saving and restoring treatments of the future.”

Allingham hopes the new building will house the talent that will ultimately put Duke Eye Center out of business: “I hope we find cures for diseases like glaucoma, diabetes, and macular degeneration that destroy sight and are becoming more common as our population ages.”

The new Hudson Building completes a decade-long vision for Duke Eye Center. Together with the Albert Eye Research Institute, renovated space in the Wadsworth Building, and the center's satellite practice offices, the Hudson Building will fulfill the Duke Eye Center credo of providing outstanding clinical care by translating research into innovative, leading patient care to help cure diseases that cause blindness. ▀



Diane B. Whitaker, OD
Chief Low-Vision
Rehabilitation Service

04.2012



CONSTRUCTION TIMELINE

02.2014



07.2014



07

08.2014

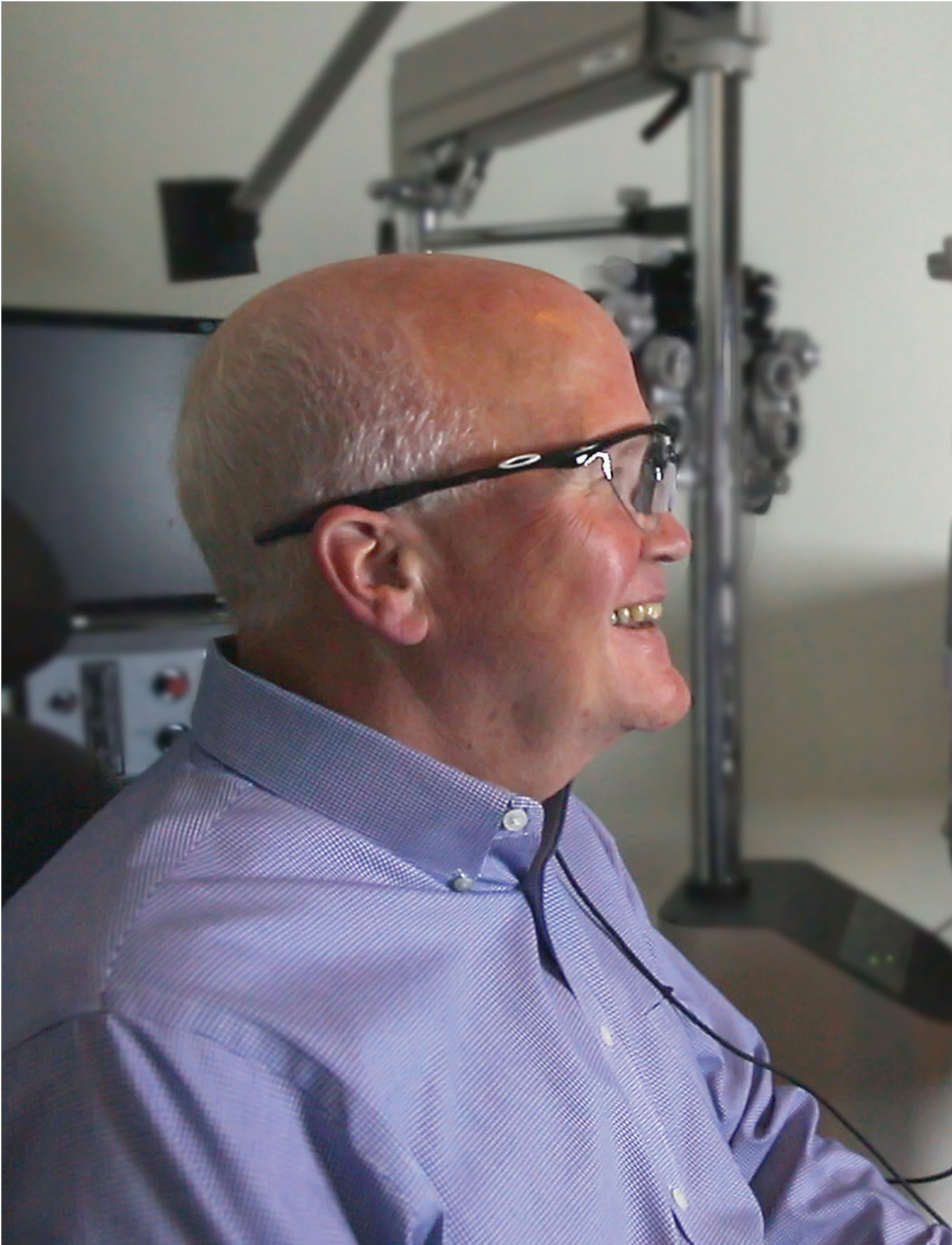


02.2015



04.2015





FIRST EIGHT SIGHTS

NORTH
CAROLINA'S
FIRST BIONIC
EYE RECIPIENT
SEES FOR FIRST
TIME IN
33 YEARS



09

Patient Larry Hester smiles the first time he sees with the Argus II, implanted by Duke Eye Center's Retina Specialist, Paul Hahn, MD, PhD, right.

As the lights dimmed in the exam room, Larry Hester fixed his gaze forward and waited nervously.

Paul Hahn, MD, PhD, a retinal surgeon at Duke Eye Center, counted backward from three and pressed a button, activating Hester's newly implanted bionic eye.

Hester startled.

"Yes!" he said, seeing a light for the first time since he became blind 30 years ago. "Oh my goodness. Yes!"

Hester, 66, was diagnosed with retinitis pigmentosa (RP) when he was in his early 30s. At the time, the degenerative disease that would rob his sight was poorly understood, and there were no known treatments.

But in the intervening years, there has been progress. On October 1, 2014, Hester became only the seventh person in the United States to have a so-called bionic eye—an Argus II Retinal Prosthesis Device—activated as a visual aid to send light signals to his brain.

TECHNOLOGY DEVELOPED AT DUKE EYE CENTER

The device incorporates technology initially developed by researchers then at Duke Eye Center; its sophisticated features were further enhanced and marketed by a company called Second Sight Medical Products.

Using wireless technology, a sensor is implanted in the eye to pick up light signals sent from a camera mounted on special eyeglasses. Hahn implanted the sensor on September 10, and activated the device three weeks later—to the sheer delight of Hester and his family.

"Can I kiss him?" his wife, Jerry Hester, exclaimed

in the moment she heard him say he saw flashing lights for the first time.

Hahn cautioned that the device will not restore normal eyesight, but instead will provide a visual aid that could help Hester distinguish a door from a wall, or a crosswalk painted in a roadway. Hester describes seeing flashes of light that are more intense when he aims the camera at lights or light-colored objects.

During a clinic visit following the device activation, Hester "seeing" sights he had long believed were past memories—a white duck swimming in a pond, the harvest moon, his wife's yellow chrysanthemums.

Hester says her most cherished moment came while they were watching a football game. She was sitting in a dark chair, and her skin was enough of a contrast that Larry could see flashes. He reached out and touched her face.

"It was just a beautiful touch," she says.

Hester will return to Duke Eye Center regularly for additional training on the device, learning to discern shapes and objects from the flashes generated by the device. He says he is eager to provide researchers with information they can use to enhance the technology, so that the next generation of patients will benefit from his pioneering effort.

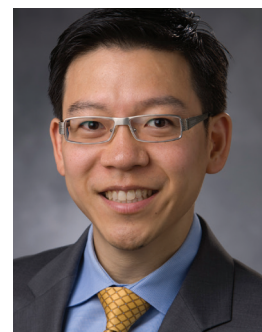
"I just wonder how I have been so lucky," he says. "Why me? But if I can use what I learn from this to help others with RP, it will not just be for my benefit." ▀

10



Video

See the video of Larry Hester's reaction to seeing for the first time in 33 years. dukemedicine.org/blog/ncs-first-bionic-eye-recipient-sees-first-time-33-years



Paul Hahn, MD, PhD
Assistant Professor of Ophthalmology and Vitreoretinal Surgery and Diseases



SAMIHA KHANNA



SHAWN ROCCO



SHAWN ROCCO

“I just wonder how I have been so lucky. Why me? But if I can use what I learn from this to help others with RP, it will not just be for my benefit.”

Larry Hester

THE EYE CENTER HAS

10

LOCATIONS
IN VIRGINIA AND
NORTH CAROLINA.



167,204

PATIENTS SERVED IN FY 2014

THE DEPARTMENT OF
OPHTHALMOLOGY AND
DUKE EYE CENTER HAVE:

350 HEALTH STAFF

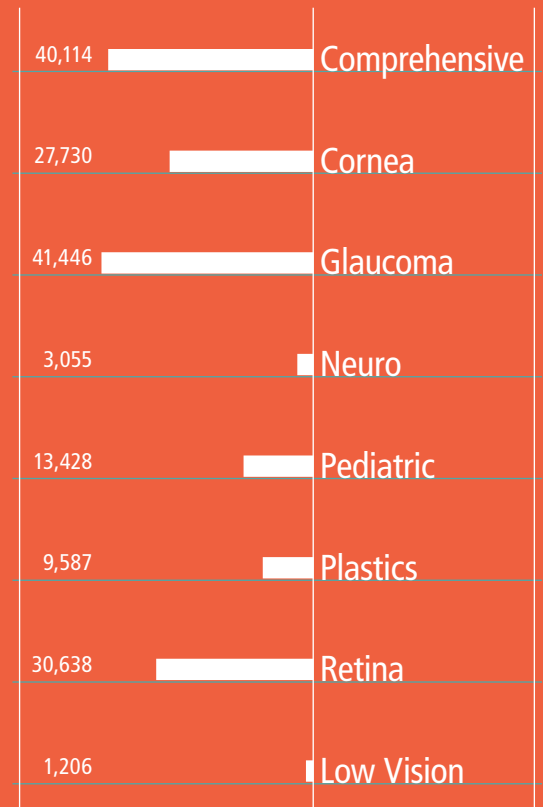
55 CLINICAL PHYSICIANS

23 OPHTHALMOLOGY FELLOWS

18 OPHTHALMOLOGY RESIDENTS

16 RESEARCH SCIENTISTS

PATIENT VISITS BY DIVISION*



* includes all satellite offices

2014 RANKED

#6

BEST HOSPITALS IN OPHTHALMOLOGY



2013 RANKING

#8

HELD DURING 2014
25
NIH GRANTS

Faculty performed

11,325
surgeries



U.S. News & World Report
Top ophthalmology
doctors in North Carolina

Neuro-ophthalmology
M. Tariq Bhatti, MD

Cornea and Refractive Surgery
Terry Kim, MD

Glaucoma
R. Rand Allingham, MD

Vitreoretinal Surgery
Tamer H. Mahmoud, MD, PhD

Neuro-ophthalmology and
Pediatric Ophthalmology
and Strabismus

Edward G. Buckley, MD

Cornea and
Refractive Surgery
Alan N. Carlson, MD



FY 2014 AWARD FUNDING:

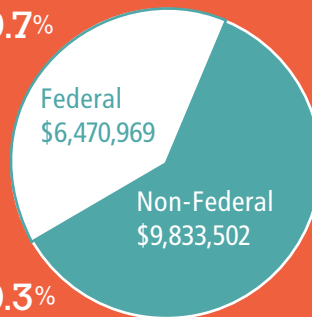
Total:
\$16,304,471

39.7%

Federal
\$6,470,969

Non-Federal
\$9,833,502

60.3%





JIM WALLACE

David L. Epstein

DAVID L. EPSTEIN, MD, MMM, the Joseph A.C. Wadsworth Clinical Professor of Ophthalmology and chair of the Department of Ophthalmology at the Duke University School of Medicine, passed away unexpectedly on his farm on March 4, 2014, at the age of 69.

During his 22 years as chair, Epstein enthusiastically built and led an outstanding community of ophthalmologists and vision scientists. Under his guidance, the department grew to include its current team of 73 faculty members and more than 300 staff members.

He was an internationally acclaimed and respected clinician-scientist, ophthalmologist, eye researcher, author, entrepreneur, organizer, advocate, and leader, as well as a cherished educator, mentor, colleague, and friend. Epstein was a passionate advocate of the role of the clinician-scientist in translating laboratory discoveries into powerful new therapies. An author of more than 230 scholarly papers, he consulted in glaucoma clinical care and maintained an active glaucoma research program. He advocated for academic medical centers and various health-care entities to stress more quality-of-life issues.

A VISION FOR VISION CARE

Known for his boundless energy, his dedication to the advancement of superior eye care, and his friendly, inspiring demeanor, he adored—and was

adored by—Duke Eye Center faculty, trainees, staff, and trustees. He cultivated a sense of unity that extended across the community of clinicians and scientists, with a major goal of increasing their direct interaction. Acknowledging the strong foundation of excellence his predecessor, Robert Machemer, MD, established early on, Epstein envisioned and created a bright future where Duke ophthalmology is known for innovation and excellence. He devoted his career as chair of Duke Eye

Center to build the infrastructure and organization that inspires quality research in mechanisms that cause disease.

HUDSON BUILDING

A champion of eye health, Epstein dedicated his life to the advancement of world-class eye care at Duke. He developed Duke Eye Center to its fullest potential by working tirelessly to build the Albert Eye Research Institute, which opened in 2002, and the soon-to-open Hudson Building, a visionary building designed to deliver the latest and most inspired clinical eye care available in the world.

In recent years, Epstein passionately helped raise funds for construction of the Duke Eye Center Clinical Pavilion (see story on page 16). He lived and breathed the new Hudson Building—not for himself but for the future of ophthalmology, for patients, for this community and for Duke. The day before he died, Epstein proudly watched over the construction of the pavilion, which is to open ahead of schedule as a result of his determined efforts. While Epstein will not be here to see it, his colleagues are certain that his visionary presence will fill the building, the entire department, and the Duke Eye Center complex for the benefit of ophthalmology and patients.

EARLY YEARS

Growing up on the north side of Chicago, Epstein attended Johns Hopkins University and medical school where he met Susan Matthews, a nursing student. She threw a snowball at him and accidentally knocked out his contact lens. They celebrated their 45th wedding anniversary in November 2013. After completing his medical internship at the University of Washington in 1969, he served as a flight surgeon in the U.S. Air Force for two years. He then began his residency and fellowship at the Massachusetts Eye and Ear Infirmary of Harvard Medical School under the guidance of Paul A. Chandler, MD, and W. Morton Grant, MD, pioneers in glaucoma research and treatment—both of whom remained his revered professional role models throughout his life. In 1978 he joined the faculty of Harvard Medical School and advanced to the position of director of the glaucoma service at the Massachusetts Eye and Ear Infirmary. He became the chair of the Department of Ophthalmology at the Duke University School of Medicine in 1992.

David is survived by his wife, Susan, his son Michael, and grandson, Samuel.

14



Learn More

About The David L. Epstein, MD, MMM, Innovation Fund at gifts.duke.edu/dukeeye or mail contributions to: David L. Epstein MD, Innovation Fund, Attn: Duke Medicine Development & Alumni Affairs, 710 West Main Street, Suite 200 Durham, NC 27701

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 Durham, NC 27701
 919.286.1000

Gordon K. Klintworth

GORDON KLINTWORTH, MD, PHD, passed away August 8th, 2014 at the age of 82 after a long battle with cancer. He had retired from Duke in 2011 after 52 years of service. His innovative and groundbreaking contributions to neuropathology, ophthalmic research, and ophthalmic pathology will continue to be the foundation for new discoveries in ophthalmology.

Founder and first president of the International Society of Ophthalmic Pathologists, Klintworth was recognized internationally for his research into corneal diseases, inherited diseases of the eye, and ophthalmic pathology. He collaborated with investigators around the globe in his quest to bring new understanding to the molecular genetics of inherited diseases of the cornea and conjunctiva. Under his leadership, Duke Eye Center built one of the finest corneal research programs in the world.

His productive academic medical research career was continuously supported by his fellowship in neuropathology through the National Institutes of Health from 1962 through his retirement. A prolific writer, he published more than 200 peer-reviewed papers in scientific publications, in addition to authoring or editing more than 87 books or book chapters. His two-volume book, *Garner and Klintworth: Pathobiology of Ocular Disease*, is a definitive pathology textbook.

A MENTOR'S MENTOR

Spending most of his professional life at Duke Eye Center, Klintworth has left the center its first research legacy. A leading authority in ophthalmic pathology, he spent five decades as an eye pathologist. He mentored countless faculty and residents, including several of Duke Cornea Service's current leaders who continue his pioneering research. Curious, honest, and extremely blunt, Klintworth was a brilliant and generous mentor, whose careful listening and candid feedback enabled those he helped to develop their research careers. He was always eager to help his colleagues and residents with research grants and publications. He was instrumental in teaching residents ocular pathology, providing monthly pathology sessions, and training the countless number of residents. With an outstanding breadth of knowledge, he generously offered insightful comments and suggestions to colleagues and residents at research conferences.

EARLY YEARS

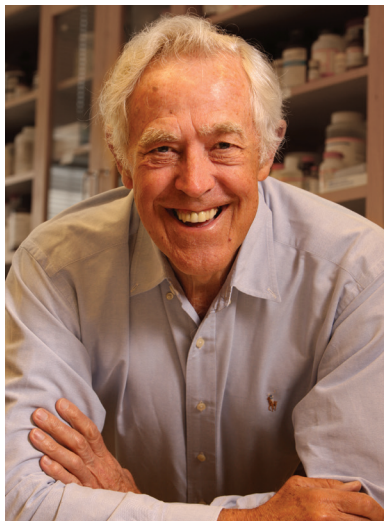
Born in southern Rhodesia (now Zimbabwe), Klintworth attended medical school at the University of Witwatersrand in Johannesburg, South Africa, where he developed a fascination with neuropathology.

At the urging of his mentor, Neville Proctor, he emigrated to the United States and to Duke University site unseen, with his wife, Felicity, and their oldest daughter.

Duke Eye Center's second ophthalmology chair, Robert Macheimer, MD, appointed Klintworth as director of research in the Department of Ophthalmology, where he taught ophthalmic pathology and related research to medical students and clinician-scientists around the world. By coordinating the research efforts of Duke, the University of North Carolina at Chapel Hill, and North Carolina State University, he was awarded a National Eye Institute Core Grant, a research consortium that continues today. He successfully obtained grant support from the National Eye Institute and for a decade was the program director of a NIH-supported K12 clinician-scientist grant. In addition, he had major NIH funding for more than 50 years—unmatched today or likely ever. He served on the Duke institutional review board for more than 20 years.

His crowning achievement, which he finished on his deathbed, was the 700-page book, *Giants, Crooks, and Jerks in Science*, which addresses the importance of honesty, truth, and ethical behavior in the study of science.

A loving husband, father, and grandfather, he is survived by his wife of 56 years, Felicity, his daughter, Susan, his son John, and four grandchildren.



JIM WALLACE

COMPRISING ONLY 0.5 PERCENT OF ALL CANCERS, EYE CANCERS ARE RARE. So are specialists experienced in evaluating and treating them.

The Duke Center for Ophthalmic Oncology, a center of excellence at Duke Eye Center, is a partnership with the renowned Duke Cancer Institute—and one of only several formal eye-cancer programs in the Southeast.

A HISTORY OF SKILLED, COMPREHENSIVE CARE

Harnessing the resources of a world-class academic medical center, the program is a regional and national referral center, offering patients of all ages the most sophisticated medical and surgical advances for diagnosing and treating eye tumors—both cancerous and benign—that can develop in and around the eyes.

TREATING EYE CANCERS WITH EXPERIENCE, EXPERTISE AND A WORLD-CLASS PARTNERSHIP

The program is led by retinal surgeon Prithvi Mruthyunjaya, MD, also a member of the Duke Cancer Institute. Fellowship-trained in ocular oncology, Mruthyunjaya is an associate professor of both ophthalmology and radiation oncology.

The shared goal of the comprehensive ophthalmic oncology team is to successfully manage each patient's disease while maximizing function and minimizing vision loss and changes in appearance. From medical oncologists to eye surgeons to social workers, experienced Duke experts work with patients to create personalized treatment plans.

"Although rare, eye cancer is as monumental and life-changing as any other type of cancer, and it has its own unique challenges," says Mruthyunjaya. "Our team addresses both the treatment of the cancer and any related visual disabilities, which can greatly impact people's quality of life, their ability to work and care for themselves, and psychosocial issues such as anxiety and self-esteem."

Soon to be housed in Duke Eye Center's new Hudson Building, the multidisciplinary service offers patients a lot of advantages, he says, including Eye Center subspecialists who work in a variety of areas.

"Our pediatric ophthalmologists care for children with eye cancers, our low-vision rehabilitation specialists help patients compensate for vision loss, and our occupational therapists work with patients to master daily-living activities like driving," he says.

The history and continuity of Duke's program are strong points, as well. Ophthalmologist Jonathan Dutton, MD, worked with oncologists to treat ocular-cancer patients at Duke until the late 1990s, when Edward G. Buckley, MD, began caring for them.

Mruthyunjaya has been managing these complex patients—and growing the dedicated Center for Ophthalmic Oncology—for the past 10 years.

"A number of practices across the country have physicians who care for patients with eye cancer, but



Prithvi Mruthyunjaya, MD
Associate Professor of
Ophthalmology and Radiation
Oncology, Director of
Continuing Education at Duke
Eye Center, and Medical
Director at Duke Eye Center

only a handful of defined centers have this level of experience, expertise, and coordinated care,” he says. “Our program is now recognized as a Center of Excellence and Innovation within the eminent Duke Eye Center.”

A RANGE OF CLINICAL OFFERINGS AND RESEARCH ADVANCES

The service offers the complete spectrum of front-line, evidence-based therapies for all types of ocular cancers. Typically diagnosed during routine eye examinations, ocular cancers include basal- and squamous-cell carcinomas, melanomas that originate in the eye, retinoblastomas, and disease that has metastasized to the eye from elsewhere in the body.

Treatments include plaque brachytherapy (an innovative targeted-radiation treatment that is custom-designed for each patient), chemotherapy, and precision surgical tumor removal. In some cases, ocular cancers require no immediate treatment; physicians simply take a careful watch-and-wait approach.

While newer therapies have reduced the risk of eye cancer spreading to other parts of the body, the rate of metastasis is historically as high as 50 percent in some cases, underscoring the importance of multidisciplinary care and ongoing monitoring. If cancer does recur, it would be diagnosed and promptly treated by the appropriate Duke experts.

The integration of comprehensive patient care with leading-edge research is another strength of the Center for Ophthalmic Oncology.

“There’s a real emphasis on conducting research and moving the field ahead,” says Mruthyunjaya. “Our research efforts have led to advances such as improving the detection of high-risk melanomas, advancing the role of ocular biopsy, reducing radiation toxicity in ocular melanoma, and using imaging to predict radiation toxicity.”

Current studies are aimed at using chemical signals to detect

malignant tumors, identifying melanoma patients at risk of vision loss, and identifying patterns of regression after treatment in patients with ocular melanoma. The program also is taking part in a national clinical trial of an intra-arterial chemotherapy drug.

Providing highly specialized medical training is another critical part of the Center for Ophthalmic Oncology.

“The physicians who have gone through our excellent training program are not only comfortable with treating these very challenging patients, they’re also able to make important, and



Resident Patrick Rafael Oellers and Prithvi Mruthyunjaya, MD, review data on a prototype OCT system.

potentially life-saving clinical decisions based on what they learned here,” Mruthyunjaya says.

Mruthyunjaya continues, “It’s exciting to play a role in training doctors to treat ocular cancer in their communities and at other centers, particularly since there are so few specialists in the United States dedicated to doing that.”

Duke Center for Ophthalmic Oncology unites nationally recognized Duke Eye Center and Duke Cancer Institute.

EMPOWER THOSE VISION

18



Duke Vision Rehabilitation
Technology Training (VRTT) Program
New relationship with therapeutic
solutions makes it possible

ERING WITH LOSS

SMARTPHONES, TABLETS AND PERSONAL COMPUTERS have become ubiquitous in our society, both in our personal and professional interactions. For people with low vision, these devices represent an opportunity and a challenge.

Thanks to accessibility improvements, the devices are more user-friendly than ever for the visually impaired. But since technology advances at such a fast pace, learning how to effectively use the devices remains a challenge.

Duke Eye Center's Diane B. Whitaker, OD, developed the Duke Vision Rehabilitation Technology Training (VRTT) Program to overcome this obstacle. The Duke VRTT Program is a collaborative project that aligns software designers, public school educators, students, and state agencies to create a conduit and vehicle to train technology users of all ages at Duke Eye Center.

In the United States, an estimated 56,000 blind or vision-impaired students are currently enrolled in public schools, with about 2,000 residing in North Carolina. On the other end of the age spectrum, the number of older adults with age-related vision loss is exponentially increasing.

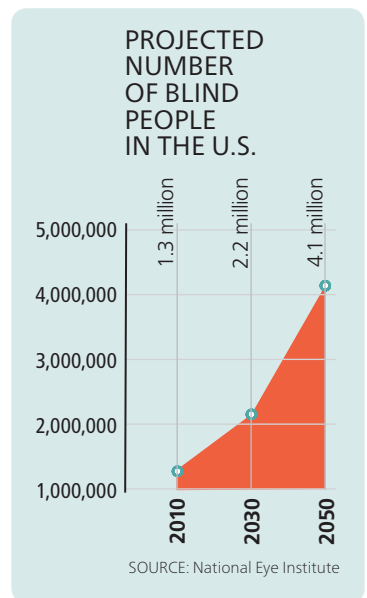
"Our technologically advancing society will be progressively more dependent on the human-machine interface skills required to successfully operate smart phones, computers, and other personal devices and efficiently navigate the Internet," Whitaker says. "It is critical for people with low vision to remain connected to mainstream society to preserve and promote personal and professional functional independence."

The VRTT Program—created by Whitaker's team along with Ed Summers, a blind senior software designer at SAS, and Diane Brauner, a teacher for the visually impaired and orientation and mobility specialist for the North Carolina public school system—creates a competitive internship that equips the participants with valuable skills and experience needed to successfully transfer to the workforce as they learn to facilitate and lead small group technology training sessions for blind or visually impaired users.

The program takes advantage of the new Vision Rehabilitation suite in the Hudson Building at Duke Eye Center, scheduled to be completed by July 2015. Whitaker's team has proposed design elements for a future virtual classroom where training will commence on-site and be broadcast remotely.

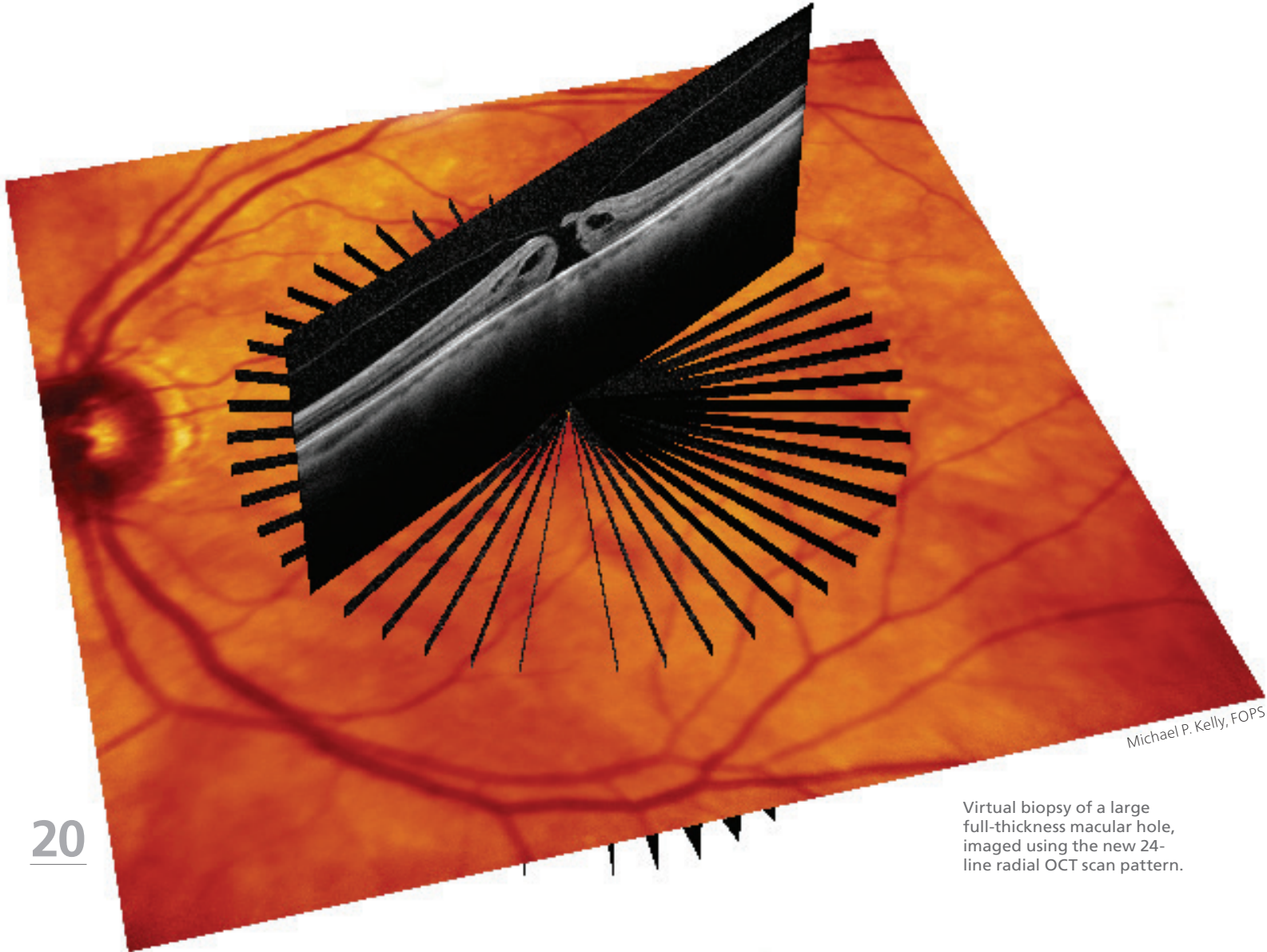
The team is currently developing the curriculum for the training program and engaging donors to help acquire hardware and software for the virtual classroom.

"The strength and innovation of the Duke VRTT Program lies in the commitment and diversity of our partners," Whitaker says. "Innovation occurs when unconventional alliances are created to accomplish shared goals and objectives through the integration of unique expertise and insight to formulate novel solutions." ▀



Diane B. Whitaker, OD, works with her patient, Johnathan Kirk.

SHAWN ROCCO



Michael P. Kelly, FOPS

Virtual biopsy of a large full-thickness macular hole, imaged using the new 24-line radial OCT scan pattern.

PIONEERING A NEW COURSE IN EYE IMAGING

DUKE OPHTHALMOLOGISTS HAVE DISCOVERED A NEW IMAGING TECHNIQUE to diagnose small macular holes. The technique—radial optical coherence tomography (OCT) scanning—can image macular holes when they are too small for traditional scans to see. As a result, patients undergo surgery much sooner, resulting in better visual acuity for those patients.

This award-winning research from Duke Eye Center is quickly being adopted as a new standard of care throughout the world.

CHANCE FINDING LEADS TO STUDY

While imaging a patient with a suspected macular hole,

Michael Kelly, FOPS, director of Duke Eye Imaging, couldn't detect a hole. However, he was able to find and image vitreomacular traction (VMT), a condition that disrupts retinal architecture and may lead to the development of a macular hole.

Standard OCT imaging creates a virtual biopsy of the retina and is often used in an attempt to detect a macular hole. OCT visualizes very subtle changes in the structure of the retina in patients who have VMT. The standard protocol when using OCT is to scan horizontally and vertically through the macula.

Discontent with the results he was getting from traditional scanning parameters and determined to find out what was causing the patient's diminished vision, Kelly decided to use a non-standard approach to OCT scanning. He performed an oblique, or radial, pattern to scan the eye at varying degrees around the radius. Using this oblique technique, Kelly was able to see a small, full-thickness macular hole in the patient's retina from certain angles.

After presenting his findings to Tamer H. Mahmoud, MD,

PhD, the two, along with Eric Schneider, MD, and Bozho Todorich, MD, PhD, conducted a formal study of the new imaging protocol.

RESEARCH WITH CLEAR RESULTS

In their formal study, the researchers examined 25 eyes from 24 patients with full-thickness macular holes. They used a standard (61-line) raster volume and a 24-line radial pattern to image the eyes. A 6-line radial scan pattern was extrapolated from the higher-density radial pattern.

The researchers compared and examined the three scan patterns and found that the high-density radial scanning demonstrated superior detection rates of small full-thickness macular holes compared to standard raster volume scanning.

In fact, the new scanning protocol allowed visualization of small macular holes in as many as 20 percent of patients who would have previously been thought to have no macular hole at all based on standard OCT scanning protocols.

“We’re excited about this new scanning protocol,” says Mahmoud. “We’ve adopted it at Duke for all patients who present with vitreomacular pathology, and we’ve detected early changes in many of our patients.”

AWARD-WINNING RESEARCH

The study, “Effect of OCT scan pattern and density on the detection of full-thickness macular holes,” was published in the May 2014 edition of the *American Journal of Ophthalmology*.

In November 2013, the paper was awarded the Don Wong Award as the most outstanding paper at the Ophthalmic Photographer Society’s annual Scientific Session. The award recognizes outstanding scientific achievement in the field of ophthalmic photography.

Dilraj Grewal, MD, a vitreoretinal fellow, is currently working with Mahmoud to adopt the new protocol on patients who had prior surgery for macular holes. The detailed image analysis provided by the oblique scans improves visualization of the healing process of macular holes as vision recovers and provides a better assessment of potential visual improvement.

VISION-SAVING RESULTS

In patients who have macular holes, early surgical intervention results in better visual outcomes. Because this new oblique scanning technique detects macular holes

before they have progressed, patients are able to undergo surgery while the macular hole is still small.

As a result, the patients end up with better vision after surgery than patients whose macular holes were found at a later time. Early detection of macular holes also allows for a more conservative surgical approach that may prevent some of the potential complications of surgery.

Because the results are so positive and patients have benefited so greatly, ophthalmologists from around the world have begun to adopt this new scanning technique when trying to detect a macular hole.

“Our 24-line oblique scanning technique is becoming standard practice the world over. We have advanced the standard of care,” Kelly says.

CONTINUING A HISTORY OF INNOVATION AT DUKE EYE CENTER

This discovery continues a long history of Duke Eye Center’s research regarding macular holes. Robert Machemer, MD, former chair of the Department of Ophthalmology at Duke, is known as the father of pars plana vitrectomy, a surgical procedure that is, in part, used to fix macular holes. His research in vitreous and retinal treatment profoundly effected ophthalmology today.

Research by Brooks McCuen, MD, also advanced and evolved the technique of vitrectomy. Mahmoud and McCuen coined the term “foveolar lucency,” which is seen on OCT as macular holes close and is now considered an integral part of macular-hole closure.

“In ophthalmology, we can’t treat what we can’t see. Intersecting our creativity, intellectual curiosity, and determination with our advanced imaging technology pays dividends for patients everywhere, and our macular hole imaging work is a prime example,” Kelly says. ▀



What is a macular hole?

The macula is responsible for central vision and allows us to appreciate detail, such as when we read. As a hole forms in the macula, the central vision may appear distorted or wavy. As the hole grows, a dark or blind spot appears. Full-thickness large macular holes are the most severe.

Macular holes usually occur in middle-aged or older individuals, more so in women than men. They can also occur as a result of a blunt injury to the eye or in patients who are very near-sighted.

EDWARD G. BUCKLEY, MD, WAS SELECTED to be the permanent chair of the Department of Ophthalmology after an extensive national search. Serving as interim chair of the department since March 2014, Buckley successfully led the department during the difficult transition in the wake of David Epstein's untimely death and through the construction of the new Hudson Building.

"I was surprised and honored to be asked to serve as chair of the department," he says. "I have a genuine love for the Eye Center and want to see it thrive and prosper. I also realize that a great department is a team effort across many domains, whether it is unparalleled patient care, cutting-edge research, or outstanding education. Being a chair is not about oneself, but about helping others achieve their full potential. This is my mantra and will serve as my measure of success."

Buckley believes the present is an exciting and pivotal time for Duke Eye Center. "We have a new clinic building opening, a vibrant research program, and one of the nation's leading residency/fellowship programs. We are an awesome department, destined for great things. I'm counting on the continued support and determination that got us to this place to continue so we can move to the next level."

The James P. and Heather Gills Professor of Ophthalmology, Buckley is a highly respected administrator, educator, researcher, and renowned pediatric ophthalmologist. He serves as director of the pediatric ophthalmology fellowship program and has trained and mentored more than 55 fellows. Since 2008, Buckley has served as vice dean for education for the School of Medicine, and he will continue in this role.

He has served as president of the American Association of Pediatric

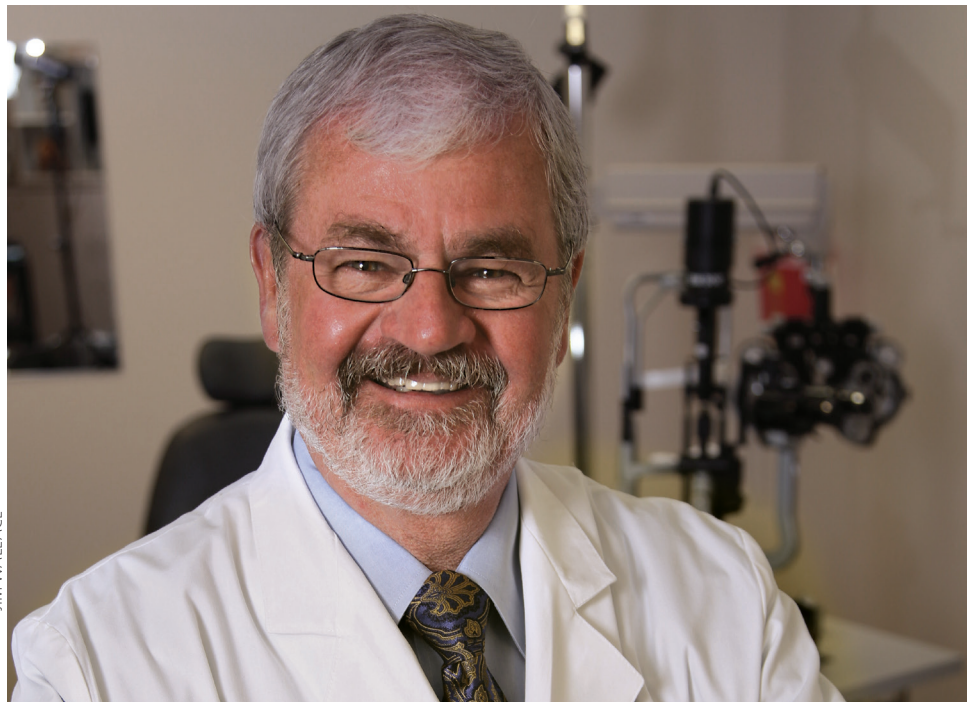
Buckley named permanent chair of the Department of Ophthalmology

"Being a chair is not about oneself, but about helping others achieve their full potential. This is my mantra and will serve as my measure of success."

Edward G. Buckley, MD

Ophthalmology and Strabismus (AAPOS), chair of the American Board of Ophthalmology, chair of the Section of Ophthalmology of the American Academy of Pediatrics, and president of the American Orthoptic Society. He also is the current editor-in-chief of the *Journal of AAPOS*. He received the Lifetime Achievement Award from the American Academy of Ophthalmology and AAPOS.

Buckley received his undergraduate degree in electrical engineering and his medical degree from Duke University. He completed an internship in medicine and a residency in ophthalmology at Duke before performing a two-year fellowship in pediatric ophthalmology and neuro-ophthalmology at the University of Miami's Bascom Palmer Eye Institute. He returned to Duke in 1983 as an assistant professor.



JIM WALLACE

RESIDENTS

Chief Resident:
Laura Vickers, MD

Third-Year Residents

Varsha Manjunath, MD
Milica Margeta, MD, PhD
Nisha Mukherjee, MD
Veena Rao, MD
Lakshmi Sonbuchner, MD, PhD
Bozho Todorich, MD, PhD

Second-Year Residents

Jaya Badhwar, MD
Sidney M. Gospe, MD
Ramiro S. Maldonado, MD
Patrick R. Oellers, MD
William B. Wainright, MD
Wenlan (Wendy) Zhang, MD

First-Year Residents

Duncan Berry, MD
Michelle Kim, MD
Andrew Lee, MD
Landon Meekins, MD
Nambi Nallasamy, MD
Sally Ong, MD

FELLOWS

CORNEAL/EXTERNAL DISEASE

Karen Grove, MD
Malav Joshi, MD
Christine Shieh, MD, MS
Gargi K. Vora, MD

GLAUCOMA DISEASE

Ninita H. Brown, MD, PhD
Garrick Chak, MD, MM
David Fleischman, MD, MS
Amanda E. Kiely, MD
Roma Patel, MD, MBA
Anita Vin, MD

NEURO

Pradeep Mettu, MD

OCULOPLASTIC & RECONSTRUCTIVE SURGERY

Betsy Colon-Acevedo, MD
Tonya Khan, MD

PEDIATRICS

Ryan Davis, MD
Jared E. Duncan, MD
Kim Jiramongkolchai, MD
Evan Silverstein, MD

MEDICAL RETINA

Francisco A. Folgar, MD
Dilraj Grewal, MD
Sung Lee, MD
Peter Nicholas, MD
Michael Seider, MD
Sumit Sharma, MD



JIM WALLACE

Michael Allingham, MD, PhD

MICHAEL ALLINGHAM IS A FELLOWSHIP-TRAINED OPHTHALMOLOGIST with expertise in the diagnosis and treatment of medical conditions affecting the retina, including age-related macular degeneration (AMD), diabetic retinopathy, retinal vein occlusion, macular edema, and other diseases. Trained in the interpretation of retinal vascular imaging techniques, including video fluorescein angiography (FA) and indocyanine green angiography (ICGA), he specializes in the use of these imaging studies to guide injection and laser-based treatment of disease. His research focuses on the elucidation of the biology of macular edema in hopes of developing new therapies and the analysis of ocular imaging to guide individualized treatment of his patients.

Allingham earned his PhD in cell and developmental biology at the University

of North Carolina at Chapel Hill. His interest in diseases of the retina was sparked during his medical training at UNC, when he first saw the retina. "For someone with an interest in vascular biology, the eye is like a mini-laboratory," Allingham says. "The retina is the only vascular bed in the body that can be seen in a noninvasive fashion, and this really appealed to me."

Allingham is pleased to join Duke Eye Center faculty because he considers it a unique environment that combined clinical excellence, a stellar faculty, and a strong base of researchers interested in retinal disease. These factors—together with Duke Eye Center's commitment to academics and a culture of intellectual curiosity—set it apart and made it Allingham's choice for his residency, fellowship and now as a faculty member.



Education and Training

Medical School: UNC School of Medicine, 2009

Graduate School: UNC, 2007

Internship: Duke University Hospital

Residency: Ophthalmology, Duke University Medical Center, 2013

Fellowship: Medical Retina, Duke University Medical Center, 2014



Cornea specialist honored

Preeya Gupta, MD, cornea and refractive surgery specialist, received the July/August 2014 Millennial Eye Outstanding Female in Ophthalmology Award. The award highlights individuals who fulfill specific criteria of advancement in ophthalmology and the promotion of women in ophthalmology.

Heed Award winners

Current glaucoma fellows **Garrick Chak, MD**, and **David Fleischman, MD**, and retina fellows **Dilraj Grewal, MD**, **Sumit Sharma, MD**, and **Michael Seider, MD**, have been awarded the prestigious Heed Ophthalmic Foundation Fellowship. The Society of Heed Fellows is a public charitable and educational foundation that provides funding for postgraduate studies in ophthalmology and the ophthalmic sciences. Beginning with the appointment of the first fellow in 1989, the society has provided more than \$430,000 in support of its mission.

Buckley, Stamer and Toth named Distinguished Professors

Edward G. Buckley, MD was named the James P. and Heather Gills Professor of Ophthalmology, **W. Dan Stamer, PhD**, was named the



Joseph A.C. Wadsworth Research Professor of Ophthalmology and **Cynthia Toth, MD** was named the Joseph A.C. Wadsworth Clinical Professor of Ophthalmology.

Arshavsky receives Nelson Trust Award

Vadim Arshavsky, PhD, Helena Rubinstein Professor of Ophthalmology, Professor of Pharmacology and Cancer Biology and scientific director of research at Duke, was awarded one of five Research to Prevent Blindness Nelson Trust Awards for Retinitis Pigmentosa.

Winners were selected after rigorous review by multiple RPB advisory panels comprised of outstanding scientists and chairs of departments of ophthalmology from across the country. "The award was originally conceived to produce at least one grant annually for the next eight to nine years," says Brian F. Hofland, PhD, RPB president, "but we realized that the exceptional pool of applicants—truly some of the nation's foremost retina investigators—created an opportunity for us to make an immediate impact. It's an unusual application of endowed funds for us, but we are seizing the moment to push this promising science toward the goal."

Each of the RPB Nelson Trust Award awardees will receive \$100,000 in flexible support to pursue novel projects.

Allingham and Toth receive Research Mentoring Awards

R. Rand Allingham, MD, and **Cynthia Toth, MD**, were selected as recipients of the 2015 Duke Research Mentoring Awards. Allingham won in the clinical science research category and Toth won in the



translational research category.

Winners of this award, established in 2009, demonstrate excellence in numerous aspects of mentoring, including accomplishments of individual mentees, programs implemented by the mentor, or by the exceptional creativity in mentoring.

Lad honored for research

Eleonora (Nora) Lad, MD, PhD, has received several awards, including the Duke Institute for Brain Sciences Incubator Award. The Research Incubator Awards program is designed to encourage innovative approaches to problems of brain function that transcend the boundaries of traditional disciplines. The award provides seed funding for collaborative research projects that will lead to a better understanding of brain function and translate into innovative solutions for health and society.

She was also honored with the Bass Connections award and the Alzheimer's Association Award.

Swamy selected for Machemer Research Award

Lakshmi Swamy, MD, was selected for the prestigious Robert Machemer Resident Research Award for her project "Funduscopy in cerebral malaria diagnosis: a survey of practice patterns." Her work was presented at the 2014 Duke Eye Center Residents and Fellows Day.

The Robert Machemer Research Award, established in 1999, recognizes a resident whose clinical or basic science research proposal demonstrates high intellectual curiosity and outstanding scientific originality, and has a significant impact on the clinical management of persons



with ophthalmic disease. The award honors Robert Machemer, MD, a past chair of the Duke Department of Ophthalmology.

Vitreoretinal fellow wins accolades

Francisco Folgar, MD, received the Duke Eye Center Annual Residents and Fellows Day best research paper award for 2014. He was also awarded with the Retina Society's Annual Retina Fellow Research Award, which is given to a fellow with outstanding original work in any aspect of vitreoretinal disease.

Fellow Sharma wins Michels Award

Sumit Sharma, MD, a Duke Eye Center vitreoretinal fellow, was selected by the Ronald G. Michels Foundation as the 2014 Michels Fellow. The Ronald Michels Fellowship Foundation Award is granted annually to outstanding second-year vitreoretinal fellows currently training in the United States. The foundation was established in 1991 to honor the memory of Michels, who trained more than 40 surgical fellows and was renowned for his work and research on vitreoretinal disorders.

Wallace wins Senior Honor award

David Wallace, MD, MPH, was the recipient of the Senior Honor Award from the American Academy of Pediatric Ophthalmology and Strabismus (AAPOS). The award is given for significant contributions to the society, including committee service and scientific presentations at meetings.



In 1907 George Mayerle, a Californian eye doctor, developed this chart to diagnose eye ailments. Mayerle helped form the first national optical association, the Optical Specialists' Association of America. There are characters for English, German, Japanese, Chinese, Russian, and Hebrew.

Bryant receives Young Optometrist and Robinson awards

Jill Bryant, OD, received the Young Optometrist of the Year Award and the John D. Robinson Clinical Excellence Award for 2014 from the North Carolina State Optometric Society during its 2014 congress.

The Young Optometrist of the Year Award is given to an optometrist who has been in active practice for less than 10 years and who has shown remarkable leadership skills when serving profession, her patients, and community.

The John D. Robinson Clinical Excellence Award is given to a North Carolina optometrist who has exemplified excellence in the clinical practice of primary eye care and ophthalmic medicine.

Fekrat named to VA leadership

Sharon Fekrat, MD, vitreoretinal specialist, was named Associate Chief of Staff at the Durham VAMC. She was also awarded with the American Academy of Ophthalmology Senior Achievement Award at the 2014 AAO

Annual Meeting. The Achievement Award program recognizes individuals who participate in the scientific programs at the annual meeting and encompasses more than 25 categories of contribution to the academy.



Fekrat was also named to the 2014 Best Doctors list from *Business North Carolina* magazine.

Malek awarded for AMD research

Goldis Malek, PhD, received a two-year \$500,000 award from the Edward N. & Della L. Thome Foundation to investigate the role of a lipid activated nuclear receptor in the pathogenesis of age-related macular degeneration.

The Edward N. & Della L. Thome Memorial Foundation was created in 2002 to advance the health of older adults through the support of direct service projects and medical research on diseases and disorders affecting older adults.

COULD EARLY ALZHEIMER'S DISEASE BE DIAGNOSED WITH EYE IMAGING?

IN THE NOT TOO DISTANT FUTURE, it may be possible to diagnose early-stage Alzheimer's disease (AD) simply by taking pictures of the retina. Duke Eye Center investigators are conducting leading-edge research aimed at realizing such a breakthrough.

"They say the eyes are the window to the soul, but they're also the window to the brain," says Duke geriatrician and Eye Center faculty member Heather E. Whitson, MD, MHS.

Whitson and retinal ophthalmologist Eleonora (Nora) Lad, MD, PhD, hope to one day be able to look through that window to definitively detect AD in its earliest stages.

To that end, the physician-scientists have been collaborating on a two-pronged study, funded by both the Alzheimer's Association and the Duke Institute for Brain Science.

THE EYE-AD CONNECTION: A LONGTIME TOPIC OF INTEREST

The interest in the eye-AD connection is not new. A number of other studies have examined—and continue to examine—the link from different perspectives.


"People are very interested in this connection for a variety of reasons," says Lad. "It's long been recognized that patients with early-stage AD experience

Duke researchers use pioneering imaging and software to examine distinctive retinal changes.

BY JENI BAKER

ILLUSTRATION BY
HARRY CAMPBELL





abnormalities in visual-system processes like visual acuity, contrast sensitivity, perception of color and motion, and the peripheral-visual field.”

In addition, Lad says, “retinal findings have been detected early in the disease and parallel the neurodegenerative changes in the brain. And because the retina is an extension of the brain—a part of the central nervous system—retinal changes may mirror the changes that occur in the brain with Alzheimer’s disease.”

Lad and Whitson’s research is evaluating retinal characteristics (biomarkers) in three age-matched groups of study participants: people diagnosed with mild cognitive impairment (MCI), a strong risk factor for AD; people diagnosed with early to moderate AD; and people characterized as neurocognitively normal.

The biomarkers include thinning nerve-fiber layers, twists and turns in blood vessels, and the presence of extracellular deposits (drusen, or eye “gunk”) in the periphery of the retina.

AN INNOVATIVE TAKE ON THE “THE HOLY GRAIL OF AD RESEARCH”

Several factors make Whitson and Lad’s research unique.

It’s the first study aimed at comparing the retinas of people with AD to two other groups: people with intact cognition and people with mild cognitive impairment (MCI)—which frequently turns out to be prodromal AD. People with MCI are notoriously difficult to identify, and there’s no definitive diagnostic test for the condition.

“Many people see geriatricians because they’re having a lot of ‘senior moments’ and want to know if they have AD,” Whitson says. “It’s frustrating—for them and for us—to spend a lot of time on testing and history-taking only to tell them that they might have some mild cognitive issues that may or may not be AD—to come back in a year and we’ll have a better idea.”

The use of sophisticated optical imaging and software to analyze the images also make Lad and Whitson’s research unique.

The study is employing both spectral domain optical coherence tomography (SD-OCT)—a revolutionary non-invasive imaging technique—and image-analysis software developed in Duke Eye Center Vision and Image Processing (VIP) Laboratory of director Sina Farsiu, PhD.

Using Farsiu’s proprietary algorithm, the software can very accurately segment (separate and measure the thickness of) the retinal layers shown on the highly detailed OCT images. Lad thinks this is a significant improvement over the automated segmentation techniques of older CT technology.

The goal is to visualize and measure any thinning of the retinal layers, which is associated with a number of optical and neurodegenerative conditions, including MCI and AD.

“A GAME CHANGER”

Being able to diagnose MCI/early-stage AD with optical imaging would be a game changer in a number of ways, Whitson says.

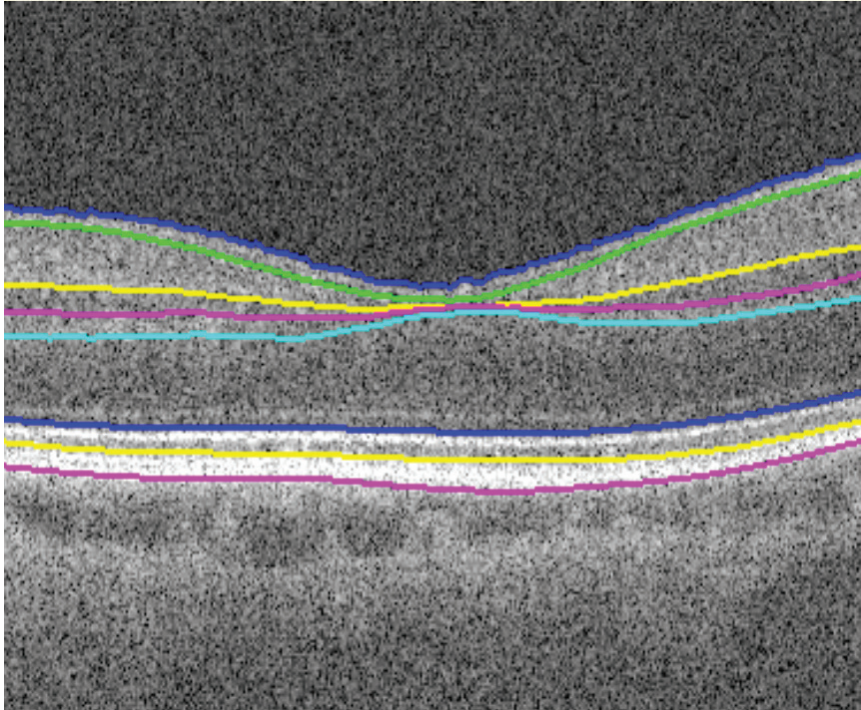
“It’s very difficult to detect and evaluate subtle cognitive changes—to know if this is AD or just mild cognitive changes within the range of normal that can occur with age,” she says. “A definitive, easy diagnostic test is kind of the holy grail of AD research.”

Using retinal findings to diagnose MCI could result in significant time and cost savings, as well.

“To diagnosis early AD, we currently must rely on costly imaging modalities such as MRI and PET, invasive procedures to collect cerebrospinal fluid, and neurocognitive assessments by specialists,” Whitson says. “In addition, the testing is very time-intensive, not perfectly accurate, and it requires patients to have access to these specialists



Eleonora (Nora) Lad, MD, PhD
Assistant Professor of
Ophthalmology and
Duke Institute for Brain Sciences Faculty



This cross-section optical coherence tomography (OCT) image of the retina demonstrates the eight retinal layers using the DOCTRAP software. The borders of these layers are indicated by colored lines. The two layers thought to be affected in Alzheimer's disease are the nerve fiber layer (NFL) between the blue and green line, and the ganglion cell layer complex (GCCL) between the green and yellow line.

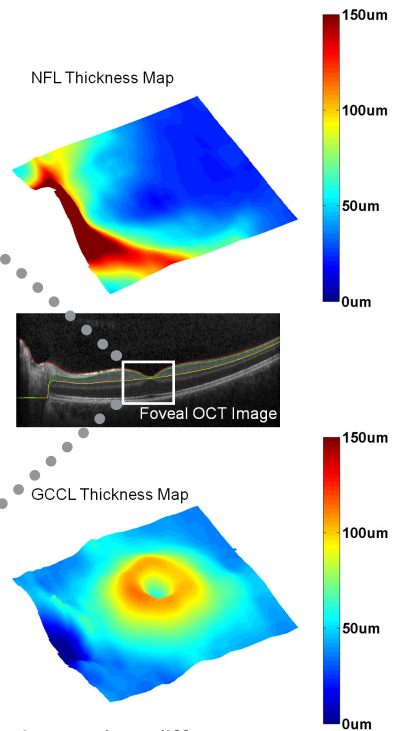
and undergo multiple evaluations."

While there are not yet drugs available that can change the disease's course, Whitson says early diagnosis of MCI/early-stage AD can help patients make more informed decisions about their futures.

She also believes that an early, accurate, inexpensive diagnostic tool such as retinal imaging would hasten the development of drugs that could hinder AD's progress.

"We know that the brain changes are going on well before the clinical disease is obvious, and this problem of not being able to definitively diagnose it until its late stages is part of what's stymied drug development," Whitson says.

"If we could just look into people's eyes and have a way to



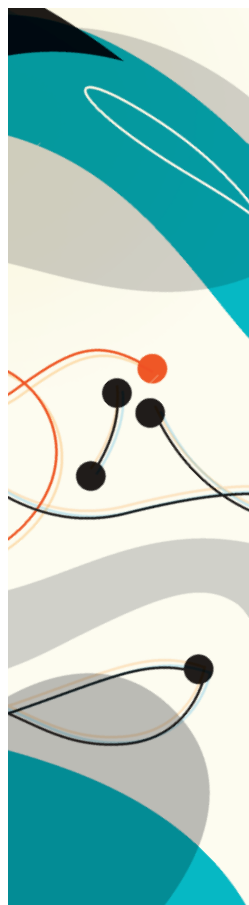
The three images show different perspectives of the same area of the retina. The top 3-D image indicates the nerve fiber layer thickness map of the patient. The middle image is a smaller version of the cross section at the left. The bottom 3-D image shows the thickness of the ganglion cell complex layer (GCCL).

accurately distinguish between those who are and aren't on the path to this disease, drug companies would know who to focus their drug-development efforts on."

Lad and Whitson have almost finished enrolling participants in this study and have begun analyzing data and conducting one-year follow-up exams. They presented their research at the 30th International Conference of Alzheimer's Disease International in Perth, Australia in April 2015, and at the Annual Meeting of the Association for Research in Vision and Ophthalmology in Denver in May.

Learn about their findings in future issues of *VISION*. ▀

Michael P. Kelly, FOPS



WHITE AND GOLD

Dress-color debate illustrates complex eye-brain relationship



A worldwide social-media debate erupted recently about the colors of a dress—a photo of which had been posted online. About half of the people who see the photo believe the dress to be white and gold, while the

other half see the dress as blue and black. A few even see it as blue and gold.

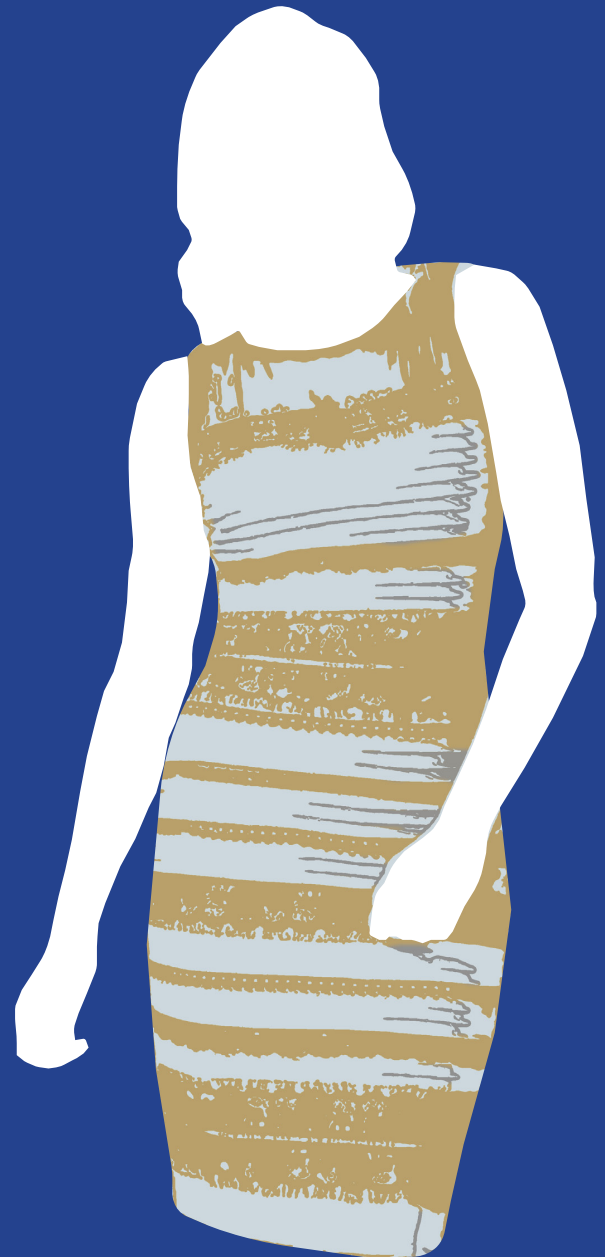
What could account for this consistent difference in color perception on such a large scale?

To most people, lights and objects either seem colored or not.

“There are likely individual differences in the eye and brain structures responsible for color perception,” says Eleonora (Nora) Lad, MD, PhD, of Duke Eye Center. “In fact, a genetic testing firm is currently trying to figure out what role genetics may play in color perception by first polling users about the color of that dress.”

However, the story is more complex.

“Although color is related to the physical composition of light, color itself truly does not exist outside the brain,” Lad explains. “The human perception of color starts with the responses of the photoreceptor cells to light falling onto the eye’s retina and continues as a pathway of connectivity among neurons at further levels of visual processing within the brain. The perception of color depends greatly on the context, and cannot be deduced from the physical nature of light itself.”



It helps to understand how the process of sight is initiated by the eyes and expanded upon by a “visual pathway” comprised of complex brain structures.

Painters place pigment on canvas, but it is the reflected light that enters our eyes, says Lad. As light falls on an object, the surface absorbs specific wavelengths and reflects others.

Light first passes through the pupil—the dark opening in the colored part (iris) of the eyes—and

— OR BLUE AND BLACK?



is then focused by the lens on the retina, a thin, translucent sheet of central nervous system tissue that lines the back of the eye, she says. The retina contains neurons called photoreceptors that are made up of cells known as rods and cones, which respond directly to light. Cones are responsible for daylight color vision, while rods are active in low light.

Most people's retinas contain three types of cone photoreceptors—each designed to respond to a different range of visible wavelengths during daylight

vision. The cones themselves do not carry information about color; the visual system compares the activation of each type of cone with the others in order to tell us about color.

When these cells absorb light, they generate neural signals, which are passed first to other retinal cells and then to the optic nerve. The optic nerve then transmits the visual information to the brain's lateral geniculate nucleus—a "relay center" for the visual pathway—and then to the striate cortex in the back of the brain. This is where visual signals are processed before being refined by more sophisticated areas of the brain to produce the images and colors we perceive.

"Our visual system is designed to assign fixed colors to objects under very different lighting conditions, which is what the principle of color constancy is about," says Lad.

As for the dress, Lad says the photo doesn't contain enough visual clues to give viewers the points of reference and perspective necessary to accurately interpret its colors.

"There are no skin tones, curtains, plants or other objects in the photo to serve as clues about the amount of ambient light in the room," she says.

"This is why about 50 percent of people perceive the dress as white and gold—their brains remove the blue cast and interpret the image as a white dress in a dark shadow. The other approximately 50 percent interpret the image as a dress that is washed out by bright light, causing them to assume that the dress is darker blue and black under normal light conditions."

Blue and black are the actual colors of the dress, which sold out quickly in the wake of the debate. ▀

"Our visual system is designed to assign fixed colors to objects under very different lighting conditions, which is what the principle of color constancy is about."

Eleonora (Nora) Lad,
MD, PhD

FACULTY LEADERSHIP

Edward G. Buckley, MD	Chair, Department of Ophthalmology Vice Dean of Medical Education, Duke University School of Medicine Joseph A.C. Wadsworth Clinical Professor of Ophthalmology
Scott W. Cousins, MD	Vice Chairman of Research Director, Translational Research Program Director, Center for Macular Diseases Director, Ophthalmic Imaging
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Prithvi Mruthunjaya, MD	Medical Director
Derek DelMonte, MD	Chief, Division of Ophthalmology, Durham VA Medical Center
Vadim Arshavsky, PhD	Scientific Director of Research
Sanjay Asrani, MD	Practice Chief, Duke Eye Center of Cary
S. Jill Bryant, OD, FAAO	Director, Contact Lens
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Sharon Fekrat, MD, FACS	Associate Chief of Staff Durham VA Medical Center and Associate Chief of Ophthalmology at VA
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Preeya Gupta, MD	Practice Chief, Duke Eye Center at Page Road
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Kelly Muir, MD, MHSc	Director, Fellowship Program
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Jullia A. Rosdahl, MD, PhD	Director, Patient Education
Stefanie Schuman, MD	Director, Center for Hereditary Retinal Diseases
Tina Singh, MD	Director, Second- and Fourth-Year Medical Student Program
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Evelyn Kelly, COA	Health Center Administrator
Jillian Ream	Development Officer
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Martha Wilson, MBA	Health Center Administrator
Renee Wynne	Coordinator, Continuing Medical Education Director, Education Program Staff

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Laurie K. Pollock, MD	Assistant Professor of Ophthalmology
Dianna Seldomridge, MD	Assistant Professor of Ophthalmology
Tina Singh, MD	Assistant Professor of Ophthalmology
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Terry Kim, MD	Service Chief Professor of Ophthalmology
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William Rafferty, OD	Assistant Professor of Ophthalmology
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Kelly W. Muir, MD	Associate Professor of Ophthalmology

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Henry Tseng, MD, PhD	Assistant Professor of Ophthalmology
Molly M. Walsh, MD, MPH	Assistant Professor of Ophthalmology
Carol Ziel, MD	Assistant Professor of Ophthalmology

HEREDITARY RETINAL DISEASES

Stefanie Schuman, MD	Director, Center for Hereditary Retinal Diseases
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LOW VISION REHABILITATION SERVICE

Diane B. Whitaker, OD	Assistant Professor of Ophthalmology Service Chief
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M. Tariq Bhatti, MD	Service Chief Professor of Ophthalmology and Professor in Medicine
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Mays El-Dairi, MD	Assistant Professor of Ophthalmology

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Michael J. Richard, MD	Assistant Professor of Ophthalmology
Julie A. Woodward, MD	Associate Professor of Ophthalmology Associate Professor in Dermatology ++ Service Chief

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Laura B. Enyedi, MD	Associate Professor of Ophthalmology Associate Professor in Pediatrics ++
Sharon F. Freedman, MD	Professor of Ophthalmology Professor in Pediatrics ++ Service Chief
S. Grace Pralapakorn, MD, MPH	Assistant Professor of Ophthalmology
Yos Priestley, OD, FAAO	Assistant Professor of Ophthalmology
David K. Wallace, MD, MPH	Professor of Ophthalmology Professor in Pediatrics ++

VITREORETINAL DISEASES AND SURGERY

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Paul Hahn, MD, PhD	Assistant Professor of Ophthalmology
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Prithvi Mruthyunjaya, MD	Associate Professor of Ophthalmology
Eric A. Postel, MD	Professor of Ophthalmology
Stefanie G. Schuman, MD	Assistant Professor of Ophthalmology
Cynthia A. Toth, MD	Professor of Ophthalmology Professor in Biomedical Engineering ++
Lejla Vajzovic, MD	Assistant Professor of Ophthalmology

RESEARCH OPHTHALMOLOGY

Vadim Arshavsky, PhD	Helena Rubinstein Foundation Professor of Ophthalmology Professor in Pharmacology & Cancer Biology ++ Scientific Director
Sina Farsiu, PhD	Assistant Professor of Biomedical Engineering Assistant Professor in Ophthalmology++
Paulo Ferreira, PhD	Associate Professor of Ophthalmology Associate Professor in Pathology ++
Pedro Gonzalez, PhD	Associate Professor of Ophthalmology Associate Professor in Pathology ++
Jeremy Kay, PhD	Assistant Professor of Neurobiology Assistant Professor in Ophthalmology
Paloma Liton, PhD	Associate Professor of Ophthalmology Assistant to Associate Professor in Pathology
Goldis Malek, PhD	Associate Professor of Ophthalmology Assistant to Associate Professor in Pathology
P. Vasantha Rao, PhD	Professor in Ophthalmology Professor in Pharmacology & Cancer Biology ++
Catherine Bowes Rickman, PhD	Associate Professor of Ophthalmology Associate Professor in Cell Biology ++
Daniel Saban, PhD	Assistant Professor of Ophthalmology
Nikolai Skiba, PhD	Associate Professor in Ophthalmology
W. Dan Stamer, PhD	Joseph A.C. Wadsworth Research Professor of Ophthalmology
Sandra Stinnett, DrPH	Assistant Professor of Biostatistics & Bioinformatics Assistant Professor in Ophthalmology ++
Fulton Wong, PhD	Professor of Ophthalmology

Secondary appointment ++



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This is an ultra-wide field retinal interior surface of the eye image of a patient with a large retinal detachment. Photograph by Brian Lutman, CRA / Duke Eye Imaging