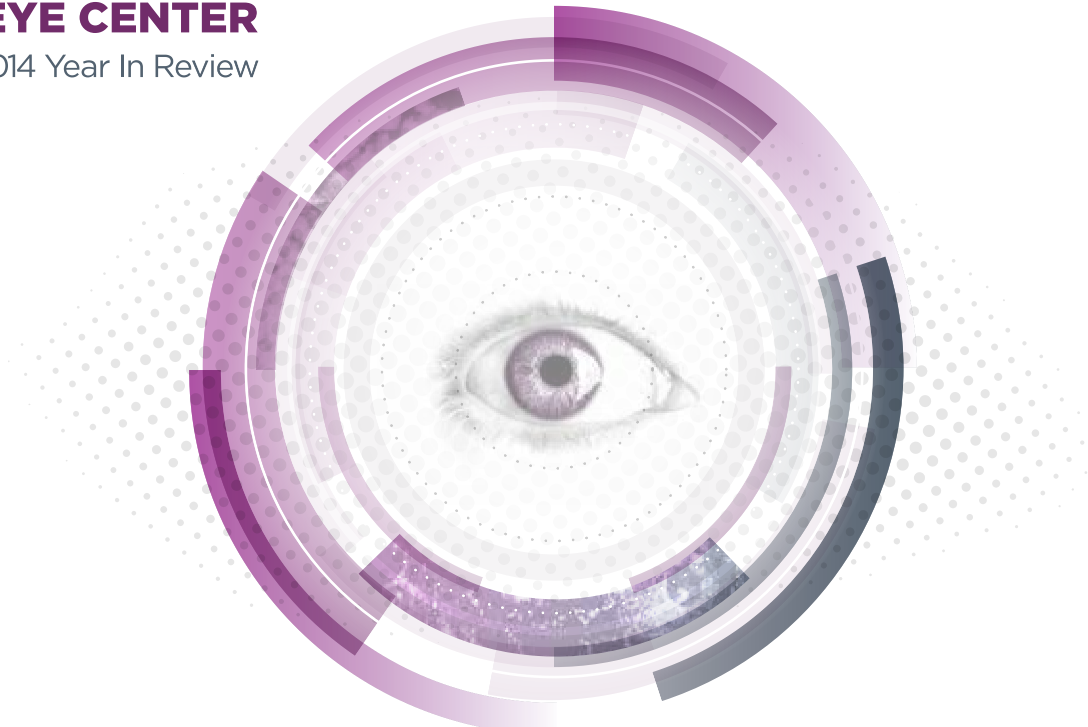
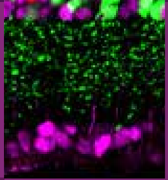
UPMC **EYE CENTER**

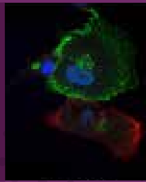
2014 Year In Review



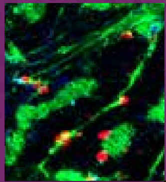
UPMC LIFE CHANGING MEDICINE

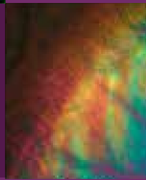
The photographs in the 2014 Year in Review were taken in the labs of our department researchers. For more information on the photographs email **EyeCenter@upmc.edu**





UPMC **EYE CENTER**





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CHAIRMAN'S MESSAGE

It is my pleasure to share with you the 2014 UPMC Eye Center Year in Review. This past year, we remained true to our mission to improve quality of life through the preservation and restoration of vision. Noteworthy accomplishments in both our clinical work and research demonstrate our sustained commitment to advancing excellence in ophthalmology.

Dear Colleagues,

In this report we are delighted to highlight the work of four faculty members. Their work is helping to advance the frontiers of clinical practice and eye research.

- **Regis P. Kowalski, MS, M(ASCP)**, is the executive director of the Charles T. Campbell Ophthalmic Microbiology Laboratory, a unique entity that is both a diagnostic microbiology laboratory dedicated to ophthalmology and a research facility with expertise in both basic and clinical microbiology.
- The research group led by **Paul R. "Kip" Kinchington, PhD**, professor of ophthalmology, molecular genetics, and biochemistry, has successfully used a novel strategy to relieve pain induced by the varicella zoster virus in a rat model of post-herpetic neuralgia. This work addresses fundamental questions about the mechanisms of zoster-related pain and points to potential new strategies for preventing this debilitating condition.
- **Matthew A. Smith, PhD**, assistant professor of ophthalmology and director of the Visual Neuroscience Laboratory, is working at the frontiers of neuroscience to understand how interaction among neurons enables visual perception. This research is building a foundation for the translational work of creating a visual neuroprosthesis that could provide an alternative path to sight for people with irreparable damage to the optic nerve.
- We are thrilled to have recruited **Joseph N. Martel, MD**, a specialist in minimally invasive vitroretinal surgery, to the faculty of the UPMC Eye Center. In addition to offering expertise in the use of micro-incisional instrumentation for retinal surgery, Dr. Martel is involved in developing and assessing new imaging technology to both diagnose retinal diseases and assess the effects of treatment.

Over the last year the Department has also made strides towards bettering the practice of ophthalmology. We were honored to receive 13 percent of the total funds awarded in the Department of Defense solicitation for research projects on vision restoration. We also successfully competed for nearly three million dollars in support for basic and clinical research from the National Institutes of Health.

James L. Funderburgh, PhD, director of the Corneal Cell Biology Laboratory, who was featured in the 2013 Annual Report, published a groundbreaking study demonstrating the regeneration of healthy corneal tissue by means of autologous stem cell therapy. This technique could one day help millions of people worldwide and reduce the need for corneal transplants.

In the clinical arena, we continue to develop new models of care and new ways to provide high-quality care more efficiently and at a lower cost. We also take with the utmost seriousness our responsibility as an academic medical center to critically evaluate new technologies to determine whether their use offers tangible benefits such as improved cost effectiveness and better patient outcomes.

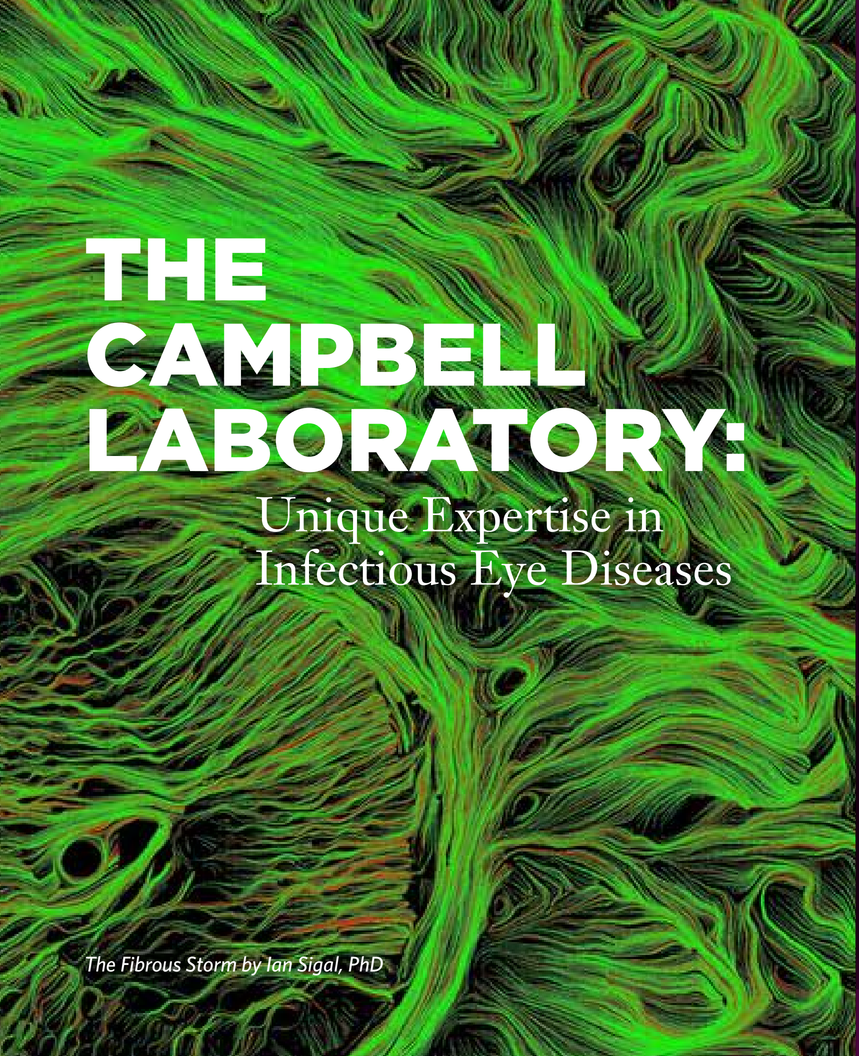
It is an honor to have led our remarkable team of physicians, researchers, and staff through another year of clinical excellence and scientific innovation. I look forward to sharing further advancements in the coming year as we continue to pursue our vision of providing leadership in the delivery of eye care.

Sincerely,

Joel S. Schuman, MD, FACS
Distinguished Professor and Chairman
Director, UPMC Eye Center
Eye & Ear Foundation Endowed Chair in Ophthalmology
Professor of Bioengineering and Clinical and Transitional Science

THE CAMPBELL LABORATORY:

Unique Expertise in Infectious Eye Diseases



The Fibrous Storm by Ian Sigal, PhD

In operation since 1973, the Charles T. Campbell Ophthalmic Microbiology Laboratory at UPMC is a unique entity: a fully certified clinical diagnostic ophthalmic microbiology laboratory that is also a research laboratory focused on the diagnosis and treatment of infectious diseases of the anterior segment of the eye.

Regis P. Kowalski, MS, M(ASCP), executive director of the Campbell Lab and a research professor of ophthalmology at the University of Pittsburgh, has been with the lab for 37 years and is internationally recognized both for his expertise as a clinical ophthalmic microbiologist and for his research on clinical microbiology testing and antibiotic discovery and testing.

The Campbell Lab is a regional and national resource for specialized ophthalmic microbiology services as well as a widely respected source of information on topics ranging from best practices in testing for ocular pathogens to the optimization of antibiotic therapy for ocular infections.

Antibiotic resistance has been a focus of research at the Campbell Lab for 25 years. Led by Mr. Kowalski, this work has shown that resistance — an increasing challenge in systemic medicine — appears to be less of a concern in the treatment of ophthalmic infections.

Topical administration and intraocular injection of antibiotics, which achieve high drug concentrations in the optical tissues, can effectively treat bacteria deemed resistant by standard interpretations of antibiotic susceptibility.

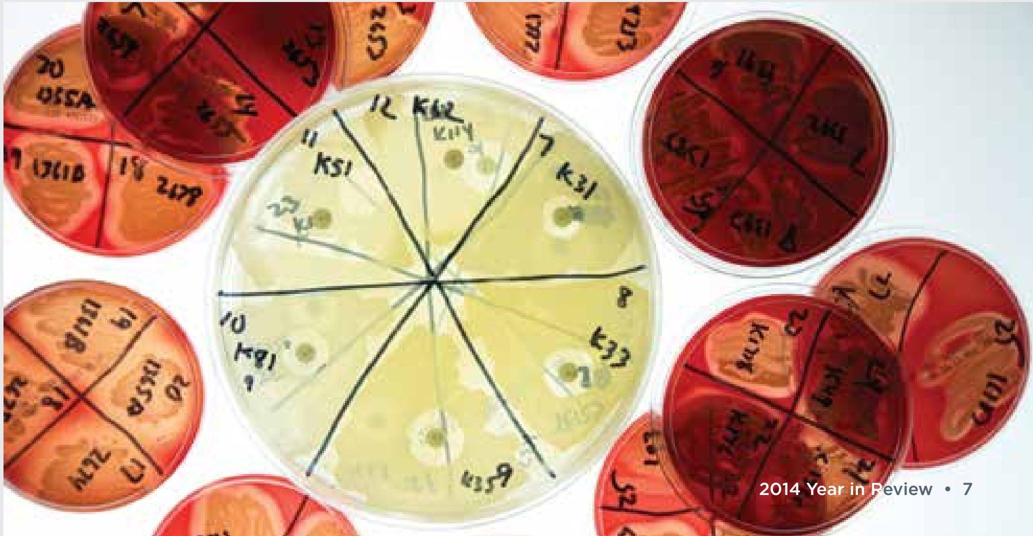
Regis P. Kowalski, MS, M(ASCP)

Mr. Kowalski and his colleagues have validated a polymerase chain reaction (PCR) test for the parasite acanthamoeba, which can cause a rare but severe and potentially blinding form of keratitis. Their work showed the PCR test to be statistically equivalent to culture isolation for detecting acanthamoeba from corneal samples. The team has also developed an in vitro assay to evaluate and screen anti-infective therapies for acanthamoeba keratitis.

The Campbell Lab's large repository of patient specimens proved invaluable in a recent study that validated a diagnostic test for Chlamydia trachomatis in ocular samples. Ocular infections caused by Chlamydia are rare nowadays, says Mr. Kowalski, but the lab's repository of chlamydia conjunctivitis samples dating back to the 1990s provided the volume of specimens required to evaluate the novel test.

The lab is also engaged in ongoing research to identify an effective therapy for adenoviral conjunctivitis.

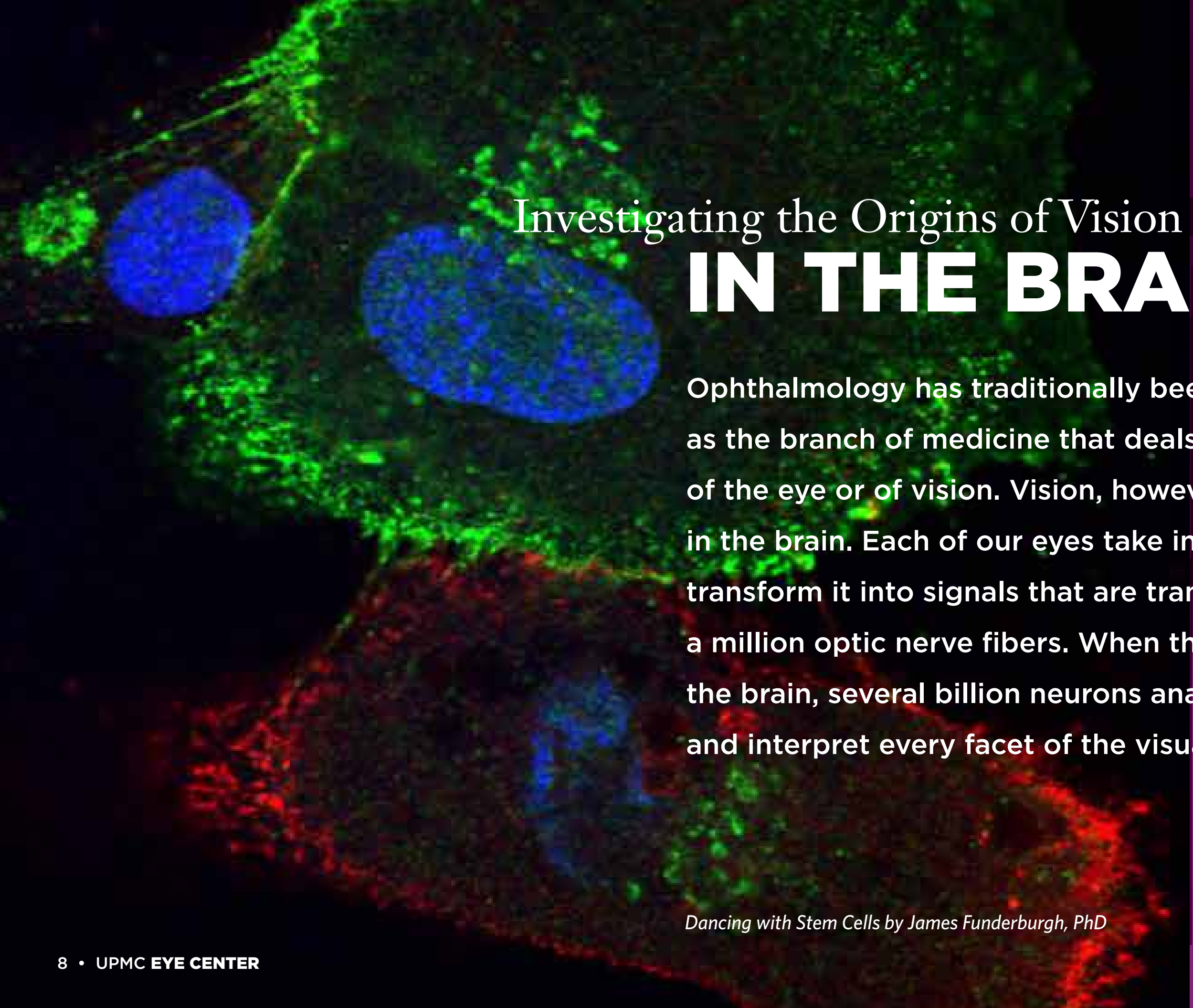
Mr. Kowalski says he enjoys the challenge of diagnosing eye infections and relishes his opportunities to contribute to and share his knowledge of ophthalmic microbiology with students, clinicians, and researchers around the world. "There are not a lot of people doing this," he says. "I still enjoy coming to work every day."



Investigating the Origins of Vision

IN THE BRAIN

Ophthalmology has traditionally been defined as the branch of medicine that deals with disorders of the eye or of vision. Vision, however, originates in the brain. Each of our eyes take in light and transform it into signals that are transmitted along a million optic nerve fibers. When those signals reach the brain, several billion neurons analyze and interpret every facet of the visual world.



Dancing with Stem Cells by James Funderburgh, PhD

A change in the visual system, whether it is a disorder such as cataracts or glaucoma or an intervention to correct that disorder, causes changes in the brain. Neither vision nor disorders of vision can be fully understood without an appreciation of how the brain processes visual information, says Matthew A. Smith, PhD, director of the Visual Neuroscience Laboratory and an assistant professor in the department of ophthalmology.

Dr. Smith and his team use a mixture of neurophysiological, behavioral, and computational techniques to study how neurons in different regions of the brain interact during active perception of the visual world.

An understanding of how the brain processes visual information is also fundamental to the quest to develop visual prostheses — devices that could restore functional vision to at least some of the more than 40 million people worldwide who are blind.

"It turns out that the circuitry of neurons is critical to understanding how we are able to see," says Dr. Smith. "One of the topics we are studying is how abnormal visual experience, such as in amblyopia or glaucoma, alters cortical circuitry, and how a better understanding of those circuits might lay the foundation for the development of cortical visual prosthetic devices."

"It turns out that the circuitry of neurons is critical to understanding how we are able to see"

Matthew A. Smith, PhD

Historically, scientists have studied the brain by listening to one neuron at a time. But the problem with that Dr. Smith explains is that "the brain is an immensely complex network of neurons, and we can't fully grasp it without understanding how neurons work together.

My research is focused on how groups of neurons communicate, how they pass signals to each another, and how that fundamentally enables us to see."

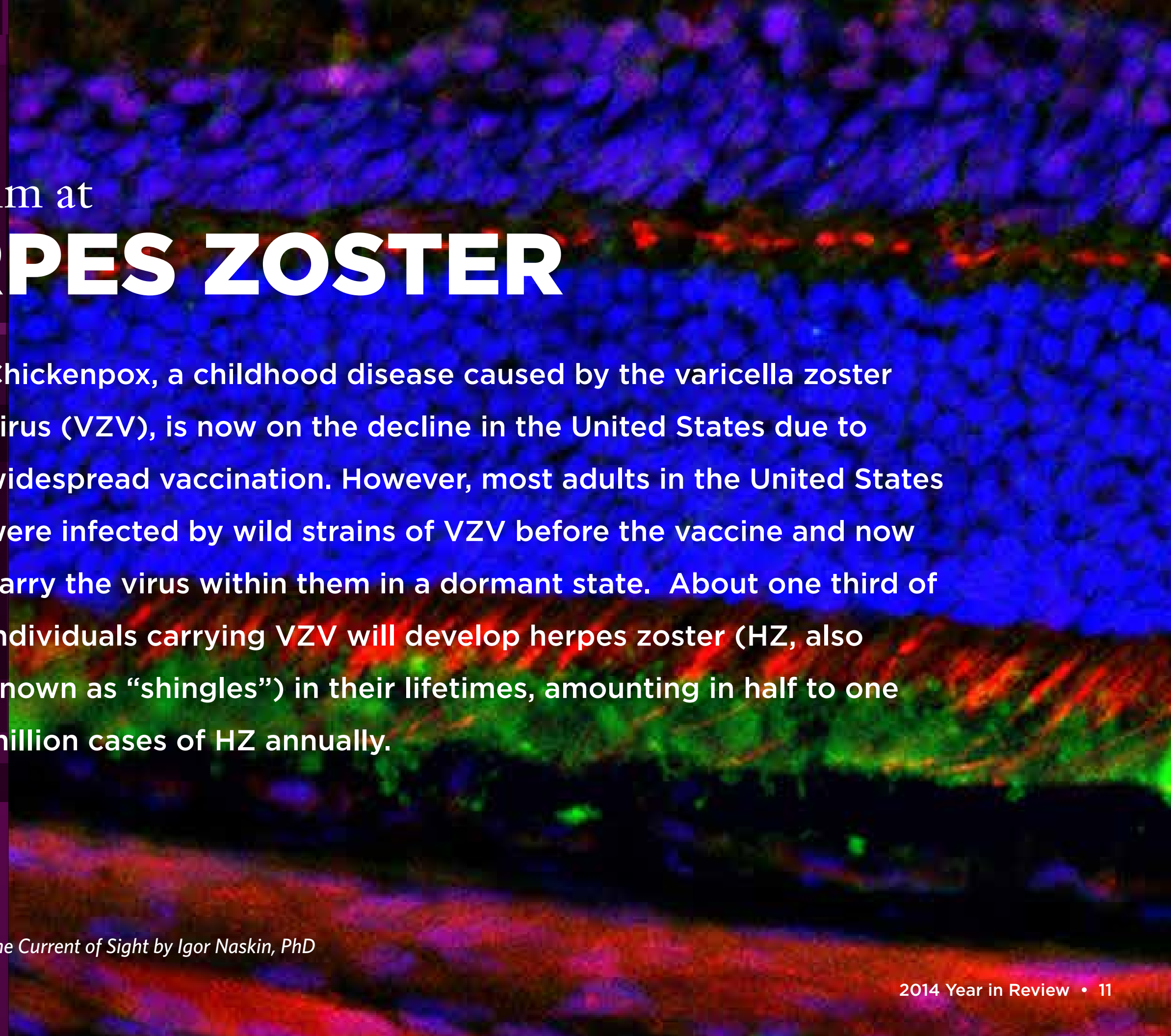
One critical faculty of the visual system is attention, the ability to select and concentrate on salient aspects of the visual world.

"The key to successful vision is being able to select the things that are important," says Dr. Smith. "One of the questions we are asking is how the brain is able to focus in on a particular feature or spatial location, concentrate on it, and over time improve the speed and accuracy of our visual perception."

Taking Aim at

HERPES ZOSTER

Chickenpox, a childhood disease caused by the varicella zoster virus (VZV), is now on the decline in the United States due to widespread vaccination. However, most adults in the United States were infected by wild strains of VZV before the vaccine and now carry the virus within them in a dormant state. About one third of individuals carrying VZV will develop herpes zoster (HZ, also known as “shingles”) in their lifetimes, amounting in half to one million cases of HZ annually.



The Current of Sight by Igor Naskin, PhD

Paul R. "Kip" Kinchington, PhD

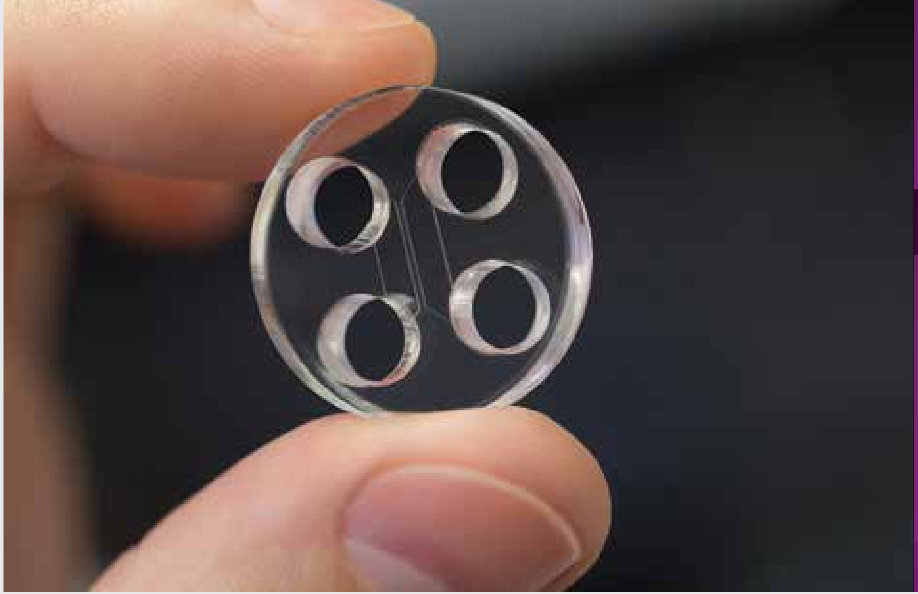
"Although our research does not directly address how VZV causes ocular disease, we are addressing the critical issues of latency and pain, which have long-term implications for vision and the eye," he explains.

Approximately one in four HZ cases will result in potentially blinding vision-related complications, particularly when the disease occurs on the head. Most often this is seen as corneal opacity or a corneal anesthesia that opens up the eye to blinding iatrogenic damage. VZV may also cause disease in almost any component of the eye, including devastating retinal disease and ophthalmoplegia. Together, HZ affects vision in an estimated 50,000 patients annually.

A large fraction of patients with HZ develop severe ocular pain or experience crippling allodynia and post herpetic neuroglia, which can be particularly difficult to treat.

There is a licensed partially effective vaccine for preventing zoster in the United States, but it remains to be widely used for several reasons, including a partial effectiveness, cost, the reluctance of the target population to vaccination and the lack of physician-based recommendation.

Paul R. "Kip" Kinchington, PhD, professor of ophthalmology, molecular genetics and biochemistry, has dedicated his career to the investigation of VZV, and his work aims to determine how the virus remains dormant in neurons for decades, how and why it reactivates, and why HZ causes so much pain. His research group is one of only a few in the world focused on the biology and pathophysiology of VZV.



Because VZV infects only humans, developing laboratory models in which to study how the virus causes human disease has been a major challenge. Dr. Kinchington's group has succeeded in developing a rodent model for investigating how VZV causes prolonged pain and the allodynia seen in many HZ patients. He is also exploiting the model to evaluate new strategies for alleviating VZV-induced pain, including non-pharmacological approaches.

In July 2014 the team published an article in *Gene Therapy* reporting successful use of a novel vector based strategy to block the release of VZV-associated pain signals in this model. Since similar strategies are currently being tested in early-stage clinical trials to treat other types of pain, his work could have translational impact for trials in people with VZV-associated pain and PHN.

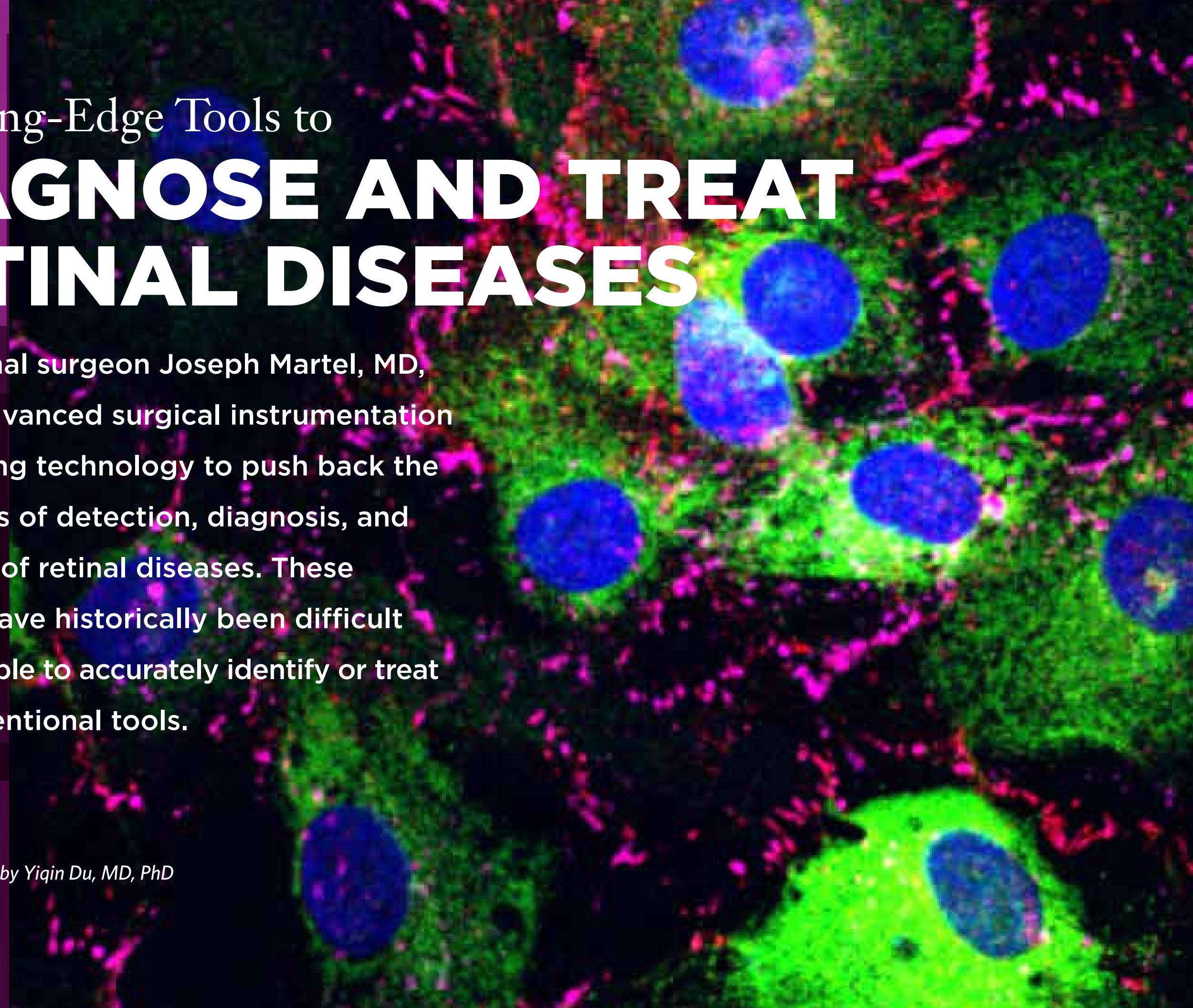
Dr. Kinchington's team has also developed a cultured human neuron model that is allowing his group to study the dormant state of the virus that occurs in humans between chickenpox and HZ. This may permit the identification of the factors that drive the reactivation of virus and ultimately, how reactivation (and VZV-induced eye disease) might be prevented.

Awareness of the human toll of VZV-associated disease and its complications fuels Dr. Kinchington's determination to continue studying the virus. "Our search for better treatment and prevention strategies is driven by knowing how much pain and suffering this virus causes."

Using Cutting-Edge Tools to

DIAGNOSE AND TREAT RETINAL DISEASES

Vitreoretinal surgeon Joseph Martel, MD, is using advanced surgical instrumentation and imaging technology to push back the boundaries of detection, diagnosis, and treatment of retinal diseases. These diseases have historically been difficult or impossible to accurately identify or treat with conventional tools.



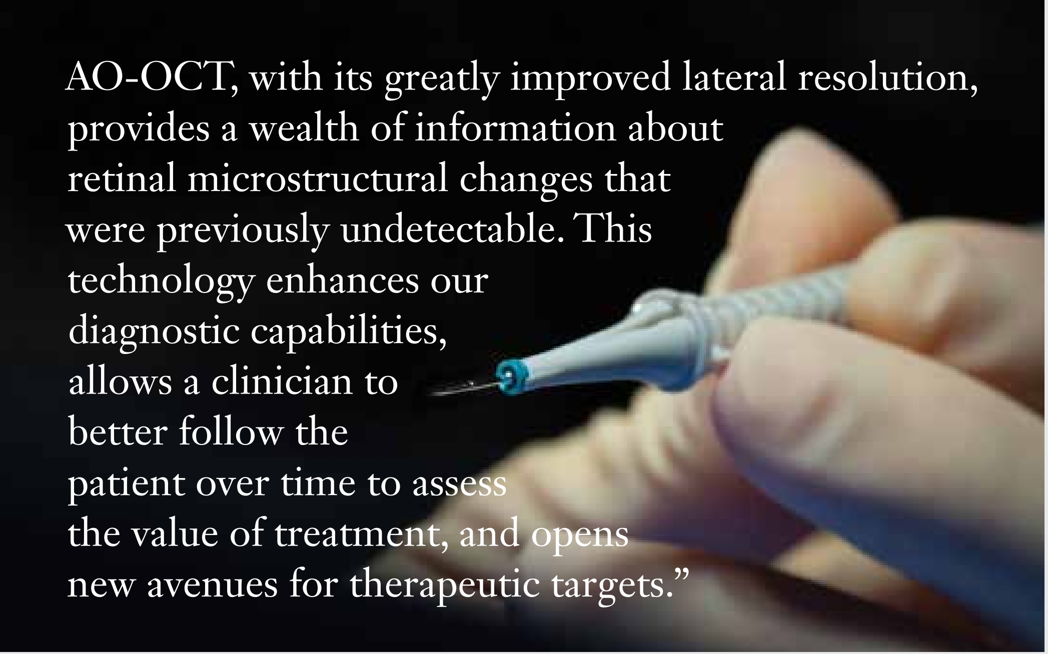
Keys to the World by Yiqin Du, MD, PhD

Dr. Martel is one of the nation's leading experts in the use of minimally invasive, micro-incisional instruments in vitreoretinal surgery. He pioneered a microsurgical technique to move massive macular hemorrhages in patients with neovascular age related macular degeneration using a subretinal air injection in tandem with vitrectomy (Martel JN, Mahmoud TH. Subretinal Pneumatic Displacement of Subretinal Hemorrhage. JAMA Ophthalmol. 2013 Dec 1;131(12):1632-5).

Led by Dr. Martel's expertise, the UPMC Eye Center is one of only a few centers in the country using minimally invasive techniques to perform complex procedures such as endoscopic vitrectomy, novel fixation techniques for dislocated intraocular lenses, repair of complex retinal detachments, and delivery of subretinal therapeutics, to name a few.

Dr. Martel also is employing ultrahigh resolution ocular imaging with adaptive-optics optical coherence tomography (AO-OCT) and swept source optical coherence tomography (SS-OCT) — rapidly advancing imaging technologies that permits ultra-fast, ultra-high-resolution, three-dimensional micron level imaging of the retina — to examine the retinal microstructure in ways previously possible only with histopathology.

Joseph N. Martel, MD



AO-OCT, with its greatly improved lateral resolution, provides a wealth of information about retinal microstructural changes that were previously undetectable. This technology enhances our diagnostic capabilities, allows a clinician to better follow the patient over time to assess the value of treatment, and opens new avenues for therapeutic targets."

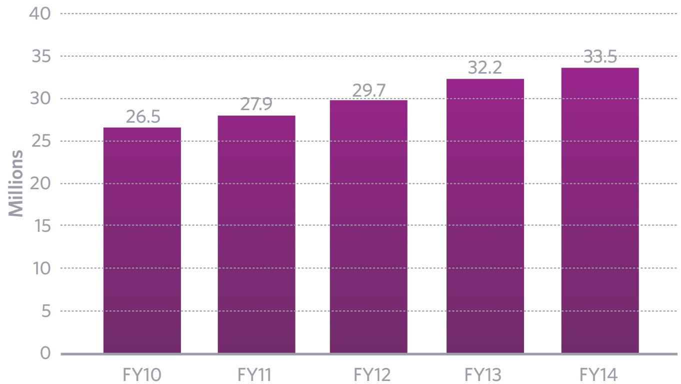
"Traditional methods often cannot identify the root cause of severe vision loss associated with retinal diseases," he explains. "AO-OCT, with its greatly improved lateral resolution, provides a wealth of information about retinal microstructural changes that were previously undetectable. This technology enhances our diagnostic capabilities, allows a clinician to better follow the patient over time to assess the value of treatment, and opens new avenues for therapeutic targets.

Ultrahigh resolution ocular imaging can be used to image a wide range of retinal disorders, from age-related macular degeneration and diabetic retinopathy to less-common ones such as autoimmune-associated or central serous retinopathy. In addition, the technology can be applied to guide surgery. "We can use it preoperatively to precisely identify our surgical targets and intraoperatively to ensure we are achieving our surgical goals," he explains.

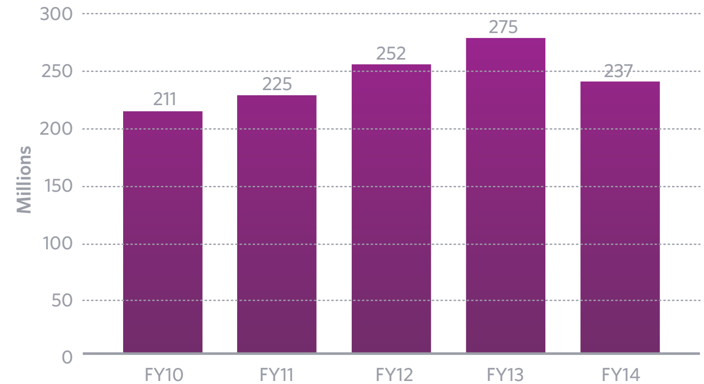
Dr. Martel joined the UPMC Eye Center as an assistant professor of ophthalmology in 2013 after completing a residency in ophthalmology at the University of California, San Francisco, and a fellowship in vitreoretinal surgery at Duke University. He is actively engaged in research to compare outcomes of minimally invasive vitreoretinal surgery with those of conventional surgery. Another research project uses ultrahigh resolution ocular imaging to preoperatively identify anatomical changes in the retina that may predict surgical outcomes.

UPMC **EYE CENTER** BY THE NUMBERS

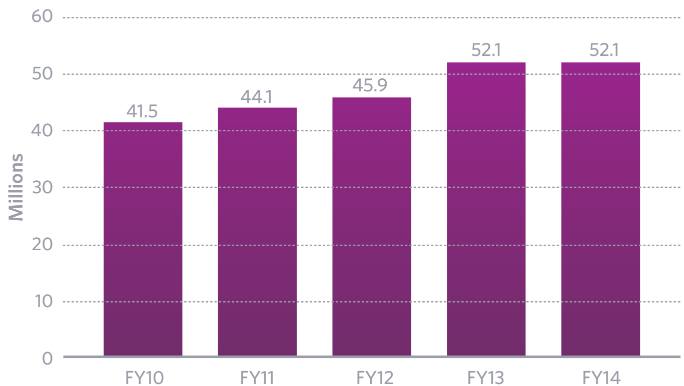
CONSOLIDATED REVENUE COMPARISON



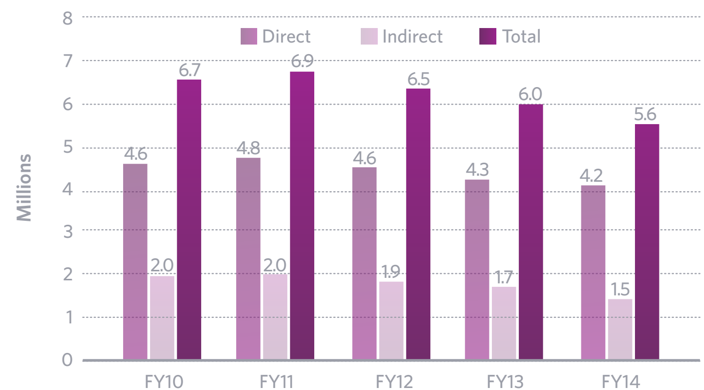
TOTAL TRANSACTIONS BILLED



GROSS PROFESSIONAL CHARGES



RESEARCH FUNDING



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203 Lothrop St.
Pittsburgh, PA 15213
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Bethel Park, PA 15102
Director: Ian Conner, MD, PhD

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of UPMC
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Pittsburgh, PA 15201
Director: Ken K. Nischal, MD, FRCOphth

UPMC Eye Center Children's
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Wexford, PA 15090
Director: Christin Sylvester, DO

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Director, Refractive and Laser Surgery Center
Director and Founder, Center for Integrative Eye Care

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Director, Medical and Surgical Retinal Diseases

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Co- Director, Imaging Module

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Assistant Professor of Ophthalmology
Visual Neuroscience Laboratory

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Assistant Professor of Ophthalmology

Shivalingappa (Shiva) Swamynathan, PhD
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Xiangyun Wei, PhD
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Gadi Wollstein, MD
Associate Professor of Ophthalmology
Director, Ophthalmic Imaging Research Laboratories

UPMC **EYE CENTER**

Residents and Fellows

UPMC EYE CENTER FELLOWS

Eric Brown, MD
Glaucoma Service

Margarita Cardenas, MD
Pediatric Service

Amr Kouchouk, MD
Cornea Service

Victor Neamtu, MD
Retina Service

Julia Polat, MD
Glaucoma Service

Renuka Rajagopal, MD
Pediatric Service

Nikisha Richards, MD
Oculoplastics Service

Tarek Shazly, MD
Neuro-Ophthalmology Service

Georgios Trichonas, MD
Retina Service

THIRD-YEAR RESIDENTS

Ashkar Abbot, MD

Salwa Abdel-Aziz, MD

Roxana Fu, MD

Ahmara Gibbons Ross, MD

Carrie Happ, MD

Nisreen Mesiwala, MD

Amanda Way, MD

SECOND-YEAR RESIDENTS

Shilpa Kodati, MD

Anton Kolomeyer, MD

Deborah Parish, MD

Colin Prensky, MD

Benjamin Stauss, MD

Joh Swogger, MD

FIRST-YEAR RESIDENTS

Jason Hooton, MD

Swarupa Kancherla, MD

Matthew Klocek, MD

Peter Knowlton, MD

Faizan Pathan, MD

Ann Shue, MD

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