USC Eye Institute
Keck Medicine of USC

2015 ANNUAL REPORT
KECK SCHOOL OF MEDICINE OF USC
DEPARTMENT OF OPHTHALMOLOGY

INSIGHT

"We live in an era of astonishing progress in understanding, preserving, and restoring eyesight. Our patients inspire us with their courage and perseverance. Our researchers and clinicians excite us with their innovations. Our residents reassure us that the future will be in good hands. Together, we continue to make progress toward our most ambitious goal — eliminating blindness."

Rohit Varma MD, MPH, director, USC Eye Institute

USC Eye Institute
Keck Medicine of USC

Sharing Insight

USC Eye Institute physicians and scientists continually develop new insights into overcoming eye diseases that may seem impossible to cure.

For more than 40 years, we have advanced vision research and knowledge — from developing an artificial retina that restores sight to the blind to treating eye diseases in babies before birth.

In Patient Care, insight guides us to understand and meet patient needs in local communities and around the world. All our work with patients centers on their needs and their success — from thousands of families in Los Angeles to earthquake victims in Kathmandu.

In Research, insight fuels discoveries that translate into unprecedented breakthroughs that change lives — from clinical trials in amblyopia, the most common vision problem in children, to new treatments of infectious keratitis, a painful inflammation of the cornea.

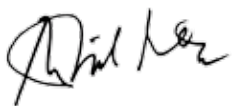
In Education, insight helps us educate generations of leaders in ophthalmology. New clinical fellowship programs, the astonishing numbers of students who compete for six coveted residency spots, a program that turns out the best-trained specialists year after year — this is our legacy.

In Preserving Sight, we share insights to fight blindness. In celebration of our 40th anniversary, distinguished researchers and clinicians gathered from around the world to tackle the world's toughest challenges in eyesight.

Eliminating blindness is far from impossible and has no magic formula. It's what happens when all the elements — science, innovation, perseverance and compassion — come together.

With the right talent, support, and an ongoing commitment to innovation, we've gained the insight to believe that nothing is impossible.

Sincerely,



Rohit Varma, MD, MPH
Grace and Emery Beardsley Professor
Chair, Department of Ophthalmology, Keck School of Medicine of USC
Director, USC Eye Institute

(from left)
***Carmen A. Puliafito**, MD, MBA, dean, Keck School of Medicine of USC*
***Rohit Varma**, MD, MPH, director, USC Eye Institute*
***C. L. Max Nikias**, PhD, president, University of Southern California*
***Thomas E. Jackiewicz**, MPH, senior vice president and chief executive officer, Keck Medicine of USC*

USC Eye Institute

ACCOLADES AND ACHIEVEMENTS

- Ranked ninth nationally by *U.S. News & World Report* for ophthalmology programs, 2014-2015
- Ranked among the nation's top 10 ophthalmology programs for more than 20 years by *U.S. News & World Report*
- Ranked ninth nationally in U.S. Ophthalmology Residency Programs by Doximity, 2015
- Ranked in the top 10 for research funding by the National Eye Institute
- Stallard Award from the International Society of Ocular Oncology presented to A. Linn Murphree, MD, clinical professor of ophthalmology, 2015
- António Champalimaud Vision Award presented to Carmen Puliafito, MD, MBA, dean of the Keck School of Medicine of USC, 2012
- Headquarters of two California Institute of Regenerative Medicine (CIRM) grants since 2012
- Headquarters of the National Science Foundation Biomimetric MicroElectronic Systems Engineering Research Center since 2003
- Headquarters of the U.S. Department of Energy Artificial Retina Project, 2002-2012
- 17 current U.S. ophthalmology chairs trained at USC Department of Ophthalmology
- Three USC ophthalmologists named Top Doctors for 2015, *Pasadena Magazine*
- 10 USC ophthalmologists named Super Doctors of Los Angeles for 2015

About the Cover:
High resolution functional MRI of the human visual pathways. (Courtesy of the Weiland Lab)

INSIGHT

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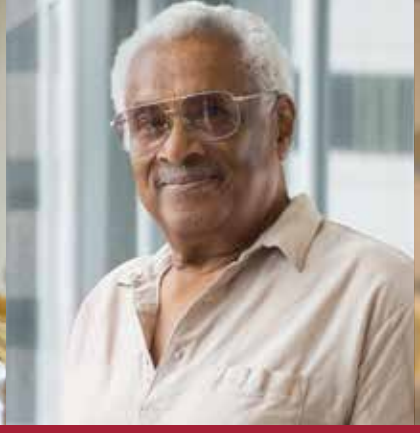



Vision is Our Mission










PRESERVE

USC Eye Institute diagnoses, treats and manages the most complex eye conditions, from *in utero* to advanced age.

PROTECT

USC Eye Institute leads major research in the epidemiology of eye disease to help prevent blindness.

RESTORE

USC Eye Institute integrates and applies emerging technologies to develop new methods to restore sight to the blind.

Fulfillment of our mission is best expressed in the remarkable triumphs of our patients. Please read their stories in the pages ahead.

INSIGHT

Patient Care

USC Eye Institute envisions the day when no one will experience loss of vision or blindness. Until then, we will provide the most advanced care possible so people from all walks of life are either cured of, or can effectively manage, a wide range of eye conditions.

Advanced Clinical Services

A full spectrum of highly specialized eye care for patients of all ages

CATARACT
Procedures and leading-edge technologies ensure better overall quality of vision. Our non-surgical laser technique is offered for precision lens removal, as well as customizable lenses.

CORNEA & EXTERNAL DISEASES
Care for problems of the ocular surface, including infections of the conjunctiva and cornea, corneal degenerations and other abnormalities of the ocular surface and anterior segment.

GLAUCOMA
The entire span of consultative, diagnostic, medical and surgical services for cases, including primary open angle, chronic angle-closure, congenital and childhood glaucoma.

LASER VISION CORRECTION
Innovative laser refractive surgery, including LASIK, PRK, LASEK, and corneal/lens-based refractive surgery for the correction of refractive errors. Conditions treated include anisometropia, astigmatism and myopia.

NEURO-OPHTHALMOLOGY & ADULT STRABISMUS
In addition to adult strabismus, comprehensive consultation and medical service for disorders of neurological origin that affect the visual pathways, including double vision, optic neuropathy, papilledema, visual field defects and hemifacial spasm and blepharospasm.

OCULAR ONCOLOGY
Diagnosis and treatment of malignant and benign tumors of the eye and orbital region. Physicians engage in medical research, imaging and diagnostic testing, such as fundus photography and fluorescein angiography.

OCULOFACIAL PLASTIC SURGERY
Ophthalmic plastic, orbital and reconstructive surgery for treating tissues surrounding the eye that affect appearance or function, including diseases of the eyelids, lacrimal system, and orbit and facial areas adjacent to the eye.

OPHTHALMIC MOLECULAR & IMMUNO-PATHOLOGY
Using the most advanced molecular diagnostic techniques for diseases of the eye, our pathologists work with ophthalmic subspecialists to determine underlying causes to create an optimal treatment plan in the most complex ophthalmic cases.

PEDIATRIC OPHTHALMOLOGY
We are the only program in the nation with expertise in virtually every pediatric ophthalmologic subspecialty with treatment methods for a wide range of complex eye diseases in infants and young children.

SPECIALTY CONTACT LENSES & PROSE
We fit a variety of contact lenses and offer innovative prosthetic replacement of the ocular surface ecosystem (PROSE) treatment for severe corneal issues and ocular surface disease.

UVEITIS & OCULAR INFLAMMATION
Cutting-edge diagnosis, treatment and surgical services are available for a broad range of inflammations and infections affecting the uveal tract, vitreous, retina and sclera.

VITREORETINAL SURGERY & RETINAL DISEASE
Diagnostic and therapeutic approaches and state-of-the-art care for all retina disorders include specialized imaging techniques, surgical techniques and clinical trials of new therapies for macular degeneration and diabetic retinopathy. Specialized Argus II surgery is available.

USC Department of Ophthalmology Patient Volumes

Year	Total Visits	Total Surgeries
2014	114,253	5,480
2015	**126,600**	**5,510**

Totals include Keck Medicine of USC, Children's Hospital Los Angeles, LAC+USC Medical Center and Veterans Administration Greater LA Healthcare System

FOR REFERRING PHYSICIANS
To consult with an ophthalmologist from the USC Eye Institute, or to schedule appointments, please call 323-442-EYES.

George Locke, MD

Corneal Transplant

OCULAR HISTORY

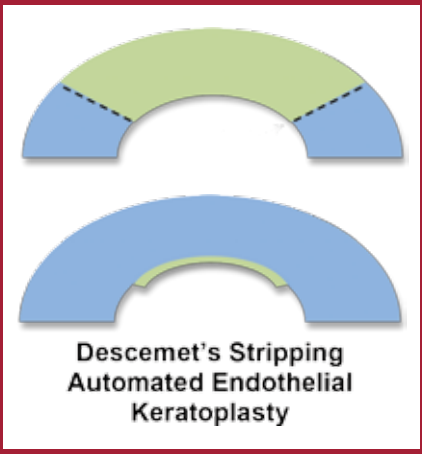
Previous treatment for glaucoma. Failed corneal transplant left significant scar tissue OD.

TREATMENT

Descemet's Stripping Automated Endothelial Keratoplasty

OUTCOME

Cornea is clear OD. Vision improved dramatically.



Blue curves represent corneal surface. Green represents area of cornea that is removed and replaced.

For George Locke, MD, a retired neurosurgeon, the USC Eye Institute was the clear choice for replacing his clouded cornea.

George struggled with vision problems for several years. He underwent various treatments and surgeries for glaucoma and cataracts, culminating in a corneal transplant that ultimately was rejected.

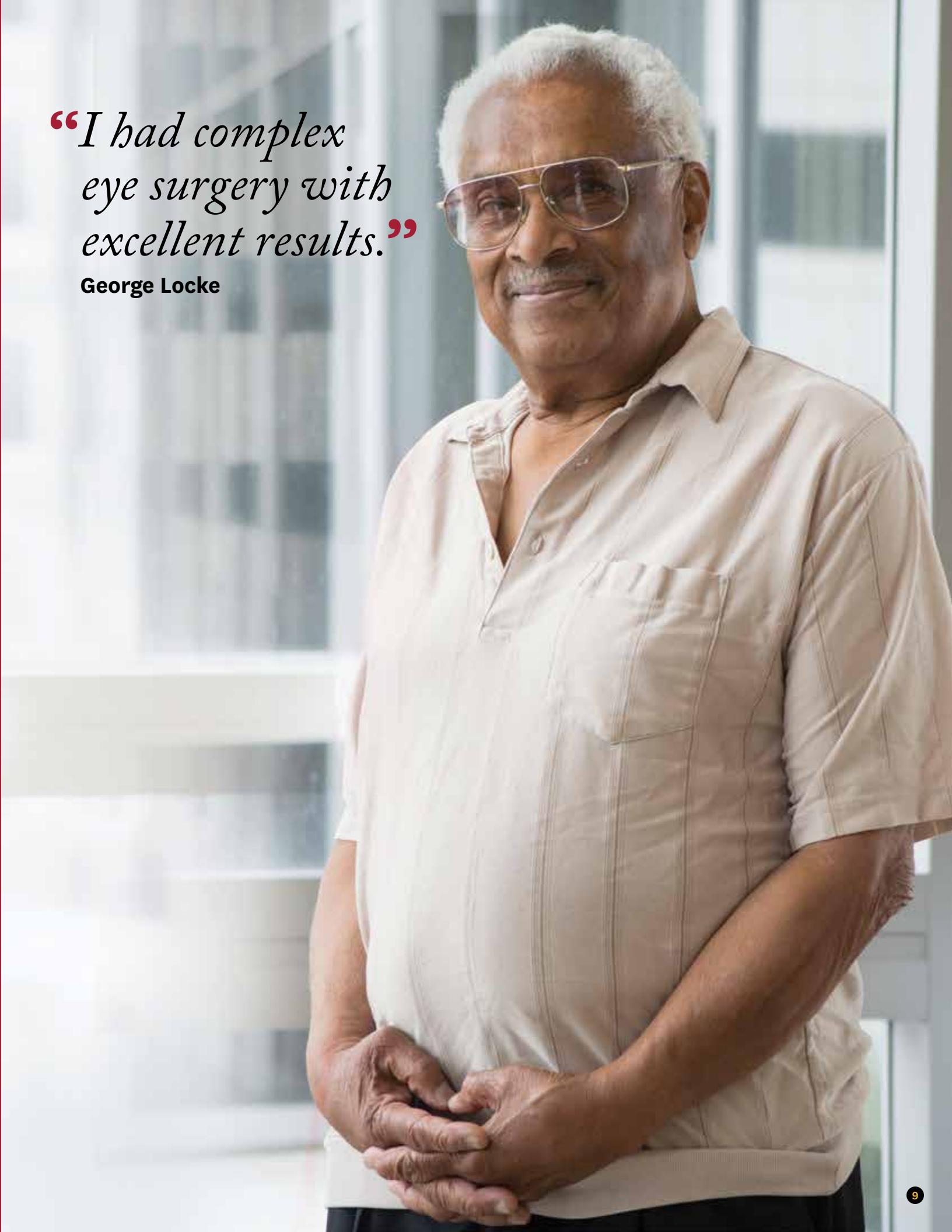
Understanding the complexities of a second surgery, George knew what to do. He changed doctors and came to the USC Eye Institute. His eyesight was worth the 60-mile trip.

USC's Bibiana Reiser, MD, MS, an expert in corneal disease and surgery, examined George and found that previous treatment had generated scar tissue that would complicate any additional surgical treatment.

To preserve George's sight, Reiser performed a Descemet's Stripping Automated Endothelial Keratoplasty (DSAEK), in which only the diseased portion of corneal tissue is removed and replaced with a graft from donor tissue. Because it does not require sutures, DSAEK promotes more rapid vision recovery, decreases the chance of surgically induced loss of visual acuity and reduces risk of surgical complications.

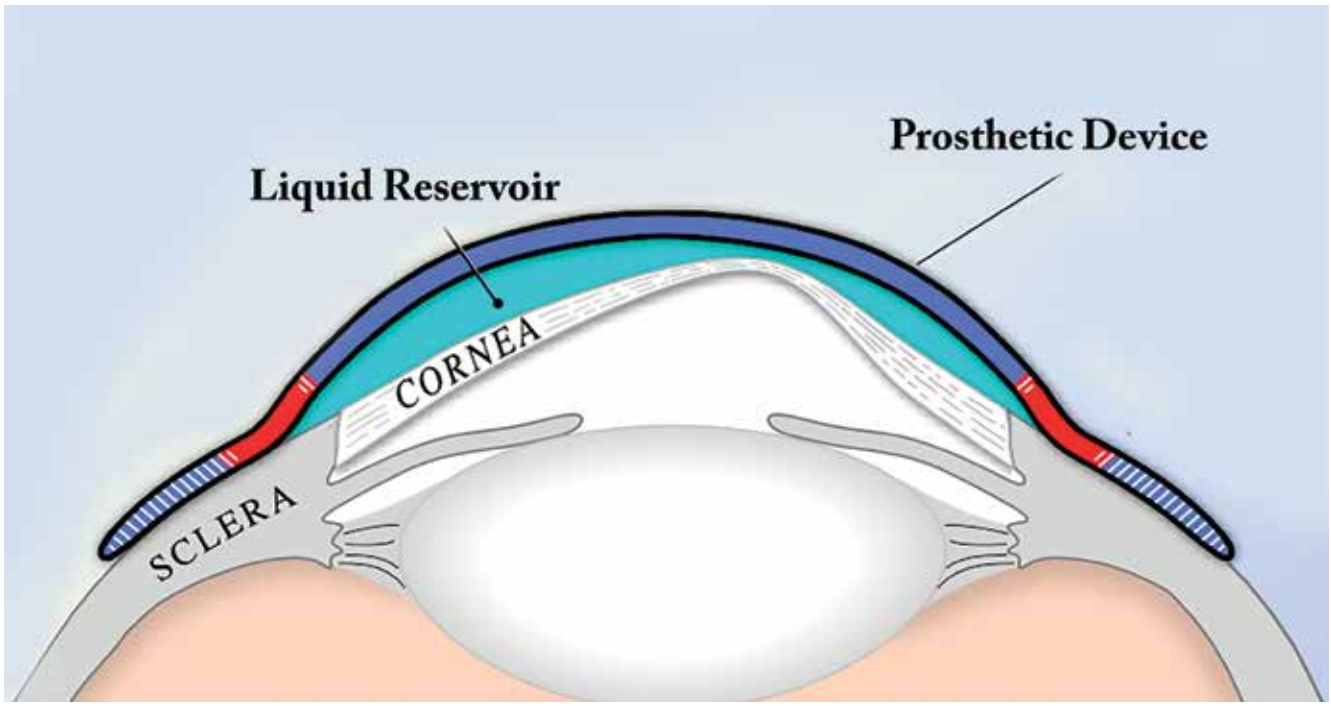
George responded well to surgery. The cornea in his right eye is now clear and his vision has dramatically improved.

*USC Eye Institute's **Bibiana J. Reiser, MD, MS,** assistant professor of clinical ophthalmology, performed George Locke's Descemet's Stripping Automated Endothelial Keratoplasty.*



"I had complex eye surgery with excellent results."

George Locke



The gas-permeable PROSE device creates a smooth optical surface above the cornea and bathes the ocular surface with a reservoir of sterile saline. Image courtesy of Boston Sight.®

With simple training, patients easily master application and use of the PROSE lens.

Co-medical directors for USC Eye Institute PROSE Service are ***Gloria Chiu OD, FAAO*** *(left), and* ***Jonathan Song, MD.***

Restoring Corneas without Surgery

Advanced corneal disease and ocular surface abnormalities often cause severe pain and debilitating vision loss that can dramatically reduce quality of life. USC Eye Institute is one of 12 sites nationwide to offer patients relief with Boston Sight® PROSE (prosthetic replacement of the ocular surface ecosystem) treatment.

PROSE therapy is a breakthrough, nonsurgical treatment that reduces symptoms, supports healing and improves eyesight through the use of a prosthetic scleral device that is tailored for each individual eye. It creates an optimal surface for visual acuity and protects damaged tissue.

The USC Eye Institute doctors trained in PROSE technology use trial devices along with patented “design to fit” electronic software to determine the potential effectiveness of PROSE for each patient. If the therapy is appropriate, a custom device is then manufactured to exacting standards, and patients are trained in proper application and use for daily wear.

The USC Eye Institute patients who formerly struggled with corneal problems have experienced life-changing outcomes through PROSE therapy.

Saving Premature Babies from Blindness

Babies who are born early run a higher risk of blindness and severe vision loss from a disease called retinopathy of prematurity (ROP). The damage is often done by the time a baby receives a standard premature infant eye exam.

ROP is difficult to detect because disease symptoms are subtle and standard diagnostic tools are unusable. Fortunately, USC Eye Institute clinician-scientists are making enormous strides in detecting and treating ROP.

In studies led by Thomas Lee, MD, director of the Vision Center at Children's Hospital Los Angeles and at the USC Eye Institute, associate professor of clinical ophthalmology, researchers are testing a new handheld device that uses optical coherence tomography (OCT) imaging to obtain highly detailed images of the retina.

The images guide specialists in determining which infants require surgery and how it might be performed. Then eye surgeons use a special scope with an ultra-thin probe to perform noninvasive surgery on tiny eyes, removing spiderweb-like tentacles of scar tissue that threaten to destroy the retina.

Each year, an estimated 16,000 premature babies are afflicted with ROP and the number is increasing as medical technology allows tinier infants to survive. ROP research at the USC Eye Institute is helping babies who start early see their way clearly through their lifetime ahead.

The advantages of sight-saving ROP treatment are not limited to infants born in the United States. Lee's team of specialists provides training and developed a telemedicine program to diagnose and treat ROP in other countries, including Armenia and the Philippines.

As new technologies and telemedicine continue to advance, more premature babies will be saved from blindness.

*Ophthalmologist **Thomas Lee, MD**, and his team with a new handheld device that uses optical coherence tomography imaging to obtain highly detailed retinal images.*

***Thomas Lee, MD,** associate professor of clinical ophthalmology and director of the Vision Center, Children's Hospital Los Angeles, provides care to patients from birth through adulthood.*

"The clinical trial, led by Dr. Lee, saved our son's sight."

Aaron Barnett, father of patient Akira Barnett

Akira Barnett

Retinopathy of Prematurity (ROP)

OCULAR HISTORY

24-week prematurity, progressive ROP. Diagnosis confirmed zone 1 stage 3 ROP OU and revealed tractional detachment involving the macula OS.

TREATMENT

Bevacizumab injection OD, endoscopic lens-sparing vitrectomy OS.

OUTCOME

20/40 OD, 20/40 OS.

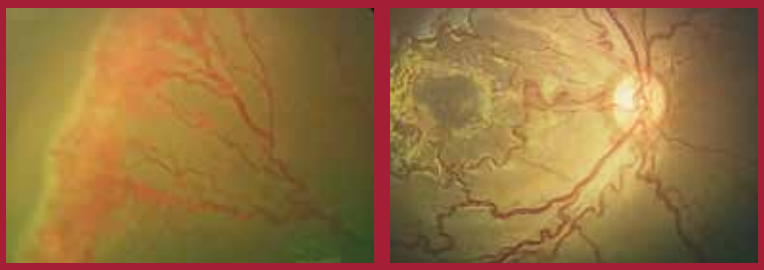
Pioneering clinical trials saved Akira Barnett's vision.

When Akira was born at just 24 weeks, his parents helped him overcome great odds to enjoy a bright future. That future dimmed when he later developed retinopathy of prematurity (ROP), a progressive disease that attacks the retina and can cause blindness.

After Akira had undergone three unsuccessful laser treatments for ROP, his parents needed to find a solution before their son lost his vision. They were referred to the Vision Center at Children's Hospital Los Angeles for a new clinical trial that used bevacizumab (Avastin) injections to arrest progression of ROP.

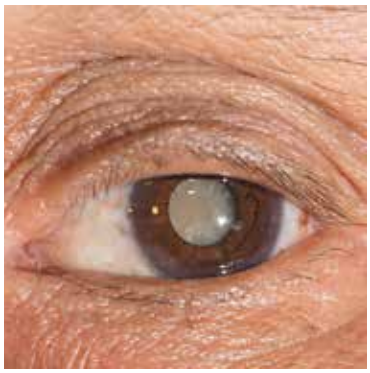
Thomas Lee, MD, a USC Eye Institute retinal specialist, examined Akira and determined that he was a good candidate for the clinical trial. He became one of the first children in the United States to have intraoperative spectral domain OCT imaging that enabled specialists to diagnose and repair a previously hidden retinal detachment in his left eye. He then became one of the first children in California to have the bevacizumab injection to treat ROP his right eye.

The treatments were successful and Akira enjoys 20/40 vision in both eyes. His ROP is under control and being managed to safeguard his sight. Now he and his family can look forward to many bright days ahead.



Fundus photo of tractional retinal detachment in left eye.

***Thomas C. Lee, MD,** associate professor of clinical ophthalmology and director of the Vision Center, Children's Hospital Los Angeles, led the clinical trial that saved Akira Barnett's vision from ROP.*



According to the National Eye Institute, after age 80, more than half of all Americans either have a cataract or have had cataract surgery.

LenSx® lasers, the newest generation of lasers, pulse in a femtosecond, or one millionth of one billionth of a second, bringing new speed and precision to eye surgery.

USC Eye Institute physicians trained in femtosecond laser technology are (top, left to right) ***Charles W. Flowers Jr., MD; J. Martin Heur, MD, PhD; Bibiana J. Reiser, MD, MS; Jonathan C. Song, MD; Alena Reznik, MD; Grace Richter, MD, MPH;*** *and* ***Julie Schallhorn, MD, MS.***

Enhancing Cataract Surgery

Patients who come to USC Eye Institute for cataract removal can also receive treatment for other conditions in a single, minimally invasive laser procedure. The result is more rapid recovery, and less dependence on eyeglasses, bifocals or eye drops.

Unlike a surgical blade used during traditional cataract surgery, the femtosecond laser enables surgeons to create a microscopic corneal incision, open the lens capsule, then fragment the cataract into small pieces — all without cutting into the eye. Extra precision allows surgeons to go beyond replacement of the clouded lens to perform additional procedures that provide even greater improvement of vision.

USC Eye Institute surgeons, fellowship-trained in femtosecond laser technology, can treat presbyopia and astigmatism so patients not only have clear vision from cataract surgery, but also no longer need eyeglasses for reading, computer work, driving and other activities. Patients with glaucoma can have an additional procedure to reduce their eye pressure, helping them avoid general anesthesia and become less dependent on eye drops.

***Narsing A. Rao, MD,** has published more than 456 peer-reviewed papers in clinical and basic science findings, and received numerous honors for his research on ocular inflammatory diseases, including those from the National Institutes of Health and Research to Prevent Blindness.*

Solving Diagnostic Mysteries

Pathologists and ophthalmic specialists at the USC Eye Institute work together to find answers and bring relief to patients struggling with severe eye inflammation, infections and tumors. Our physicians have the resources and experience to diagnose and resolve eye problems when other courses of treatment fail.

The USC Eye Institute opened a state-of-the-art laboratory in 2015 that applies genomic, proteomic, cytogenetic immuno-histologic and polymerase chain reaction technologies for analysis of ocular tissues and intraocular fluids. This enhanced diagnostic approach gives our subspecialists the ability to discover underlying causes, formulate effective treatment plans and update the prognosis of each patient's condition.

The USC Eye Institute pathology laboratory has become a prominent service both locally and regionally, providing consultation and expertise in the most complex ophthalmic cases. Further, our world-class experts strive to improve patient care by participating in clinical trials and by continuing to develop novel diagnostic tools.

***Narsing A. Rao, MD,** professor of ophthalmology and director, Uveitis Service and Ophthalmic Pathology Laboratory.*

Protecting and Training Athletes

USC is synonymous with excellence in sports. The USC Eye Institute is getting in on the action.

Jake Olson, number 17, didn't let blindness stop him from playing on the USC Trojan football team.

Establishing a Sports Vision Institute

Many athletes risk damaging their eyesight from balls or pucks that fly at dangerous speeds or contact that can cause concussions. If athletes engage in vision training, they can strengthen their abilities to focus quickly, enhance depth perception, coordinate eye movement and interpret visual information. This can improve their performance and help them avoid injury.

The USC Eye Institute developed a partnership with USC Athletics to establish a Sports Vision Institute. Its goals include: providing world-class eye care to USC athletes, developing performance-improving vision exercise programs, studying the effects of sports vision training on injury prevention and rehabilitation, and researching the effects of concussions and other central nervous system trauma on the eye and visual processing system.

***Jonathan Kim, MD,** associate professor of clinical ophthalmology, and director of the Retinoblastoma Program at Children's Hospital Los Angeles, helped Jake Olson reach his goal to play for the USC Trojans.*

Supporting an Exceptional Athlete

Jake Olson, who lost sight in both eyes from a rare form of eye cancer, became an official USC Trojan football team member in 2015. His sheer determination and hard-earned skills secured a position as a long snapper. It also required special clearance from the National Collegiate Athletic Association.

Jonathan Kim, MD, USC Eye Institute ophthalmologist, examined Olson to ensure compliance to stringent medical requirements. Kim confirmed that Olson was cancer-free, and that his eye prostheses and surrounding tissues could withstand the stress of a high-contact sport. Continuing check-ups help ensure Olson's health and safety.

Despite blindness, Olson pursues an active life that is an inspiration to people worldwide. Olson's grandmother told the *Los Angeles Times* that Olson never complains, but that he once said, "Someday, I'd really like to be able to open my eyes and seen the greens when I'm playing golf."

As research into development of a bionic eye advances, perhaps one day the USC Eye Institute will help Olson reach his ambitious goal.

INSIGHT

Research

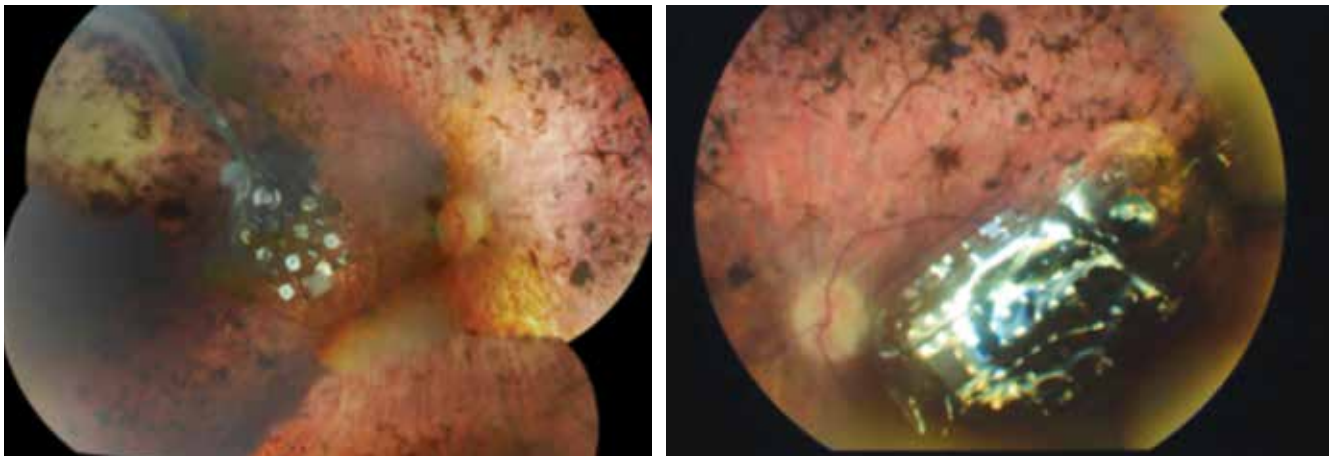
To preserve and restore vision, USC Eye Institute clinician-scientists envision what seems impossible and dedicate themselves to making it a reality. Patient needs inspire rigorous bench research that translates into treatments that change lives.

Active Fundamental Research Funding: Department of Ophthalmology, Keck School of Medicine of USC

as of December 2015

PROJECT	SOURCE	PRINCIPAL INVESTIGATOR
Snapshot Retinal Imaging Mueller Matrix Polarimeter	NIH	Amir Kashani, MD, PhD
Bioelectronic Therapy for Ocular Neovascular Diseases	GSK	Andrew Weitz, PhD
Optimizing Stimulation Strategies for Cortical Visual Prostheses	DOD	Andrew Weitz, PhD
Restoring Vision by Sheet Transplants of Retinal Progenitors and Retinal Pigment Epithelium (RPE) Derived From Human Embryonic Stem Cells (hESCs)	CIRM	Biju Thomas, PhD
Molecular Remedy of Mitochondrial Defects	NIH	Biju Thomas, PhD
An Experimental Approach to Maculopathy	NIH	David Hinton, MD
Zebrafish Model of Human Corneal Development and Disease	NIH	J. Martin Heur, MD, PhD
Research to Prevent Blindness Career Development Award	RPB	J. Martin Heur, MD, PhD
Biocompatible Hermetic Coatings: High Density Feedthroughs and Hermeticity Test Chips for Implantable Biomedical Devices	DARPA	James Weiland, PhD
Novel Ultra-Flexible Hybrid Circuits for Intraocular Retinal Prostheses	NIH	James Weiland, PhD
Experimental and Clinical Investigations of Retinal Stimulation	NIH	James Weiland, PhD
Human Connectomes for Low Vision, Blindness and Sight Restoration	NIH	James Weiland, PhD
EAGER: Neural Plasticity Driven by Electrical Stimulation of the Retina	NSF	James Weiland, PhD
INSPIRE: Bioelectronic Systems for Investigating Neural Plasticity	NSF	James Weiland, PhD
Wearable Visual Aid as Treatment for TBI Associated Visual Dysfunction	U.S. Army	James Weiland, PhD
Enhanced Biocompatible Materials for the Repair of Ocular Injuries	U.S. Army	John Whalen, PhD
Phase 1 Safety Assessment of CPCB-RPE1, hESC-derived RPE Cell Coated Parylene Membrane Implants, in Patients with Advanced Dry Age-related Macular Degeneration	CIRM	Mark Humayun, MD, PhD
A Novel Treatment for Major Blinding Diseases	Harrington Discovery Institute	Mark Humayun, MD, PhD
Development of a Biomimetic Small Molecule Therapeutic for Neovascular Retinal Diseases	NIH	Mark Humayun, MD, PhD
A Novel Treatment for Retinal Ischemia	NIH	Mark Humayun, MD, PhD
An Engineering Research Center for Biomimetic Microelectronic Systems	NSF	Mark Humayun, MD, PhD
Retinal Nanophotoswitch	NSF	Mark Humayun, MD, PhD
VRPI Thermoresponsive Reversibly Attachable Patch for Temporary Intervention in Ocular Trauma	U.S. Army	Mark Humayun, MD, PhD
Los Angeles Latino Eye Study	NIH	Rohit Varma, MD, MPH
Primary Open-Angle African American Glaucoma Genetics Study (POAAGG)	NIH	Rohit Varma, MD, MPH
Mexican American Glaucoma Genetic Study	NIH	Rohit Varma, MD, MPH
African American Eye Disease Study	NIH	Rohit Varma, MD, MPH
Research to Prevent Blindness Unrestricted Grant	RPB	Rohit Varma, MD, MPH
Stimulus-Secretion Coupling in Diseased Lacrimal Gland	NIH	Sarah Hamm-Alvarez, PhD
Tear Fluid and Serum Levels of Cathepsin S and its Endogenous Inhibitor Cystatin C as Biomarkers for Sjögren's Syndrome	Sjögren's Syndrome Foundation	Sarah Hamm-Alvarez, PhD
The Pediatric Eye Disease Consortium: a Pooled Analysis of Individual-Participant Data from Population-Based Studies	NIH	Xuejuan Jiang, PhD

CIRM (California Institute for Regenerative Medicine) · **DARPA** (Defense Advanced Research Projects Agency) · **DOD** (U.S. Department of Defense) · **GSK** (GlaxoSmithKline) **NIH** (National Institutes of Health) · **NSF** (National Science Foundation) · **RPB** (Research to Prevent Blindness)



Patient Terry Byland received the first generation Argus I in his right eye (left image) and the newest generation of Argus II in his left eye.

Enhancing the Bionic Eye

USC Eye Institute patient Terry Byland became the first person in the world to have two retinal prostheses — one in each eye — and his progress signals greater hope for people going blind from retinitis pigmentosa (RP).

Byland was part of the clinical trial for the original prosthesis, Argus I, from 2004 to 2010. His right eye was implanted with a 16-electrode device on June 23, 2004. His work with the first-generation implant was instrumental in development of the FDA-approved Argus II.

On June 22, 2015, USC Eye Institute surgeon Lisa Olmos de Koo, MD, MBA, implanted the new 60-electrode Argus II into Byland's left eye. In addition to more electrodes for greater image sensitivity, the Argus II uses upgradeable software that can take advantage of innovations in image-processing technology to further improve sight.

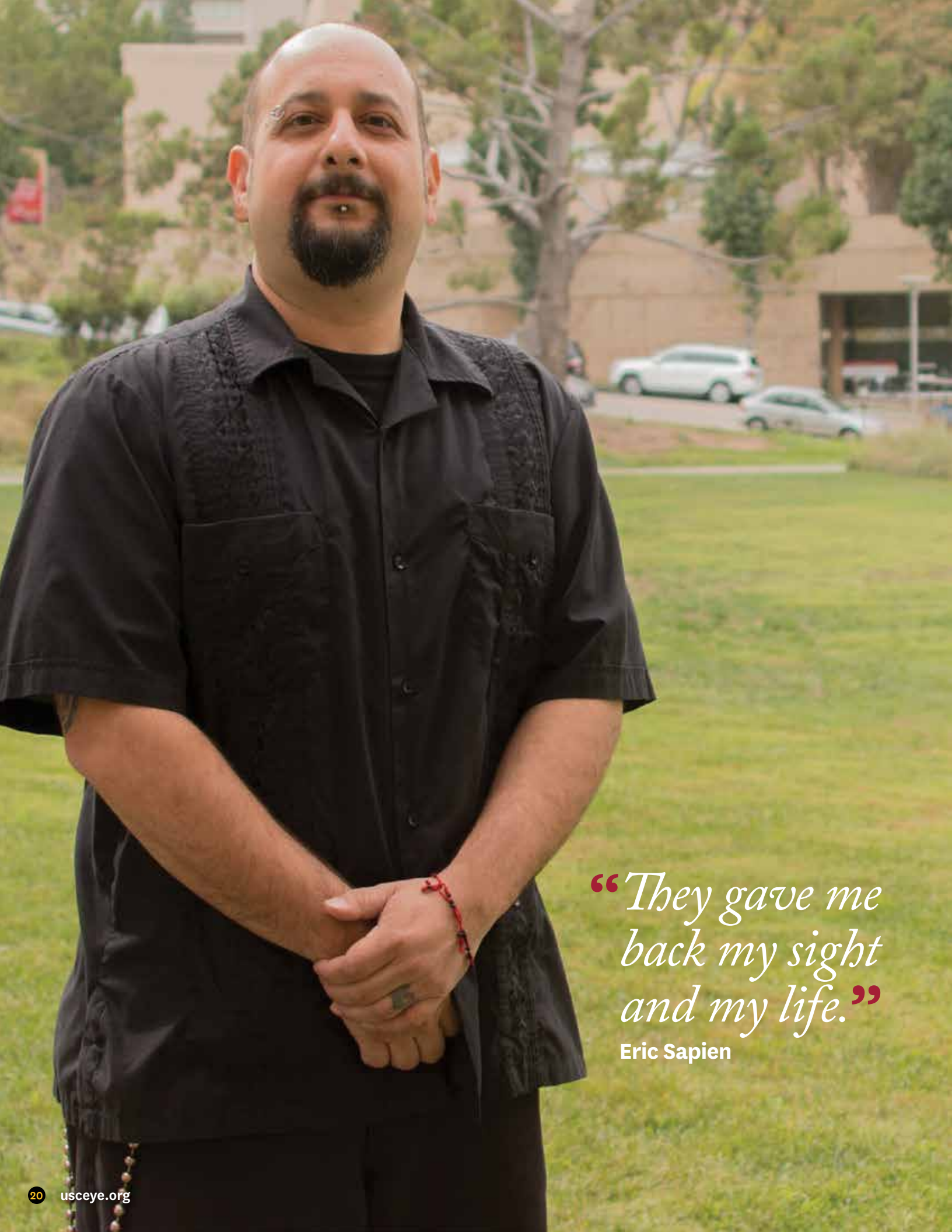
The enhanced bionic eye's performance was apparent right away. When the Argus II was activated, Byland reported that he immediately could see what it took the original device more than two years to enable him to see.

The Argus II system includes a small video camera mounted on a pair of eyeglasses, a video processing unit that transforms images from the camera into wirelessly transmitted electronic signals, and an implanted retinal prosthesis to stimulate visual neurons. The receiver sends signals to the retina that travel through the optic nerve to the brain, where they can be interpreted as a visual picture.

With Argus II, patients have some visual capability to recognize light, shapes and movement, including recognizing large letters and locating the position of objects. It offers new hope for people with RP, an inherited retinal degenerative disease that affects about 100,000 people nationwide.

Terry Byland, with his wife, Sue, on the morning of Argus II implant surgery, now has two bionic eyes. Photo courtesy of Second Sight.

***Lisa Olmos de Koo, MD, MBA** (left), assistant professor of clinical ophthalmology, and **Mark Humayun, MD, PhD** (right), professor of clinical ophthalmology and bioengineering, are leading further development of Argus II.*



"They gave me back my sight and my life."

Eric Sapien

Eric Sapien

Advanced Keratoconus

OCULAR HISTORY

Advanced keratoconus with central scars, OU. Incoming visual acuity (VA) = counting fingers at 1 foot, OD & OS.

TREATMENT

Evaluated for traditional rigid gas permeable (RGP) contact lenses, which did not work due to steep corneal shape and poor comfort. Proceeded with PROSE treatment OU.

OUTCOME

VA: 20/40 OD and 20/30 OS.

Patient is comfortable with PROSE devices and is able to see and work again. Walking cane no longer required. Corneal transplant avoided.

Eric Sapien's vision slipped away until he became legally blind by age 30.

Diagnosed with advanced keratoconus, a disease that gradually distorts the shape of the cornea and contributes to severe vision loss, Eric lost hope for saving his sight. Corneal transplants could restore his vision, but when his uncle had the procedure, the results did not last.

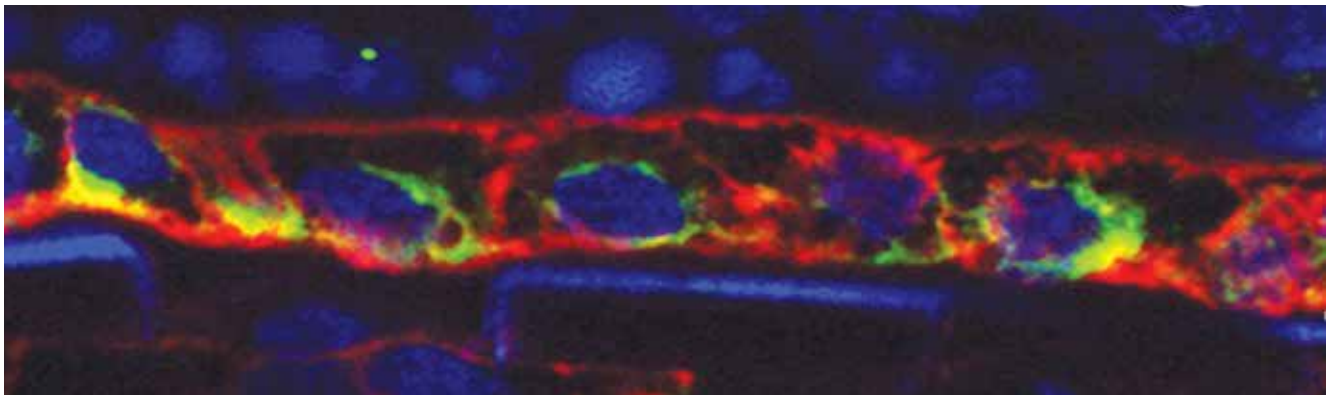
Eric's wife convinced him to seek treatment, and he was referred to USC Eye Institute corneal surgeon Charles Flowers Jr., MD. Although Eric's case of advanced keratoconus could be treated by surgery, Flowers referred him to his colleague Gloria Chiu, OD, FAAO, an expert in prosthetic replacement of the ocular surface ecosystem (PROSE) treatment. By wearing precision-crafted large diameter scleral devices over the surface of his distorted corneas, Eric could have corrected vision where traditional contact lenses and eyeglasses had failed.

When Eric saw Chiu, he navigated with a cane and his vision was limited to seeing fingers at a distance of 12 inches. After his PROSE fitting, Eric's vision improved to 20/40 in his right eye and 20/30 in his left eye. His vision was restored without requiring surgical intervention.

With new hope for the future, Eric has returned to his career as an airbrush artist and is again playing his guitar.

A representation of a normal eye, left, in comparison to an eye with keratoconus, a condition that causes corneal tissue to thin and become distorted into a cone shape that impairs vision.

***Charles Flowers Jr., MD**, (left) associate professor of clinical ophthalmology, and **Gloria Chiu, OD, FAAO**, (right) assistant professor of clinical ophthalmology, provided the optimal treatment for Eric Sapien's eye condition.*



Human embryonic stem cell-derived RPE cells labeled red with a human-specific marker implanted into the subretinal space of a rat with severe retinal degeneration. Nuclei of retinal cells are stained blue.

Implanting Stem Cells to Restore Vision

According to the World Health Organization, age-related macular degeneration (AMD) is the leading cause of blindness in industrialized nations. Because there is no effective treatment for AMD, millions of people worldwide lose their sight each year.

AMD causes loss of retinal pigment epithelial (RPE) cells that are essential for replenishing the photoreceptor cells that capture images and send them to the brain.

The ideal treatment for AMD would be to regenerate RPE cells, a goal that has led to many investigations into stem cell therapy. Most involve injecting stem cells into the eye.

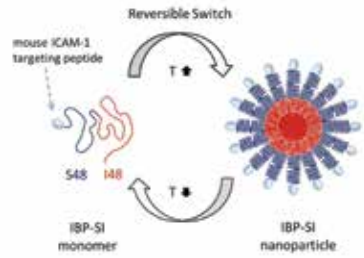
To optimize stem cell therapy, researchers at the USC Eye Institute developed a unique approach that delivers new RPE cells directly to the diseased portion of the retina and provides sustained opportunity to preserve and restore photoreceptors in that exact location.

*USC Eye Institute clinician-scientists leading the research effort are **Mark Humayun, MD, PhD** (top), **David Hinton, MD** (bottom left), **Amir Kashani, MD, PhD** (bottom right)*

Funded by a $38 million grant from the California Institute for Regenerative Medicine (CIRM), the multidisciplinary team of stem-cell researchers, material scientists and clinician-scientists achieved a series of breakthroughs that resulted in the novel stem-cell based implant therapy.

Stem-cell researchers initially developed a method to differentiate RPE cells from stem cells and grow them in thin layers. Material scientists created an implantable membrane that replaces the damaged natural scaffold in the aging eye and holds the RPE cell layers. Clinician-scientists performed pre-clinical testing on the biocompatible implant to prove that the stem cell implants successfully decreased retinal degeneration, leading to the FDA Phase 1 clinical trial that will assess the safety of the device in human subjects.

This innovative treatment may eventually restore eyesight to the many millions of people afflicted with AMD whose quality of life diminishes as they lose clear vision and eventually go blind.



Schematic shows a diblock elastin-like polypeptide (ELP) fusing with an intercellular adhesion molecule (ICAM)-1 targeting peptide (IBP-SI) to form a bio-polymeric nanoparticle that represents a new method of drug delivery.

Sarah Hamm-Alvarez, PhD, studies the fundamental mechanisms responsible for development of aqueous tear deficiency, one of the primary causes of dry eye disorder.

Delivering Drugs by Nanoparticle

According to the Sjögren's Syndrome Foundation, more than 4 million Americans suffer from Sjögren's syndrome, an autoimmune disease that impairs normal function of the lacrimal and salivary glands, causing dry eyes and dry mouth. If unchecked, it progresses to affect other organs and is associated with a high incidence of B-cell lymphoma.

Many of the drugs currently used to treat Sjögren's syndrome and other autoimmune diseases can depress beneficial immunity, as well as increase rates of infection and cause organ toxicity. To protect patients from these harmful long-term side effects, dosing must be limited.

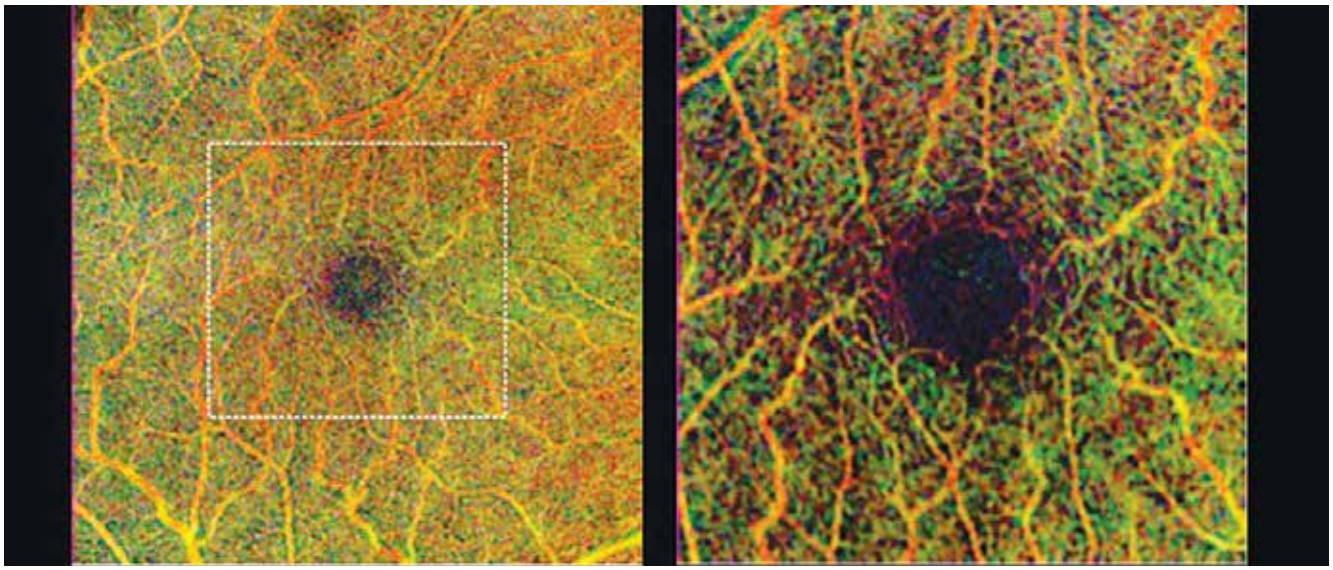
Sarah Hamm-Alvarez, PhD, and her colleagues are developing a nanoparticle that binds to an immunosuppressive agent, rapamycin, used to regulate immune responses and carries it directly to the cells of the lacrimal and salivary glands where it takes effect.

Formed from ELPs, or elastin-like polypeptides (present in a diblock configuration with two different repeating core subunits), this 50 biodegradable nanoparticle represents a new platform for drug delivery. The particle can be delivered specifically to disease sites and can be tailored to incorporate a variety of agents, such as peptides which home to sites of inflammation and drug-binding proteins, depending on the disease being treated.

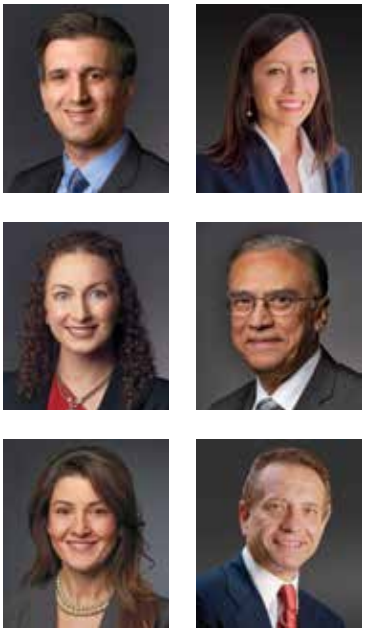
In the laboratory, the particle has the potential to deliver effective concentrations of rapamycin directly into lacrimal gland tissue to reduce autoimmune inflammation of the gland.

Nanotechnology provides the precise delivery required to optimize drug delivery at effective concentrations which reduce toxicity and minimize side effects. Work by Hamm-Alvarez and her colleagues is proving the effectiveness of nanoparticle drug delivery and opening possibilities for its use in treating autoimmune and inflammatory diseases affecting the visual system beyond Sjögren's syndrome.

***Sarah Hamm-Alvarez, PhD**, vice chair of basic research, Department of Ophthalmology, and associate dean of basic and translational research, Keck School of Medicine of USC.*



OCT angiography can resolve single capillaries in the retina as small as ~10 microns by measuring the light scattering properties of red blood cells as they move through the retinal vessels.



*The OCT angiography research team is led by **Amir Kashani, MD, PhD,** (top left) and includes specialists **Grace Richter, MD, MPH,** (top right); **Jesse Berry, MD,** (middle left); **Narsing Rao, MD,** (middle right); **Lernik Torossian, OD, FAAO,** (bottom left), and **Carmen Puliafito, MD, MBA,** (bottom right), co-inventor of the technology of optical coherence tomography (OCT), and the first ophthalmologist to use this technology to study the human macula in health and disease.*

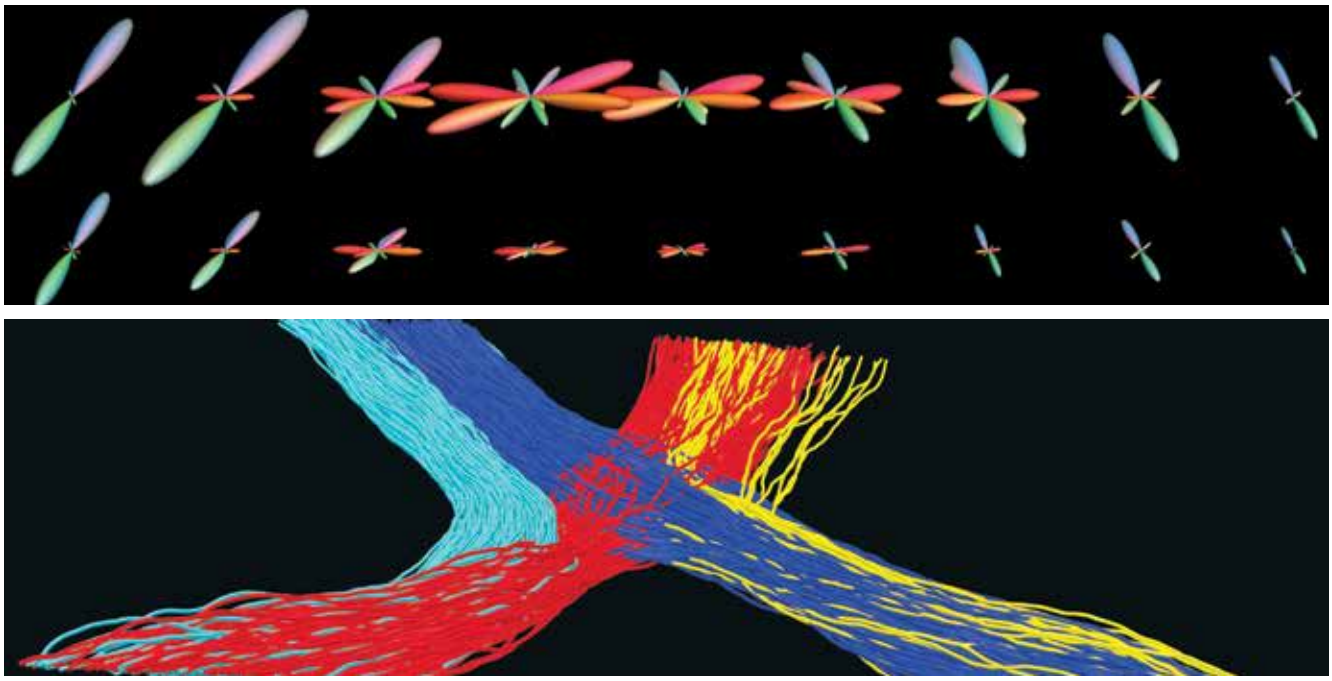
Reinventing Imaging Technology

In September 2015, the FDA approved optical coherence tomography (OCT) angiography for noninvasive evaluation of blood flow in the eye. The decision was based on preclinical pilot studies conducted at the USC Eye Institute, one of two sites worldwide with access to the research devices.

OCT angiography allows direct, real-time visualization of the retinal veins, arteries and capillaries. Retinal capillaries are known to be the site of very early changes in retinal vascular diseases such as diabetic retinopathy and retinal vein occlusions, as well as glaucoma, which is thought to involve abnormality in fine capillaries within the retinal nerve fiber layer.

USC Eye Institute researchers have shown that changes in capillary density, organization and size are among the earliest changes that can be detected in diabetic retinopathy. They also demonstrated that OCT angiography is safer, has higher resolution and is faster than fluorescein angiography, the current method of assessing retinal vasculature.

With the advent of OCT angiography, clinicians and researchers will be able to detect eye diseases much earlier than before, so they can begin treatment and preserve vision that may previously have been lost.



Top: Fiber orientation distribution (FOD) visualization of the crossing fibers where two optic nerves meet in the brain. Bottom: FOD-based reconstruction of the optic nerve bundles at the point below the brain where the optic nerves cross over each other. Red: right contralateral; Blue: left contralateral; Yellow: right ipsilateral; Cyan: left ipsilateral.

Exploring Brain and Vision Connections

Vision researchers at the USC Eye Institute and their collaborators were recently awarded a $4 million grant from the National Eye Institute to investigate how changes in the human brain resulting from blinding eye diseases may affect subsequent treatment designed to restore vision. This multidisciplinary initiative applies psychology, neurology, neuroimaging and ophthalmology to better understand what happens to the brain when someone goes blind.

Principal investigator Bosco Tjan, PhD and his colleagues theorized that differences in how patients respond to vision-restoring therapies may arise from structural and functional changes in their brains that may vary corresponding to the damage caused by a particular eye disease.

USC clinician-scientists will combine the world's most advanced retinal imaging with the brain-mapping techniques developed in the Human Connectome Project using novel and robust analytical methods. The investigations will explore the preconditions of brain structure and function as it relates to the central visual pathway (CVP), focusing on the damage to retinal tissue as a result of eye disease.

Discovering the relationships between retinal pathology and their downstream impact on the CVP may increase the effectiveness of current vision-restoring therapies and lead to new therapies based on greater understanding of the brain-vision connection.

USC Eye Institute researchers participating in the study include from top, left to right, principal investigator ***Bosco Tjan, PhD,*** *and co-investigators* ***James D. Weiland, PhD; Amir H. Kashani, MD, PhD; Andrew Moshfeghi, MD, MBA; Lisa Olmos de Koo, MD, MBA;*** *and* ***Vivek Patel, MD****. Not shown, USC collaborators* ***Meng Law, MBBS,*** *and* ***Yonggang Shi, PhD****.*

Veronica Aguirre

Juvenile Glaucoma

OCULAR HISTORY

Trabeculectomy OS 1995. Trabeculectomy OD 1997. PKP OD X 3 in 2002, 2011 and 2014. Referred for combined mechanism glaucoma (juvenile and secondary glaucoma after multiple surgeries). IOP 25 mmHg with maximum tolerated topical agents.

TREATMENT

Added oral Diamox with marginal effect. Implanted Ahmed glaucoma valve OD.

OUTCOME

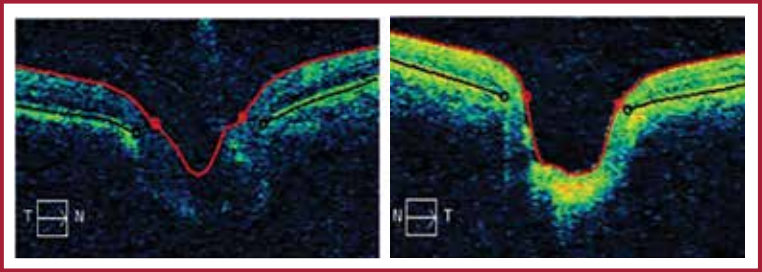
IOP reduced to 18. Corneal graft remains clear.

With juvenile glaucoma in both eyes, Veronica Aguirre battled to save her sight.

Over the past decade, Veronica has undergone eye surgery five times. Glaucoma surgery in both eyes was followed by corneal transplant surgery three times in her right eye, including two failed corneal transplants. Despite medications, eye pressure from her glaucoma continued to rise, placing her vision at further risk.

In 2015, she came to the glaucoma experts at the USC Eye Institute. Alena Reznik, MD, confirmed that Veronica had mixed mechanism glaucoma and began treatment conservatively by adding Diamox to Veronica's medication regimen. Improvement was marginal, so Reznik surgically implanted an Ahmed glaucoma valve in Veronica's right eye to drain fluid and release harmful eye pressure.

After surgery, Veronica's eye pressure decreased to acceptable levels. She confidently continues treatment at the USC Eye Institute, knowing she has the resources she needs to preserve her sight.



Extracted horizontal tomogram images show inferior and superior optic nerve thinning in both eyes from glaucoma. Left eye, shown above left, and right eye.

***Alena Reznik, MD,** assistant professor of clinical ophthalmology, is treating Veronica Aguirre's glaucoma and helping to preserve her sight.*

“Now I don’t worry about going blind.”

Veronica Aguirre

Mark S. Humayun, MD, PhD, *professor of ophthalmology, biomedical engineering and cell and neurobiology, director of the Institute for Biomedical Therapeutics and co-director of the USC Eye Institute.*

USC EYE INSTITUTE RESEARCHERS' TOP 20 MOST RECENT PUBLICATIONS

Ameri H, MD, PhD; Kashani AH, MD, PhD; Olmos de Koo LC, MD, MBA; Puliafito CA, MD, MBA

1. Matsunaga DR, Yi JJ, Olmos de Koo LC, Ameri H, Puliafito CA, Kashani AH. Optical Coherence Tomography Angiography of Diabetic Retinopathy in Human Subjects. Ophthalmic Surg Lasers Imaging Retina. 2015. Sep 1;46(8):796-805.

Berry JL, MD; Lee TC, MD; Kim JW, MD; Murphree AL, MD

2. Berry JL, Jubran R, Lee TC, Murphree AL, Lee D, Kim JW. Low-Dose Chemoreduction for Infants Diagnosed with Retinoblastoma before 6 Months of Age. Ocul Oncol Pathol. 2015 Feb;1(2):103-10.

Cobrinik D, MD, PhD

3. Dimaras H, Corson TW, Cobrinik D, White A, Zhao J, Munier FL, Abramson DH, Shields CL, Chantada GL, Njuguna F, Gallie BL. Retinoblastoma. Nature Reviews Disease Primers. 2015 Aug:15021.

Craft CM, PhD

4. Deming JD, Pak JS, Brown BM, Kim MK, Aung MH, Eom YS, Shin JA, Lee EJ, Pardue MT, Craft CM. Visual Cone Arrestin 4 Contributes to Visual Function and Cone Health. Invest Ophthalmol Vis Sci. 2015. Aug 1;56(9):5407-16.

Hamm-Alvarez SF, PhD

5. Hsueh PY, Edman MC, Sun G, Shi P, Xu S, Lin YA, Cui H, Hamm-Alvarez SF, MacKay JA. Tear-Mediated Delivery of Nanoparticles through Transcytosis of the Lacrimal Gland. J Control Release. 2015 Jun 28;208:2-13.

Heur M, MD, PhD; Jeong S, PhD

6. Bauskar A, Mack WJ, Mauris J, Argueso P, Heur M, Nagel BA, Kolar GR, Gleave ME, Nakamura T, Kinoshita S, Moradian-Oldak J, Panjwani N, Pflugfelder SC, Wilson MR, Fini ME, Jeong S. Clusterin Seals the Ocular Surface Barrier in Mouse Dry Eye. PLoS One. 2015. Sep 24;10(9):e0138958.

Jeong S, PhD

7. Wu PC, Tsai CL, Gordon GM, Jeong S, Itakura T, Patel N, Shi S, Fini ME. Chondrogenesis in Scleral Stem/Progenitor Cells and Its Association with Form-Deprived Myopia in Mice. Mol Vis. 2015 Feb;21:138-47.

Kashani AH, MD, PhD; Moshfeghi A, MD, MBA; Puliafito CA, MD, MBA

8. Kashani AH, Lee SY, Moshfeghi A, Durbin MK, Puliafito CA. Optical Coherence Tomography Angiography of Retinal Vein Occlusion. Retina. 2015 Nov;35(11):2323-31.

Kim JW, MD

9. Kim JW, Retinoblastoma Evidence for Postenucleation Adjuvant Chemotherapy. Int Ophthalmol Clin. 2015 Winter;55(1):77-96.

Patel VR, MD

10. Miller NR, Subramanian PS, Patel VR. Walsh and Hoyt's Clinical Neuro-Ophthalmology: The Essentials 3rd Edition. Textbook co-editor. August. 2015.
11. Patel VR, Zee DS. The Cerebellum in Eye Movement Control: Nystagmus, Coordinate Frames and Disconjugacy. Eye (Lond). 2015 Feb;29(2):299.

Rao N, MD; Rodger D, MD, PhD

12. Rao N, Lee SY, Cheng V, Rodger D. Clinical and Laboratory Characteristics of Ocular Syphilis: A New Face in the Era of HIV Co-Infection. J Ophthalmic Inflamm Infect. 2015 Dec;5(1):56.

Schallhorn JM, MD, MS

13. Schallhorn JM, Schallhorn SC, Ou Y. Factors That Influence Intraocular Pressure Changes after Myopic and Hyperopic Lasik and Photorefractive Keratectomy: A Large Population Study. Ophthalmology. 2015 Mar;122(3):471-9

Toga AW, PhD; Thompson PM, PhD

14. Toga AW, Thompson PM, et al, Medland SE. Common Genetic Variants Influence Human Subcortical Brain Structures. Nature. 2015 Apr 9;520(7546):224-9

Varma R, MD, MPH

15. Varma R, Haller JA, Kaiser PK. Improvement in Patient-Reported Visual Function after Ocriplasmin for Vitreomacular Adhesion: Results of the Microplasmin for Intravitreous Injection-Traction Release without Surgical Treatment (Mivi-Trust) Trials. JAMA Ophthalmol. 2015 Sep 1;133(9):997-1004
16. Varma R, et al. Low-Frequency and Rare Exome Chip Variants Associate with Fasting Glucose and Type 2 Diabetes Susceptibility. Nat Commun. 2015 Jan;6:5897
17. Varma R, Bressler NM, Doan QV, Danese M, Dolan CM, Lee A, Turpcu A. Visual Impairment and Blindness Avoided with Ranibizumab in Hispanic and Non-Hispanic Whites with Diabetic Macular Edema in the United States. Ophthalmology. 2015 May;122(5):982-9

Weiland JD, PhD

18. Yue L, Falabella P, Christopher P, Wuyyuru V, Dorn J, Schor P, Greenberg RJ, Weiland JD, Humayun MS. Ten-Year Follow-up of a Blind Patient Chronically Implanted with Epiretinal Prosthesis Argus I. Ophthalmology. 2015 Sep 16

Weitz AC, PhD; Humayun MS, MD, PhD; Weiland JD, PhD

19. Weitz AC, Nanduri D, Behrend MR, Gonzalez-Calle A, Greenberg RJ, Humayun MS, Chow RH, Weiland JD. Improving the spatial resolution of epiretinal implants by increasing stimulus pulse duration. Science Trans Med. 2015. In press.

Zhang-Nunes SX, MD

20. Briceno CA, Zhang-Nunes SX, Massry GG. Minimally Invasive Options for the Brow and Upper Lid. Facial Plast Surg Clin North Am. 2015 May;23(2):153-66.

The complete list of 2015 publications by USC Eye Institute faculty begins on page 43.

USC EYE INSTITUTE FACULTY COLLABORATORS' TOP 10 MOST RECENT PUBLICATIONS

Chen J, PhD

1. Sakurai K, Chen J, Khani SC, Kefalov VJ. Regulation of mammalian cone phototransduction by recoverin and rhodopsin kinase. J Biol Chem. 2015; 290:9239-9250.

Fini ME, PhD

2. Bauskar A, Mack WJ, Mauris J, Argüeso P, Heur M, Nagle BA, Kolar GM, Gleave ME, Nakamura T, Kinoshita S, Moradian-Oldak J, Panjwani N, Pflugfelder SC, Wilson MR, Fini ME, Jeong S. Clusterin Seals the Ocular Surface Barrier in Mouse Dry Eye. PLoS One. 2015; 10:e0138958.
3. Brilliant MH, Vaziri K, Connor TB, Schwartz SG, Carroll JJ, McCarty CA, Schrodi SJ, Hebbring SJ, Fini ME, McKay BS. Mining Retrospective Data for Virtual Prospective Drug Repurposing: L-DOPA and Age-related Macular Degeneration. Am. J. of Med. 2015; Oct. 30, 2015.

Hinton DR, MD

4. Ishikawa K, He S, Terasaki H, Nazari H, Zhang H, Spee C, Kannan R, Hinton DR. Resveratrol inhibits epithelial-mesenchymal transition of the retinal pigment epithelium and development of proliferative vitreoretinopathy. Scientific Reports. 2015; Nov. 10;5:16386.

Hofman FM, PhD

5. Hu CM, Fang RH, Wang KC, Luk BT, Thamphiwatana S, Dehaini D, Nguyen P, Angsantikul P, Wen CH, Kroll AV, Carpenter C, Ramesh M, Qu V, Patel SH, Zhu J, Shi W, Hofman FM, Chen TC, Gao W, Zhang K, Chien S, Zhang L. Nanoparticle biointerfacing by platelet membrane cloaking. Nature. 526(7571):118-21, 2015.

McGee AW, PhD

6. Céleste-Élise S, Frantz MG, McGee AW. Multiple Roles for Nogo Receptor 1 in Visual System Plasticity. The Neuroscientist. 1–14, Nov. 9, 2015.

Mircheff AK, PhD

7. Mircheff AK, Wang Y, Ding C, Warren DW, Schechter JE. Potentially pathogenic immune cells and networks in apparently healthy lacrimal glands. The Ocular Surface. 2015; 13:47-81.

Tao HW, PhD

8. Liang F, Xiong XR, Zingg B, Ji XY, Zhang LI, Tao HW. Sensory cortical control of a visually induced arrest behavior via corticotectal projections. Neuron. 2015; 86:755-767.

Tjan BS, PhD

9. Bao P, Purington CJ, Tjan BS. Using an achiasmic human visual system to quantify the relationship between the fMRI BOLD signal and neural response. eLife. Nov. 27, 2015.

Zhou Q, PhD

10. Zhu J, Qu Y, Ma T, Li R, Du Y, Huang S, Shung KK, Zhou Q, Chen Z, Imaging and characterizing shear wave and shear modulus under orthogonal acoustic radiation force excitation using OCT Doppler variance method. Opt Lett. 2015;40(9):2099-102.

USC Professor of Psychology Bosco Tjan, PhD, studies the human visual system using structural and functional MRI with a 3 Tesla Siemens MAGNETOM Prisma MRI scanner.

USC Eye Institute Collaborators

We are grateful to the researchers and organizations that work with us on a variety of major initiatives to advance vision science and clinical ophthalmology.

INDIVIDUALS

Bioengineering Initiative

COLLABORATOR	ORGANIZATION
Theodore Berger, PhD	USC (Biomedical Engineering)
Robert Chow, MD, PhD	USC (Zhilka Institute)
Scott E. Fraser, PhD	USC (Biomedical Engineering)
Malancha Gupta, PhD	USC (Materials Science)
Hossein Hashemi, PhD	USC (Electrical Engineering)
Laurent Itti, PhD	USC (Computer Science)
Gianluca Lazzi, PhD	University of Utah, UT
Mark Liker, MD	USC (Neurosurgery)
Gerard Medioni, PhD	USC (Computer Science)
Ellis Meng, PhD	USC (Biomedical Engineering)
Alapakkam Sampath, PhD	UCLA, CA
Kirk Shung, PhD	USC (Biomedical Engineering)
Dong Song, PhD	USC (Biomedical Engineering)
Armand Tanguay, PhD	USC (Electrical Engineering)

Human Connectome Project

COLLABORATOR	ORGANIZATION
James T. Becker, PhD	University of Pittsburgh, PA
Adam L. Boxer, MD, PhD	UCSF, CA
Kyle Chard, PhD	University of Chicago, IL
Kristi Clark, PhD	USC (Neurology)
Eric Deutsch, PhD	Institute for Systems Biology, WA
Ivo Dinov, PhD	University of Michigan, MI
James Duncan, PhD	Yale University, CT
Jerome Engel, MD	UCLA, CA
Ian Foster, PhD	University of Chicago, IL
Giovanni Frisoni, MD	IRCCS Fatebenefratelli, Italy
Gustavo Glusman, PhD	Institute for Systems Biology, WA
Dana Goldman, PhD	USC (Schaeffer Center for Health Policy and Economics)
Gerig Guido, PhD	University of Utah, UT
Susan Hayflick, MD	Oregon Health & Science University, OR
Scott Holland, PhD	Cincinnati Children's Research Foundation, OH
Leroy Hood, MD, PhD	Institute for Systems Biology, WA
John Van Horn, PhD	USC (Neurology)
Carl Kesselman, PhD	USC (Industrial and Systems Engineering)
Richard Leahy, PhD	USC (Electrical Engineering)
Robert Scott Mackin, PhD	UCSF, CA
Geoffrey T. Manley, MD, PhD	UCSF, CA
Tom Nichols, PhD	University of Warwick, United Kingdom
Yuko Y. Palesch, PhD	Medical University of South Carolina, SC
Nathan Price, PhD	Institute for Systems Biology, WA
Bruce Rosen, MD, PhD	Massachusetts General Hospital, MA
Howard Rosen, MD	UCSF, CA
Seth Seabury, PhD	USC (Schaeffer Center for Health Policy and Economics)
Yonggang Shi, PhD	USC (Neurology)
Olaf Sporns, PhD	Indiana University, IN
Michael Weiner, MD	Northern California Institute for Research & Education, CA
Wenle Zhao, PhD	Medical University of South Carolina, SC

Imaging Initiative

COLLABORATOR	ORGANIZATION
Antonio Capone, MD	Oakland University, MI
Thomas Karnowski, PhD	Oak Ridge National Labs, TN
Michael Trese, MD	Oakland University, MI
George Williams, MD	Oakland University, MI
Mark Wong, PhD	National Aeronautics and Space Administration, MD

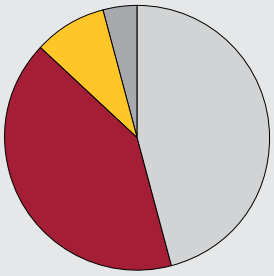
Ocular Epidemiology

COLLABORATOR	ORGANIZATION
Stanley Azen, PhD	USC (Preventive Medicine)
Xiaoyi Gao, PhD	University of Illinois at Chicago, IL
James Gauderman, PhD	USC (Preventive Medicine)
Joanne Katz, ScD	Johns Hopkins University, MD
Ronald Klein, MD, MPH	University of Wisconsin-Madison, WI
Roberta McKean-Cowdin, PhD	USC (Preventive Medicine)
Joan M. O'Brien, MD	University of Pennsylvania, PA
Jeremy Rotter, PhD	Los Angeles Biomedical Institute, CA
Kristina Tarczy-Hornoch, MD	Seattle Children's Hospital, WA
Tien Wong, MD, PhD	National University of Singapore, Singapore

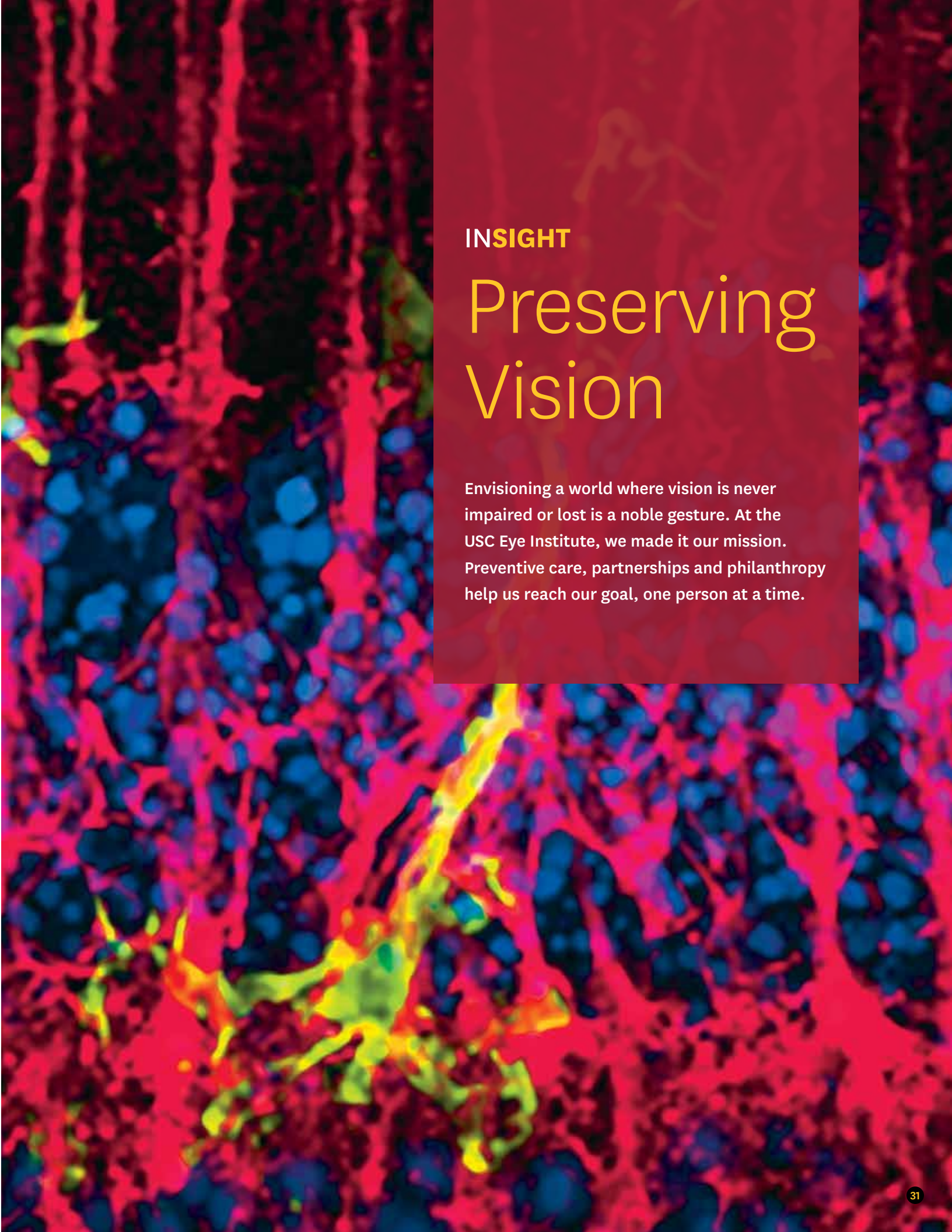
Regenerative Medicine for Blinding Eye Diseases

COLLABORATOR	ORGANIZATION
Larry A. Couture, PhD	City of Hope, CA
Dennis Clegg, PhD	UCSB, CA
Lincoln V. Johnson, PhD	UCSB, CA

USC EYE INSTITUTE COLLABORATORS



- 12% U.S. Research Institutions within California
- 45% U.S. Research Institutions outside California
- 04% International Research Institutions
- 39% University of Southern California: Other Departments



INSIGHT

Preserving Vision

Envisioning a world where vision is never impaired or lost is a noble gesture. At the USC Eye Institute, we made it our mission. Preventive care, partnerships and philanthropy help us reach our goal, one person at a time.

TAKING THE DOCTOR'S ADVICE

In the online article "20/20 What You Need to Know about Eye Health in 2015," USC Eye Institute Director Rohit Varma, MD, MPH, prescribed the following: "Above all, routine comprehensive ophthalmological examinations can detect disease early and prevent damage before it occurs or advances. If you feel there is something wrong with your vision, do not ignore it."

Empowering Prevention

Despite its tremendous resources for diagnosing and treating eye disease, the USC Eye Institute believes that the most effective treatment for eye disease is to stop it from occurring.

Research

A major series of studies on epidemiology of eye disease conducted by the USC Eye Institute identified alarming statistics, including:

- One in four preschool-aged children may have an untreated vision problem that could lead to permanent vision loss.
- Only 36 percent of Southern California Latinos age 40 years and older report having an eye care visit of any kind in the past year.

*USC Eye Institute epidemiologists **Xuejuan Jiang, PhD,** assistant professor of research, and **Rohit Varma, MD, MPH,** professor and chair, USC Department of Ophthalmology, lead community health research.*

- 70 percent of patients with diabetic retinopathy are unaware that diabetes had affected their eyes.

As the national leader in funding for studies of the incidence and presentation of eye disease, the USC Eye Institute will continue to discover the medical and social causes of eye disease and blindness — until the day when no one is at risk of losing precious sight.

Advocacy

USC Eye Institute research into how eye disease presents in various ethnic populations is used by the U.S. government and medical authorities to set policies and guidelines for vision care.

To empower prevention, USC Eye Institute clinicians and researchers also reach out to the public at events, in the media and online to advocate for good health, proper eye care and regular vision check-ups.

ALUMNUS PROFILE:

Pravin Dugel, MD

A DEDICATED PARTNER IN PRESERVING EYESIGHT

On His Motivations

"Dr. [Rohit] Varma and I were born in developing countries. We were fortunate enough to become educated, and actually trained together in ophthalmology. Now we are in a position to give back by helping others internationally. We feel a strong obligation that goes beyond our local patients and includes those who don't have access to eye care and are needlessly suffering from blindness."

On His New Role at ORBIS

"As chair of the International Medical Advisory Board at ORBIS, I'm dedicated to the organization's mission of education. Besides providing care worldwide through the Flying Eye Hospital, we train local people at all levels so they can provide the sophisticated eye care that is so desperately needed in so many places."

On International Ophthalmology Education

"The USC Eye Institute provides ORBIS with a wide variety of expertise backed by a keen interest in educating ophthalmologists worldwide. We are looking to develop virtual grand rounds, a lecture series and a library of educational resources. Telemedicine and new programs offer great opportunities."

On Meeting Patients' Needs

"Dr. Varma's epidemiology research has shown that eye diseases present differently in various ethnic populations. This knowledge helps us at Retinal Consultants of Arizona with our Hispanic and Native American patients, and globally as well. We can practice better medicine and more effectively allocate resources to provide care."

On Future Research

"We would like to work with Dr. Varma to expand knowledge of cultural influences on eye disease, particularly in the Native American population."

On His Success

"My success is not about me. It's about all the talented people who come together and provide the knowledge, work and support necessary to accomplish great things. I'm especially grateful to Dr. Varma, Dr. Carmen Puliafito, dean of the Keck School of Medicine, and Dr. Mark Humayun for their unique talents and efforts."

PRAVIN DUGEL, MD
Managing Partner, Retinal Consultants of Arizona; Founding Member, Spectra Eye Institute; Clinical Professor, USC Eye Institute

Medical School: David Geffen School of Medicine at UCLA
Ophthalmology Residency: USC Eye Institute
Retina Medical Fellowship: Bascom Palmer Eye Institute
Retina Surgical Fellowship: USC Eye Institute

Professional Organizations: American Academy of Ophthalmology, American Society of Retinal Specialists

Publications: More than 200 papers and 35 book chapters

Research: Primary investigator on more than 50 multicenter clinical trials

Humanitarian Service: Leadership in nonprofits includes ORBIS Flying Eye Hospital, A New Vision and Project SENA

Pravin Dugel, MD, right, in Kathmandu during voluntary medical and relief efforts following the 2015 Nepal earthquake.

Incha Kim and Atul Dhablania gave a generous gift to USC Eye Institute for the purchase of a powerful new diagnostic imaging tool.

Giving the Gift of Sight

Early detection of eye disease and ongoing clinical research are vital to preserving precious eyesight. A generous gift from Incha Kim and Atul Dhablania will provide USC Eye Institute clinicians and scientists with a powerful tool to enhance their efforts to prevent blindness.

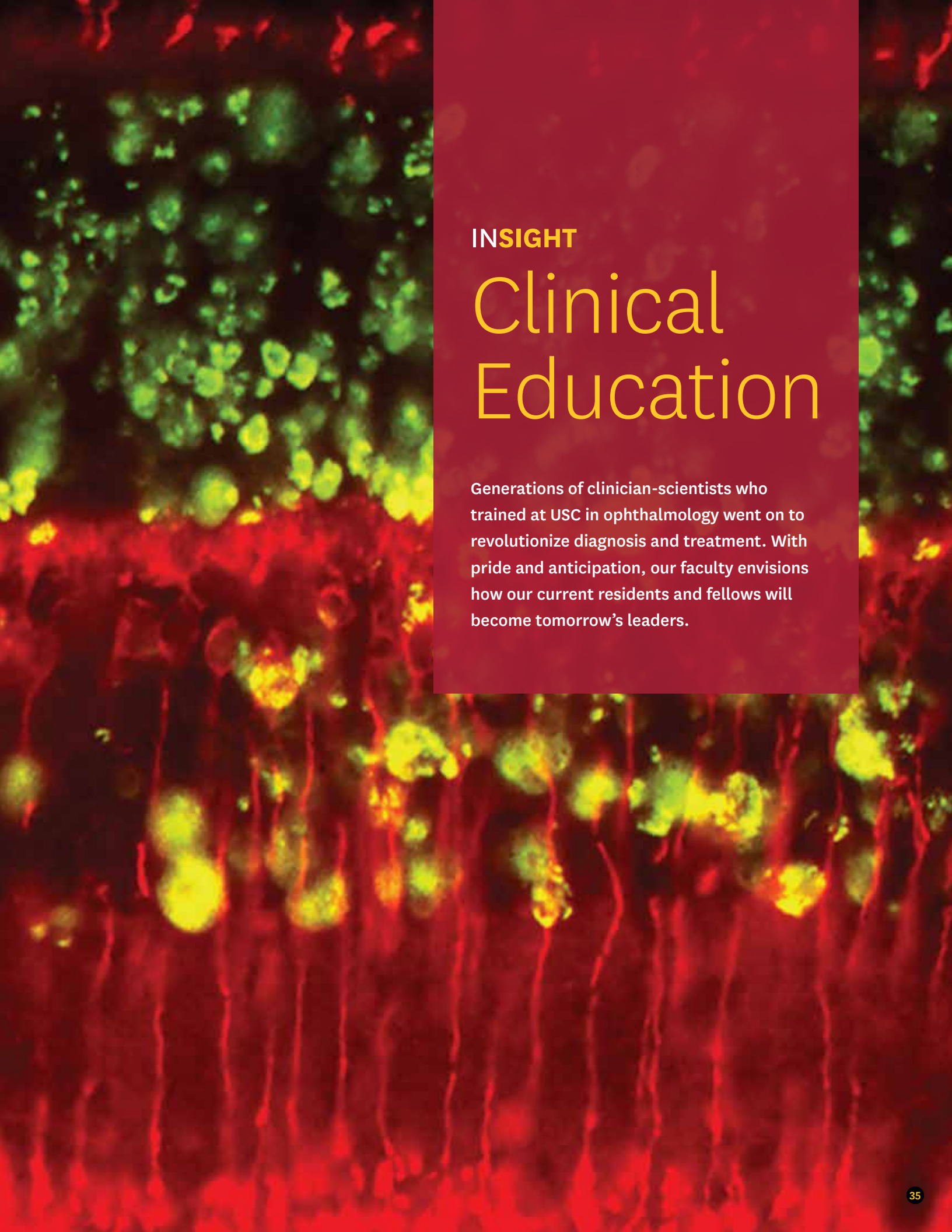
A new Optos ultra-widefield digital scanning laser will allow ophthalmologists to capture 80 percent of the retina, compared to 10 to 20 percent shown in traditional imaging. The panoramic view will make it easier to detect the earliest signs of eye disease, and provide more detailed imaging for clinical studies.

The gift was given in loving memory of Dhablania's brother-in-law, Sunil Bahri, who suffered from diabetic retinopathy and died in June 2015. The gift agreement was executed on October 8, 2015, in celebration of Bahri's birthday.

As experts use the new scanner to detect, diagnose, analyze and document ocular disease, including diabetic retinopathy, they will honor the memory of Bahri. Their treatment and research will transform the generous contribution from Kim and Dhablania into a gift with worth beyond measure — the gift of sight.

USC Eye Institute is grateful to Kim and Dhablania for their gift that enables the purchase, installation and technical support of an advanced digital scanning laser for imaging retinas.

USC Eye Institute is privileged and honored to have the support of donors who help us fulfill our mission to prevent blindness. To learn more about how you can help us provide excellent patient care, conduct groundbreaking research and educate the next generation of clinician-scientists, contact Rebecca Melville, senior director of development, at 323-442-5396 or Rebecca.Melville@usc.edu.



INSIGHT

Clinical Education

Generations of clinician-scientists who trained at USC in ophthalmology went on to revolutionize diagnosis and treatment. With pride and anticipation, our faculty envisions how our current residents and fellows will become tomorrow's leaders.

Educating Tomorrow's Leaders

The USC Department of Ophthalmology has a long and proud history of training and inspiring many of the world's leaders in ophthalmology and vision science.

Our residents and fellows train in four diverse and highly acute clinical and surgical settings:

- USC Eye Institute at Keck Medicine of USC
- Children's Hospital Los Angeles
- Los Angeles County Hospital (LAC+USC Medical Center)
- Veterans Administration Downtown Los Angeles Medical Center

Residency

Six new resident positions open each year, and the most outstanding candidates are selected from hundreds of applicants. The program includes attending review courses in preparation for National Board and Ophthalmic Knowledge Assessment Program (OKAP) examinations, the opportunity to attend and presenst at two academic conferences each year and hands-on cataract surgery courses around the country throughout the year.

Fellowship

Clinical fellowship positions open each year in the following specialties:

- Cornea and External Disease/Refractive Surgery
- Glaucoma
- Medical Retina
- Neuro-Ophthalmology
- Orbit and Oculofacial Plastics
- Vitreoretinal Surgery
- Pediatric Ophthalmology at Children's Hospital Los Angeles

Senior members of residency and fellowship programs may apply for postdoctoral scholar status at USC, which provides tuition remission for courses that advance clinical skills or knowledge, and offers access to USC academic resources.

PROGRAM LEADERSHIP

Rohit Varma, MD, MPH
Director, USC Eye Institute

Vivek Patel, MD
Residency Program Director

Jesse Berry, MD
Associate Residency Program Director

Malvin Anders, MD
Chief of Ophthalmology
LAC+USC Medical Center

USC Eye Institute Residents and Fellows 2015-16

Residents

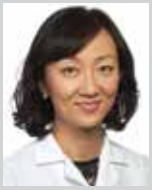
Each year the USC Eye Institute recruits six exceptional residents from hundreds of applicants.

3RD YEAR


Mica Bergman, MD, PhD


Lilangi Ediriwickrema, MD, MS
Co-Chief Resident


Esther Lee Kim, MD


Sun Young Lee, MD, PhD

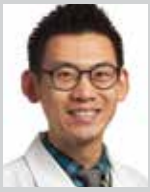

Benjamin Xu, MD, PhD
Co-Chief Resident


Dagny Zhu, MD

2ND YEAR


Jiun L. Do, MD, PhD


Stavros Moysidis, MD
Co-Chief Resident


Billy Pan, MD


Kelly Rue, MD


Grace Shih, MD


Philip Storey, MD, MPH

1ST YEAR


Walid F. Abdallah, MD, PhD


On-Tat Lee, MD


Natasha Naik, MD


Ananth Sastry, MD


Brandon Wong, MD


Arman Zaman, MD

Fellows and Clinical Instructors

The USC Eye Institute offers clinical fellowship training in six subspecialty areas, including cornea and external disease, glaucoma, neuro-ophthalmology, ophthalmic plastic surgery, retina and uveitis.

Informal research fellowships are also awarded by each service and laboratory independently. The USC Eye Institute attracts promising academic ophthalmologists from around the world who spend one or two years participating in research programs. Many return to their home countries where they assume positions of national or international leadership.


Hassan Abdul Aziz, MD
Research Fellow


Diana Chao, MD
Glaucoma


Meena George, MD
Vitreoretinal


Lee R. Katzman, MD
Cornea


Jacqueline Mandell, MD
Medical Retina


Ehsan Mozayan-Isfahni, MD
Medical Retina


Emile Sharifi, MD
Cornea


Jeffrey J. Tan, MD
Vitreoretinal

New Full-Time USC Eye Institute Faculty for 2015

Name	Title	Specialty
Hossein Ameri, MD, PhD	Assistant Professor of Clinical Ophthalmology	Vitreoretinal Surgery and Retinal Disease
Farzana Choudhury, MBBS, MPH, PhD	Assistant Professor of Research, Ophthalmology	Ocular Epidemiology
Sarah Hamm-Alvarez, PhD	Professor of Ophthalmology	Nanotechnology and Drug Delivery
Karen Morgan, MD	Clinical Professor of Ophthalmology	Comprehensive Ophthalmology and Clinical Education
Grace Richter, MD, MPH	Assistant Professor of Clinical Ophthalmology	Glaucoma and Ocular Epidemiology
Damien C. Rodger, MD, PhD	Assistant Professor of Clinical Ophthalmology and Biomedical Engineering	Vitreoretinal Surgery and Retinal Disease, Uveitis and Ocular Inflammation
Julie Schallhorn, MD, MS	Assistant Professor of Clinical Ophthalmology	Corneal and External Disease, Uveitis and Ocular Inflammation
Lernik Torossian, OD, FAAO	Assistant Professor of Clinical Ophthalmology	Sports Vision
Andrew Weitz, PhD	Assistant Professor of Research, Ophthalmology	Biomedical Engineering
Dara West, MD	Assistant Professor of Clinical Ophthalmology	Neuro-Ophthalmology
John Whalen, PhD	Assistant Professor of Research, Ophthalmology	Biomedical Engineering

Expanding Educational Opportunities

The USC Eye Institute added new programs and faculty in 2015.

Vitreoretinal Clinical Fellowship

A joint fellowship program with Retinal Consultants of Arizona provides training from retina and vitreous surgeons who have made significant technical and clinical advancements in the diagnosis and management of vitreoretinal diseases.

Oculoplastic Clinical Fellowship

The American Society of Ophthalmic Plastic and Reconstructive Surgery fellowship provides university and private practice training in functional eye plastic surgery and cosmetic facial surgery.

Julie Schallhorn, MD, MS, *and* ***Dara West, MD,*** *are among the new faculty who joined the USC Eye Institute in 2015.*

Celebrating 40 Years of Achievement

In celebration of the 40th anniversary of USC's Department of Ophthalmology, the USC Eye Institute hosted an academic symposium at the Huntington Library, Art Collections and Botanical Gardens in Pasadena. A capacity crowd of nearly 400 ophthalmologists and optometrists attended the event, which included presentations from all subspecialties of ophthalmology. During breaks, attendees viewed **"Good Looking: 16th- through 19th-century Histories of Eye Disease"**, an exhibition specially curated for the symposium.

USC Eye Institute Director Rohit Varma, MD, MPH, presented Stanley Chang, MD, the K.K. Tse and Ku Teh Ying Professor of Ophthalmology at Columbia University, with the inaugural USC Eye Institute Laureate Award in honor of his pioneering efforts and international leadership in vitreoretinal surgery.

40th Anniversary Symposium, clockwise from top, welcome remarks by USC President C. L. Max Nikias, PhD; USC Eye Institute faculty; more than 400 opthalmology professionals attended the symposium.

40TH Anniversary Symposium Distinguished Ophthalmology Faculty

Stanley Chang, MD
K. K. Tse and Ku Teh Ying Professor of Ophthalmology at Columbia University

Kathryn A. Colby, MD, PhD
Professor and Chair, Department of Ophthalmology and Visual Science, The University of Chicago Medicine

Pravin U. Dugel, MD
Clinical Professor, USC Eye Institute, Keck School of Medicine of USC; Managing Partner of Retinal Consultants of Arizona and Founding Member of the Spectra Eye Institute

Jonathan J. Dutton, MD, PhD
Professor Emeritus of Ophthalmology and Ophthalmic Oncology, University of North Carolina

Jeffrey Goldberg, MD, PhD
Professor and Chair, Department of Ophthalmology, Stanford University School of Medicine

Farhad Hafezi, MD, PhD
Professor of Ophthalmology, University of Geneva, Switzerland; Medical Director, The ELZA Institute AG, Zurich Switzerland; Adjunct Clinical Professor of Ophthalmology, USC Eye Institute

Jonathan M. Holmes, MD
Joseph E. and Rose Marie Green Professor of Visual Sciences and Professor of Ophthalmology; Former Chair, Department of Ophthalmology, College of Medicine, Mayo Clinic

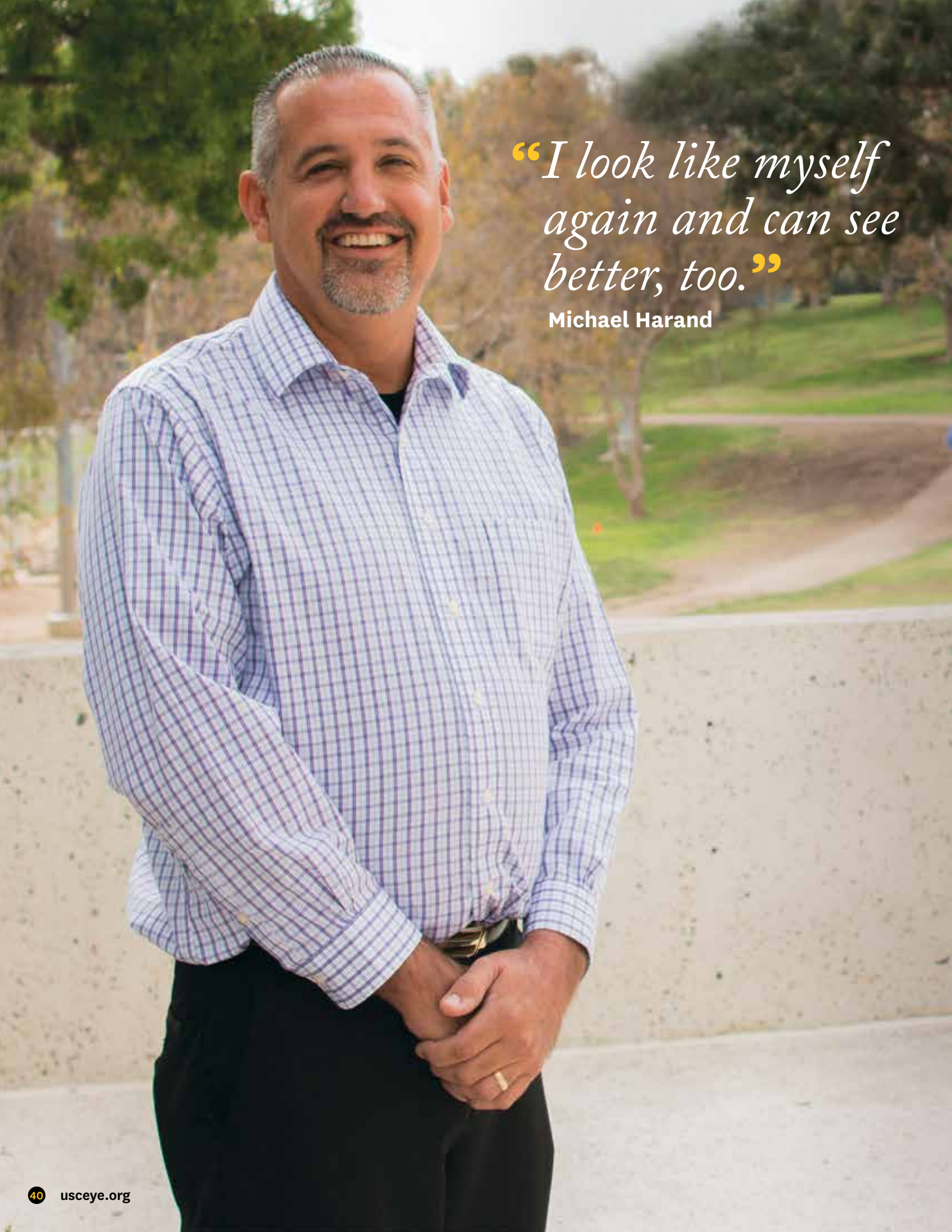
Robert K. Maloney, MD, MA
(Oxon) Director, Maloney Vision Institute; Clinical Professor of Ophthalmology, David Geffen School of Medicine at UCLA

Carmen A. Puliafito, MD, MBA
Dean, Keck School of Medicine of USC; The May S. and John Hooval Dean's Chair in Medicine; Professor of Ophthalmology and Health Management

Arthur W. Toga, PhD
Director, USC Mark and Mary Stevens Neuroimaging and Informatics Institute

Robert N. Weinreb, MD
Director, Shiley Eye Institute; Distinguished Professor and Chair of Ophthalmology; Distinguished Professor of Bioengineering; Director, Hamilton Glaucoma Center at the University of California, San Diego

M. Roy Wilson, MD, MS
President, Wayne State University


“I look like myself again and can see better, too.”
Michael Harand

Michael Harand

Severe Eye Injury

OCULAR HISTORY

Initial injury OD included fractured eye socket and traumatic choroidal rupture. Initial emergency orbital repair had failed. Orbital contents significantly prolapsed into maxillary sinus. Secondary ectropion. Double vision. Choroidal neovascularization.

TREATMENT

Oculoplastic surgery to repair fractured socket and secondary ectropion. Sinus surgery and replacement of orbital plates to treat subsequent infection. Surgery to release muscle, build eye volume and correct alignment. Intravitreal injection of Avastin (bevacizumab).

OUTCOME

Appearance OD is now normal. Double vision resolved. Stabilization of central visual acuity, possible modest improvement in VA. Scarring from original injury may limit vision.

Harand before surgical treatment at USC Eye Institute.

Harand after surgical treatment at USC Eye Institute.

Taking a golf ball in the eye damaged Michael Harand's vision and appearance. Expert teamwork restored both.

Michael feared the worst when a ball struck his right eye during a golf outing in Las Vegas, and immediately sought medical help. The impact fractured his eye socket and affected his vision. After treatment, Michael was relieved that he had not gone blind in that eye.

Within two weeks, Michael's right eye began to sink down into his face. He came to the USC Eye Institute for help. Oculofacial plastic surgeon Sandy Zhang-Nunes, MD, determined that the orbital fracture had not been fully repaired and performed successful surgery to restore the eye socket.

A few weeks later, Michael developed a cold that led to an infection that caused his right eye to sink back into his sinuses. Zhang-Nunes and USC otolaryngology specialist Bozena Wrobel, MD, performed a procedure to halt the sinus infection and exchange his orbital plate.

As he healed, Michael developed worsening scar tissue in the muscle below his eye from an infection that caused the eye to sink again. Zhang-Nunes collaborated with USC neuro-ophthalmologist and eye muscle specialist Vivek R. Patel, MD, to perform surgery to release the muscle from the scar tissue and increase the volume behind Michael's eye with fat from his abdomen to restore the eye to a normal position.

Retinal specialist Andrew Moshfeghi, MD, MBA, also examined Michael and discovered abnormal new blood vessels under the retina that were leaking. To stop bleeding that threatened Michael's vision, Moshfeghi treated the eye with an injection of Avastin (bevacizumab).

After such a hazardous golf outing, Michael is grateful for his restored vision and appearance, made possible by a dedicated foursome from USC.

(Left to right) ***Sandy Zhang-Nunes, MD****, assistant professor of clinical ophthalmology,* ***Vivek R. Patel, MD****, associate professor of clinical ophthalmology, and* ***Andrew Moshfeghi, MD, MBA****, associate professor of clinical ophthalmology, treated Michael Harand.*

USC Eye Institute Full-time Faculty


Hossein Ameri, MD, PhD
Assistant Professor


Malvin Anders, MD
Associate Professor


Jesse Berry, MD
Assistant Professor


Mark Borchert, MD
Associate Professor


Angela Buffenn, MD, MPH
Assistant Professor


Gloria Chiu, OD, FAAO
Assistant Professor


Farzana Choudhury, MBBS, MPH, PhD
Assistant Professor


David Cobrinik, MD, PhD
Associate Professor


Joseph Cocozza, PhD
Assistant Professor


Cheryl Craft, PhD
Professor


Charles Flowers Jr., MD
Associate Professor


Henry Fong, PhD
Associate Professor


Sarah Hamm-Alvarez, PhD
Professor


J. Martin Heur, MD, PhD
Associate Professor


Mark Humayun, MD, PhD
Professor


Veronica Isozaki, OD, FAAO
Assistant Professor


Shinwu Jeong, PhD
Assistant Professor


Xuejuan Jiang, PhD
Assistant Professor


Amir Kashani, MD, PhD
Assistant Professor


Jonathan Kim, MD
Associate Professor


Tali Kolin, MD
Adjunct Clinical Associate Professor


Linda Lam, MD
Associate Professor


Carlos Lastra Gonzalez, MD
Clinical Research Instructor


Thomas Lee, MD
Associate Professor


Debbie Mitra, PhD
Assistant Professor


Karen Morgan, MD
Clinical Professor


Andrew Moshfeghi, MD, MBA
Associate Professor


Arlanna Moshfeghi, MD, MPH
Assistant Professor


A. Linn Murphree, MD
Professor


Sudha Nallasamy, MD
Assistant Professor


Lisa Olmos de Koo, MD, MBA
Assistant Professor


Vivek Patel, MD
Associate Professor


Carmen Puliafito, MD, MBA
Professor


Narsing Rao, MD
Professor


Bibiana Reiser, MD
Assistant Professor


Alena Reznik, MD, MS
Assistant Professor


Grace Richter, MD, MPH
Assistant Professor


David Richardson, MD
Adjunct Assistant Professor


Damien Rodger, MD, PhD
Assistant Professor


Julie Schallhorn, MD, MS
Assistant Professor

Jonathan Song, MD
Associate Professor

Biju Thomas, PhD
Assistant Professor

Paul Thompson, PhD
Professor

Arthur Toga, PhD
Provost Professor

Lernik Torossian OD, FAAO
Assistant Professor

Rohit Varma, MD, MPH
Professor

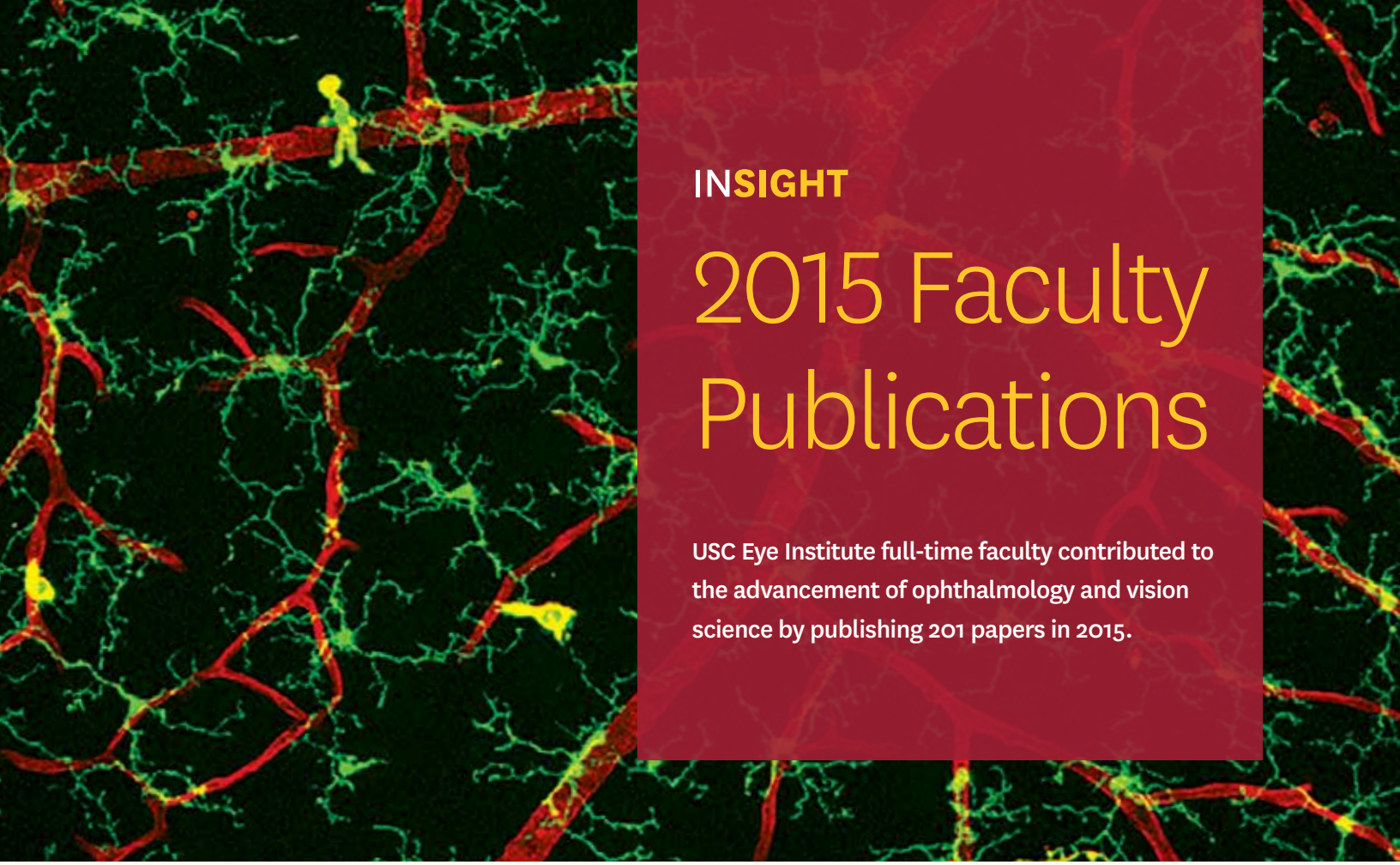
James Weiland, PhD
Professor

Andrew Weitz, PhD
Assistant Professor

Dara West, MD
Assistant Professor

John Whalen, PhD
Assistant Professor

Sandy Zhang-Nunes, MD
Assistant Professor



INSIGHT

2015 Faculty Publications

USC Eye Institute full-time faculty contributed to the advancement of ophthalmology and vision science by publishing 201 papers in 2015.

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Philip Kohn

Diabetic Retinopathy

OCULAR HISTORY

Diabetic retinopathy in both eyes. Retinal detachment 2013, two surgeries. Active untreated proliferative DR OD. Recurrent tractional retinal detachment OS with light perception only OS.

TREATMENT

Laser pan retinal photocoagulation OD. Pars plana vitrectomy surgery with membrane peeling and silicone oil tamponade OS.

OUTCOME

Retained 20/25 vision OD. Regained 20/400 vision OS with attached, stable retina.

Philip Kohn struggled with Type II diabetes for years, but had no idea it could affect his vision.

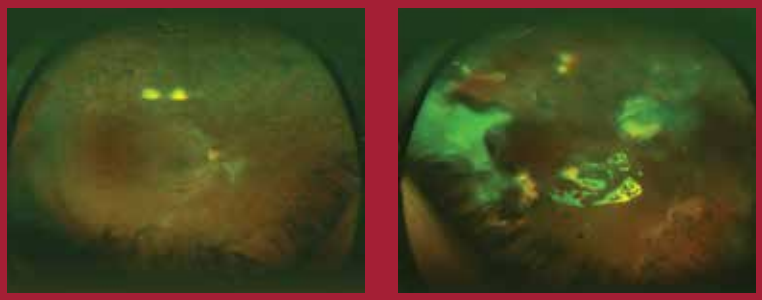
One day Philip suddenly lost vision in his left eye. He called a local ophthalmologist who saw him right away. Philip was shocked to learn he had suffered a retinal detachment caused by his diabetes, a condition called diabetic retinopathy (DR).

Although the ophthalmologist treated Philip for the retinal detachment, his vision continued to worsen. Within months, Philip was referred to the USC Eye Institute to repair his detachment and evaluate his DR.

Retinal specialist Lisa Olmos de Koo, MD, MBA, examined Philip and confirmed that he had a recurrent retinal detachment in his left eye and active DR in both eyes. Philip had 20/25 vision in his right eye, but was limited to only light perception in his left eye.

Olmos treated Philip's right eye with a series of laser sessions and then performed surgery on his left eye to repair the retinal detachment. She also taught him about the risks of DR and how to protect his vision.

After laser treatment, Philip retained 20/25 vision in his right eye despite sight-threatening bleeding due to DR. After surgery, the vision in his left eye improved to 20/400 and his retina is attached and held in position by an injection of silicone oil tamponade.



Wide angle fundus photos of OD after laser procedure to treat proliferative DR (left) and OS after (right) successful surgery to reattach retina.

Lisa Olmos de Koo, MD, MBA, *assistant professor of clinical ophthalmology, treated Philip Kohn's diabetic retinopathy and continues to monitor his condition.*


“They restored my vision and help me protect it.”
Philip Kohn

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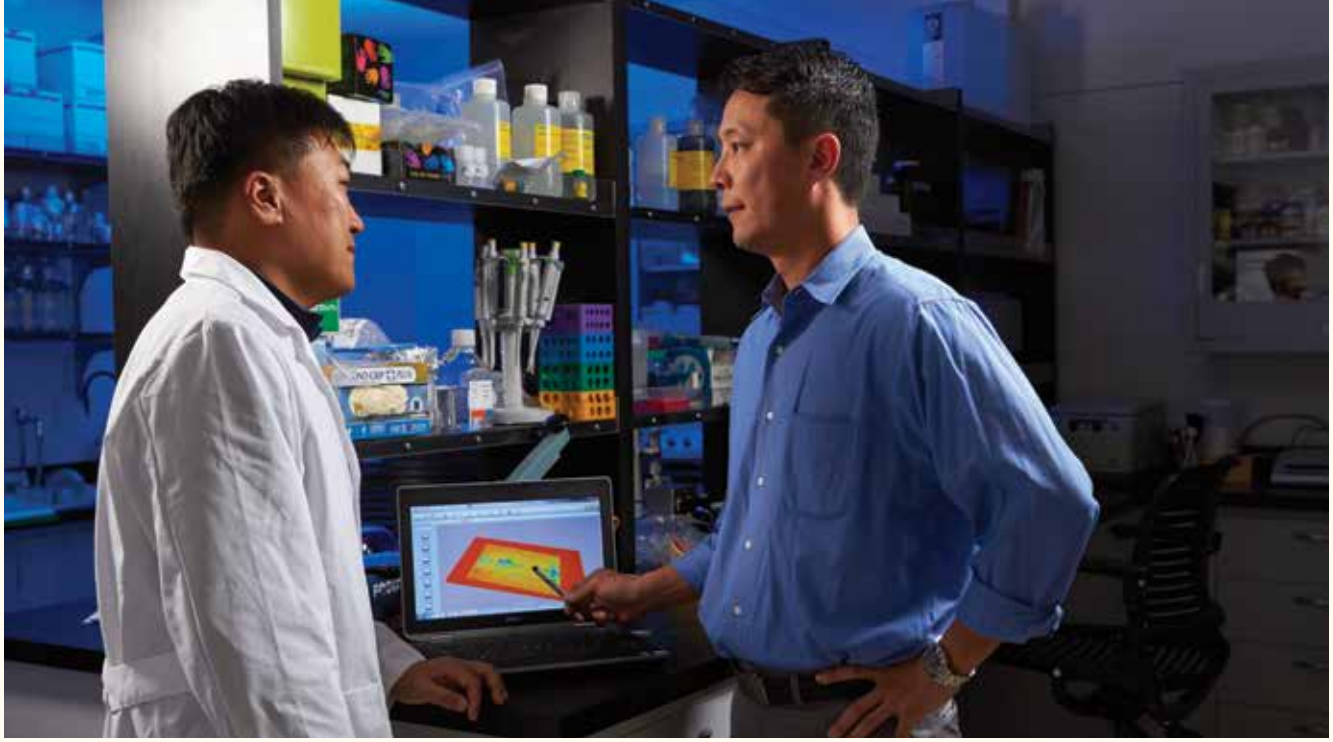

*As director of USC's Cornea & External Disease Fellowship Program, **J. Martin Heur, MD, PhD,** associate professor of clinical ophthalmology (right), oversees the significant interaction between fellows and residents in the clinics, operating rooms and research labratories.*

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PUBLISHED BY THE USC EYE INSTITUTE

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