The mission of the USC Roski Eye Institute is to provide exceptional clinical care, to train the future leaders in ophthalmology and to develop novel therapies in the fight against blindness. As our team educates tomorrow’s medical leaders, we continue to be at the forefront of innovation through the convergence of medicine and science.

In 2019, the USC Department of Ophthalmology ranked #1 among all ophthalmology departments in the country in terms of federal NIH Funding. In research funding held by individual principal investigators, Arthur Toga, PhD; Paul Thompson, PhD; Mahnaz Shahidi, PhD; and Qifa Zhou, PhD, were respectively ranked 1st, 8th, 19th and 37th nationally in terms of NIH funding within ophthalmology departments. The Department has been nationally ranked in U.S. News & World Report for 26 consecutive years.

Through an integrative and multidisciplinary approach, our extraordinary dedicated team of clinicians, scientists, staff and trainees strive to provide exceptional patient care through state-of-the-art diagnostic services and innovative treatments. The USC Roski Eye Institute continues to offer treatments not widely available in the community, including management of complex retina, glaucoma, neuro-ophthalmology, and uveitis cases, Prosthetic Replacement of the Ocular Surface (PROSE) scleral lens, corneal cross-linking, and advanced keratoplasties such as Descemet’s membrane endothelial keratoplasty (DMEK). In November, we proudly launched our Dry Eye Center of Excellence, one of the first centers to identify ocular surface disease biomarkers through the analysis of tear film.

The USC Ophthalmology Residency Program is nationally ranked in the U.S. by Doximity. With the expansion of our residency, fellowship, and hands-on teaching programs, we continue to strengthen our educational mission. Notably, we are grateful to our exceptional alumni who volunteer their time at LAC+USC Medical Center to mentor the next generation of ophthalmologists.

Eliminating blindness is far from impossible. It is what happens when all of the elements – science, innovation, perseverance, and compassion – come together that breakthroughs are made in service of our patients. We thank you for all of your continued dedication and support of our mission and look forward to the year ahead as we strive to develop new treatments and therapies to preserve, protect and restore vision.

Narsing A. Rao, MD
Grace and Emery Beardsley Professor in Ophthalmology
Professor and Chair
USC Department of Ophthalmology
Keck School of Medicine of USC
Co-Director, USC Roski Eye Institute

Mark S. Humayun, MD, PhD
Cornelius J. Pings Chair in Biomedical Sciences
Co-Director, USC Roski Eye Institute
Director, USC Ginsburg Institute for Biomedical Therapeutics
YOUR VISION IS OUR MISSION

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

PROTECT
The USC Roski Eye Institute leads major research in the diagnosis of eye disease with advanced imaging technology to help prevent blindness.

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

SPECIALIZED CARE for ADULTS & CHILDREN
The USC Roski Eye Institute treats the full spectrum of eye conditions - from the most common to the most complex.

- CATARACT
- CORNEA & EXTERNAL DISEASES
- GLAUCOMA
- LASER VISION CORRECTION
- LOW VISION REHABILITATION
- NEURO-OPHTHALMOLOGY AND ADULT STRABISMUS
- OCULAR ONCOLOGY
- OCULO-FACIAL PLASTIC SURGERY
- OPHTHALMIC MOLECULAR AND IMMUNOPATHOLOGY
- PEDIATRIC OPHTHALMOLOGY
- SPECIALTY CONTACT LENSES AND PROSE
- UVEITIS AND OCULAR INFLAMMATION
- RETINA, VITREOUS AND MACULAR DISEASES & SURGERY
USC DEPARTMENT OF
OPHTHALMOLOGY

#1

IN NIH RESEARCH FUNDING
AMONG OPHTHALMOLOGY
DEPARTMENTS
FY 2018

*Source: Blue Ridge Institute for Medical Research

Top NIH Principal Investigators

#1 Arthur Toga, PhD

#8 Paul Thompson, PhD

#19 Mahnaz Shahidi, PhD

#37 Qifa Zhou, PhD

Cover image: Portions of the connectome of central vision. Created from MRI diffusion tensor imaging data and tractographic reconstruction. Image by James Stanis, Yonggang Shi and Arthur Toga, Professor of Ophthalmology, Laboratory of Neuro Imaging, USC Stevens Neuroimaging and Informatics Institute.

eye.keckmedicine.org
A New Dry Eye Center of Excellence

Millions of people suffer from the discomfort of dry eye syndrome. From irritation, redness, and sensitivity to light, dry eyes can make everyday life difficult. In August 2019, the USC Roski Eye Institute established the USC Dry Eye Center of Excellence. Here, a team of experts trained in ocular surface disease offer a multidisciplinary, personalized approach to treating specific dry eye causes and symptoms. Some of the treatments include prescription eye medication, broad band light therapy and tear film analysis.

**Treatments offered include:**
- Broad Band Light Therapy (BBL)
- LipiView II ocular surface interferometer
- Prescription eye medications
- Punctal occlusion
- Prosthetic Replacement of the Ocular Surface Ecosystem (PROSE) or scleral lens treatment
- Tear film analysis

Above: The Dry Eye Center Team.
(2) Dr. J. Martin Heur examines a patient. (3) Dr. Gloria Chiu consults with a patient.

Above: The Dry Eye Center of Excellence Grand Opening Ribbon Cutting. L to R: Keck School of Medicine Dean Laura Mosqueda, Center Co-Director Dr. Sarah Hamm-Alvarez, Department of Ophthalmology Chair Dr. Narsing Rao, Keck Medicine of USC CEO Rod Hanners, Center Director Dr. J. Martin Heur.
In 2009, Professor Narsing Rao met ophthalmology faculty and residents of the teaching hospital in Siem Reap, Cambodia, including Drs. Piseth Kong from Cambodia and Somsiri Sukavatcharintr from Thailand. Through their interactions, it became apparent that the ophthalmic education in Indochina was focused on cataract, diabetic retinopathy, and glaucoma. However, the students were not exposed to other diseases such as Intraocular Infections, Inflammations, and Uveitis, which are common in developing Asian countries. These disorders, if not diagnosed and treated properly, resulted in blindness.

In 2010, the concept of the Indochina Ocular Inflammation and Infection Education Meeting was developed by Professor Rao with Drs. Kong and Sukavatcharintr. The major purpose: to provide current methods of diagnosis and treatment of the ocular inflammations and infections by experts from the USA, Europe, Japan, Thailand, India, Australia and the USC Roski Eye Institute. Moreover, to stimulate research collaboration on ocular inflammatory and immune processes and establish guidelines on the medical management and surgical approaches to the treatment of ocular infections and inflammatory diseases.

In 2012, the first Indochina meeting was organized in Siem Reap by Professor Rao and the Cambodian ophthalmological society. In an effort to educate as many students from the region as possible and compensate for lack of student travel funds, the meeting was planned so that the teachers traveled to the students.

Subsequent meetings have been held annually in Laos, Malaysia, Mongolia, Myanmar, Thailand, Vietnam, and again this year in Siem Reap, Cambodia.

In recent years, several ophthalmologists from Indochina developed an interest in the diagnosis and treatment of infectious uveitis entities. They became speakers and local leaders in the field and in teaching young ophthalmologists. Such change will assure long-term sustainability of the educational mission of the Indochina meetings. This will help with early diagnosis and interventions to prevent or minimize vision loss in patients suffering from uveitis and related intraocular inflammations and infections.
Fiji

Dr. Grace Richter returned for the third time to the Taveuni Eye Project in rural Fiji this year. She joined other volunteers performing manual small incision cataract surgery (MSICS). MSICS is an ideal form of cataract surgery in developing regions that is highly cost-effective, performed manually without expensive equipment (the only needed electricity being for the operating microscope), yet uses an efficient and specialized surgical technique that can remove very mature cataracts and creates a self-sealing sutureless wound. The effect of this annual project in Taveuni is numerous blind Fijians being given the gift of sight again. While Fiji has recently initiated a residency program graduating local Fijian ophthalmologists that perform MSICS, the need is still too great and they still rely on international volunteers to reduce the burden of treatable blindness.

Armenia

“We love all children equally.” As a faculty member of the USC Roski Eye Institute, Dr. Thomas C. Lee upholds this philosophy for all children who come through the doors of the Vision Center at Children’s Hospital Los Angeles. It doesn’t matter where a child lives, the Vision Center believes every child deserves to see the beauty of the world around them. But their desire isn’t limited to LA, California or even the nation. They also reach out to train doctors half way around the world to care for children in need. In partnership with the Armenian Eye Care Project, the Vision Center has trained ophthalmologists in Armenia to diagnose and treat a devastating form of childhood blindness. As Armenia’s healthcare systems have evolved, the pediatricians have saved premature babies that historically died but now survive with the advent of the latest technology and incubators. However, every new solution creates a new problem. As more premature infants survive, some develop a devastating form of childhood blindness, Retinopathy of Prematurity (ROP). With no prior experience managing ROP, the eye doctors in Armenia were at a loss on how to diagnose or treat this devastating form of blindness. The Armenian Eye Care Project reached out to the Vision Center to establish a training program that would educate both ophthalmologists and neonatologists about this disease, how to diagnose, and then treat the more severe forms. In addition to annual workshops in the capital city of Yerevan, Dr. Lee and his team have supervised them remotely using a specialized retinal camera that would take images of the babies in Yerevan and then upload them to the Internet, which they could then review remotely. As a result of this partnership, the rate of blindness from ROP has dropped significantly and now the Armenian doctors are training ophthalmologists in the neighboring countries as a way to give back and pay it forward.
Christopher Sanchez was born with Usher Syndrome Type 2, an eye condition that affects the light-sensitive cells in the retina. His eyesight worsened throughout his youth until he went blind at age 27. He spent the next 20 years in darkness.

Christopher’s dream was to see his son’s face. But for many years, the concept of a cure sounded impossible. However, when Christopher learned of the reputation of the USC Roski Eye Institute, he traveled with his wife from their home in Stockton, CA to Los Angeles, hoping to meet an ophthalmologist who could improve his vision.

He came under the care of Hossein Ameri, MD, PhD, the Director of the USC Retinal Degeneration Center. Through many tests and discussions, Dr. Ameri deemed Christopher a strong candidate for the Argus II – a cutting-edge device invented by Dr. Mark Humayun, Co-Director of the USC Roski Eye Institute that would be surgically implanted into Christopher’s eyes.

“He is suitable,” Dr. Ameri said of the decision. “He seemed to be a great candidate in every respect.”

Dr. Ameri made sure Christopher understood what eyesight would be gained. He would not have strong enough vision for driving or recognizing faces, but would be aware of his surroundings.

The surgical team, led by Dr. Ameri, placed a belt around Christopher’s eye and inserted an electrode array, the size of a microchip, into his eye and fixed it onto his retina. The video captured by the camera in Christopher’s glasses transforms the electrical signals by a small video processing unit that wirelessly communicates with the electronics placed around his eye, allowing Christopher to see.

After surgery, Christopher can see many details he thought he would never see again. He can see the lights on a Christmas tree, the movement of a car, the shine of light hitting metal. Oftentimes, he will touch an object he sees for the first time in twenty years to remember that it is a table or a chair. He can tell when the train he uses to commute approaches the platform, when its doors open, and whether he needs to step up or down from the platform to enter. Most importantly, he can see the shape of his son’s face.

“I waited for this surgery for many years,” Christopher said. “My family and I are so amazed and so happy with the level of care and perfect outcome with the results.”
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MULTIDISCIPLINARY COLLABORATIONS
Extending Beyond the Department

With a multitude of USC departments, schools and institutions, USC Roski Eye Institute clinicians and researchers continue to advance vision research through dynamic collaborative initiatives.

- **EFRI CEE: Engineered Retinal Epigenomics**
  - **Sarah Hamm-Alvarez, PhD**
  - **Mark Lew, MD**
  - **J. Andrew MacKay, PhD**
  - **David Hinton, MD**
  - **Dan Hong Zhu, MD, PhD**
  - **Stan Louie, PharmD**
  - **Brent Liu, PhD**
  - **Benjamin Xu, MD, PhD**

- **Expansion of Tear Biomarker Studies in Parkinson’s Disease Patient Cohorts**
  - **Department of Neurology**
  - **Department of Pharmacology and Pharmaceutical Sciences**
  - **Department of Preventive Medicine**
  - **Research Groups and Collaborations**:
    - **Laboratory of Neuro Imaging Resource (LONIR)**
    - **USC Stevens Neuroimaging and Informatics Institute**
    - **Laboratory of Neuroimaging**
  - **Professors and Researchers**:
    - **Mark Lew, MD**
    - **Wendy Mack, PhD**
    - **Curtis Okamoto, PhD**
    - **Arthur Toga, PhD**
    - **J. Andrew Mackay, PhD**
    - **Sarah Hamm-Alvarez, PhD**
    - **Bodour Salhia, PhD**
    - **Mark Humayun, MD, PhD**
    - **Gianluca Lazzi, PhD, MBA**
    - **Peter Kuhn, PhD**
    - **Brent Liu, PhD**
    - **Benjamin Xu, MD, PhD**

- **PRPE-SF, polarized hESC-derived RPE Soluble Factors, as a Therapy for Early Stage Dry Age-related Macular Degeneration**

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    - **Gianluca Lazzi, PhD, MBA**
    - **Peter Kuhn, PhD**
    - **Brent Liu, PhD**
    - **Benjamin Xu, MD, PhD**
Research Progress

The USC Ophthalmology Department received five new NIH R01 grants in the 2019 calendar year.

Recent NIH R01 Grant recipients include:

**Xuejuan Jiang, PhD,** received a 5-year R01 grant from the National Eye Institute to investigate biomarkers that relate exposure to maternal smoking during pregnancy to children’s vision health and evaluate epigenome as a potential driver of differential susceptibility to pediatric ocular diseases.

**Amir Kashani, MD, PhD,** received a 5-year R01 grant from the National Eye Institute to develop methods to detect and quantify preclinical changes in retinal capillaries of subjects with diabetes before the onset of diabetic retinopathy, thereby improving our ability to prevent irreversible changes associated with retinal ischemia.

**Gianluca Lazzi, PhD, MBA,** received a 3-year R01 grant from the National Institute of Biomedical Imaging and Bioengineering to develop a modular, integrated, multiscale computational modeling framework for the design of safe and effective peripheral neurostimulators. The proposed effort will consists of a) generation of computational models of peripheral nerves; b) development of the computational modules and platform; and c) experimental verification of the results.

**Biju Thomas, PhD,** received a 3-year R01 grant from the National Eye Institute to study the use of a stem cell derived co-graft transplantation technique to repair permanent damage of the retina caused by a laser.

**Qifa Zhou, PhD,** received a 4-year R01 grant from the National Eye Institute to investigate the biophysical mechanisms of ultrasound stimulation on retinal neurons, and to conduct functional testing of the ultrasound devices developed.

*Figure Legend:* Depth encoded wide field swept source optical coherence tomography (OCTA) of the human retina (PlexElite, Carl Zeiss Meditec Inc) provides high resolution and non-invasive images of the retinal capillaries. OCTA does not require injection of contrast dye into human patients and is therefore much safer and less costly than conventional fluorescein angiography. The technology can identify individual capillaries and detect the earliest changes in blinding retinal vascular diseases like diabetic retinopathy and age-related macular degeneration. Dr. Kashani’s lab is leading the implementation of this technology in several ongoing human clinical trials.
Unlike most cancers, retinoblastoma, a cancer that forms in the eyes of young children, cannot be directly biopsied due to the spread of the cancer outside the eye. To overcome this clinical problem, Dr. Jesse Berry focuses her research on a novel approach to creating a surrogate biopsy -- or liquid biopsy -- to detect RB tumor-specific DNA using the aqueous humor, the clear fluid in front of the eye.

The discovery of tumor DNA in the aqueous humor holds exciting potential for a molecular diagnosis, prognosis and possibly personalized treatment for children with retinoblastoma. This novel liquid biopsy technique has already identified a novel biomarker -- gain of chromosome 6p -- which is associated with an aggressive phenotype. These children are more likely to relapse after treatment and need the eye removed.

This was published in Molecular Cancer Research, an American Association for Cancer Research Journal. A recent publication in Ophthalmology further demonstrated that this biomarker could be isolated from the aqueous humor only, and not the blood.
Cathepsin S Activity As a Driver of Aqueous Tear Deficiency in Sjögren’s Syndrome

Research in the Hamm-Alvarez laboratory has explored the role of the cysteine protease, cathepsin S, in the development of the aqueous-deficient dry associated with the autoimmune disease, Sjögren’s syndrome. Cathepsin S is increased in tears and in the tear-producing lacrimal gland, in Sjögren’s syndrome. Activity of this protease may play a role in disease development. To test this, the Hamm-Alvarez laboratory recently utilized a murine disease model of tear deficiency in Sjögren’s syndrome. They administered a specific inhibitor of cathepsin S in two forms to mice with established tear deficiency: systemically and topically. Administration through either modality suppressed lacrimal gland inflammation and improved tear flow, confirming a role for cathepsin S in disease development.

Cathepsin S is broadly implicated in inflammation. The Hamm-Alvarez laboratory has focused recently on its role in activation of a chemokine, fractalkine, in the lacrimal gland and on the ocular surface in Sjögren’s syndrome. Membrane bound fractalkine can be shed into the extracellular space by cleavage by different proteases, including cathepsin S, an event that increases migration of immune cells containing the fractalkine receptor to the site of cleavage. The Hamm-Alvarez laboratory has found that fractalkine levels are enhanced in tears, cornea and lacrimal glands of the murine model of Sjögren’s syndrome. Fractalkine receptor-enriched immune cells are also increased in the lacrimal glands of diseased mice. Cathepsin S may thus contribute to inflammation by increasing local fractalkine in tissues of the ocular surface system, thus signaling to immune cells enriched in fractalkine receptor to migrate to the gland.

Electrical Fields Direct RGC Axon Regeneration In Vivo

It is estimated that 18 million people worldwide are legally blind from glaucoma, a disease that damages the optic nerve, the cable that connects the eye to the brain. Blindness is irreversible because the cells that make up the optic nerve, retinal neurons, have a limited capacity for self-repair and are incapable of regenerating. Although scientists have been able to use stem cells to produce new neurons to replace degenerated cells, when these healthy retinal neurons were injected into rodent eyes, they failed to make new connections with the brain. These experiments demonstrate that the native signals in the eye and optic nerve are unable to direct the growth of transplanted retinal neurons on their own.

Our research group, led by Dr. Kimberly Gokoffski, takes an innovative approach to this problem using electrical stimulation to direct retinal neuron growth. The body has naturally occurring electrical currents and they have been shown to play an important role in directing wound healing and tissue patterning during development. In tissue culture experiments, we have demonstrated that electric fields direct the growth of retinal neurons (Gokoffski et al. IOVS 2019). To test whether electric fields will direct growth of retinal neurons in living animals, we placed electrodes along the optic nerve of rodents whose nerves were previously injured via crush injury (Fig. 1A). Our preliminary data show that 10 days of electric field application directed significantly more regeneration of damaged retinal neurons over control animals (Fig. 1B). These results suggest that electrical fields may be an effective adjuvant for cell-transplantation based strategies, used to direct transplanted retinal neurons to regenerate the optic nerve and restore vision in patients blinded by glaucoma.
Understanding Retinal Oxygen Dynamics in Retinal Diseases

The research program directed by Mahnaz Shahidi, PhD, Professor of Ophthalmology and Biomedical Engineering, targets comprehensive evaluation of retinal vasculature, hemodynamics, and oxygen metabolism in health and disease. Her research team is investigating disease mechanisms in experimental models coupled with conducting clinical research studies.

One of her ongoing translational research projects is focused on understanding retinal oxygen dynamics in experimental models of retinal diseases with the use of novel imaging technologies that she has pioneered. Oxygen supplied to the retinal tissue by the vasculature is necessary for cellular metabolism to maintain normal function. Derangements in retinal oxygenation have been implicated in a number of eye diseases, including vascular occlusions, diabetic retinopathy, retinopathy of prematurity, and glaucoma. Her research aims to gain knowledge of impaired oxygen availability and utilization to better understand the pathophysiology of retinal ischemia and thereby advance therapeutic interventions for retinal diseases.

Overall, the findings from her research studies impact the field by broadening knowledge of the pathophysiology of retinal diseases that is necessary for devising interventions for restoration of vision and prevention of vision loss.

Book-Length Faculty Publications

- Clinical Ophthalmic Oncology
- Ophthalmic Plastic Surgery of the Upper Face
- Posterior Uveitis
- Multimodality Imaging
- MEMS Technology for Biomedical Imaging Applications

Jesse Berry, MD  Michael Burnstine, MD  Narsing Rao, MD  Qifa Zhou, PhD  Qifa Zhou, PhD
Giving Back to the Community

Teen Innovation Entrepreneurship Program

The USC Roski Eye Institute hosted 25 local high school students in a two-week eye health educational program as part of the Teen Innovation Entrepreneurship Summer Program. Faculty in ophthalmology introduced students to various eye conditions and the latest research and technology in eye care, as well as provided guidance for students interested in pursuing careers in ophthalmology.

Students participated in hands-on activities such as cow eye dissections and peer exams with diagnostic equipment. Students also learned about the global impact of ocular conditions and created solutions to help improve eye health in their local communities.

LA Times Festival of Books Vision Screenings

In April of 2019, the USC Roski Eye Institute offered basic vision screenings and education at the Los Angeles Times Festival of Books for the fifth year in a row. Drs. Lernik Torossian, OD; Kent Nguyen, OD; and Jessica Chang, MD; along with staff and volunteers, set up at the Keck Medicine of USC Health Pavilion. Community members of all ages approached the booth with questions and left with a better knowledge of prescription glasses and various eye conditions.

Medical Student Rotation

The USC Roski Eye Institute offers a special ophthalmology training rotation available to medical students both nationally and internationally. Every year, medical students who have specific sub-specialty interests in ophthalmology are encouraged to apply. Selected medical students rotate three at a time from March through October. The program exposes them to clinical work, OR procedures, as well as other specialties.

The medical student rotation is part of our mission to serve as mentors to the doctors of tomorrow. Several students who participated in rotations have gone on to become residents in our program. Rotations are also available for optometry students. Currently, optometry students at Marshall B. Ketchum University in Fullerton, CA, rotate once a week for 10 weeks in our clinic.
Education and Training

RESIDENCY PROGRAM
Each year, hundreds of applicants compete for seven positions. In addition to clinical rotations at the USC Roski Eye Institute, training is also provided at Los Angeles County+USC Medical Center (LAC+USC), Children’s Hospital Los Angeles (CHLA), and the VA Downtown Los Angeles Medical Center. With a total of 21 residents, we have positioned ourselves as one of the largest programs in the Western U.S.

PROGRAM LEADERSHIP

- Our residency program maintains its large volume of clinical material, consistently excellent hands-on training and high research output within the resident body. Our residents have been in the top 5% of programs nationwide for the past seven consecutive years in total ophthalmologic surgeries and procedures performed.
- Our residency continues to maintain one of the highest Accreditation Council of Graduate Medical Council (ACGME) resident survey results across all post-graduate programs at LAC+USC Medical Center.
- Our AUPO-compliant fellowship programs continue to thrive, with fellows from across the nation choosing our institute to further their subspecialty training.
- Our faculty are very involved in medical student education through lectures, workshops, hands-on teaching in the clinic and OR, and mentoring research projects. There is also a thriving ophthalmology student interest group that engages in several community outreach activities each year with faculty guidance, led by Dr. Jessica Chang, Director of Medical Student Education.
2019-2020 Graduating Residents

Jennifer Danesh, MD  
UCLA  
Los Angeles, CA

Yong (Andy) Han, MD  
Yale  
New Haven, CT

Tiffany Ho, MD,  
Co-Chief  
USC  
Los Angeles, CA

Hadi Kaakour, MD, MS  
University of Miami  
Miami, FL

Ravi Shah, MD,  
Co-Chief  
Baylor College of Medicine  
Houston, TX

Jing (Meghan) Shan, MD, PhD  
Harvard  
Cambridge, MA

Youning Zhang, MD  
USC  
Los Angeles, CA

2019-2020 Graduating Fellows

Walid Abdallah, MD, PhD  
Surgical Retina  
Zagazig Faculty of Medicine  
Zagazig, Egypt

Justin Dredge, MD  
Glaucoma  
SUNY - Stony Brook  
Stony Brook, NY

Eric Hamill, MD  
Oculoplastics  
Baylor College of Medicine  
Houston, TX

Sagar Patel, MD  
Surgical Retina  
UT Southwestern  
Dallas, TX

Kristina Voss, MD  
Cornea  
University of Arizona  
Tucson, AZ

Siwei Zhou, MD  
Neuro-Ophthalmology  
University of Pittsburgh  
Pittsburgh, PA
Grand Rounds Case Study

“SOMETHING SEEMS DIFFERENT”

HISTORY
- Chief complaint: sudden blurry vision
- 51 yo M with recently diagnosed acute promyelocytic leukemia complains of sudden blurry vision.
- Review of systems:
  - No past ocular history, surgical history of open reduction internal fixation of the right leg in 1989, no pertinent family history
- Medications: ATRA (All Trans Retinoic Acid) – started 2 weeks prior to presentation, Idarubicin, Arsenic trioxide, Vancomycin for neutropenic fever

EXAM FINDINGS
- BCVA: count fingers at 3 feet OU
- Pupils round and reactive, no rAPD
- IOP 10 OD, 11 OS
- Brightness sense 50% OD, no red desaturation, color plates 1/8 OU
- Extraocular movements full
- Anterior segment exam unremarkable without signs of inflammation

DIFFERENTIAL DIAGNOSIS
- Neoplastic (e.g. Leukemic infiltration)
- Medication induced
- Inflammatory (e.g. Voyt-Kayanagi-Harada disease)
- Infectious
- Vascular (e.g. Malignant hypertension)
- Surgical (e.g. Intraocular surgery)
- Idiopathic (e.g. Uveal effusion syndrome)

DIAGNOSIS
- The first reported case of bilateral choroidal effusions due to differentiation syndrome - a complication of all trans retinoic acid and arsenic trioxide
- Leukemic retinopathy

PATHOPHYSIOLOGY
- Differentiation syndrome occurs in the setting of induction therapy for acute promyelocytic leukemia with all trans retinoic acid (ATRA) and arsenic trioxide (ATO).
- Acute promyelocytic leukemia manifests with leukemic blast cell morphology, coagulopathy, and
chromosome translocation t(15:17).

- Mainstay of induction therapy is ATRA and ATO
- Differentiation syndrome occurs in ~25% of patients receiving ATRA/ATO
- Our patient demonstrates, to our knowledge, the first case of bilateral choroidal effusions as an ophthalmic manifestation of differentiation syndrome

TREATMENT

- Patient was started on dexamethasone 10 mg IV BID 2 hours later
- ATRA was held, arsenic trioxide was continued

PROGNOSIS AND FUTURE DIRECTIONS

- Vision improved from count fingers to 20/70 and 20/50 in 4 days after treatment for differentiation syndrome
- 2 weeks later, choroidal effusions and subretinal resolved, with improving leukemic retinopathy
- 8 months later, patient is doing well on ATRA and ATO therapy with vision returning to 20/20 OU

REFERENCES

Residents at LAC+USC Medical Center engage in a rich learning environment seeing everything from trauma to complex neurological conditions involving the eye to common eye ailments, including diabetic retinopathy, cataracts, and glaucoma. They simultaneously manage the complex inpatient and emergency consult service for ophthalmology as well as run the busiest outpatient clinic in the hospital. Between 250-350 patients are seen in the ophthalmology clinic daily with 8-10 surgeries also being performed daily. Our residents come out of their three year residency with supreme experience and extraordinary skills prepared for any job or fellowship they desire.
LAC+USC Ophthalmology
Emeritus & Alumni Pay it Forward

ALUMNI BY THE NUMBERS

50 VOLUNTARY FACULTY
16 DEPARTMENT CHAIRS
272 RESIDENTS TRAINED
300 FELLOWS TRAINED

"It continues to be an honor and a privilege to participate in the training of residents and fellows."
- Ronald Green, MD
Professor Emeritus

"Proud to support USC ophthalmology as a former resident, chief resident and faculty member."
- Lawrence Chong, MD

"USC residents, you are the best and you are the future. It is a pleasure helping you in the OR for the past 30 years."
- Garlan Lo, MD

"It's gratifying to share my training and experience with the talented Roski residents in the operating room today."
- Paul Urrea, MD

"Training at LAC+USC gives an incredible scope of learning that prepares our residents to be mentors and trusted doctors to our patients and colleagues."
- W. Lee Wan, MD
On Friday, June 15th, USC Roski Eye Institute faculty, staff, residents and fellows came together to celebrate the department’s latest innovations across all subspecialties of ophthalmology, hosted at the Health Sciences Campus.

Highlighted topics included: advance retinal implants, the role of OCTA in clinical glaucoma, iridocorneal angle assessment methods, updates on electrical fields for neuro-regeneration, prism use in general and speciality clinics, gene therapy for leber congenital amaurosis, the role of vision in the assessment of concussion, and uveitis epidemiology.

This year’s speakers included several USC and CHLA ophthalmology faculty, including David Boyer, MD; Jessica Chang, MD; Melinda Chang, MD; Pravin Dugel, MD; Charles Flowers, Jr., MD, FACS; Kimberly Gokoffski, MD, PhD; J. Martin Heur, MD, PhD; Mark Humayun, MD, PhD; Michael Javaheri, MD; Thomas Lee, MD; Alfred Marrone, MD; Aaron Nagiel, MD, PhD; Vivek Patel, MD FRCSC; Grace Richter, MD, MPH; James Salz, MD; Lernik Torossian, OD, FAAO; Brian C. Toy, MD; Benjamin Xu, MD, PhD, and many others.

USC Roski Distinguished Lecturer Awardee
Dr. Robert N. Weinreb
for his lecture entitled "Smart Ophthalmology"
In December 2019, Brian F. Hofland, PhD, President of Research to Prevent Blindness (RPB), visited the USC Roski Eye Institute. Dr. Hofland toured several labs to view ongoing research and met with multiple faculty on the USC Health Sciences Campus. During the visit, he evaluated our research facilities, current NIH funding, mentorship of junior faculty, and the medical school Dean's support of department research.

RPB awarded Narsing Rao, MD, Professor and Chair, USC Department of Ophthalmology with a Research to Prevent Blindness unrestricted grant in 2018. The grant was renewed this past July.

“It enjoyed the visit and learned a lot,” said Dr. Hofland. “I was gratified to see the Department building towards strong success on so many levels.”

Notable Accolades & Achievements

**Jesse Berry, MD**
AAO 2019 Secretariat Award, American Academy of Ophthalmology
AAO Achievement Award, American Academy of Ophthalmology
Hope on Wheels Scholar, Hyundai Merit Award, The Saban Research Institute

**Cheryl Craft, PhD**
2019 ARCS Light Recipient

**Sarah Hamm-Alvarez, PhD**
Member, Bioengineering of Neuroscience, Vision and Low Vision Technologies Study Section

**Mark Humayun, MD, PhD**
Medal for Innovations in Healthcare Technology, Institute of Electrical and Electronics Engineers (IEEE)

**Gianluca Lazzi, PhD, MBA**
Fellow, National Academy of Inventors (NAI)

**Aaron Nagiel, MD, PhD**
Baxter Foundation Awardee

**Lernik Torossian, OD, FAAO**
California Young Optometrist of the Year Award, California Optometric Association

**Benjamin Xu, MD, PhD**
Mentoring for Advancement of Physician-Scientists (MAPS) Award, American Glaucoma Society

**Sandy Zhang-Nunes, MD**
Leadership Award, 2019 Los Angeles Multi-Speciality Cosmetic Academy

**Qifa Zhou, PhD**
2019 Institute of Electrical and Electronics Engineers Ultrasonics, Ferroelectrics and Frequency Control Society (UFFC IEEE) Fellow
The USC Roski Eye Institute and LAC+USC Medical Center see patients at the following locations:

- **Keck School of Medicine of USC**
  - Department of Ophthalmology
  - **USC Roski Eye Institute**
  - 1450 San Pablo Street, 4th Floor
  - Los Angeles, CA 90033
  - (323) 442-6335

- **USC Roski Eye Institute - Arcadia**
  - 65 N. First Avenue, Suite 101
  - Arcadia, CA 91006
  - (626) 446-2122

- **USC Roski Eye Institute - Pasadena**
  - 625 S. Fair Oaks Avenue, Suite 400
  - Pasadena, CA 91105
  - (323) 442-6335

- **USC Roski Eye Institute - USC Village**
  - 835 W. Jefferson Boulevard, Suite 1720
  - Los Angeles, CA 90089
  - (833) USC-EYES

- **Children’s Hospital Los Angeles**
  - The Vision Center
  - 4650 Sunset Boulevard
  - Los Angeles, CA 90027
  - (323) 660-2450

- **USC Roski Eye Institute**
  - Keck Medicine of USC

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For more information, please contact
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