



BOLDLY EXPLORING

RESEARCH INSPIRING HOPE

2021 National Glaucoma Research Projects



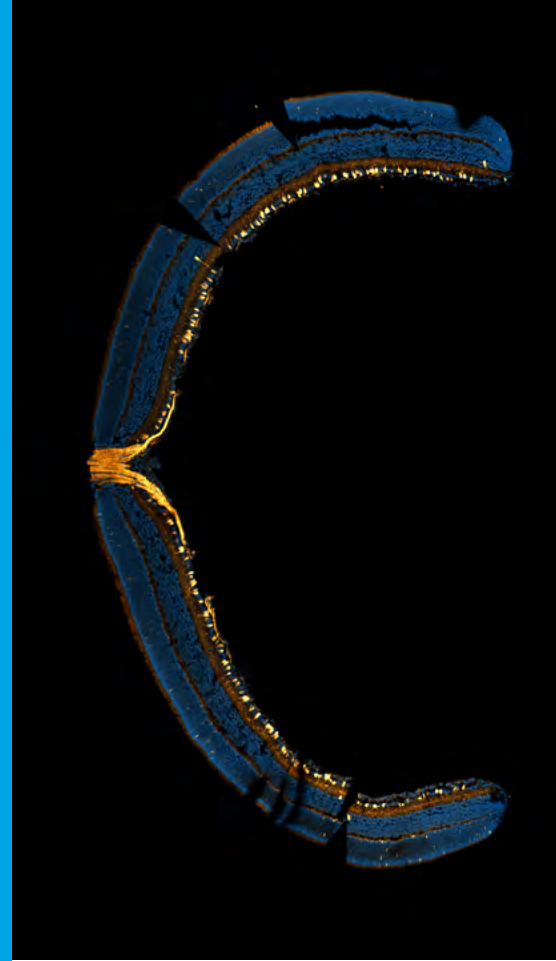
**BrightFocus[®]
Foundation**

**National
Glaucoma
Research**



NATIONAL
GLAUCOMA
RESEARCH

WE'RE FUNDING 60 PROJECTS WORLDWIDE THIS YEAR IN RESEARCH.



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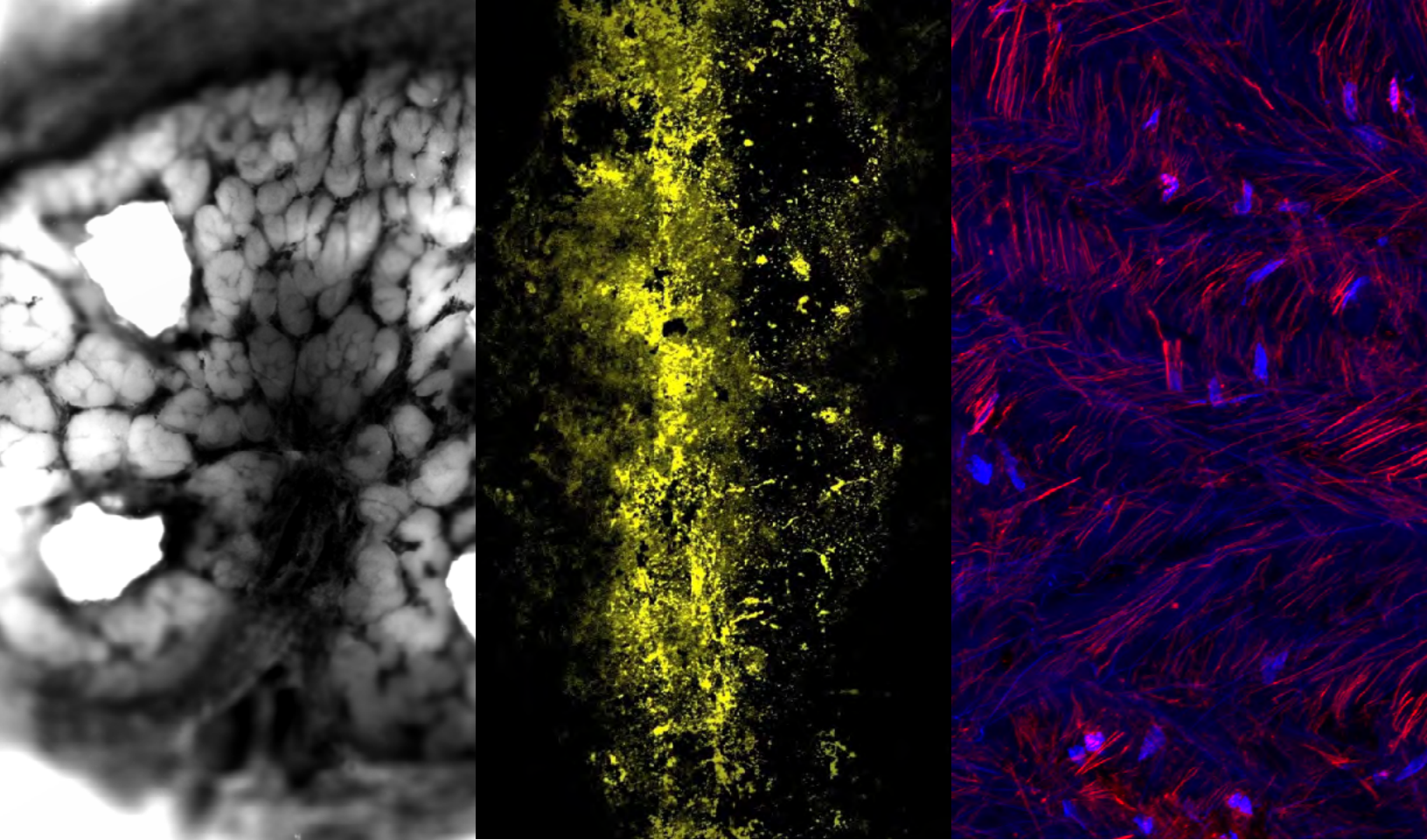
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Glaucoma is a group of eye diseases that can damage the optic nerve and result in vision loss and blindness. It has gained a reputation as the “silent thief of sight” because it has very few symptoms; yet if left untreated, will steadily damage sight, beginning with peripheral vision needed for driving and moving about safely. Glaucoma is a leading cause of irreversible blindness in the United States and worldwide.



There are about 80 million people in the world today who have glaucoma, and this number is expected to increase to 111 million by 2040. In the United States, more than three million people live with glaucoma, and the great majority of them-age 40 or older have the most common type, open-angle glaucoma. In the United States, glaucoma disproportionately affects and is a leading cause of blindness among African American and Latinx communities.

There is currently no clear, widely accepted understanding for the causes of glaucoma. National Glaucoma Research (NGR), a BrightFocus Foundation program, is taking a full,

360-degree approach to the disease, looking at everything from age to environment. Our researchers are advancing new techniques and strategies for nourishing, regenerating and transplanting retinal nerve cells. Advances in technology and imaging are helping to better monitor and control eye pressure, a key biomarker for glaucoma.

BrightFocus, through the NGR program, is one of the world's leading funders of glaucoma research, having supported more than \$44 million in scientific grants on the disease.

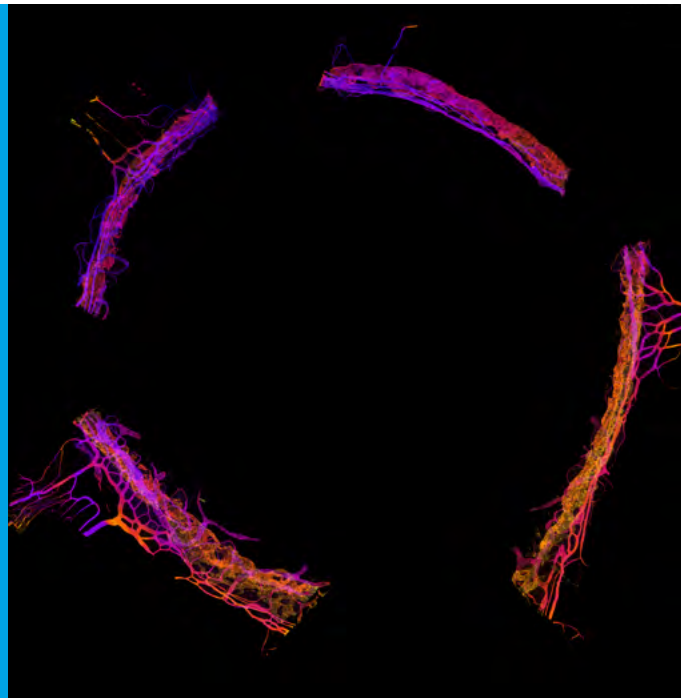
We are currently supporting 60 glaucoma research projects around the globe.

Co-principal investigator and fellowship mentor institutions are listed if different than the PI.

Cover: Eye with exfoliation syndrome, a type of glaucoma (Courtesy of Karen Curtin, PhD, University of Utah)

Above left to right: Mouse retina showing the optic nerve (gold) formed of retinal ganglion cells. (Courtesy of Michael Reber, PhD, University Health Network, Canada); Section showing the optic nerve head in a porcine eye. (Courtesy of Babak Safa, PhD, Georgia Tech Research Corporation); Mouse eye with bright areas showing greater outflow (Courtesy of Ester Reina-Torres, PhD, Imperial College of Science, Technology and Medicine, UK); Cells in the sclera, or protective outer layer of the eyeball. (Courtesy of Ian Pitha, MD, PhD, Johns Hopkins University School of Medicine)

CONTROLLING EYE PRESSURE IN NEW WAYS



Elevated eye pressure, or intraocular pressure (IOP), is present in most forms of glaucoma. This can happen when the fluid that constantly bathes the front of the eye, called aqueous humor, cannot drain properly. Normally it drains through a spongy tissue known as the trabecular meshwork and flows into Schlemm's canal, a ring-like passageway that then delivers it to the blood stream. Blockages and other forms of resistance to the outflow of aqueous humor can raise eye pressure. In addition, eye pressure can be affected by fluid volume, and

by other factors such as trabecular meshwork stiffness, which is reported to be 20 times higher in individuals with glaucoma than in normal eyes. With critical National Glaucoma Research funding, grantees are unraveling novel mechanisms that regulate eye pressure and are looking for new ways to decrease stiffness and control eye pressure.

Above: In a mouse model, eye blood vessels and outflow pathways are studied to develop molecules that lower eye pressure. (Courtesy of Ester Reina-Torres, PhD, Imperial College of Science, Technology and Medicine, UK)



C. Ross Ethier, PhD

Georgia Tech Research Corporation

(03/31/2021 – 02/29/2024)

Next-Generation Glaucoma Drugs to Selectively Release the Pressure-Building Block in Schlemm's Canal

We now understand that endothelial cells of the inner wall of Schlemm's canal (SC) play a key role in homeostatic control mechanisms that maintain IOP within a target range. The long-term goal of this project is to develop novel therapies that directly target SC cells to improve IOP control. These targeted therapies will be highly effective due their specificity, and will thus greatly benefit glaucoma patients.

www.brightfocus.org/grant/CG2020001

Part A of Joint Research Award for a collaborative inter-institutional grant.



Simon John, PhD

(03/31/2021 – 02/29/2024)

Columbia University

Co-Principal Investigator: Krish Kizhatil, PhD

The Jackson Laboratory, Bar Harbor, ME

Novel Gene-Therapy Approach for Glaucoma

The project aims to develop and test resources for Schlemm’s canal specific targeting and expression of genes for gene therapy. Successful development of this targeted therapy will help control eye pressure more effectively and provide better treatment options for glaucoma patients.

www.brightfocus.org/grant/CG2020004

Part D of Joint Research Award for a collaborative inter-institutional grant.



Darryl Overby, PhD

(03/31/2021 – 02/29/2024)

Imperial College London (UK)

Co-Principal Investigator: Joseph M. Sherwood, PhD

Developing New Drugs to Lower Eye Pressure in Glaucoma

Our research has identified a particular cell type (Schlemm’s canal cells) that regulate eye pressure by controlling the drainage of aqueous humor from the eye. In this project, we will develop and apply novel screening technologies to identify new drugs to lower eye pressure by improving aqueous humor drainage across Schlemm’s canal cells.

www.brightfocus.org/grant/CG2020003

Part C of Joint Research Award for a collaborative inter-institutional grant.



Chan Young Park, PhD

(7/1/19 - 9/30/22)

Harvard T.H. Chan School of Public Health, Boston, MA

Small Molecular Compounds for Glaucoma Therapy

The fluid in glaucoma patients’ eyes has a higher concentration of a chemical than the fluid in healthy eyes. This chemical, a growth factor, transforms tissues to be stiffer which is known to increase the chance of glaucoma. This study proposes to test a new drug (called “remodilins”) to see if it can make those stiffened tissues go back to a softer state.

www.brightfocus.org/grant/G2019179



Michael Reber, PhD

(7/1/21 - 6/30/23)

University Health Network (Canada)

Potential Role for New Sensors of Elevated Eye Pressure in Models of Glaucoma

This study looks into a new set of pressure sensor molecules discovered in 2010. In mammals, the Piezo1 and 2 receptors expressed by retinal ganglion cells (RGCs) are sensing eye pressure. In this project, researchers want to investigate further Piezo1 and 2 receptors' role in sensing eye pressure in an animal model of glaucoma using pharmacological and genetic approaches and measure the effect on RGC death.

www.brightfocus.org/grant/G2021014S



Ester Reina-Torres, PhD

(7/1/21 - 6/30/23)

Imperial College of Science, Technology and Medicine

Fellowship Co-mentors: Darryl Overby, PhD & William Daniel Stamer, PhD

Mechanisms Controlling Aqueous Humor Drainage in Mice

This project will help understand aqueous humor drainage better, which would help develop more effective drugs to lower eye pressure and treat glaucoma.

www.brightfocus.org/grant/G2021004F



W. Daniel Stamer, PhD

(03/31/2021 – 02/29/2024)

Duke University

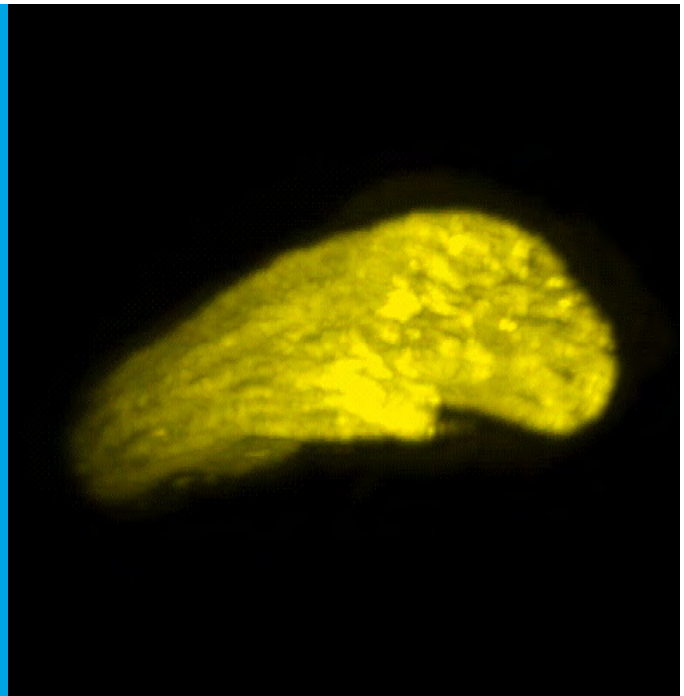
Next Generation Glaucoma Drug Development

For the Project, we will screen candidate adeno associated viruses and engineered promoters cloned into lentiviruses obtained from collaborators in human Schlemm's canal cells in vitro and anterior segments ex vivo for selective tropism to/activity in trabecular meshwork versus Schlemm's canal.

www.brightfocus.org/grant/CG2020002

Part B of Joint Research Award for a collaborative inter-institutional grant.

GAINING KNOWLEDGE ABOUT WHAT CAUSES GLAUCOMA



Glaucoma is a group of eye diseases united under one name. Ultimately, glaucoma threatens sight by damaging the optic nerve, at the back of the eye, which carries light signals from the eye to the brain. However, our knowledge of how and when glaucoma damages nerve cells remains imprecise. It's mostly linked to chronic pressure increases inside the eye, referred to as elevated intraocular pressure (IOP), which may be caused by the eye's inability to drain properly. There may be other factors besides IOP

increases that lead to glaucoma. National Glaucoma Research is funding studies on genetics—including racial disparities in glaucoma incidence and onset; more sensitive methods to study onset of glaucoma; and new research models that will lead to increased understanding of glaucoma's causes. New understanding will lead to new therapies.

Above: Energy-producing mitochondria in the retinal ganglion cells of the eye. (Courtesy of Romain Cartoni, PhD, Duke University Medical Center)



Rouzbeh Amini, PhD

(7/1/18 - 12/31/21)

Northeastern University, Boston, MA

Co-Principal Investigator: Cyril K. Dorairaj, MD

Mayo Clinic, Jacksonville, FL

Detecting Iris Stiffening and Its Significance in Certain Types of Glaucoma

The main goal of this project is to examine if, why, and how the iris becomes stiffer and consequently becomes abnormally deformed in the eyes of certain groups of patients who suffer from angle-closure glaucoma.

www.brightfocus.org/grant/G2018177



Jessica Cooke Bailey, PhD (7/1/18 - 6/30/22)

Case Western Reserve University, Cleveland, OH

Co-Principal Investigator: Jonathan L. Haines, PhD

Amish Study to Understand Glaucoma Genetics

With the Genetics of Glaucoma Evaluation in the Amish pilot study (GGLEAM), researchers will study an Amish population concentrated in Holmes County, Ohio, wherein primary open-angle glaucoma is present, with the goal of identifying a novel genetic contributor to this disease.

www.brightfocus.org/grant/G2018042



Revathi Balasubramanian, PhD (7/1/21 - 6/30/23)

Columbia University Medical Center

Mechanisms of Angle Development and Glaucoma

In several cases of glaucoma and especially early-onset glaucoma, drainage structures that regulate eye pressure are affected. To address this, we need to understand the genetics of drainage structure development. We have developed a mouse model of early-onset glaucoma. Using a newly developed mouse model of early-onset and modern imaging methods, researchers will determine how drainage structures develop and the mechanism through which abnormalities in drainage tissue contribute to glaucoma.

www.brightfocus.org/grant/G2021007S



Kathryn Burdon, PhD (9/1/20 - 8/31/22)

University of Tasmania, Australia

Co-Principal Investigator: Girum Gessesse, MD

St. Paul's Hospital Millennium Medical College, Ethiopia

Genetics of Glaucoma in Africa

This study will investigate genetics of glaucoma in Ethiopia, expanding our understanding of glaucoma and aiming to make genetic information useful in the diagnosis and management of glaucoma for patients all around the world.

www.brightfocus.org/grant/G2020293



Romain Cartoni, PhD
Duke University Medical Center

(7/1/21 - 6/30/23)

Deciphering the Local Effect of Glaucoma Risk Factors on Axonal Mitochondria

Mitochondria, an intracellular organelle responsible for key cellular processes such as energy production and programmed cell death regulation, are impaired in retinal ganglion cells (RGCs) affected by glaucoma. This study will uncover regulators of mitochondrial functions involved in glaucomatous conditions that may constitute novel therapeutic targets.

www.brightfocus.org/grant/G2021008S

Recipient of the Thomas R. Lee Award for Glaucoma Research.



John Fingert, MD, PhD
University of Iowa, Iowa City

(9/1/20 - 8/31/22)

Regulation of APBB2 Gene Expression and How it Influences Risk for Glaucoma

Researchers in this study have identified a new gene (APBB2, which stands for amyloid beta precursor protein binding family B member 2") that is the first risk factor for glaucoma that is unique to African American populations and may explain in part why they are at much higher risk for glaucoma than other groups. The current proposal seeks to understand what DNA sequences are responsible for controlling APBB2 gene activity and thus the production of beta amyloid in the retina and risk for glaucoma.

www.brightfocus.org/grant/G2020119



Puya Gharahkhani, PhD
The Council of the Queensland Institute of Medical Research (Australia)
Co-Principal Investigators: Stuart MacGregor, PhD, Alex W. Hewitt, PhD
Menzies Research Institute Tasmania
Maciej, Trzaskowski, PhD, *Max Kelsen, Australia*
David Mackey, MD, *University of Tasmania*
Jamie E. Craig, PhD, *Flinders Medical Centre, Australia*

(7/1/21 - 6/30/23)

Artificial Intelligence Approaches to Better Understand Genetic Contributions

In this study, researchers propose applying artificial intelligence (AI) approaches to identify the genes contributing to optic nerve damage and any trends in nerve damage over time. They will investigate whether these genes are targeted by existing approved drugs (used for the treatment of the other diseases), as this provides an avenue to develop novel accessible treatments for glaucoma blindness aimed at preventing optic nerve damage.

www.brightfocus.org/grant/G2021009S



F. Kent Hamra, PhD (7/1/18 - 6/30/22)
University of Texas Southwestern Medical Center, Dallas

Genetically Engineering a New Animal Model to Find Cures for Glaucoma

Our project will generate novel visual systems for inventing new glaucoma medicines by genetically engineering an animal model so that their eyes express clinically relevant, heritable human glaucoma-causing genes.

www.brightfocus.org/grant/G2018080



Michael Hauser, PhD (3/2/21 - 2/8/23)
Duke University, Durham, NC

The Genetics of Glaucoma Risk

Large studies have identified many genes and genetic variants that increase risk of glaucoma, but little is known about the mechanism. The work described in this proposal will examine the levels of these genes in individual cells in the retina, and how genetic variants change those levels. It will provide the basic information that will enable us to understand mechanism and may lead to the development of new treatments for glaucoma. Importantly, this work will follow up new findings in African Americans, a group that is disproportionately affected by glaucoma.

www.brightfocus.org/grant/G2019357



Gareth Howell, PhD (9/1/20 - 8/31/22)
The Jackson Laboratory, Bar Harbor, ME

Determine the Genetic Element on Human Chromosome 9 that Increases the Risk for Glaucoma

Human genetic studies show glaucoma is caused by a combination of genetic risk factors. However, few specific changes have been determined. This is severely hampering our ability to identify those at risk for developing glaucoma and of developing new treatments. This study aims to determine the specific genetic element in a genomic region that shows one of the strongest associations with glaucoma.

www.brightfocus.org/grant/G2020254



Monica Jablonski, PhD (7/1/18 - 6/30/22)
The University of Tennessee, Memphis

New Glaucoma Models

This study will identify and characterize new glaucoma models that mimic the human disease more closely. These models will be a very useful resource for all vision scientists.

www.brightfocus.org/grant/G2018116



Robert Johnston, PhD (7/1/19 - 6/30/22)
Johns Hopkins University, Baltimore, MD

Growing Human Retina in a Dish to Model Glaucoma

During glaucoma, the neurons that connect the eye to the brain die, leading to vision loss. In this study, researchers propose to grow human retinas in a dish from adult stem cells to (1) determine what genes are on or off in these critical neurons, (2) develop treatments to increase the number of these neurons, and (3) study how these neurons die and develop ways to prevent their death.

www.brightfocus.org/grant/G2019300



Ian Pitha, MD, PhD (7/1/21 - 6/30/23)
Johns Hopkins University School of Medicine

Mapping Scleral Fibroblasts and Their Significance in Glaucoma

Damage to the nerve cells occurs because the pressure within the eye pinches the nerve at the optic nerve head. Intraocular pressure reduction alleviates this pinching and allows the cell to function properly. Thus, this proposal aims to better understand how the wall of the eye remodels in glaucoma and test an approach to prevent the nerve cells' pinching by altering this process.

www.brightfocus.org/grant/G2021013S



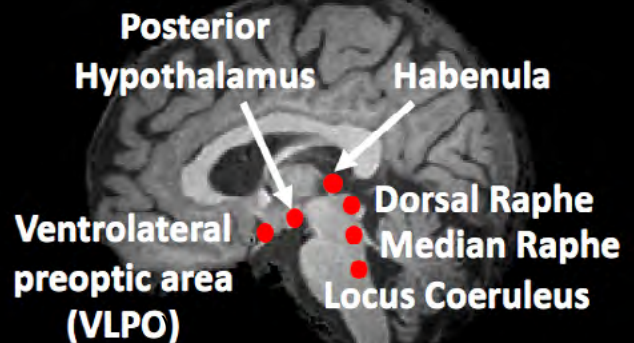
Alberta Thiadens, MD, PhD (9/1/20 - 8/31/22)
Erasmus Medical Center, Rotterdam, The Netherlands
Co-Principal Investigator: Caroline C.W. Klaver, MD, PhD

Investigating Risk Factors for Primary Open-Angle Glaucoma in African Descendants

This proposal aims to find the genetic causes for glaucoma in African populations. In addition we will focus on nutritional and environmental influences, and ancestry related anatomical variation of the eye that might explain the higher vulnerability of the optic nerve. This will help us understand why glaucoma is so frequent and severe in persons from African ancestry, provide us with knowledge about the causes of glaucoma, and help create means to cure and prevent this disease.

www.brightfocus.org/grant/G2020116

IMAGING & EXPLORING THE EYE-BRAIN CONNECTION



Eye changes associated with glaucoma contribute to tiny blind spots, known as “visual field defects,” which, if they worsen, might advance to vision loss and blindness. The chance of that, and the speed at which it happens, vary greatly from person to person. Early diagnosis is key, and much progress has been made in imaging the eye to detect the tiniest changes that may precede glaucoma. National Glaucoma Research grantees are developing and using new technologies to look at individual retinal ganglion cells (RGCs) of the eye and their nerve fibers, which carry light signals to the brain. It’s

challenging because RGCs are nearly transparent and very difficult to image. They are also using new techniques to detect changes to synapses, or connections between cells, and observe the energy regulation in the RGCs. The contributions of cerebrospinal fluid and other mechanisms are also being explored to better understand the eye-brain connection. This exploration may result in earlier detection and new ways to treat glaucoma.

Above: Glaucoma may alter key parts of the brain that are involved in the sleep-wake cycle. (Courtesy of Ji Won Bang, PhD, NYU School of Medicine)



Ji Won Bang, PhD

(7/1/21 - 6/30/23)

New York University School of Medicine

Fellowship Co-mentors: Kevin C. Chan, PhD & Joel Schuman, MD

Yuka Sasaki, PhD

Brown University, Providence, RI

Alterations of the Sleep-Regulating Systems in Glaucoma

This study will use multimodal brain neuroimaging, clinical ophthalmic assessments, and sleep quality assessments in early-stage and advanced-stage glaucoma patients and healthy subjects. The outcomes should provide a mechanistic account of the high incidence of sleep disorders in glaucoma and could lead to therapeutic advancements benefitting millions of people.

www.brightfocus.org/grant/G2021001F



Kevin Chan, PhD

(7/1/19 - 6/30/22)

New York University School of Medicine, NY

The Role of Brain Waste Clearance Pathway in Glaucoma

This study will determine the cerebrospinal fluid dynamics along the optic nerve, and the corresponding visual system impairments, using advanced, multi-parametric magnetic resonance imaging in animal models.

www.brightfocus.org/grant/G2019103

Recipient of the Thomas R. Lee Award for Glaucoma Research.



Yali Jia, PhD

(9/1/20 - 8/31/22)

Oregon Health and Science University, Portland

Co-Principal Investigator: Shaohua Pi, PhD

A Novel Tool for Seeing Neuron Cells in Eyes with Glaucoma

This study proposes to improve the current state-of-the-art ocular imaging systems using optical tools originally developed for astronomy. This will enhance image quality so that even individual cells in the eye can be clearly seen. The goal of this study is to image glaucoma models using this instrument in order to discover new and improved indicators of glaucoma progression and help understand the nature of the disease.

www.brightfocus.org/grant/G2020168



Jason Porter, PhD
University of Houston, TX

(7/1/18 - 12/31/21)

A New Method to Detect Glaucoma by Examining Changes in Blood Vessels in the Eye

This project proposes to use high-resolution in vivo imaging to better clarify changes in the capillaries and optic nerve head in relation to neuronal damage in eyes of animal models with experimental glaucoma. The results of the proposed work may aid in earlier diagnosis and management of this disease.

www.brightfocus.org/grant/G2018061



Philip Williams, PhD
Washington University in Saint Louis, MO

(9/1/20 - 8/31/22)

Direct Observation and Manipulation of Energy Regulation in RGCs During Glaucoma

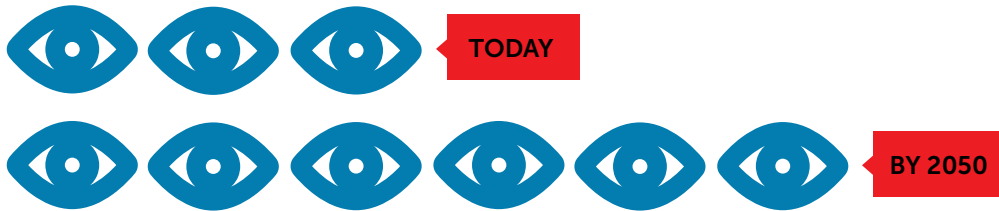
Many RGCs die during the course of glaucoma, and yet some cells persist despite the harsh disease environment. This study will determine how these RGCs survive by directly observing their energy characteristics over the course of a disease in a model system. This information will be used to reprogram the energetic state of RGCs to attempt their rescue in conditions of glaucoma.

www.brightfocus.org/grant/G2020255

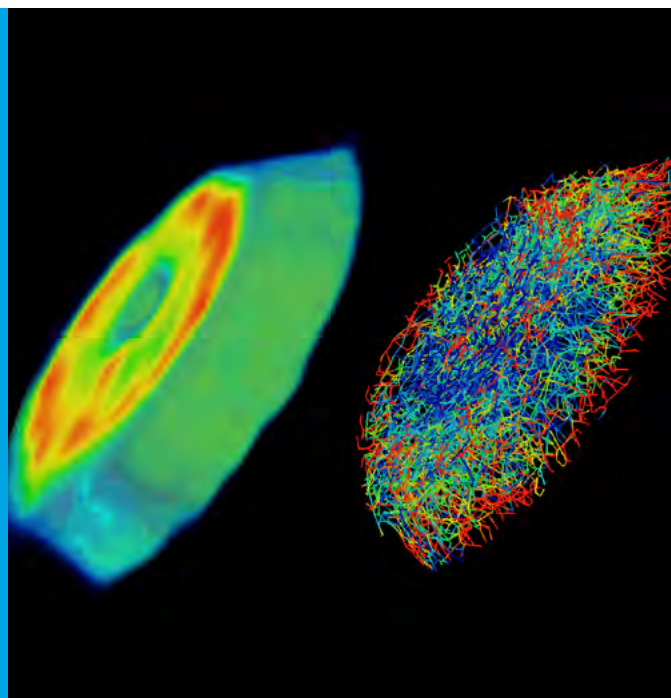
GLAUCOMA IN THE UNITED STATES

Today, more than **3 million** Americans have glaucoma. By 2050, it is estimated that the number will double to

6 million people



PREDICTING OUTCOMES & OTHER TREATMENT INNOVATIONS



Currently approved treatments for glaucoma primarily focus on eye pressure. Numerous therapies exist to lower eye pressure effectively; however, the bulk of them (eyedrops and surgeries) require skill and consistency to achieve results, or present recognizable risks (surgery). More reliable treatments are needed, as well as new therapies to address other underlying causes of glaucoma besides intraocular pressure (IOP). National Glaucoma Research grantees are working to develop drugs that will lower eye pressure and protect against nerve cell injury and

death, as well as genome editing approaches to restore the function of trabecular meshwork (a spongy tissue that drains fluids from the eye). In addition, computerized algorithms are being designed to analyze an assortment of biometric data to better predict and track a patient's risk of progression to vision loss.

Above: A model showing oxygen levels (left) and blood vessels (right) surrounding the optic nerve head, which are being studied in glaucoma. (Courtesy of Yi Hua, PhD, University of Pittsburgh)



Karen Curtin, PhD

University of Utah, Salt Lake City

Co-Principal Investigator: Barbara M. Wirostko, MD

(9/1/20 - 8/31/22)

Preventing Vision Loss by Predicting and Treating Exfoliation Syndrome Earlier in Patients

From researching thousands of medical records of exfoliation syndrome patients to find the clinical conditions and personal characteristics that correlate with changes in their eyes over time, this study will provide direction to doctors who care for these patients and help prevent or delay vision loss from glaucoma through earlier medical treatment.

www.brightfocus.org/grant/G2020317



Michael Girard, PhD

(10/1/21 - 9/30/23)

Singapore Eye Research Institute, Singapore National Eye Centre (Singapore)

Co-Principal Investigators: Aung Tin, MBBS, PhD & Monisha E, Nongpiur, MBBS, PhD

The Biomechanical Phenotype of Normal-Tension Glaucoma

To understand why some patients with normal eye pressure develop glaucoma, this study proposes engineering and artificial intelligence tools to fully assess and understand the robustness of the optic nerve head (ONH) in a given patient. Their goal is to establish whether ONH robustness can help us predict who is at risk of developing future glaucoma damage. If proven, we will be able to provide earlier treatment in the eyes that are deemed mechanically unstable.

www.brightfocus.org/grant/G2021010S



Pirro Hysi, MD, PhD

(7/1/21 - 6/30/23)

King's College London (UK)

Integrated Machine Learning Analysis of Biomarkers for Glaucoma Therapy

The purpose of this project is to identify highly variable and modifiable molecular changes that participate in mechanisms causing primary open-angle glaucoma, as immediate targets of novel treatments. This project will identify modifiable changes of metabolism or chemical modifications of the DNA that lead to glaucoma. This project will use powerful machine learning to stack millions of data points acquired through high-throughput platforms ("omics") in a very large number of individuals to identify robust signals of epigenetic and metabolic changes that together modulate the glaucoma risk.

www.brightfocus.org/grant/G2021011S



Yi Hua, PhD

(7/1/21 - 6/30/23)

University of Pittsburgh

Fellowship Mentor: Ian Sigal, PhD

Hemodynamics and Biomechanics of the Lamina Cribrosa (LC)

This study will test if elevated eye pressure deforms the microvessels that supply blood, nutrients, and oxygen to the lamina region at the back of the eye to support the nerve cells. The long-term goal is to understand axon death mechanisms in glaucoma and help develop novel diagnostic and therapeutic agents for clinical glaucoma treatment.

www.brightfocus.org/grant/G2021003F



Amanda Melin, PhD

(3/1/21 - 2/28/23)

University of Calgary, Canada

Co-Principal Investigator: James Higham, PhD

New York University

Insights into a Naturally Occurring Glaucoma Model

By leveraging access to a large, existing sample of eye tissues, this study proposes to examine genes expressed, their sequences, and the metabolites that are present in individuals with and without naturally-occurring glaucoma-like phenotypes in a closely related animal model. These data have large promise to guide genetic screening panels used in diagnosis and prognosis of glaucoma in humans, and to identify molecules in our blood that can be used for early detection and treatment.

www.brightfocus.org/grant/G2020047



Robert Zawadzki, PhD

(7/1/21 - 6/30/23)

University of California Davis

Co-Principal Investigator: Pengfei Zhang, PhD

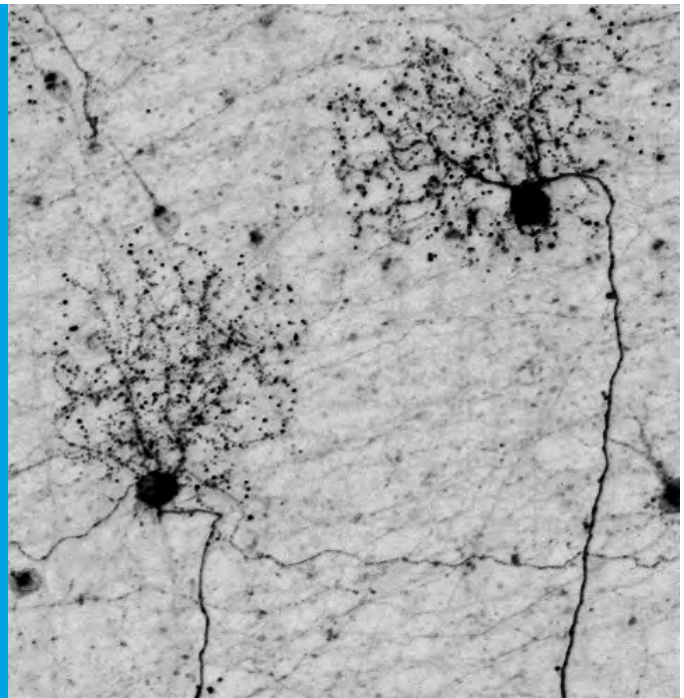
Validation of Novel OCT-Based Imaging Tools for Noninvasive Monitoring

Novel treatments focused on restoring vision in glaucoma, using Gene or Stem Cell therapies, would benefit from developing cellular resolution in vivo imaging tools, which could offer sensitivity and specificity beyond current clinical tests. To achieve that, we propose developing and validating novel structural and functional extension of optical coherence tomography (OCT), so-called temporal speckle analysis OCT (TSA-OCT), for basic science research.

www.brightfocus.org/grant/G2021017S

Recipient of the Dr. Douglas H. Johnson Award for Glaucoma Research.

PROTECTING & REGENERATING THE OPTIC NERVE



Unlike most cells in the body, which repair themselves, the nerve cells providing our vision don't regrow once damaged. National Glaucoma Research is supporting research into ways of protecting cells threatened by advancing glaucoma and regenerating those cells after vision loss. A major challenge is to refine lab-grown retinal ganglion cells (RGCs), nerve cells which make up the optic nerve and carry visual signals over long tails (axons) extending from the eye to the brain, and developing methods for transplanting

and reconnecting them to surrounding tissues, including the optic nerve. This is a sophisticated undertaking, given how RGCs are wired into the brain. Another focus is to develop neuroprotective drugs and therapies that will help nourish and support fragile RGCs in disease models and regeneration efforts, helping to ensure their long-term viability.

Above: Retinal ganglion cells of zebrafish are being studied for their ability to regenerate. (Courtesy of Matthew V. Veldman, PhD, Medical College of Wisconsin)



Petr Baranov, MD, PhD

(9/1/20 - 8/31/22)

Schepens Eye Research Institute/Massachusetts Eye and Ear and Harvard Medical School, Boston

Cell Replacement in Glaucoma: Making Mature RGCs

This proposal aims to improve the adult donor stem cell-derived RGCs to make them differentiate to become closer to the "real" RGCs. That should significantly increase the transplantation success, leading to development of potential therapy.

www.brightfocus.org/grant/G2020231



Jeffrey Boatright, PhD

(9/1/20 - 8/31/22)

Emory University, Atlanta, GA

Co-Principal Investigator: Ying Li, MD, PhD

A Dietary Supplement in Treatment of Glaucoma

Mitochondria are the energy factories of cells. The mitochondria of RGCs lose function with age, probably due to age-related loss of nicotinamide adenine dinucleotide (NAD⁺), an enzyme cofactor needed for energy production, making the cells more susceptible to damage. The goal of this study is to test whether systemic delivery of the NAD⁺ precursor nicotinamide riboside, a dietary supplement, increases retinal NAD⁺ and protects RGCs in glaucoma models.

www.brightfocus.org/grant/G2020286



Babak Safa, PhD

(7/1/21 - 6/30/23)

Georgia Tech Research Corporation

Fellowship Mentor: Christopher Ross Ethier, PhD

Investigating the Optic Nerve Head Remodeling in Glaucoma

In this project, researchers will (1) provide the most accurate characterization of the mechanical properties and mechanobiology of the optic nerve head, the primary site of damage in glaucomatous optic neuropathy, and (2) will develop a physiologically appropriate ex vivo 3D culture model to study the mechanobiological response of ONH cells, thought to drive characteristic changes in glaucoma. This system will eventually form the basis of a high-throughput drug discovery system, accelerating the development of future treatments for glaucoma.

www.brightfocus.org/grant/G2021005F



Kin-Sang Cho, PhD

(9/1/20 - 8/31/22)

Schepens Eye Research Institute/Massachusetts Eye and Ear and Harvard Medical School, Boston

A Novel Use of Specialized Pro-Resolvin Mediators to Treat Glaucoma

Microglial activation has been known as an early responsive immune cell in glaucoma disease among various immune cells. This proposal will investigate the role of docosahexaenoic acid (DHA)-derived anti-inflammatory pro-resolvins as mediators in suppressing microglial activation, promoting neuronal survival and vision in mouse models of glaucoma.

www.brightfocus.org/grant/G2020333



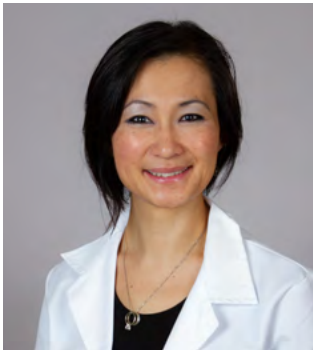
Eldon Geisert, PhD
Emory University, Atlanta, GA

(7/1/19 - 6/30/22)

Making Optic Nerve Regeneration Faster

For the adult optic nerve to regenerate in humans, the regenerating axons must travel a considerably longer distance. The goal of this study is to use a mouse model developed by this group that will make it possible to identify genes that increase the number of regenerating axons by at least four times and the distance the axons grow by at least three times.

www.brightfocus.org/grant/G2019111



Kimberly Gokoffski, MD, PhD
University of Southern California Roski Eye Institute, Los Angeles

(9/1/20 - 8/31/22)

Using Electric Fields to Regenerate the Optic Nerve

This project employs an innovative technology that uses electrical stimulation to direct neuron growth so that healthy neurons that have been injected into diseased eyes may form new connections with the brain and thereby restore vision.

www.brightfocus.org/grant/G2020331

Recipient of the Dr. Douglas H. Johnson Award for Glaucoma Research



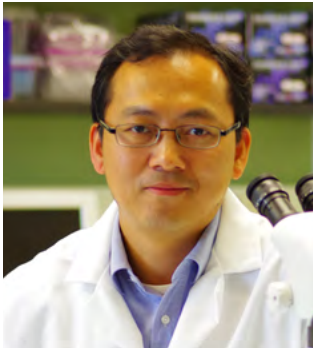
Jeffrey Gross, PhD
University of Pittsburgh, PA

(9/1/20 - 8/31/22)

Identifying Factors that Protect Ganglion Cells from Death After Optic Nerve Injury

Experiments in this proposal utilize the zebrafish as a model system, leveraging its unique biology whereby RGCs do not die when their axons are damaged, even in extreme cases when the optic nerve is completely severed. By understanding how zebrafish RGCs survive after axonal damage, this team will uncover novel modes of neuroprotection that could ultimately be translated into new targets for neuroprotection to preserve RGCs in glaucoma patients.

www.brightfocus.org/grant/G2020277



Yang Hu, MD, PhD
Stanford University, CA

(7/1/18 - 6/30/22)

Studying Gene Regulation Networks in Retinal Ganglion Cells for Novel Neuroprotective Targets

This study takes advantage of newly developed genetic tools to survey gene expression and epigenetic regulatory elements (heritable genetic changes that turn genes on or off) that are associated with RGCs at normal function, under disease, or after treatment. Through this effort, researchers in this study will create a comprehensive gene regulatory network blueprint to develop novel neuroprotectants for glaucoma.

www.brightfocus.org/grant/G2018183



Richard Libby, PhD
University of Rochester Medical Center, NY

(9/1/20 - 8/31/22)

Defining the Importance of Extrinsic Signaling in Glaucoma Neurodegeneration

This work explores the importance of extrinsic signalling in glaucomatous neurodegeneration. It builds on the work of many groups who have proposed that after an ocular hypertensive injury, glial cells (cells that support retinal neurons) transition from being helpful to being toxic to RGCs. Specifically, this study proposes to test the importance of three molecules thought to turn glial cells neurotoxic after a glaucomatous injury.

www.brightfocus.org/grant/G2020095

Recipient of the Thomas R. Lee Award for Glaucoma Research.



Jason Meyer, PhD
Indiana University, Indianapolis

(9/1/20 - 8/31/22)

Astrocytes Regulate the Health and Degeneration of RGC in Glaucoma Neurodegeneration

Astrocytes are known to play vital roles in the maintenance of RGCs, with these interactions adversely affected in glaucoma. The use of human pluripotent stem cells allows for the precise modeling of these interactions in a dish, providing the spatial and temporal resolution to closely examine how astrocyte function is changed in these cells as a result of glaucoma, as well as how these changes in astrocytes alter the health and function of RGCs as a whole.

www.brightfocus.org/grant/G2020369



Jeff Mumm, PhD

(9/1/20 - 8/31/22)

Wilmer Eye Institute, Johns Hopkins University, Baltimore, MD

A Novel Model for Replacing Lost Cells and Restoring Vision in Glaucoma Patients

Although humans do not normally regenerate lost RGCs, our eyes do retain a capacity to produce new neurons, suggesting an untapped potential for RGC regeneration. Unlike us, zebrafish have a natural ability to replace lost cells in the retina, including RGCs. By studying how zebrafish are able to naturally regenerate RGCs, we hope to 1) identify genes and pathways that are important for stimulating the eye's ability to repair itself and 2) apply this knowledge toward the development of transformative regenerative therapies for glaucoma patients.

www.brightfocus.org/grant/G2020315



Robert W. Nickells, PhD

(7/1/18 - 03/31/22)

University of Wisconsin-Madison

A Study to Define the Link Between Cell Adhesion and Retinal Ganglion Cell Death

Cells living in a complex tissue are most healthy when they make and retain contacts with other cells, and to the extracellular environment. The goal of this research is to determine if loss of cell-to-cell, and/or cell-to-surface, contacts by RGCs stimulates the biological pathway leading to their death after damage to the optic nerve.

www.brightfocus.org/grant/G2018166



Matthew Veldman, PhD

(7/1/21 - 6/30/23)

Medical College of Wisconsin

New Neuroprotective Genes Against Axonal Damage and Glaucoma

The current project uses loss of function studies in zebrafish and gain of function studies in mammalian cells to test the neuroprotective ability of four candidate genes identified in zebrafish. The goal of this study is to understand the basic biology of injury resilience and optic nerve regeneration in the zebrafish and apply that knowledge to mammalian models of glaucoma with the long-term hopes of identifying new avenues for therapeutic development in patients.

www.brightfocus.org/grant/G2021015S



Kimberly Wong, PhD

(7/1/21 - 6/30/23)

Children's Hospital Boston

Fellowship Mentor: Larry Benowitz, PhD

Transcriptional Regulation of Nerve Cell Survival and Axon Regeneration

This research aims to investigate how cell death and axon regeneration are regulated by proteins dual leucine zipper kinase (DLK) and leucine zipper kinase (LZK) that are crucial for RGC death. This work can lead to the development of new therapies to halt or even reverse RGC death and vision loss.

www.brightfocus.org/grant/G2021006F



Sarah Zhang, MD

(7/1/19 - 6/30/22)

State University of New York at Buffalo

Targeting Inflammatory Cells to Treat Glaucoma

The proposed research studies a novel protein that was recently identified as a key regulator of macrophages, a type of immune cell that are activated during glaucoma. Using genetic tools and animal models, the study will explore how this protein regulates macrophage activation and inflammation in the retina of glaucoma eyes. Furthermore, the study will develop a novel therapy using small vesicles secreted from bone marrow stem cells to manipulate macrophage behavior and protect retinal neurons in glaucoma.

www.brightfocus.org/grant/G2019302



Siamak Yousefi, PhD

(9/1/20 - 8/31/22)

University of Tennessee, Memphis

Identifying Which Retinal Ganglion Cell Types Die Earlier in Glaucoma

This study aims to develop artificial intelligence (AI) approaches to identify RGC subtypes that are more susceptible to glaucoma-induced insult. Results from this study could advance our understanding of the genetic basis for glaucoma-induced RGC cell death and possible therapeutic interventions.

www.brightfocus.org/grant/G2020374



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