

Glaucoma

The sneak thief of sight

Glaucoma, a leading cause of blindness, affects more than two million Americans and is responsible for fifteen percent of world blindness. It is a family of ocular diseases characterized by progressive damage to the optic nerve, which is the part of the eye that carries the images we see to the brain. Due to the rapidly aging American population, the number of persons losing their vision to glaucoma will increase by 50% in the next 15 years.

The ophthalmologists of Bascom Palmer Eye Institute see patients with glaucoma ranging in age from newborn infants to seniors. Individuals with high risk for glaucoma include people over age 60, those with a family history of glaucoma and people of African descent over age 40. Hypertension, diabetes and other systemic diseases are also risk factors. Among Hispanics and African Americans in the U.S., glaucoma is the leading cause of blindness.

Often called the “sneak thief of sight” most forms of glaucoma do not produce symptoms until the optic nerve is already severely damaged. But if diagnosed early, the disease can be controlled and permanent vision loss can be prevented. Bascom Palmer offers the most technologically advanced and comprehensive computer imaging analysis available for detecting glaucoma and its progression.

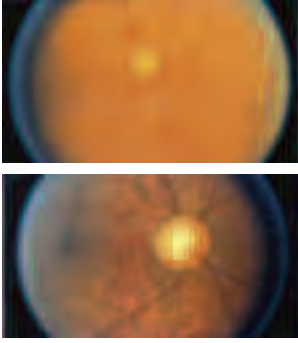
Glaucoma often involves high levels of pressure inside the eye known as the intraocular pressure (IOP). The front part of the eye is filled with a clear fluid called the *aqueous humor* that is produced continuously by the *ciliary body*. The aqueous humor also nourishes nearby tissues, and leaves the chamber at the *angle* where the iris inserts into the *sclera* or white of the eye. It flows through a meshwork-like drainage system as it leaves the eye.

Proper drainage helps keep eye pressure at a normal level. In many types of glaucoma, the eye drainage system does not work properly so that intraocular fluid cannot drain. As the fluid builds up, it causes pressure to build inside the eye. This high pressure damages the sensitive optic nerve resulting in vision loss.

Primary open-angle glaucoma, the most common type of glaucoma, occurs when the eye’s drainage canals malfunction, probably on the cell and tissue level. The intraocular pressure rises because the proper amount of fluid cannot drain out of the eye. With early detection, open-angle glaucoma usually responds well to medication.



Steven J. Gedde, M.D., with Bascom Palmer Chief Resident Daniel M. Miller, M.D., Ph.D., and Bascom Palmer Fellow Krista K. Rosenberg, M.D.



WHAT IS GLAUCOMA?

Glaucoma is a leading cause of blindness in the United States, especially for older people. But loss of sight from glaucoma can often be prevented with early treatment.

RISK FACTORS FOR GLAUCOMA

- FAMILY HISTORY OF GLAUCOMA
- AGE 60+
- ABNORMALLY HIGH INTRAOCULAR PRESSURE
- AFRICAN DESCENT, AGE 40+
- PAST EYE INJURIES
- DIABETES

Regular eye examinations by your ophthalmologist are the best way to detect glaucoma.

To schedule an appointment with a glaucoma specialist, please call 1-888-845-0002 or visit us online at www.bascompalmer.org

Armed with research results, doctors now understand how to halt vision loss in nearly all moderate to severe cases of open-angle glaucoma, according to Paul F. Palmberg, M.D., Ph.D., Professor of Ophthalmology at Bascom Palmer Eye Institute.

Bascom Palmer has a long and noteworthy history in glaucoma diagnosis, treatment and research. Glaucoma surgeons at Bascom Palmer pioneered the use of locally applied anti-scarring drugs that revolutionized glaucoma surgery around the world. "The introduction of 5-Fluorouracil here in 1982 and the independent introduction of Mitomycin by Chen in Taiwan in 1981," Palmberg says, "greatly increased the chance that a glaucoma operation to create a new drain for the eye will not scar shut and enabled us to adjust the eye pressure to the low-normal range that is required to stabilize patients with advanced damage, and the mid-normal range that is required to stabilize patients with moderate damage."

In 1988, the Advanced Glaucoma Intervention Study (AGIS), a multi-center clinical trial sponsored by the National Eye Institute of the National Institutes of Health, was launched to compare how well patients did after being randomized to either laser or incisional surgery when eye drop therapy of glaucoma proved insufficient. Palmberg, a member of the Monitoring Committee, realized that the trial's long-term monitoring of patients offered a unique opportunity to also answer the question of just how low the eye pressure needs to be to achieve the best possible result.

Another form of the disease is called angle closure glaucoma. This type, which is rare in Caucasians, but more prevalent in people of Asian origin, occurs when the angle of the eye closes for anatomical reasons preventing fluid from reaching the drainage canals and resulting in very high IOP. Acute angle closure glaucoma develops very quickly, has noticeable symptoms including hazy vision, eye and head pain, nausea, sudden vision loss or rainbow-colored circles around bright lights and demands immediate medical attention as permanent vision loss can occur within hours.

In recent years, we have come to appreciate that IOP is not the only factor leading to optic nerve damage. "While increased eye pressure means higher risk for glaucoma, elevated intraocular pressure is no longer the primary definition of the disease," says David S. Greenfield, M.D., Associate Professor of Ophthalmology. "Glaucoma is a neurological disorder whose common pathway is optic nerve injury." So-called "low tension glaucoma" is being diagnosed with rapidly increasing frequency. While this form of the disease is associated with normal IOP, some benefit is still seen if IOP is lowered, suggesting that pressure might still be a factor, at least indirectly.

Other types of glaucoma include pseudoexfoliation glaucoma, pigmentary glaucoma, angle recession glaucoma, and neovascular glaucoma. Bascom Palmer's pediatric and glaucoma specialists are also skilled at detecting pediatric glaucoma, which is diagnosed and treated differently than adult glaucoma.

Medical Therapy

In the past 10 years, technological advances in ocular imaging and the number of available medications have made a significant difference in the diagnosis and treatment of glaucoma. Glaucoma is typically treated with the use of medications that either help aqueous humor drain better from the eye or decrease the amount of aqueous humor that is made by the eye. Different types of glaucoma require different therapies to prevent further damage to the eye's structures.

Various classes of medical agents are available for treatment of glaucoma including prostaglandin analogs, beta blockers, alpha-andrenergic agonists, carbonic anhydrase



Douglas R. Anderson, M.D., has a long history in glaucoma research. Pictured here with Dr. Aino Zschauer (left) in 1992 at which time they were studying pericytes, a type of capillary cell that helps control blood flow in the retina and optic nerve. Pericyte function may be part of the abnormality that develops in diabetic retinopathy and in glaucoma.

inhibitors (CAI), sympathomimetics and cholinergics. Compliance, the patient's ability to follow their prescribed medication regimen, is extremely important in keeping glaucoma under control.

Richard K. Parrish, II, M.D., Professor of Ophthalmology, was lead investigator for a 45-site U.S. study comparing three prostaglandin analogs used to reduce intraocular pressure in people who have open-angle glaucoma or high IOP. "As with any medication, failure by patients to use medication as directed is one of the biggest hurdles for physicians," says Parrish. "With possible side effects from the drugs, it is difficult to convince patients to stay on medications or take them exactly as prescribed."

In advanced glaucoma, medication alone no longer reduces IOP adequately and the eye has visual field defects. Therefore, Bascom Palmer glaucoma specialists also use laser and conventional surgery as treatment for glaucoma. To treat open-angle glaucoma, laser surgery may be used to improve the flow of fluid exiting the eye. In laser trabeculoplasty a laser makes tiny, evenly spaced burns in the trabecular meshwork to stimulate the drain to function more efficiently. Another treatment is laser iridotomy, where a laser makes a small hole in the iris to improve the flow of fluid to the drainage angle.

If surgery is needed, two types of glaucoma procedures have been shown to be safe and effective. These are known as tube-shunt (implant) surgery and trabeculectomy. Both tube-shunt surgery and trabeculectomy lower the IOP by creating a route for the aqueous fluid to drain out of the eye. Tube shunts, such as the Baerveldt glaucoma implant, is when a tube inserted into the eye shunts aqueous fluid to a silicone plate that is attached to the sclera. Trabeculectomy is a procedure where a hole is surgically created under a trap-door incision in the sclera allowing the aqueous fluid to drain. Mitomycin, an anti-scarring medicine, is commonly applied at the operation site to reduce scarring that could possibly close the trap door.

Steven J. Gedde, M.D., Associate Professor of Ophthalmology, is the lead investigator of the national Tube versus Trabeculectomy (TVT) Study, an important multi-center clinical trial evaluating these two types of surgical procedures for glaucoma patients. While both procedures yield positive outcomes and low complication rates, there is little agreement on which is the better operation in certain clinical situations.

"The economic impact on society to decrease the number of people who suffer from glaucoma-related blindness is impressive, but for the individual whose vision is preserved the effect is incomparable."

– Richard K. Parrish II, M.D.

Diagnostic tests for glaucoma

Bascom Palmer's Glaucoma Service uses several diagnostic tests to accurately assess the progression of glaucoma:

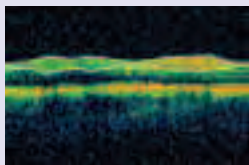
■ **Tonometry** – a pen-like instrument is placed on the surface of the eye, after numbing drops have been applied, to measure the pressure inside the eye.

■ **Perimetry** (visual field test) – the peripheral (side) vision is measured by responses to a series of flashing lights.

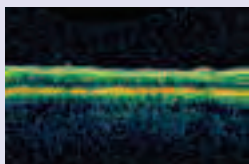
■ **Gonioscopy** – a special mirrored contact lens is used to allow the doctor to examine the structures in the front of the eye to assess the eye's drainage system.



■ **Optical Coherence Tomography (OCT)** – a non-invasive, painless scan which enables the doctor to evaluate the health of the retina by providing a unique cross section image of the layers of the retina.



OCT image of a normal retina



OCT image of a retina affected by glaucoma

Bascom Palmer Eye Institute glaucoma specialists also participated in a landmark nationwide clinical trial, the Ocular Hypertension Treatment Study (OHTS). The OHTS evaluated the safety and effectiveness of glaucoma medical therapy in preventing or delaying the development of glaucoma in patients with elevated IOP but normal optic nerves, a condition known as *ocular hypertension*. The study found that reducing IOP with glaucoma medications decreased the rate at which patients with ocular hypertension progressed to glaucoma. Furthermore, the OHTS was able to identify factors that helped to predict which patients with ocular hypertension were more likely to develop glaucoma.

Parrish served as vice chairman and a member of the Executive/Steering Committee for the study. Donald L. Budenz, M.D., M.P.H., Associate Professor of Ophthalmology, was Bascom Palmer's principal investigator for the study and Douglas R. Anderson, M.D., Professor of Ophthalmology and holder of the Douglas R. Anderson Chair in Ophthalmology, served on the Executive/Steering Committee.

Parrish, Anderson and Budenz also served as co-directors for the OHTS Optic Disc Reading Center, which evaluated photographs of the optic nerves from all participating centers without knowing the treatment group so that the condition of the patient was evaluated objectively. The significance of these findings underscores that a disease once thought uncontrollable might be delayed from developing or prevented altogether for some patients with proper medical attention. "The economic impact on society to decrease the number of people who suffer from glaucoma-related blindness is impressive, but for the individual whose vision is preserved the effect is incomparable," says Parrish.



A tonometer or a tonopen may be used to measure the intraocular pressure.

The study also confirmed that the risk for developing glaucoma is higher among African Americans compared with others. Glaucoma is a leading cause of blindness in African Americans and is almost three times as common in African Americans than among Caucasians. The study has been renewed as OHTS-2 and continues at Bascom Palmer. "The results emphasize the need for African Americans over 40 to have a comprehensive eye exam at least once every two years to learn if they are at

higher risk for glaucoma, but they do not imply that every African American with high eye pressure requires treatment," added Budenz.

Later this year, Palmberg and research glaucoma Fellow Kyoko Ishida, M.D., Ph.D., will report to the American Academy of Ophthalmology the results of a 10-year study in which 205 eyes undergoing a first glaucoma operation received anti-scarring drugs. "The exciting result of our study, which we call Consequences of Surgical Intervention: Miami, or 'CSI: Miami' in short, is that there was no average loss of visual field in the group," says Palmberg. "In other words, we were able to achieve in the whole group of patients the



Donald L. Budenz, M.D. examines a patient for glaucoma.

kind of control that the AGIS showed was achieved in only a quarter of their patients with more conventional surgery.”

Bascom Palmer has a long tradition of offering ophthalmologists in academia and private practice a variety of courses and lectures on the latest development in their fields. For the past three years, general ophthalmologists and glaucoma specialists from throughout the country have gathered in Miami for the Glaucoma Mid-winter Symposium. Co-directed by Francisco E. Fantes, M.D., Associate Professor of Clinical Ophthalmology, the course explores the current diagnostic tools and newest strategies for the clinical practice of glaucoma. “Bascom Palmer is at the forefront of glaucoma discoveries,” says Fantes, “and sharing these discoveries with doctors around the world is essential to Bascom Palmer’s mission.”

Physicians and scientists at Bascom Palmer are focusing on developing advanced technologies to diagnose glaucoma. For many years they have studied the optical properties of the retinal nerve fiber layer (RNFL) to aid doctors who are using RNFL as a diagnostic

method. While visual fields tests have long been the primary method for detecting glaucoma, recent studies show that examinations applying new optical technologies reveal more definitive diagnostic RNFL information.

Glaucoma research is being conducted at Bascom Palmer at the molecular level. “If we can understand how proteins affect the health of the optic nerve or affect drainage of the eye, that is how we will understand glaucoma,” says Parrish. “Bascom Palmer physicians and scientists will be leading the way.”



Francisco E. Fantes, M.D., directs Bascom Palmer’s annual continuing medical education symposium on glaucoma.

“Bascom Palmer is unmatched in its quality of patient care, physician training and research in the area of glaucoma.”

– Steven J. Gedde, M.D.