

# Understanding and Living with Glaucoma



**Betty hopes future generations won't have to live with glaucoma.**



**Dr. Goldberg's breakthrough research could mean they won't have to.**

**GLAUCOMA**  
RESEARCH FOUNDATION

SUPPORTED BY AN EDUCATIONAL GRANT FROM AERIE PHARMACEUTICALS, INC.

**Glaucoma** is an eye disease that gradually steals your vision. Usually, glaucoma has no symptoms in its early stages. But without proper treatment glaucoma can lead to blindness.

The good news is that with regular eye exams, early detection, and treatment, you can preserve your sight. This guide will give you a complete introduction to the facts about glaucoma.

## **2 INTRODUCTION**

### **3 UNDERSTANDING GLAUCOMA**

- 3 Understand the Eye to Understand Glaucoma
- 4 How Glaucoma Affects the Eye
- 6 Who Gets Glaucoma?
- 7 Are There Symptoms?
- 7 When Should You Get Your Eyes Checked for Glaucoma?

### **8 DIFFERENT TYPES OF GLAUCOMA**

- 8 Primary Open-Angle or Open-Angle Glaucoma
- 9 Primary Angle-Closure or Angle-Closure Glaucoma or Narrow-Angle Glaucoma
- 10 Other Types of Glaucoma
  - 10 • Normal-Tension Glaucoma
  - 10 • Secondary Glaucoma

### **12 DETECTING GLAUCOMA**

- 12 How Is Glaucoma Diagnosed?
- 12 What To Expect During Glaucoma Examinations
  - 12 • Tonometry
  - 12 • Ophthalmoscopy
  - 15 • Perimetry
  - 16 • Gonioscopy
  - 16 • Pachymetry

### **17 TREATING GLAUCOMA**

- 17 Treatment of Primary Open-Angle Glaucoma
  - 17 • Selective Laser Trabeculoplasty
  - 18 • Glaucoma Medications
  - 21 • Incisional Surgeries
  - 25 • Unapproved Treatments
- 25 Treatment of Primary Angle-Closure Glaucoma
- 26 Treatment of Other Types of Glaucoma

### **28 FREQUENTLY ASKED QUESTIONS**

### **30 LIVING WITH GLAUCOMA**

- 30 Working with Your Doctor
- 32 Responding to Vision Changes Due to Glaucoma
- 32 Questions For Your Doctor
- 34 Your Lifestyle Counts
- 35 Looking Ahead

### **36 APPENDIX**

- 36 A Guide To Glaucoma Medications
- 38 Glossary

# Introduction

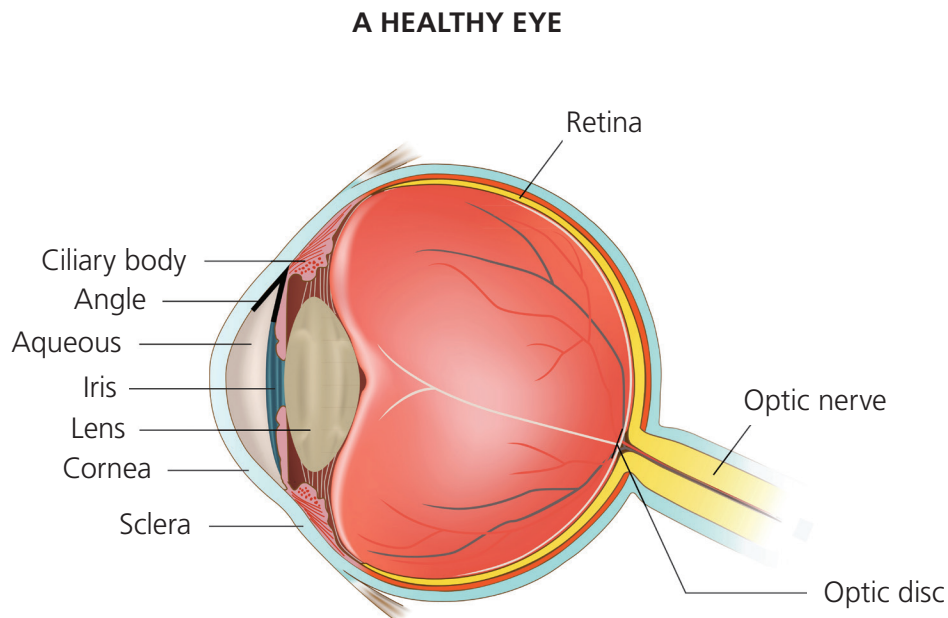
If you have been diagnosed with glaucoma, or are a glaucoma suspect, you probably have a lot of questions and some concerns. Coping with a long-term eye condition can seem overwhelming, but you are fortunate compared to the many who have glaucoma and don't know it. You are now empowered to learn how you can preserve your vision and live a normal life as a glaucoma patient.

When faced with a new diagnosis of glaucoma there is one question that is foremost in every patient's mind: "Will I go blind?" Thankfully, for most patients the answer is no. Glaucoma typically progresses very slowly over many years, and most people never lose vision if they see their eye doctor regularly and follow their treatment plan.

Excellent glaucoma treatments are available that work to control eye pressure, the main cause of vision loss in glaucoma. These treatments include a wide range of eye drop medications, laser treatments that are performed in the office, and many types of surgery. Newer treatments are continuously being developed and evaluated.

Glaucoma is a chronic disease, and you are the most important part of your treatment. Working closely with their doctor, the vast majority of people with glaucoma will retain their vision. The key to preserving your vision is speaking honestly with your doctor about your disease and its treatment.

This guide will give you a complete introduction to the facts about glaucoma and how to work with your doctor to manage your glaucoma.





# Understanding Glaucoma

Glaucoma is an eye disease that usually has no symptoms in its early stages. Without proper treatment, glaucoma can lead to blindness. The good news is that with regular eye exams, early detection, and treatment, you can preserve your sight.

## UNDERSTAND THE EYE TO UNDERSTAND GLAUCOMA

To understand glaucoma, it is important to have an idea of how the eye works and the different parts of the eye.

Covering most of the outside of the eye is a tough white layer called the *sclera*. A clear thin layer called the *conjunctiva* covers the sclera. At the very front of the eye is a clear surface, like a window, called the *cornea* that protects the pupil and the iris behind that window. The *iris*, a muscle, is the colored part of the eye that contracts and expands to let light into the eye. At the center of the iris is a hole (covered by the clear cornea) called the *pupil*, where light enters the eye. The *lens* inside our eye focuses this light onto the back of the eye, which is called the *retina*. The retina converts the light images into electrical signals, and the retina's nerve cells and fibers carry these signals to the brain through the *optic nerve*. The *optic disc* is the area on the retina where all the nerve fibers come together to become the optic nerve as it leaves the eye to connect to the brain.

## Healthy Eye Drainage

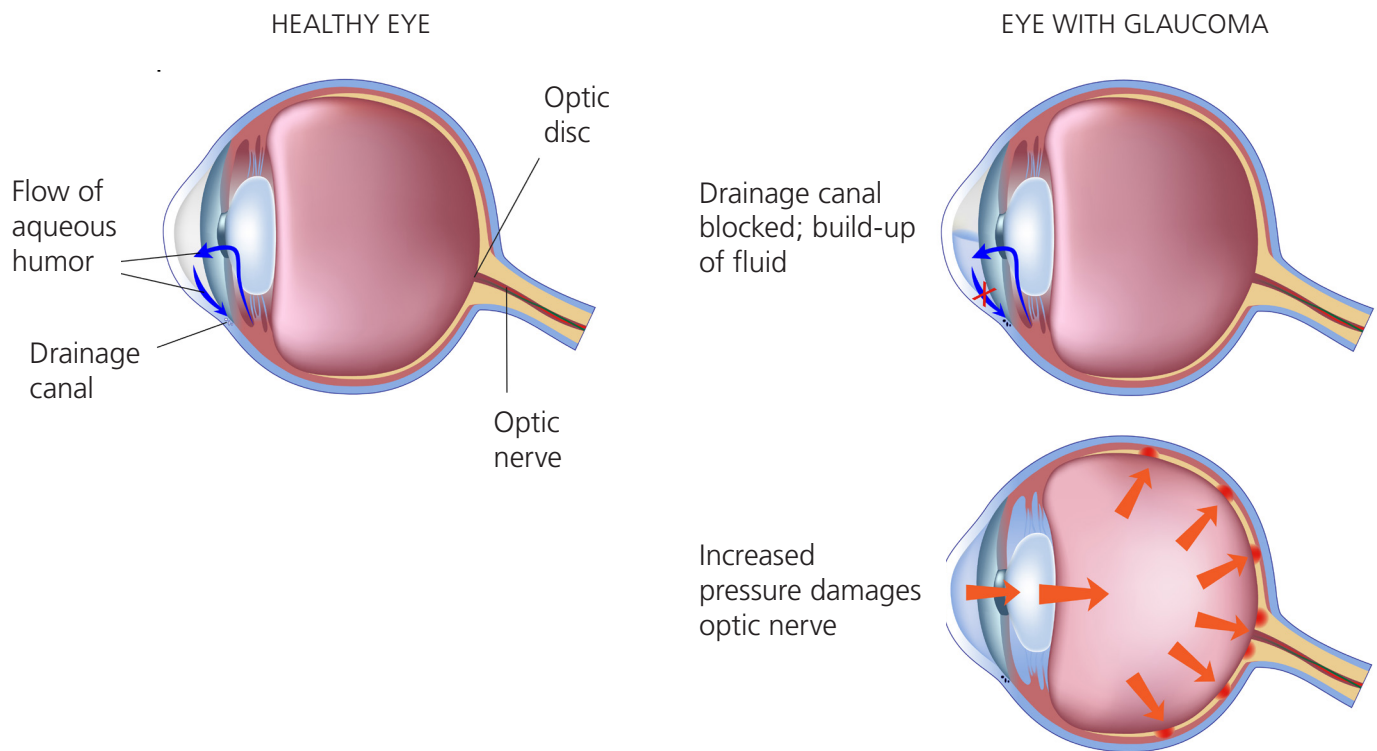
The front part of the eye is filled with a clear fluid (called *aqueous humor*) made by the *ciliary body*. The fluid flows out through the pupil. It then reaches the eye's drainage system, including the *trabecular meshwork* and a network of canals. The inner pressure of the eye (intraocular pressure or "IOP") depends on the balance between how much fluid is made and how much drains out of the eye. If your eye's fluid system is working properly, then the right amount of fluid will be produced. Likewise, if your eye's drainage system is working properly, then fluid can drain freely out to prevent pressure buildup. Proper drainage helps keep eye pressure at a normal level and is an active, continuous process that is needed for the health of the eye.

# HOW GLAUCOMA AFFECTS THE EYE

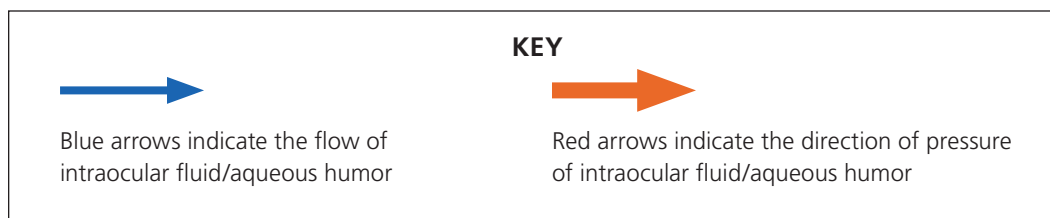
## The Optic Disc

You have millions of nerve fibers that run from your retina to form the optic nerve. These fibers meet at the optic disc. In most types of glaucoma, the eye's drainage system becomes clogged so the intraocular fluid cannot drain. As the fluid builds up, it causes pressure to build inside the eye, which can damage these sensitive nerve fibers and result in vision loss. As the fibers are damaged and lost, the optic disc begins to hollow and develops a cupped shape. Doctors can identify this cupping shape in their examinations. Doctors can identify this cupping shape in their examinations.

### DEVELOPMENT OF GLAUCOMA



**The blockage of drainage canals at the front of the eye causes fluid to build up and increases eye pressure. This can lead to optic nerve damage at the back of the eye.**

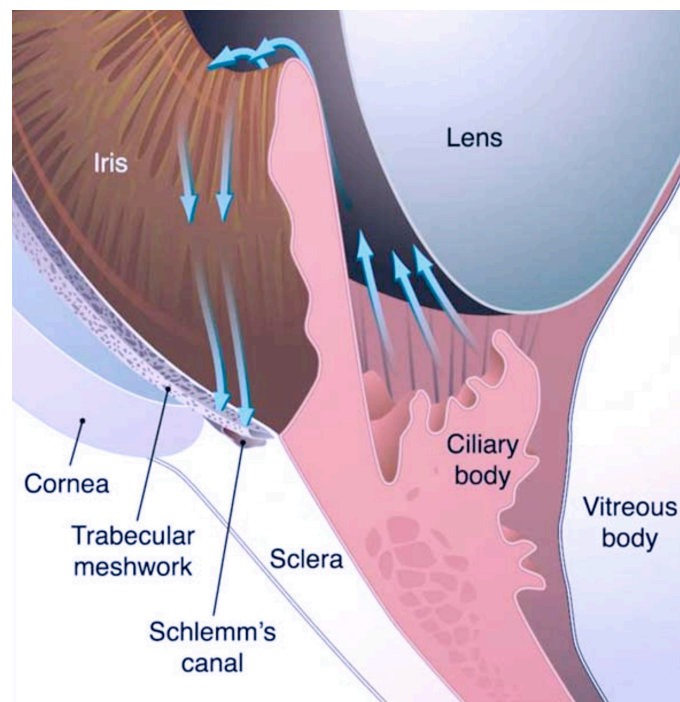


## Intraocular Pressure

A normal intraocular pressure (IOP) ranges between 12 and 22 mmHg (“millimeters of mercury,” a measurement of pressure.) If the pressure remains too high for too long, the extra pressure on the sensitive optic disc can lead to permanent vision loss.

Although high IOP is clearly a risk factor for glaucoma, we know that other factors also are involved because people with IOP in the normal range can experience vision loss from glaucoma. Identifying these other factors is a focus of current research.

### AQUEOUS FLUID PRODUCTION AND DRAINAGE PATHWAY



## Vision Loss in Glaucoma

Glaucoma usually occurs in both eyes, but increased eye pressure tends to happen in one eye first. This damage may cause gradual visual changes and loss of sight over many years. Often, peripheral (side) vision is affected first, so the change in your vision may be small enough that you may not notice it. With time, your central vision may also be affected. Sight lost from glaucoma cannot be restored. However, early detection and treatment can prevent vision loss and maintain remaining vision.

## WHO GETS GLAUCOMA?

Glaucoma affects people of all ages, from babies to teens to younger and older adults.

**ALTHOUGH EVERYONE IS AT RISK FOR GLAUCOMA, THOSE AT HIGHER RISK INCLUDE PEOPLE WHO:**

- Are over 60 years old
- Are of African, Asian, or Hispanic descent
- Have relatives with glaucoma
- Are very nearsighted (myopic) or far-sighted (hyperopic)
- Use steroid medications
- Have high eye pressure
- Have a thin central cornea
- Have had an eye injury



**People who are of African, Asian, or Hispanic descent are at higher risk for glaucoma.**



## ARE THERE SYMPTOMS?

**In the most common form of glaucoma, Primary Open-Angle Glaucoma, buildup of fluid pressure happens very slowly.** There are no uncomfortable or painful symptoms. Usually, the initial loss of vision is of side (peripheral) vision, and central vision is maintained until late in the disease. Since we use our central vision for driving, reading and most tasks, the gradual loss of peripheral vision in glaucoma isn't typically noticed until a significant amount of vision has been permanently lost.

In the less common kinds of glaucoma, symptoms can be noticeable.

### THESE SYMPTOMS CAN INCLUDE:

- Hazy vision
- Eye and head pain
- Nausea or vomiting
- The appearance of rainbow-colored circles around bright lights
- Sudden sight loss

*You should see your doctor if you experience any of the symptoms listed above.*

## WHEN SHOULD YOU GET YOUR EYES CHECKED FOR GLAUCOMA?

Early detection, through regular and complete eye exams, is the key to protecting your vision from damage caused by glaucoma. It is important to have your eyes examined regularly.

You should get a baseline eye screening at age 40. Early signs of eye disease and changes in vision may start to occur at this age. Your eye doctor will tell you how often to have follow-up exams based on the results of this screening. If you have diabetes, high blood pressure, or a family history of glaucoma, you should see an eye doctor now to determine how often to have eye exams.

# Different Types of Glaucoma

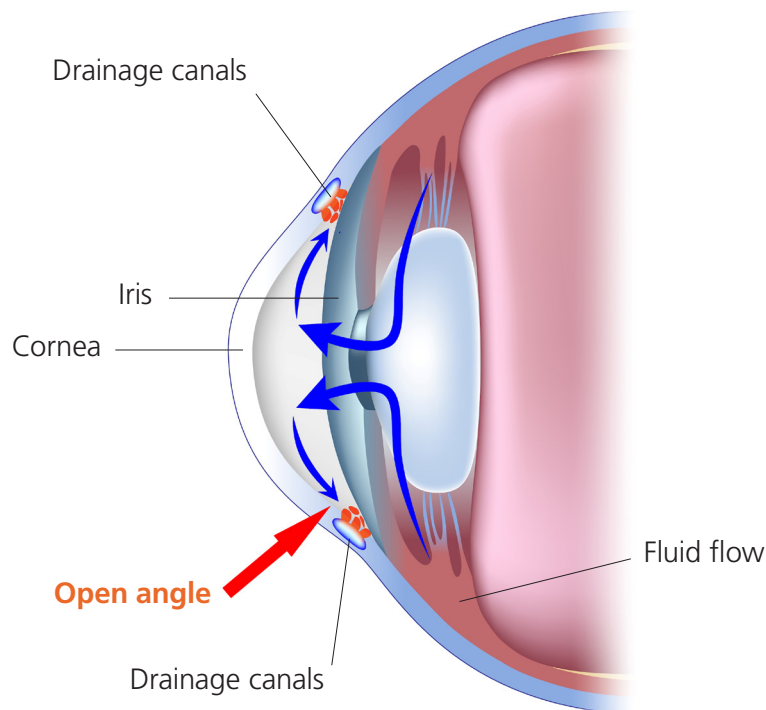
There are several types of glaucoma. The two main types are Open-Angle and Angle-Closure.

## Primary Open-Angle Glaucoma

Primary Open-Angle Glaucoma, the most common form of glaucoma and also called Open-Angle Glaucoma, is a lifelong condition that accounts for at least 90% of all glaucoma cases. In patients with Open-Angle Glaucoma, the angle in your eye where the iris (the colored part of their eye) meets the cornea (the clear window at the front of the eye) is as open as it should be, but the eye's drainage canals become clogged over time, similar to a clogged pipe below the drain in a sink. This can result in the buildup of intraocular fluid and increased eye pressure that can damage the optic nerve.

There are no early warning signs of Open-Angle Glaucoma. It develops slowly and sometimes without noticeable sight loss for many years. If Open-Angle Glaucoma is not diagnosed and treated, it can cause gradual loss of vision. With regular eye exams, Open-Angle Glaucoma may be found early and usually responds well to treatment to preserve vision.

### FLUID PATHWAY IN OPEN-ANGLE GLAUCOMA



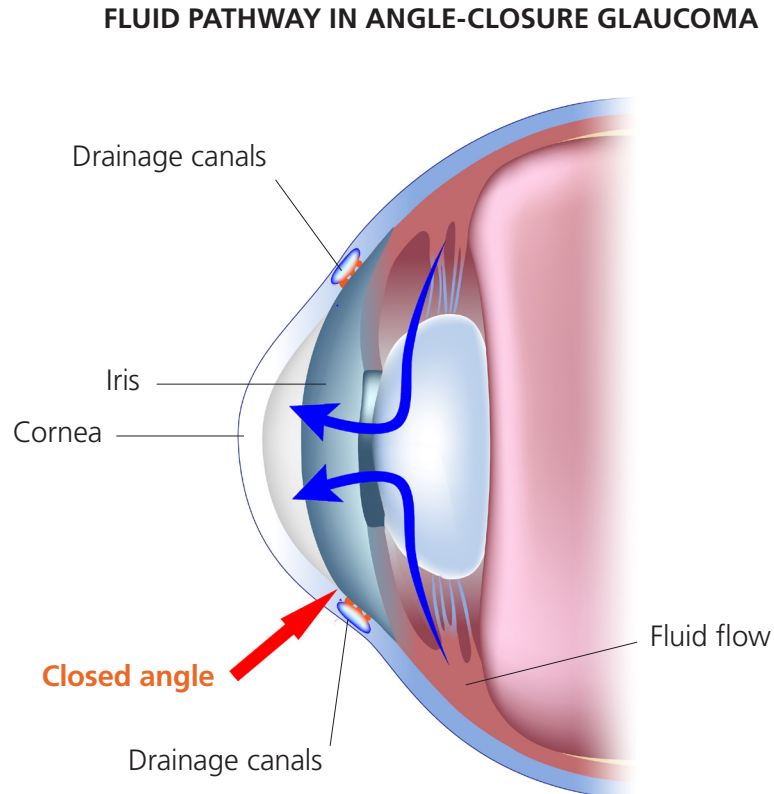
**The angle between the iris and cornea is open in Open-Angle Glaucoma. But the drainage canals become clogged over time.**

## Primary Angle-Closure Glaucoma

The other main type of glaucoma is Primary Angle-Closure Glaucoma, also called Narrow-Angle Glaucoma. In this type of glaucoma, the angle in many or most areas between the iris and cornea is closed, reducing fluid drainage and causing increased eye pressure. This increased pressure leads to optic nerve damage and possible vision loss. There are also early stages of the disease in which parts of the angle are closed, but the eye pressure may or may not be high and the optic nerve is not yet affected.

Eye pressure elevation in Primary Angle-Closure Glaucoma usually occurs gradually and has no symptoms. Rarely the rise in pressure occurs rapidly—an acute attack of angle-closure. In Acute Angle-Closure Glaucoma, the intraocular pressure rises very quickly, causing noticeable symptoms such as eye pain, blurry vision, redness, rainbow-colored rings (“haloes”) around lights, and nausea and/or vomiting.

Acute Angle-Closure Glaucoma is a medical emergency. It can cause permanent vision damage and requires immediate medical attention.



**The angle between the iris and cornea is narrow or closed in Angle-Closure Glaucoma. More of the angle may become closed over time.**

## OTHER TYPES OF GLAUCOMA

Most other types of glaucoma are variations of the open-angle or angle-closure types. These glaucoma types can occur in one or both eyes.

### Normal-Tension Glaucoma

Normal-Tension Glaucoma (NTG), also known as Low-Tension Glaucoma, is a form of glaucoma in which damage occurs to the optic nerve even though the eye pressure is not high. The cause of Normal-Tension Glaucoma is unknown. Researchers are studying why some optic nerves are damaged by these relatively low fluid pressures.

People at higher risk for Normal-Tension Glaucoma have a family history of Normal-Tension Glaucoma, are of Japanese ancestry, or have a history of systemic heart disease such as irregular heart rhythm, have migraines, or low diastolic blood pressure.

### Secondary Glaucoma

Secondary Glaucoma is any form of glaucoma that has an identifiable cause for increased eye pressure that results in optic nerve damage and vision loss. For example, an eye injury, inflammation, and certain drugs may cause a Secondary Glaucoma. Secondary Glaucoma includes Pigmentary Glaucoma, Congenital Glaucoma, Exfoliative Glaucoma, Neovascular Glaucoma, Uveitic Glaucoma, and Traumatic Glaucoma. The treatment for Secondary Glaucoma depends on whether it is open angle or angle closure.

### Pigmentary Glaucoma

Pigmentary glaucoma is a form of Open-Angle Glaucoma that occurs when tiny pigment granules on the back of the iris break off into the aqueous humor and become trapped in the eye's drainage system. The pigment can block the eye's drainage canals and lead to an increase in eye pressure and damage to the optic nerve. This condition is more common in young, Caucasian, male patients who are near-sighted.

### Congenital Glaucoma

Congenital Glaucoma occurs in babies when there is incorrect or incomplete development of the eye's drainage canals before birth. This leads to increased eye pressure that can damage the optic nerve. Symptoms of Congenital Glaucoma include unusually large eyes, excessive tearing, cloudiness of the cornea, and sensitivity to light. This is a rare condition that may be inherited.

## Exfoliative Glaucoma

Exfoliative Glaucoma, also known as Pseudoexfoliative Glaucoma, occurs when a flaky, dandruff-like material peels off the outer layer of the lens within the eye. The material collects in the angle between the cornea and iris and can clog the drainage system of the eye, causing eye pressure to rise. This is a type of Open-Angle Glaucoma that is known for causing more episodes of high pressure, more fluctuations, and higher peak pressures than other types of glaucoma. It is associated with a gene and is more common in certain racial groups, including people from Nordic countries, Russia, and India, Mediterranean populations, and others.

## Neovascular Glaucoma

Neovascular Glaucoma is caused by the abnormal formation of new blood vessels on the iris and over the eye's drainage canals. The new blood vessels block the eye's fluid from exiting through the drainage canals, causing an increase in eye pressure. Neovascular Glaucoma is always associated with other abnormalities, most often diabetes.

## Uveitic Glaucoma

Uveitic Glaucoma is a result of uveitis, an inflammation of the iris and other nearby structures (together called the "uvea") in the eye. These structures become inflamed and disrupt fluid drainage out of the eye, or the steroid medication used to treat the inflamed structures can damage the drainage canals and result in increased fluid pressure.

## Traumatic Glaucoma

Injury to the eye may cause Traumatic Glaucoma. This form of Open-Angle Glaucoma can occur immediately after the injury or develop many years later. It can be caused by blunt injuries that bruise the eye ("blunt trauma") or by injuries that penetrate the eye.



**Congenital glaucoma can often be corrected with surgery.**



# Detecting Glaucoma

## HOW IS GLAUCOMA DIAGNOSED?

**TO ACCURATELY AND SAFELY DIAGNOSE GLAUCOMA, YOUR EYE DOCTOR WILL CHECK FIVE FACTORS DURING YOUR EXAMINATION:**

- **Tonometry**  
A measure of the pressure inside the eye (intraocular pressure or IOP)
- **Ophthalmoscopy**  
Examination of the shape and color of the optic nerve, also called a dilated eye exam
- **Perimetry**  
A test that measures your field of vision
- **Gonioscopy**  
Examination of the angle in the eye where the iris meets the cornea
- **Pachymetry**  
A measure of the thickness of the cornea

## WHAT TO EXPECT DURING GLAUCOMA EXAMINATIONS

### Tonometry

During tonometry, eye drops are used to numb the eye. Then a doctor or technician uses a device called a tonometer to measure the eye pressure. A small amount of pressure is applied to the eye by a small device. The average range for eye pressure is 12–22 mm Hg (“mm Hg” refers to *millimeters of mercury*, a scale used to record eye pressure.) The level of eye pressure at which glaucoma develops is not the same for everyone, and some people can get glaucoma even if their eye pressures are within the average range of 12–22 mm Hg.

### Ophthalmoscopy

Eye drops are used to dilate the pupil so that the doctor can see into your eye with a special lens to examine the shape and color of the optic nerve and note whether there is glaucoma damage. You may need to wait in a waiting room for your eyes to fully dilate. The doctor will use a small device to shine light on and magnify the optic nerve. The doctor will check if the optic nerve is cupped or not a healthy pink color, which may be a cause for concern.



**Checking the eye pressure using tonometry.**

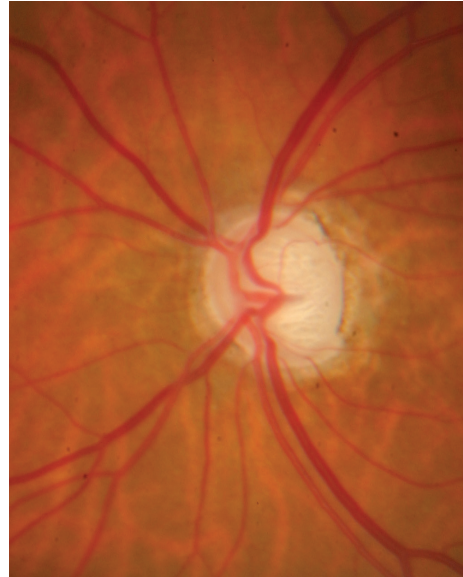


**An ophthalmoscope helps your doctor see your optic nerve.**

Various laser-based imaging technologies can also be used to examine the optic nerve and of these, Optical Coherence Tomography (OCT) is the most commonly used. OCT measures the reflection of laser light (much like ultrasound measures the reflection of sound) and can directly measure the thickness of the nerve fiber layer. Imaging your optic disc over time during multiple visits can help detect progressive loss of optic nerve fibers.



**Healthy optic nerve**



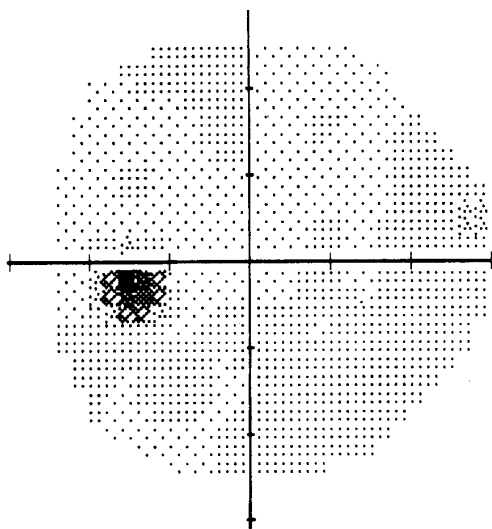
**Optic nerve in eye with glaucoma**

## Perimetry

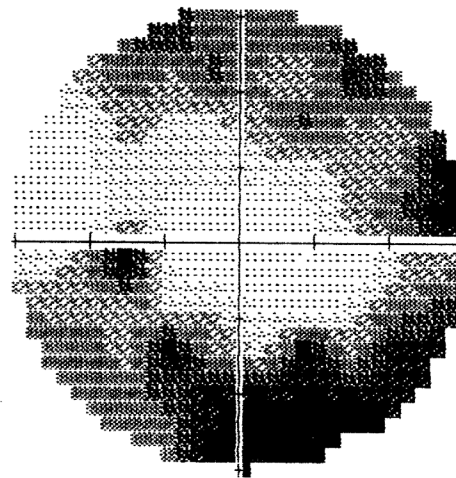
Perimetry (or “visual field testing”) produces a map of your field of vision. This test will help your doctor determine whether your vision has been affected by glaucoma.

During this test, you will be asked to look straight ahead and then press a button whenever you see a spot of light in your peripheral (side) vision. The spots of light will vary in intensity such that some are very easy to see and others are not visible even when vision is normal. Do not be concerned if there is a delay in seeing the light as it may be in or around your blind spot. This is perfectly normal and does not necessarily mean that your field of vision is damaged. Try to relax, blink normally, and respond as accurately as possible during the test. Don’t worry if you feel you missed a spot as areas are automatically retested. Your test performance may vary if you are tested at the end of a long day.

Your doctor may want you to repeat the test to see if the results are the same. After glaucoma has been diagnosed, visual field tests are usually done one to two times a year to check for any changes in your vision.



Visual field within normal limits



Visual field outside normal limits

**Test results from a normal visual field without vision loss (left) and a visual field with vision loss from glaucoma (right). Darker gray and black areas represent loss of vision in a visual field. The optic disc appears black in both fields since there is no vision there; this is normal.**

## Gonioscopy

Gonioscopy is a diagnostic exam that helps determine whether the angle where the iris meets the cornea is open or closed. During the exam, eye drops are used to numb the eye, and a special hand-held lens is gently placed on the eye for a few moments. This special lens includes a mirror that allows the doctor to see the angle between the iris and cornea to determine its status.



**Gonioscopy uses a special mirrored lens to see the angle between the iris and cornea.**

## Pachymetry

Pachymetry is a simple, painless test that measures the thickness of the cornea—the clear window at the front of the eye—using a probe that is gently placed on your eye. A thin cornea is a risk factor for glaucoma. Corneal thickness also has the potential to influence eye pressure readings. For example, if a cornea is thicker than average, pressure readings with a tonometer may be higher than the actual pressure and if a cornea is thinner pressure readings may be lower than actual. Using pachymetry, your doctor can better understand your eye pressure readings and develop a treatment plan that is right for you.

## WHY ARE THERE SO MANY DIFFERENT EXAMS AND TESTS?

Diagnosing glaucoma is not always easy, and careful evaluation of the optic nerve continues to be essential to diagnosis and treatment. Doctors look at many factors before they make recommendations about your treatment. Their most important goal is to protect your sight. If your condition is particularly difficult to diagnose or treat, you may be referred to a glaucoma specialist. A second opinion is always wise if you or your doctor become concerned about your diagnosis or your progress.



# Treating Glaucoma

Glaucoma is treated by lowering intraocular pressure, and this can be achieved with laser surgery, medications, conventional (“incisional”) surgery, or a combination of these. Treatment plans can differ depending on the type of glaucoma and the individual patient. Treatment options are organized below by glaucoma type.

## TREATMENT OF PRIMARY OPEN-ANGLE GLAUCOMA

### Selective Laser Trabeculoplasty (SLT)

Selective laser trabeculoplasty (SLT), often a first-line treatment for Open-Angle Glaucoma, can also be effective in patients already on eye drops. SLT uses low levels of laser light to improve drainage of intraocular fluid through the natural drainage pathway out of the eye. For most eyes this improved drainage helps lower eye pressure and a single treatment’s effect lasts 2 to 3 years, and sometimes longer. Since SLT leaves the drainage canals intact, it can be repeated if the initial treatment was effective. Minor self-limited inflammation follows SLT and may aid in the eye pressure lowering effect.

Some patients can have their eye pressure controlled with SLT alone. Others require glaucoma medications also or incisional surgery in the operating room.

#### WHAT TO EXPECT:

- SLT is performed in an outpatient setting, frequently in the doctor’s office.
- Your doctor will use special eye drops to numb your eye. Then, your doctor will have you sit at the laser and place a special lens with contact lens gel on your eye to help direct the laser light onto the drainage canals in your eye.
- You will hear a series of clicks and see bright lights, like a camera flash, as your doctor performs the procedure. You may feel a slight tingling sensation, but the procedure is nearly painless.
- SLT takes about 5-10 minutes.
- At the end of the treatment, the lens is removed and your vision will be blurry until the thick contact lens gel is rinsed off.
- After the treatment, you should take it easy for a day and then return to your daily routine.

## Glaucoma Medications

Open-Angle Glaucoma is often treated with medications that either help the eye's fluid drain better or decrease the amount of fluid being made. Medications must be taken daily to keep eye pressure at a safe level. In most cases, medications can safely control eye pressure for many years.

### TIPS TO HELP STAY ON TRACK WITH YOUR MEDICATION ROUTINE:

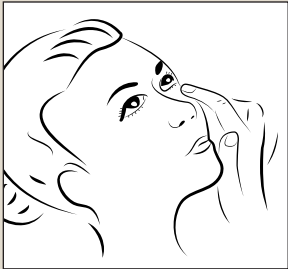
- **Make a schedule:** Write down the name, dosage, and number of times your medication(s) should be taken each day.
- **Use an alarm or smartphone to set reminders.** There are many smartphone apps now available.
- **Schedule medications around daily routines like waking and mealtime.** Remember that twice a day means every 12 hours, for example, 7 am and 7 pm.
- **Put your medications and your schedule in a place where you will see them often,** such as on the refrigerator door or above your desk at work.
- You may find **color coding your medications will help** you identify them easier.
- **Take your medications with you** when you go out.
- **If you forget to use your eye drops, put them in as soon as you remember** instead of waiting until the next scheduled time. Get back on your regular schedule for the next dose.
- **Always check with your doctor if you are not sure about any part of your medication routine.** You may want to demonstrate for your doctor how you put in your eye drops to be sure you are doing it most effectively.

It is normal for your medication prescriptions to change over time. Changing medications does not necessarily mean that your glaucoma is getting worse. As your body begins to develop a tolerance for a medication, it may slowly lose its effectiveness and may need to be replaced by a stronger version of the same drug or a different medication. Doctors often can return to previously used medications after your body has had a chance to “forget” the old medication.

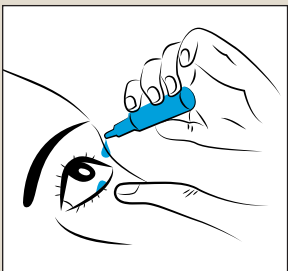
Glaucoma medications most commonly are in the form of eye drops. It is important to put them in your eye correctly.

## HOW TO USE EYE DROPS

Before using eye drops, wash your hands. Sit down and tilt your head back, or lie down and look at the ceiling.



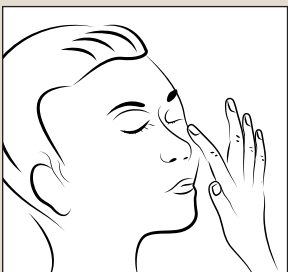
Make a pocket in your lower lid by pulling the lid down with your index finger.



Look up. Squeeze one drop into the pocket in your lower lid. To prevent the tip from getting dirty, don't blink, wipe your eye, or touch the tip of the bottle to your eye or face.

*Tip:* If you are having trouble holding onto the bottle, try wrapping something (like a paper towel) around the bottle to make it wider. If your hands are shaking, try approaching your eye from the side so you can rest your hand on your face to help steady your hand.

*Tip:* If you are having trouble getting the drop into your eye, lie down flat, face up, with your eye closed. Place the drop outside of the lid in the corner of your eye near your nose. As you open your eye, the drop will roll in.



Close your eye gently. Keep your eye closed for 2-3 minutes without blinking.

*Tip:* If you are not sure the drop actually got into your eye, put in another. The eyelid can hold only about one drop, so any excess will run out of your eye. It is better to have excess runoff than to not have enough medication in your eye.

**If using two or more medications at the same time, wait 3-5 minutes before putting the next drop in your eye to make sure the first drop has been absorbed. Repeat steps 1-4 for each eye and each medication you use.**

Some manufacturers of glaucoma eye drop medications make helpful devices that can assist you in putting the drops in your eye. If you continue to have trouble despite these suggestions, ask your eye doctor if such a device might be useful to you.

Most medications have some side effects, including effects on vision, eye comfort, and sometimes other parts of your body. In particular, older people with glaucoma should look for changes in behavior or mobility that may be a side effect of medications. If the side effects are very uncomfortable or last a while, your doctor may be able to prescribe a different medication. To make sure your glaucoma medications are not interacting with other medications you are taking, make sure to tell all of your doctors, including your family physician, about your glaucoma medications and any other drugs you may be taking, including aspirin, vitamins and natural remedies. Tell your doctors about any side effects you may be experiencing or allergies you have.

#### **THE FOLLOWING ARE SOME OF THE POSSIBLE SIDE EFFECTS OF THE MAIN CLASSES OF GLAUCOMA MEDICATIONS:**

- **Prostaglandin Analogs**

Eye color change, darkening of eyelid skin, eyelash growth, droopy eyelids, sunken eyes, stinging, eye redness, and itching

- **Beta Blockers**

Low blood pressure, slowed pulse rate, fatigue, shortness of breath

- **Alpha Agonists**

Burning or stinging, fatigue, headache, drowsiness, dry mouth and nose, allergic reaction

- **Carbonic Anhydrase Inhibitors**

In eye drop form—stinging, burning, eye discomfort; in pill form—tingling hands and feet, fatigue, stomach upset, memory problems, frequent urination

- **Rho Kinase Inhibitors**

Eye redness, deposits on cornea, stinging, small bleeds on the white of the eye

*For more information on possible side effects of medications, see Glaucoma Medication Guide in the Appendix. (Pages 36–37)*

## ON THE HORIZON

New forms of glaucoma drug delivery are being developed to improve medication treatment options. One area of interest is “sustained-release” medication. Sustained-release medication evenly releases a drug over a longer time. In this way, medications can be used weekly, monthly, or at even longer intervals. This would make the process of taking medications more convenient and efficient and potentially reduce side effects. There are many sustained-release options being researched and developed.

In addition, new classes of drugs to treat glaucoma are being studied. Researchers are working to find glaucoma medications with fewer side effects, ones that can be taken less often, and drugs that are more responsive to the eye and so more effective at lowering eye pressure.

Medications and Selective Laser Trabeculoplasty are important ways of treating Open-Angle Glaucoma. Medications may be used before SLT, with SLT, and after SLT to manage glaucoma. You and your doctor will decide together the best initial treatment approach for you.

## Incisional Surgery

When SLT, glaucoma medications, and other treatments do not lower eye pressure to the desired level, your doctor may recommend some form of incisional surgery. This surgery is done in a hospital or surgery center, using a microscope and microsurgery instruments, and includes making a cut (incision) in the eye.

### WHAT TO EXPECT:

- Before surgery begins, a local anesthetic along with a medication to help you relax is given to prevent you from feeling any discomfort during the procedure.
- During surgery, the doctor looks through a microscope that is placed several inches above your eye.
- Eye surgery does require some recovery time, which will vary according to your age, daily activities, and other personal factors. Most people can move around and return to their normal activities soon after going home, though you may have to wear an eye patch to protect your eye.
- For at least a week after glaucoma surgery, it is advisable to keep water out of the eye. It is also good to take a break from driving, reading, bending, and strenuous exercise.
- Glaucoma surgery may have to be repeated, especially if excessive scarring cannot be prevented or after long periods of time.



## MINIMALLY INVASIVE GLAUCOMA SURGERY (MIGS)

Minimally Invasive Glaucoma Surgery (MIGS) procedures have been developed in recent years to treat patients earlier and more safely than conventional surgery. As with all new procedures, multi-year follow-up studies are required to see which ones will remain useful long-term.

MIGS procedures include microsurgical instruments and devices and smaller incisions that manipulate the eye tissues less and therefore reduce the risk of complications. The increased safety of these surgeries is traded for reduced effectiveness.

MIGS procedures and devices may work in a number of ways. Some enhance fluid outflow within the eye's drainage system, some carry fluid to the outside of the eye. Some types of MIGS procedures are to be done only with cataract surgery, whereas other MIGS procedures can be performed independent of cataract surgery.

Cataract surgery alone lowers pressure, and the combination of a MIGS surgery and cataract surgery can lower pressure more to help reduce the need for medication. Implanting a MIGS device adds a few minutes to cataract surgery.

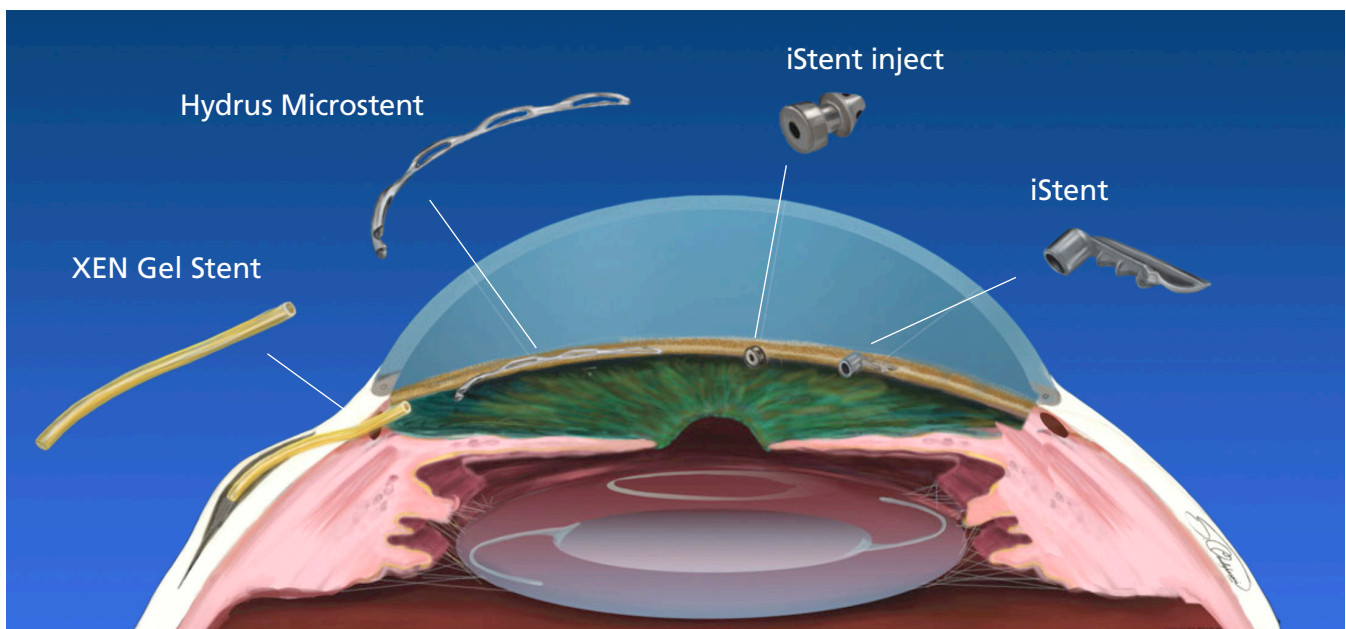


**MIGS procedures promise improved safety.**

## THE MIGS GROUP OF DEVICES AND SURGERIES ARE DIVIDED INTO CATEGORIES ACCORDING TO HOW THEY WORK:

- **Miniaturized versions of trabeculectomy:** In these procedures, tiny tubes are inserted into the eye to help drain fluid from inside the eye to underneath the outer membrane of the eye (conjunctiva). For example, the FDA cleared XEN Gel Stent and the PRESERFLO (formerly InnFocus) MicroShunt cleared outside the US.
- **Trabecular surgery:** Several procedures use specialized instruments and devices to cut through or bypass the eye's drainage canals (trabecular meshwork) without damaging any other tissues in the drainage pathway. The Trabectome, Trab360, and Kahook Dual Blade procedures are examples of this type of surgery.
- **Totally internal shunts:** Using tiny tubes with very small internal openings, the front of the eye is connected to the drainage channels of the eye bypassing the trabecular meshwork to improve the drainage of fluid from the eye. Shunts made by Glaukos and Ivantis are devices currently in use.

### PLACEMENT OF SOME MIGS DEVICES



Conventional surgeries for glaucoma include trabeculectomy or aqueous shunts (see below). While they can be more effective at lowering eye pressure and preventing progression of glaucoma, they also have more potential complications.

### **TRABECULECTOMY SURGERY**

In this procedure, a tiny opening is made in the sclera (the white part of the eye) with a small surgical instrument. This new opening allows the intraocular fluid to bypass the clogged drainage canals and directly flow out of this new opening. Special medications (“antifibrotics”) may be used to prevent scarring and closure of the new opening. The opening is covered by conjunctiva creating a bleb on the sclera. This procedure requires stitches and the recovery period is usually a few weeks.

### **AQUEOUS SHUNT SURGERY**

During aqueous shunt surgery, a tiny tube is implanted that drains fluid out of the eye. Like trabeculectomy, this conventional surgery also requires stitches and the recovery period is usually a few weeks.



**Three-dimensional eye models are often used as visual aids to explain surgical eye procedures.**

## Unapproved Treatments

There are many unapproved treatments that are promoted on the internet and elsewhere, including marijuana/cannabidiol (CBD), stem cells, herbal medicines, and nutritional supplements. These treatments are not part of the standard of care in glaucoma treatment and may negatively impact your current treatment. You should discuss any additional treatments you are considering with your doctor before starting them.

**Stem cells:** Stem cells have not yet been properly tested in patients with glaucoma to look for their ability to stabilize or reverse vision loss. The risks for undergoing stem cell injections could be significant, including infection, inflammation, and more severe vision loss.

**Marijuana/Cannabidiol:** While marijuana does lower eye pressure, it has major drawbacks as a treatment for a chronic, long-term disease like glaucoma, including only temporary reduction in eye pressure and physical and mental side effects of use including impaired judgment and coordination, increased paranoia, elevated heart rate, and eye irritation. Cannabidiol, or “CBD,” may actually increase eye pressure and therefore increase your risk of vision loss.

**Herbal Medicines and Nutritional Supplements:** While good nutrition plays a role in disease prevention and overall health, there is no convincing data that herbal medicines or nutritional supplements, such as vitamins, help to prevent glaucoma. Certain herbs such as ginkgo biloba and bilberry may even increase the risk of bleeding with glaucoma surgery.

## TREATMENT OF PRIMARY ANGLE-CLOSURE GLAUCOMA

Treatment of Angle-Closure Glaucoma and eyes at risk for this disease usually involves a laser procedure, laser peripheral iridotomy, to create a small opening in the outer edge of the iris. If you have Angle-Closure Glaucoma in one eye, your doctor may treat the other eye as a safety measure.

Other treatments are similar to those for Open-Angle Glaucoma and include medications to lower eye pressure, trabeculectomy or tube shunt surgery, and, rarely, Selective Laser Trabeculoplasty. To learn more about these treatments, see the corresponding sections for Open-Angle Glaucoma in the Treating Glaucoma section.

Cataract surgery has also been shown to help in the treatment of Primary Angle-Closure Glaucoma. Removing the cataract opens the angle and usually has a favorable effect on the eye pressure.

## **TREATMENT OF OTHER TYPES OF GLAUCOMA**

### **Treatment of Normal-Tension Glaucoma**

Most doctors treat Normal-Tension Glaucoma by reducing the eye pressure as low as possible using medications, laser treatments, and surgery. To learn more about these treatments, see the corresponding sections for Open-Angle Glaucoma in the Treating Glaucoma section.

### **Treatment of Pigmentary Glaucoma**

The treatment of Pigmentary Glaucoma involves lowering eye pressure using medications, laser treatments, or surgery. Unfortunately, it is difficult to reduce or eliminate the release of iris pigment. Therefore, attention is focused on reducing eye pressure. To learn more about these treatments, see the corresponding sections for Open-Angle Glaucoma in the Treating Glaucoma section.

### **Treatment of Congenital Glaucoma**

Both medication and surgery are used to treat Congenital Glaucoma. Medications can be in the form of eye drops, pills, or liquids to be taken by mouth. Laser surgery also may be used.

These treatments help to either decrease the amount of fluid made in the eye or increase the amount of fluid out of the eye to lower eye pressure. Surgical procedures that are used to help control eye pressure in Congenital Glaucoma include filtering surgery, aqueous shunt surgery, and goniosurgery, a special procedure that opens canals in the trabecular meshwork. It is sometimes necessary to repeat glaucoma surgery in order to successfully control eye pressure. To learn more about these treatments, see the corresponding sections for Open-Angle Glaucoma in the Treating Glaucoma section.

### **Treatment of Exfoliative Glaucoma**

Generally, this kind of glaucoma is more difficult to control with medication. Patients with Exfoliative Glaucoma often require a more aggressive, stepwise treatment plan and more often need laser treatment or surgery. Often more frequent visits to their eye doctor are necessary to monitor for disease progression.

To learn more about these treatments, see the corresponding sections for Open-Angle Glaucoma in the Treating Glaucoma section.



## Treatment of Neovascular Glaucoma

Treatments for Neovascular Glaucoma often involve decreasing the growth of blood vessels. These treatments include laser treatment to the retina and anti-VEGF drugs which lead to regression of abnormal blood vessels in the eye. Medications used for Open-Angle Glaucoma may be used also, as well as surgery that includes trabeculectomy and drainage implant procedures. To learn more about these treatments, see the corresponding sections for Open-Angle Glaucoma in the Treating Glaucoma section.

## Treatment of Uveitic Glaucoma

To treat elevated eye pressure in Uveitic Glaucoma, doctors use many of the same eye pressure-lowering medications as those used for Open-Angle Glaucoma. Laser treatments typically are not used because they can cause more inflammation. In cases that cannot be controlled with medication, surgical treatment may involve an aqueous shunt. To learn more about these treatments, see the corresponding sections for Open-Angle Glaucoma in the Treating Glaucoma section. In addition to treatment by an eye doctor, sometimes a rheumatologist will prescribe medication to treat the root cause of the inflammation.

## Treatment of Traumatic Glaucoma

The treatment of Traumatic Glaucoma varies depending on when glaucoma develops and the type of eye injury. When glaucoma occurs years after an eye injury, the treatment is similar to Open-Angle Glaucoma except that SLT is usually not effective. When glaucoma develops immediately after eye injury, the treatment is mainly guided by the type of trauma and the extent of damage to the eye.



**Medicated eye drops are used as a treatment in many kinds of glaucoma.**



# Frequently Asked Questions

## **WILL I GO BLIND?**

Fortunately, for most patients the answer is no. Blindness does occur from glaucoma, but it is a relatively rare occurrence in about 5% of glaucoma patients. However, sight impairment is more common and occurs in about 10% of patients.

Correct treatment and follow-up will stabilize the vast majority of patients with glaucoma. By working with your doctor to manage your glaucoma in the ways we have outlined in this booklet, a favorable outcome is more likely.

## **WHAT IS IT LIKE TO HAVE GLAUCOMA?**

You will have periodic visits with your doctor to check on your condition, and you may need to take eye drop medications as a part of your daily routine, but overall you can continue with what you were doing before you were diagnosed with glaucoma. You can make new plans and start new ventures. The eye care community, including the Glaucoma Research Foundation, is here to support you and will keep looking for better methods to treat glaucoma and eventually find a cure.

Some daily activities such as driving or playing certain sports may become more challenging. Loss of contrast sensitivity (the ability to see shades of the same color,) problems with glare, and light sensitivity are some of the possible effects of glaucoma that may interfere with your activities.

### *Useful tips:*

The key is to trust your judgment. If you are having trouble seeing at night, you may want to consider not driving at night. Stay safe by adjusting your schedule so that you do most of your travel during the day.

Sunglasses or tinted lenses can help with glare and contrast. Yellow, amber, and brown are the best tints to block out glare from fluorescent lights. On a bright day, try using glasses with brown lenses. For overcast days or at night, try using the lighter tints of yellow and amber. Experiment to see what works best for you under different circumstances.

## **HOW OFTEN SHOULD I SEE MY EYE DOCTOR?**

As a newly diagnosed person with glaucoma, you may need to have your eye pressure checked every week or month until it is under control. Even when your eye pressure is at a safe level, you may need to see your doctor several times a year for checkups. How often you get checked by your eye doctor is part of the treatment plan you and your doctor will decide together.

## **WHAT IS THE IMPORTANCE OF EYE EXAMS FOR FAMILY MEMBERS?**

People who have a family history of glaucoma may be at higher risk for developing the condition, so you should encourage your family members to go to an eye doctor to have their eye pressure and optic nerves checked regularly. Many people are unaware of the importance of eye checkups and do not know that individuals with glaucoma may have no symptoms.

## **IS THERE A CURE?**

Glaucoma is not curable, and vision lost cannot be restored. With medication, laser treatment and surgery, it is possible to slow or stop further loss of vision. Since Open-Angle Glaucoma cannot be cured, it must be monitored for life. Diagnosis is the first step to preserving your vision.

## **IS IT HEREDITARY?**

Some forms of glaucoma are inherited, and many scientists worldwide are studying genes and their influence on glaucoma. But in many cases, glaucoma is not inherited, and the factors leading to disease onset are not well understood.

## **CAN VISION THAT IS LOST DUE TO GLAUCOMA BE RESTORED?**

In the retina, neurons (nerve cells) and the optic nerve are not regenerated once they are lost. However, many research centers are working to develop ways for replacing lost retinal neurons. If successful, this research could one day be applied to glaucoma and other neurodegenerative diseases.

# Living with Glaucoma

## WORKING WITH YOUR DOCTOR

It is important that your doctor listens and responds to your concerns and questions, is willing to explain your treatment options, and is available for calls and checkups. If you do not feel confident and comfortable with your doctor, or at any point in your care, remember you always have the right to seek a second opinion. Effective treatment starts with a good working relationship with your eye doctor.

### TIPS FOR WORKING WITH YOUR DOCTOR

- Keep a good record of your appointment date and time, and make sure you have enough time planned for the visit. Go for a checkup before you go on a long trip or start a long-term project.
- Write down any questions you have about your eyes, vision, or medications before you see your doctor. During your checkup, bring this list of questions, and write down your doctor's answers.
- Let your doctor know if, for any reason, your medications are not working for you or if your daily routine has changed. Your doctor may be able to solve such problems by changing the type or timing of your medications.
- Bringing a friend or family member along to your appointment as a second set of ears can help you capture all the details from your visit. This can be especially helpful early in your diagnosis.
- Report any new symptoms to your doctor such as redness, irritation, itching, tearing, or decreased vision. Symptoms that you have may be related to the disease or to side effects or complications of medication or surgery.



**A good relationship with your eye doctor is important.**

- Bring all of your medications and an updated list to your appointment. This not only allows your doctor to see what you are currently using and how often but also allows you to check the need for refills. Be honest about how regularly you have been taking your eye drops, as this may influence treatment decisions. Any new medication added by other doctors should be mentioned to your glaucoma doctor.
- It is important to leave your doctor's office with a clear understanding of whether things are remaining stable or possibly getting worse, or if additional testing is required. Make sure you have the information you need. Details can be hard to remember. Ask the doctor to write out the treatment plan in large clear letters and, if necessary, color code the medication and instructions.
- Schedule your next appointment before you leave the doctor's office and put the appointment on your calendar.
- Use the medical support team. Trained staff at your doctor's office, such as technicians and nurses, can be an enormous support to helping you manage your disease. These knowledgeable professionals can often give you the information, time, and attention that can make a big difference.

With these tips, going to see your glaucoma doctor can not only be less stressful but also more productive. Having the right outlook can strengthen your patient-doctor partnership for providing you the most beneficial care.

## Responding to Vision Changes Due to Glaucoma

Some people with glaucoma have “low vision.” Low vision means there may be problems doing daily, routine things even when wearing glasses or contact lenses. With glaucoma, this can include loss of contrast sensitivity (the ability to see shades of the same color), problems with glare, light sensitivity, and reduced visual acuity (the ability to see fine details). A variety of products and resources are available to help people who have low vision. Examples include magnifiers, colored lenses, computer text enlargers, and apps for voice to text and text to audio. If you have concerns about low vision, help is available. Discuss your concerns with your doctor.

### QUESTIONS FOR YOUR DOCTOR

#### **The Basics**

- What type of glaucoma do I have?
- Did something cause my condition? And if so, what?
- How will my vision be affected now and long-term?
- Is it hereditary? What should I tell my family about my glaucoma?

#### **Treatment**

- What are my treatment options?
- Which treatments are most appropriate for me? Why?
- What are the possible risks and side effects of this treatment?
- What could happen without treatment?
- What medications do you recommend? Will they interact with any other medications or dietary supplements I am taking?
- How long will this treatment last?
- How will I know if the treatment is working?
- How often will I need checkups?

#### **Lifestyle Changes**

- Should I take special precautions when working or driving?  
And if so, what?
- Which activities should I avoid?

#### **Support**

- Can you recommend any glaucoma support groups?





## Your Lifestyle Counts

- Do not rub your eyes, even though some glaucoma medications might make them feel itchy or blurry.
- If you have had eye surgery, it is a good idea to wear goggles when swimming and protective glasses when doing yard work or when playing contact sports.
- Take care of the rest of your body. Keeping in good general health is just as important as taking care of your eyes.
- Eating healthy foods, getting enough exercise, not smoking, not ingesting too much caffeine, and staying at a healthy weight are important. Be sure to check with your doctor before you start any strenuous exercise program.
- Space out your fluid intake.
- Reduce stress in your life and make time for relaxation.



## Looking Ahead



Glaucoma has another side—the emotional and psychological aspects of having a chronic, sight-threatening health condition. When you are first diagnosed with glaucoma you may experience worry, fear, helplessness, depression, or low energy. Your feelings are important. Take the time to learn about the disease and you will find that there are many steps you can take to help manage your glaucoma. Even if you lose some of your vision, you can work with low-vision rehabilitation counselors to learn how to continue leading an active life.

As a glaucoma patient, you have the chance to teach your friends and relatives about this disease. Many people are unaware of the importance of eye checkups and do not know that individuals with glaucoma may have no symptoms. You can help protect their eye health by encouraging them to have their eye pressure and optic nerves checked regularly.

We are limited only by what we think we can or cannot do. You can continue with what you were doing before your glaucoma was diagnosed. And you can trust the eye care community to keep looking for better treatment methods for glaucoma. Take good care of yourself and your eyes and get on with enjoying your life.

# A Guide to Glaucoma Medications

## ALPHA AGONISTS

MANUFACTURER	PRODUCT NAME	GENERIC NAME
Allergan, Inc.	Alphagan® P	Brimonidine tartrate 0.1%, 0.15%
Novartis	lopidine®	Apraclonidine HCl 0.5%, 1%

**ACTION:** Decreases the production of intraocular fluid. Also increases drainage of intraocular fluid.

**NOTES:** Side effects can include burning or stinging upon instillation of the eye drop, fatigue, headache, drowsiness, dry mouth, and dry nose.

## BETA BLOCKERS

MANUFACTURER	PRODUCT NAME	GENERIC NAME
Akorn Inc.	Betimol®	Timolol hemihydrate 0.25%, 0.5%
	Timolol Maleate USP	Timolol maleate 0.5%
Allergan, Inc.	Betagan®	Levobunolol HCl 0.25%, 0.5%
	Istalol®	Timolol maleate ophthalmic solution 0.5%
	OptiPranolol®	Metipranolol 0.3%
Bausch & Lomb, Inc.	Timoptic in Ocudose (PF)	Timolol Maleate Ophthalmic Solution 0.25%, 0.5% in Ocudose dispenser
	Timoptic-XE®	Timolol maleate ophthalmic gel forming solution 0.25%, 0.5%
Novartis	Betoptic® S	Betaxolol HCl 0.25%, 0.5%

**ACTION:** Decreases production of intraocular fluid.

**NOTES:** Side effects can include low blood pressure, reduced pulse rate, and fatigue. Beta blockers can also cause a shortness of breath in people who have a history of asthma or other respiratory disorders. Additionally, beta blockers can change cardiac activity by decreasing the amount of blood the heart pumps out, which may reduce the pulse rate and/or slow down the heart's response rate during exercise. Rare side effects include reduced libido and depression. "PF" indicates "Preservative-Free Medication."

## CARBONIC ANHYDRASE INHIBITOR (CAI)

MANUFACTURER	PRODUCT NAME	GENERIC NAME
Fera Pharmaceuticals	Neptazane®	Methazolamide
Merck & Co., Inc.	Trusopt®	Dorzolamide HCl 2%
Novartis	Azopt™	Brinzolamide ophthalmic suspension 1%
Teva	Diamox® Sequels®	Acetazolamide

**ACTION:** Decreases production of intraocular fluid.

**NOTES:** Side effects of Diamox Sequels can include tingling or loss of strength of the hands and feet, upset stomach, memory problems, depression, kidney stones, and frequent urination. Side effects of Azopt and Trusopt include stinging, burning, and other eye discomfort.

## CHOLINERGIC (MIOTIC)

MANUFACTURER	PRODUCT NAME	GENERIC NAME
Bausch & Lomb, Inc.	Pilocarpine HCl Ophthalmic Solution USP	Pilocarpine HCl 1%, 2%, 4%
	Isopto® Carbachol	Carbachol 0.75%, 1.5%, 3%
Novartis	Isopto® Carpine	Pilocarpine HCl 1%, 2%, 4%
	Pilopine HS® Gel	Pilocarpine HCl gel 4%

**ACTION:** Increases drainage of intraocular fluid.

**NOTES:** Many people who use these medications complain of dim vision, especially at night or in a darkened area such as movie theaters. This is due to constriction of the pupil. Miotics increase drainage of intraocular fluid by making the pupil size smaller and thereby increasing the flow of intraocular fluid from the eye.

## PROSTAGLANDIN ANALOGS

MANUFACTURER	PRODUCT NAME	GENERIC NAME
Akorn Inc.	Zioptan™	Tafluprost ophthalmic solution 0.0015% (PF)
	Durysta™	Bimatoprost 10 mcg implant
Allergan, Inc.	Lumigan®	Bimatoprost 0.01%, 0.03%
Bausch & Lomb, Inc.	Vyzulta™	Latanoprostene bunod 0.024%
Novartis	Travatan® Z	Travaprost 0.004%
Pfizer	Xalatan®	Latanoprost 0.005%
Sun Ophthalmics	Xelpros™	Latanoprost ophthalmic emulsion 0.005%

**ACTION:** Increases drainage of intraocular fluid.

**NOTES:** Side effects can include eye color change, darkening of eyelid skin, eyelash growth, droopy eyelids, sunken eyes, stinging, eye redness, and itching.

## RHO KINASE INHIBITORS

MANUFACTURER	PRODUCT NAME	GENERIC NAME
Aerie Pharmaceuticals, Inc.	Rhopressa®	Netarsudil 0.02%

**ACTION:** Increases drainage of intraocular fluid.

**NOTES:** Side effects can include eye redness, corneal deposits, stinging, and small bleeds on the white of the eye.

## COMBINED DRUGS

MANUFACTURER	PRODUCT NAME	GENERIC NAME
Aerie Pharmaceuticals, Inc.	Rocklatan®	Netarsudil and Latanoprost ophthalmic solution 0.02%/0.005%
Akorn Inc.	Cosopt® Cosopt PF	Dorzolamide HCl & Timolol Maleate
Allergan, Inc.	Combigan®	Brimonidine tartrate & Timolol Maleate ophthalmic solution 0.2%/0.5%
Novartis	Simbrinza®	Brinzolamide & Brimonidine tartrate 1%/0.2%

**ACTION:** Increases drainage of intraocular fluid.

**NOTES:** Rocklatan® is a combination of a rho kinase inhibitor and a prostaglandin analog—side effects include eye redness and stinging. Combigan® is a combination of beta blocker and alpha agonist—side effects include symptoms of both. Cosopt® is a combination of beta blocker and carbonic anhydrase inhibitor—side effects include burning and/or stinging of the eyes and changes in sense of taste. “PF” indicates “Preservative-Free Medication.”

# Glossary

**Angle-Closure Glaucoma or Primary Angle-Closure Glaucoma:** A type of glaucoma in which the angle is closed in many or most areas, causing increased eye pressure, which leads to optic nerve damage, and possible vision loss. This rise in eye pressure may occur suddenly (an acute attack of angle closure) or gradually.

**Aqueous Humor:** The fluid filling the front part of the eye.

**Bleb:** A bubble in the eye tissue that lays over the new drainage opening created during surgery.

**Central Vision:** What is seen when you look straight ahead or when you read.

**Ciliary Body:** Tissues located around the lens of the eye that supply fluid to nourish the eye.

**Congenital Glaucoma:** A rare form of glaucoma that occurs in babies and young children. This condition can be inherited. It is usually the result of incorrect or incomplete development of the eye's drainage canals during the prenatal period.

**Conjunctiva:** A thin, clear membrane that lines the inner surface of the eyelids and the outer surface of the eyeball, except for the cornea.

**Cornea:** The clear part of the eye located in front of the iris. Part of the eye's protective covering.

**Drainage Canals:** Small openings around the outer edge of the iris. These canals provide the final pathway for fluid to leave the inside of the eye. Sometimes referred to as the trabecular meshwork or Schlemm's canal.

**Glaucoma Suspect:** An adult who has one of the following findings in at least 1 eye: an optic nerve or nerve fiber layer defect suggestive of glaucoma, a visual field abnormality consistent with glaucoma, or an elevated IOP greater than 21 mm Hg.

**Gonioscopy:** In this diagnostic procedure a contact lens that contains a mirror is gently placed on the eye. The mirror lets the doctor look sideways into the eye to check whether the angle where the iris meets the cornea is open or closed. This helps the doctor decide whether Open-Angle or Angle-Closure Glaucoma is present.

**Intraocular Pressure (IOP):** The inner pressure of the eye. Normal intraocular pressure usually ranges from 12-22 mm Hg, although people with relatively low pressures can still have glaucoma (see Normal-Tension Glaucoma).

**Iris:** The colored part of the eye that can expand or contract to allow just the right amount of light to enter the eye.

**Laser Surgery:** A type of surgery in which a tiny beam of light energy is used to modify tissues in the eye. There are three common forms of laser surgery for glaucoma.

**Laser Peripheral Iridotomy:** Creates a new drainage hole in the iris, allowing the iris to fall away from the outflow channel so fluid can drain out of the eye.

**Laser Trabeculoplasty:** In this procedure, the laser is aimed toward the normal drainage channels of the eye, in an attempt to open those channels so fluid can leave the eye more efficiently.

**Laser Cyclophotocoagulation:** This laser procedure is usually used in people who have severe glaucoma and are not responding to standard glaucoma surgery. The laser is used to partially destroy the tissues that make the fluid in the eye.

**Lens:** Located behind the iris, this helps light focus onto the retina.

**Microsurgery:** Surgery performed under a microscope.

**mm Hg:** An abbreviation for “millimeters of mercury,” which is a scale for recording intraocular pressure.

**Normal-Tension Glaucoma:** Also called low-tension glaucoma. A type of glaucoma in which intraocular pressure stays within the normal range (12-22 mm Hg), but damage still occurs to the optic nerve and visual fields.

**Ocular Hypertensive:** When the pressure inside the eye (intraocular pressure or IOP) is higher than normal, but the optic nerve looks normal and there are no signs of vision loss. People with ocular hypertension may be considered Glaucoma Suspects.

**Open-Angle Glaucoma or Primary Open-Angle Glaucoma:** The most common form of glaucoma in the western world. This form of glaucoma usually develops very slowly as the eye’s drainage canals gradually become clogged. There are no early warning signs for Open-Angle Glaucoma, which is why it is often called the “sneak thief of sight.”

**Ophthalmoscopy:** An exam used to look at the inside of the eye, especially the optic nerve.

**Optical Coherence Tomography (OCT):** Measures the reflection of infrared light off eye tissues to produce an image of the retina and optic nerve and to measure the thickness of the retinal nerve fiber layer.

**Optic Nerve:** The nerve in the back of the eye that carries visual images to the brain.

**Perimetry:** Also known as the visual field test. A test that produces a map of the complete visual field, to check whether there is damage to any area of vision.

**Peripheral Vision:** The top, sides, and bottom areas of vision. These are usually the first areas of vision affected by glaucoma.

**Pupil:** The opening that controls how much light enters the inner part of the eye.

**Retina:** The retina converts the light images into electrical signals, and the retina’s nerve cells and fibers carry these signals to the brain through the optic nerve.

**Sclera:** The tough, white, protective outer covering of the eye.

**Secondary Glaucoma:** A form of glaucoma that can occur as the result of an eye injury or inflammation. Includes forms such as Pigmentary Glaucoma and steroid-induced glaucoma.

**Tonometry:** The use of a device to measure the pressure in the eye.

**Trabecular Meshwork:** The formal name of the mesh-like drainage canals surrounding the iris.



# Cure Glaucoma with Us

Founded in 1978 in San Francisco, Glaucoma Research Foundation (GRF) is the largest and most experienced organization dedicated specifically to *curing glaucoma and restoring vision through innovative research*.

For more than 40 years, Glaucoma Research Foundation has been deeply committed to advancing scientific discovery toward finding new treatments and a cure. Just one example of the transformational work funded is the landmark Collaborative Normal-Tension Glaucoma Study, the first controlled clinical trial to establish that lowering eye pressure preserves vision.

Additional advances have continued through our Catalyst for a Cure consortium. Initially launched in 2002, this innovative program recruits investigators from prestigious academic centers across the country to pursue promising leads together. This proven approach to collaborative discovery, since adopted by other organizations, including the National Eye Institute, has attracted specialists not previously researching glaucoma to help accelerate a cure.

## Catalyst for a Cure Vision Restoration Initiative

In 2019, our third Catalyst for a Cure team began to pursue exciting leads in vision restoration. The consortium will explore many promising avenues, from optic nerve regeneration to transplantation to gene manipulation, toward the goal of restoring useful sight to patients who have lost vision to glaucoma. To learn more about our sight-saving endeavors, please visit our website at **[www.glaucoma.org/research](http://www.glaucoma.org/research)**.

In addition to advancing scientific and clinical research, Glaucoma Research Foundation is a trusted source of comprehensive, reliable information for patients, families, and doctors, through our print materials, online resources, and events.

As a 501(c)(3) non-profit organization, Glaucoma Research Foundation is almost entirely supported through donations from private individuals—often patients like you. With your support and partnership, together we can create a future without glaucoma for everyone.

Please visit **[www.glaucoma.org/donate](http://www.glaucoma.org/donate)** to make a tax-deductible contribution. Each and every gift will make a difference and advance us closer to a cure.

## On the Cover

Glaucoma Research Foundation works to bring solutions to glaucoma patients and their doctors through innovative research and education programs. Betty Wong is a glaucoma patient seeking answers, and Dr. Jeffrey Goldberg is a researcher and clinician focused on finding better treatments and ways to protect and restore the optic nerve in glaucoma patients.



**Betty Wong,**

*Glaucoma patient*

Betty supports the Glaucoma Research Foundation in their mission to cure glaucoma and restore vision.



**Jeffrey L. Goldberg, MD, PhD,**

*Professor and Chair, Department of Ophthalmology, Stanford University School of Medicine, and Glaucoma Research Foundation Scientific Advisor*

“Glaucoma Research Foundation funds innovative research directed at preventing vision loss in glaucoma, and towards restoring vision in those who have lost it in this disease.”

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