

I Checked the Intraocular Pressure. Now What Do I Do?

KEY TECHNICAL SKILLS

BY JANET HUNTER, BS, COMT

An hour behind schedule, the waiting room is packed with anxious patients, and the physician is not in the best mood. Your current patient may have glaucoma. You ask yourself,

Should I perform a visual field test? Do I need to refract? Should I dilate the pupil? Should I just go ask the doctor?

The role of the ophthalmic technician has grown along with the many new technologies. You distinguish yourself not only by knowing how to perform the various diagnostic tests but also by knowing why and when to perform them.

You, the technician, are the first clinical person with whom the patient has contact; hence, the patient's entire first impression of the office is based upon this experience. You serve as the gateway to effective and efficient doctor-patient relationships. An efficient technician provides clear and accurate information to support the physician's assessment, diagnosis, and treatment of the patient. To do this well, you must know more than the "how to" but also the "why to."

VISION ASSESSMENT

Typically, the patient is unaware that he or she has glaucoma until after he or she experiences a serious loss of vision. This is the very reason that a careful assessment of visual acuity should take place at each visit.

Never assume binocularity. Each eye must be tested separately.

Make certain that the occluded eye is completely covered, and be sure to tell the patient he or she must not press on that eye. Patients do not realize this causes blurriness (Figure 1).

Ensure that the patient wears his or her distance glasses for the Snellen chart and near spectacles for the Rosenbaum near vision assessment.

The visual field test (perimetry) detects the loss of both peripheral and central vision and, in some cases, can indicate glaucomatous optic nerve damage.¹ To manage the glaucoma patient, the visual field test is typically performed every 3 to 6 months. An invaluable technician

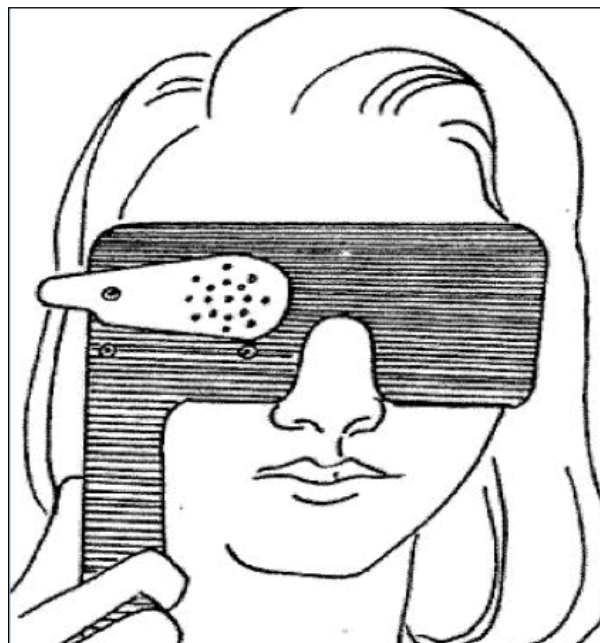


Figure 1. Pinhole disc testing is recommended if the patient presents with diminished visual acuity. It helps to differentiate whether the vision loss is refractive in nature, due to a disorder of the eye (eg, glaucoma, macular degeneration, retinal detachment, cataract), or owing to a brain lesion.²

reviews a patient's chart to guarantee the timing of this practice.

A quick field screening tool is the confrontation field test. This is a crude test performed simply by having the patient look straight ahead and count the examiner's fingers held within the periphery of the patient's field of view.

In working with innumerable glaucoma specialists, I found it highly advantageous to ask each physician for his or her own test selection criteria. For example, you may find one physician prefers a 24-2 testing strategy for every patient, no matter what. Another may prefer 24-2 for all patients with a visual acuity of 20/200 or better but a 10-2 for patients with central islands or a visual acuity of 20/400 or worse. Kinetic visual fields may be helpful for observing patients with poor vision as well. Why not make your work go more smoothly by noting these preferences?

REFRACTION AND LENSOMETRY

The Mayo Clinic has reported that both nearsighted and farsighted patients are at higher risk for glaucoma. For the farsighted, they report an increased risk of developing narrow-angle glaucoma and/or angle-closure glaucoma.³

The following glaucoma surgeries can also cause changes in refractive error, specifically, an induction of astigmatism:

- trabeculectomy
- canaloplasty
- deep sclerectomy⁴

Check patients' eye glasses at every visit, the exception's being the postoperative patient.

Be advised that it is not unusual for glaucoma patients with poor vision to have several different pairs of glasses. They often bring one pair of spectacles for one visit and a different pair for a subsequent visit! This is another reason why you should perform lensometry at each visit.

PUPILLARY EVALUATION

A pupillary assessment can produce extremely significant clinical findings. Glaucoma, for instance, can cause pupillary abnormalities such as a relative afferent pupillary defect. The pupil's size, shape, and function can be indicators of related neurological (cranial nerve) function. Note that pupillary size, iris color, and refractive error can vary with age. Some causes of pupillary dilation include

- acute glaucoma attack (mildilated and fixed pupil)
- retinal disease
- cranial nerve III palsy (consensual reflex absent)
- cyloplegia (2° to eyedrops)⁵

Constricted pupils can be caused by the glaucoma medication pilocarpine.

Swinging Flashlight Test

Pupillary reaction to light is tested for each eye, one eye at a time. The direct and consensual pupillary reaction to light at near and distance are measured and noted along with the pupil's size and shape. Testing the afferent sensory stimulus pathway from eye to brain helps the physician determine whether the cause of the patient's reduced vision is ocular disease. An abnormal result indicates a relative afferent pupillary defect (Figure 2).

Procedure

To perform the procedure:

- Check the patient's left eye
- Shine the light onto the left eye and check for pupillary constriction of the left eye (direct)
- Shine the light onto the left eye and check for pupillary constriction of the right eye (consensual)
- Check the right eye
- Shine the light onto the right eye and check for pupillary constriction of the right eye (direct)
- Shine the light onto the right eye and check for pupillary constriction of the left eye (consensual)



Figure 2. Direct response to flashlight test.

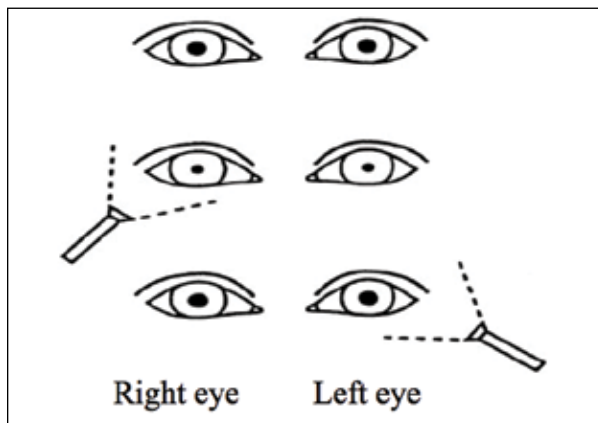


Figure 3. A left afferent pupillary defect.

RELATIVE AFFERENT PUPILLARY DEFECT

Typically, both pupils should constrict when light is shone into either eye. An injury to the optic nerve, however, can decrease the amount of light ultimately transmitted to the brain, thus decreasing the pupil's normal reaction to the light. A typical result is dilation of the pupil rather than constriction.⁶ For example, in Figure 3, the left pupil dilates with light. This can indicate a left optic nerve lesion, which will ultimately result in the attenuation of the light signal to the brain.

OCULAR MOTILITY AND ALIGNMENT

Performing tests of ocular motility and alignment can be useful in the detection of potential ocular health problems (Figure 4). By observing how the eyes move when covered and uncovered, the physician can observe proper ocular alignment and how well the eyes move together. Problems with eye movement can be indicative of a large number of troubles—neurologic, ocular, and/or systemic.

Movement of the eyes is measured in all nine positions of gaze:

- primary
- up, down
- left, right
- four corners (up + right, up + left, down + right, down + left)

Eye movements are tested individually (ductions) and together (versions).

COVER AND UNCOVER TEST

To perform the test, place the occluder over the right eye (Figure 5). Then, uncover and evaluate the eye for movement. Repeat for the left eye.

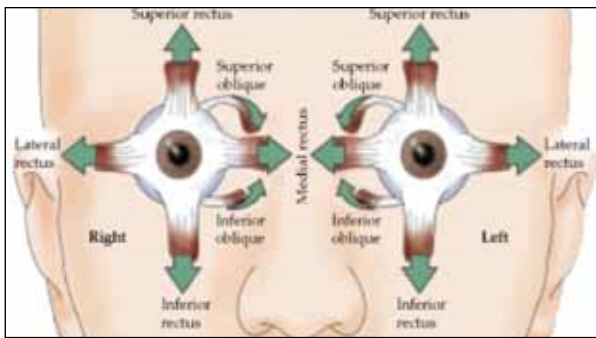


Figure 4. Extraocular muscles and eye movement.

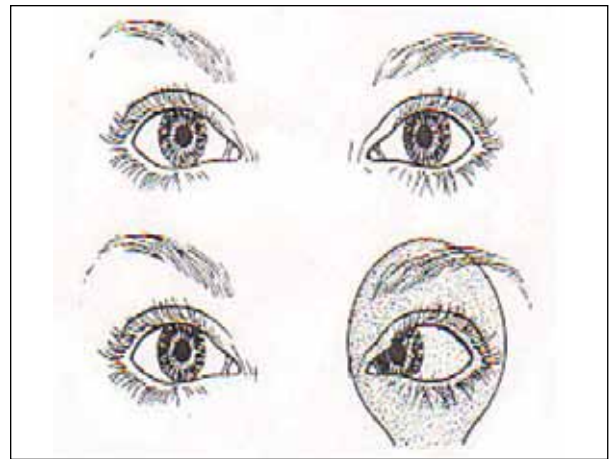


Figure 5. Cover and uncover test.

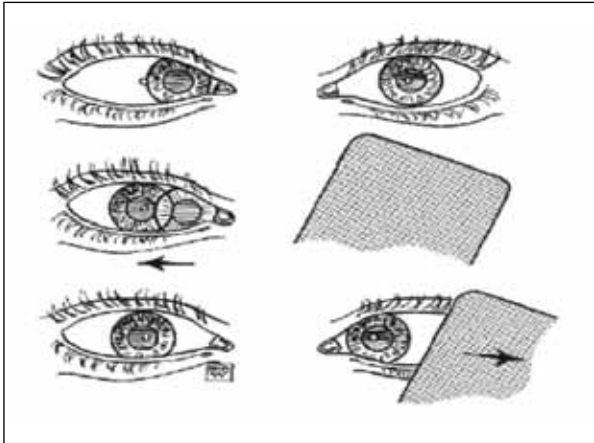


Figure 6. Alternate cover test.

This test evaluates the patient for the presence of a phoria, a muscular imbalance or an ocular misalignment that only occurs some of the time. The goal is to disrupt fusion of the eyes and to observe the direction in which the covered eye moves.

ALTERNATE COVER TEST

This test evaluates the patient for the presence of tropia, a misalignment that is always present. The test is performed after the cover test. Cover the right eye, and then switch to cover the left eye. Now, repeat by moving the cover from the left eye to the right (Figure 6).

HIRSHBERG TEST

The Hirshberg test gives a rough estimate of any ocular deviation (Figure 7). A light is shone onto the patient's eyes while he or she fixates on a distant target. The location of the light reflex relative to the pupil should be noted. The light reflex may be on the nasal edge of the pupil (eso), the temporal edge (exo), or central (ortho).

KRIMSKY TEST

The Krimsky test also assesses the binocular alignment of the patient's eyes (Figure 8). The test is performed in the same way as the Hirshberg test but situates prisms of different strength in front of the eye in such a way as to center the light reflex inside the pupil.⁷

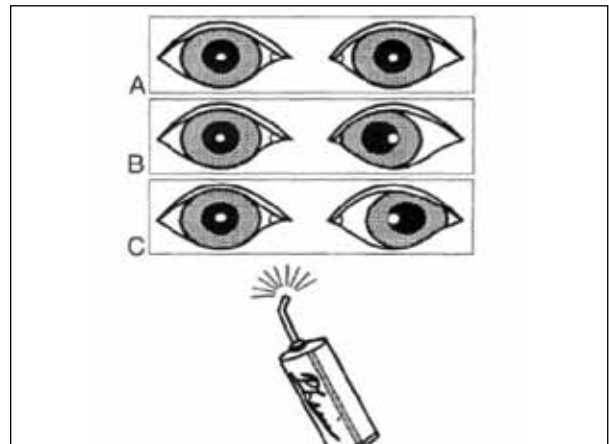


Figure 7. Hirshberg test.

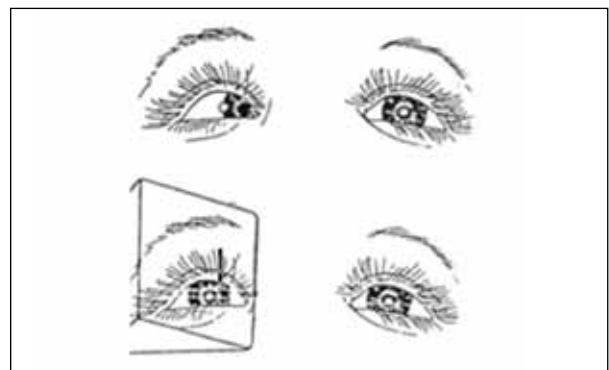


Figure 8. Krimsky test.

INTRAOCULAR PRESSURE MEASUREMENT

Applanation Tonometry

During a glaucoma evaluation, one of the most important measurements a technician makes is applanation tonometry. The Goldmann applanation tonometer is the gold standard for intraocular pressure (IOP) measurements and provides acceptable accuracy for most patients. The Goldmann tonometer measures a 3.06-mm-diameter area on the cornea. Correct endpoint mire alignment is seen

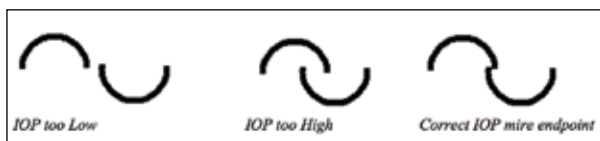


Figure 9. Examples of IOP measurement mire alignment.



Figure 11. Measuring corneal pachymetry.

when the two inner margins of the semicircles just touch (Figure 9).

Mire Patterns

Few things frustrate the physician more than inaccurate IOP measurements taken by the technical staff. Equipment lacking calibration can lead to an inaccurate reading. To ensure quality control and minimize factors in incorrect measurements, do the following:

- Check the tonometer's calibration at least once a month (a must).
- Inspect the tonometer prism for scratches or signs of degradation (Figure 10).
- Become familiar with the slit lamp. Different models function differently. You should be comfortable with the movement of the slit lamp prior to performing applanation tonometry.
- Improve your applanation technique and work on corneal centering.
- Question differences of more than 3 mm Hg between a patient's two eyes. This is a red flag. Possible causes include poor technique, glaucoma, and uveitis, among others.
- Ensure that the patient's eye is in the primary position.
- Note the presence of any venous pulsations observed during applanation.
- Do not put any pressure on the globe when checking the IOP. Pressure on the globe will raise the patient's IOP. Lids and eyelashes should not touch the tonometer's head.
- Instruct patients to breathe normally and not to hold their breath, which can alter IOP.
- Ask men wearing neckties or with tight collars to loosen them prior to tonometry, because constriction



Figure 10. Goldmann applanation tonometer prism.

can alter IOP.

- Instruct patients who have difficulty getting their chin into the chin rest cup to move to the edge of the chair so that they are not leaning so far forward.
- Account for corneal astigmatism. Regular astigmatism of greater than 3.00 D may result in an underestimation of IOP in eyes that have with-the-rule astigmatism and an overestimation of IOP in eyes with against-the-rule astigmatism. Rotate the tonometer prism so that the red line of the prism lines up with the axis of the flattest meridian (in minus cylinder).

Corneal irregularities/scarring may cause errors due to difficulty in endpoint determination.⁸

CORNEAL PACHYMETRY

Corneal pachymetry is the measurement of corneal thickness (Figure 11). It has been used to evaluate people with corneal disease and aids in the assessment of individuals at risk for glaucoma.⁹ Studies have shown that corneal thickness can alter the accuracy of IOP measurements.¹⁰ For patients with thick corneas, the actual IOP may be overestimated. For those with thin corneas, the actual IOP may be underestimated. Since the procedure is noninvasive and painless, you can perform it with ease using a topical

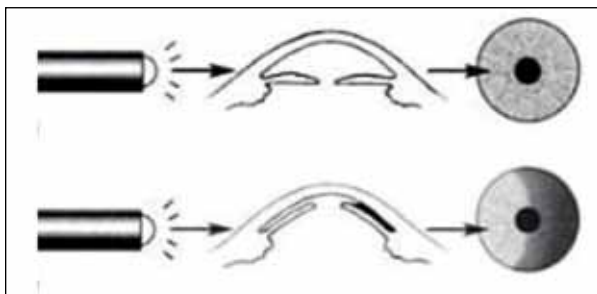


Figure 12. Flashlight test.

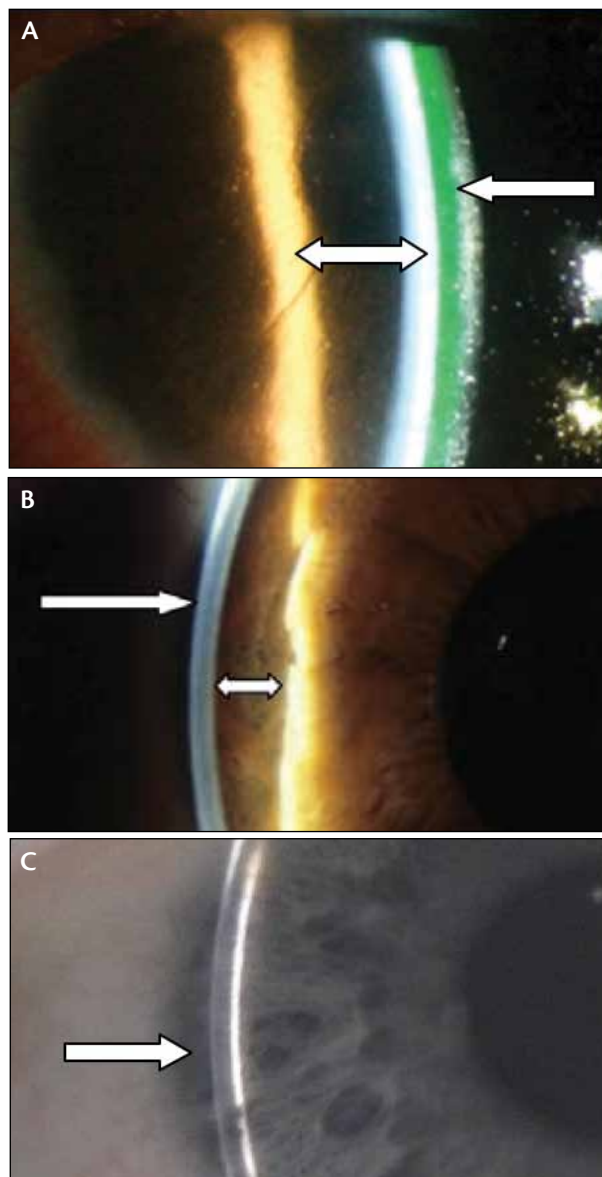


Figure 13. Wide-open anterior chamber angle (A). Open anterior chamber angle (B). Dangerously narrow anterior chamber angle (C).

local anesthetic. With this measurement, you can develop a better appreciation of the relationship between elevated IOP measurements and corneal thickness.^{11,12}

SLIT-LAMP EXAMINATION

The slit lamp provides a three-dimensional view of the structures in the eye. It is used to examine the front (anterior) portion of the eye. This allows the physician to make a careful observation of the orbits, lids, conjunctiva, cornea, anterior chamber, and iris. The angle of aqueous drainage at the peripheral edge of the iris should also be measured. Two methods of determining the draining angle are

- flashlight test
- Van Herrick test

Flashlight Test

In the flashlight test, a light is shone from the temporal side onto the cornea along an angle parallel to the iris. A shadow on the nasal limbus will identify an eye with a shallow anterior chamber (Figure 12).

Van Herrick Test

The Van Herrick test uses a slit beam to compare the depth of the peripheral anterior chamber to the thickness of the cornea.

When the depth of the peripheral anterior chamber is less than one-quarter of the corneal thickness, it is considered shallow. If the anterior chamber depth is as deep as the cornea is thick, then the angle is presumed to be wide open. If only a slit of aqueous is visible, then the angle is estimated to be dangerously narrow (Figure 13).

How Is the Test Performed?

The slit-lamp settings are as follows:

- 60° angle
- narrow beam
- right beam
- magnification of 16×

The slit beam is very bright and thin, and it is offset 60° temporally to the slit-lamp oculars.

The temporal sclera is illuminated, and the slit lamp beam is brought slowly toward the cornea until the anterior chamber is first identified. Here, the thickness of the cornea is compared to the depth of the peripheral anterior chamber.

If the anterior chamber is as deep as the cornea is thick, then the angle is presumed to be wide open. If there is only a slit of aqueous, then the angle is estimated to be dangerously narrow.

None of the aforementioned tests is a definitive determination of suspected occludable angles and, therefore, should not be used as a replacement for gonioscopy. They are, however, means of confirming what the gonioscopic examination reveals.¹³ ■

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PATIENT WORKUP

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HISTORY AND CHIEF COMPLAINT

History taking is one of the most important skills taught to ophthalmic technical personnel. Most troubles can be uncovered by taking a comprehensive history of the patient, which will greatly assist the physician in determining the patient's needs and risk factors.

The history of a patient with glaucoma should specifically include the following:

- Any ocular redness, discomfort, or pain? In which eye? For how long?
- Any blurred vision? In which eye? For how long?
- Do you see any halos around lights? In which eye? For how long?
- Are you experiencing glare? In which eye? For how long?
- Which glaucoma eye drops are you taking? How frequently? In which eye? Are you taking the drops as prescribed?
- Did you use the glaucoma drops today? When was the last time you used your drops? At what time? In which eye?
- Any burning or stinging when you instill the glaucoma drops?
- Are you performing punctal occlusion? For how long per eye?
- Are you having difficulty with dark/light adaptation?
- Are you having difficulty following fast-moving objects with your eyes?

PAST OCULAR HISTORY

A complete history of past surgery, trauma, and previous ocular disease is imperative. Key areas for direct questioning include

- glaucoma, macular degeneration, retinal tears or detachment
- amblyopia
- diabetes
- strabismus
- contact lenses and spectacles
- past ocular trauma

When taking the history of patients who were diagnosed in the past with glaucoma, ask the following:

- How long ago were you diagnosed with glaucoma?
- Do you use eye drops? Which one(s)? How frequently? In which eye?
- Any history of surgery? Laser treatment? What type? In which eye? On what date?

- Any history of refractive surgery? In which eye? On what date?
- Do you have a family history of glaucoma? Who?
- Have you taken any steroid medications? If yes, which type?
- Have you ever suffered ocular trauma? If yes, what type?

PAST MEDICAL HISTORY

Carefully study the patient's records for a past diagnosis of glaucoma. Certain glaucoma medications are contraindicated should the patient suffer from other medical problems such as hypertension, asthma, chronic obstructive pulmonary disease, etc. It cannot be overstated that these are an absolute red flag for a potential glaucoma patient. If these facts are left out of the chart, they may compromise the physician's choice of glaucoma therapy and, in some cases, may become life threatening to the patient.

Pertinent questions to ask the glaucoma patient include the following:

- Do you have a history of high blood pressure? Low blood pressure?
- Do you have a history of elevated cholesterol?
- Do you have a history of migraines?
- Do you suffer from cold hands or feet (Raynaud disease)?
- Do you snore (sleep apnea)?
- Do you have a history of any autoimmune disease?

SOCIAL HISTORY

A patient's lifestyle can also be a significant determining factor of how the physician ultimately decides to treat the glaucoma. A number of studies have shown an association between alcohol consumption and the risk of glaucoma.¹ Emotional upsets and stress can increase external blood pressure and thus affect intraocular pressure. For this reason, the technician's documentation of the patient's lifestyle and use of alcohol and tobacco is imperative.

ALLERGIES

Many physicians speculate whether allergies affect glaucoma. People who suffer from food or environmental allergies or from a compromised immune function can appear to be at higher risk of developing glaucoma. It is imperative that the technician chart any allergies in addition to the patient's current medications. The documentation of any

adverse reaction to medications is urgent. Severe allergic reactions to medication can include

- itching
- redness
- hives
- difficulty breathing
- death

SYSTEMIC MEDICATIONS

Many nonocular medications can significantly increase intraocular pressure and even cause glaucoma. A few examples of these medications are

- Corticosteroids, which can lead to ocular hypertension and open-angle glaucoma
- Anticholinergics and tricyclic antidepressants, which can cause angle closure
- Anticonvulsants, which can cause nasal peripheral visual field loss
- Antihistamines
- Topiramate (Topomax; Janssen Pharmaceuticals, Inc.)
- Birth control medications^{2,3}

OCULAR MEDICATIONS

Many patients simply do not remember the names of their glaucoma medications. This is quite understandable when some of them are well beyond the layman's pronunciation capabilities. For this reason, technicians should familiarize themselves with the cap color associated with each different type of medication (Table).

EXAMINATIONS

In addition to the patient's history, the following physical examinations should also be completed.

New Glaucoma Patient Workup

- Ocular examinations

- Visual acuity, which includes checking glasses and refraction
- Confrontation visual fields (may defer if automated perimetry performed)
- Motility and alignment
- Pupils
- Tonometry, using tonopen on corneal transplant patients

TABLE. OCULAR MEDICATIONS

CAP COLOR	CLASS	EXAMPLES	MECHANISM
Yellow and blue	β-blocker	<ul style="list-style-type: none"> • Generic: timolol maleate solution • Branded: Betimol (Santen, Inc.), Istalol (Ista Pharmaceuticals, Inc.) 	Decreases volume of aqueous humor produced
Green	Miotic	<ul style="list-style-type: none"> • Generic: pilocarpine 	Stimulates iris sphincter to contract and pupillary constriction, which increase aqueous outflow
Purple	α-adrenergic agonist	<ul style="list-style-type: none"> • Generic: brimonidine • Branded: Alphagan P (Allergan, Inc.) 	Decreases fluid production
Orange	Carbonic anhydrase inhibitor	<ul style="list-style-type: none"> • Branded: Trusopt (Merck & Co., Inc.) 	Decreases fluid production
Clear or teal	Prostaglandin analogue	<ul style="list-style-type: none"> • Generic: latanoprost • Branded: Lumigan (Allergan, Inc.), Travatan (Alcon Laboratories, Inc.), Xalatan (Pfizer, Inc.), Zioptan (Merck & Co., Inc.) 	Increases aqueous humor drainage
Red	Mydriatic or cycloplegic	<ul style="list-style-type: none"> • Generic: atropine, cyclopentolate 	Dilates the pupil
Pink	Anti-inflammatory drug or steroid	<ul style="list-style-type: none"> • Branded: Durezol (Alcon Laboratories, Inc.), Lotemax (Bausch + Lomb), Pred Forte (Allergan, Inc.) 	Controls inflammation. Note: steroids should not be used for long periods of time; these drugs can cause the intraocular pressure to rise and induce glaucoma. ⁴

- Corneal pachymetry (three measurements for each eye)
- *Gonioscopy*
 - Before pupillary dilation
- *Glaucoma flow sheet*
 - Patient identification information
 - Diagnosis
 - Date and time of tonometry
 - Tonometry measurements (right, left)
 - Medications, including dosing, allergies, ineffectiveness
 - Corneal pachymetry average
- *Prescriptions*
 - Medication
 - Glasses

Returning Glaucoma Patient Workup

- *Review of last clinical notes and instructions*
- *Photograph file placed with chart*

- *IOP recorded on flow sheet*
- *Last dilated examination and last visual field recorded*

General Patient Workup

- *Detailed history*
- *Ocular examinations*
 - Visual acuity, which includes checking glasses and refraction
 - Confrontation visual fields
 - Motility and alignment
 - Pupils
 - Tonometry
- *Corneal pachymetry, glaucoma flow sheets, and stereo-disc photography deferred*
- *Review of last clinical notes and instructions*
- *Last dilated examination recorded*
- *Prescriptions for medication and glasses* ■

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