Because of its potential to reveal serious retinal, neurologic or other disease, pupil testing is a crucial part of the ophthalmic examination and requires astute observation. This procedure should be included as a component of every comprehensive examination or any time a patient needs to be dilated—in addition to any problem-focused visit involving eye health, such as a red eye visit, ocular emergency, or intraocular pressure (IOP) check. This article will focus on the proper procedure for testing pupils as well as point out some of the more commonly encountered pupil abnormalities.

Before testing pupils, the patient should be instructed to remove her spectacle correction. A distant, non-accommodative target two to three lines larger than the patient’s uncorrected visual acuity should be utilized. If the patient is unable to see the 20/400 E, the red/green filter can be utilized over the optotype, and the patient should be instructed to fixate on the colors. A target that is too small for the patient might result in accommodation, with associated with pupillary constriction, which you will want to avoid when testing pupils.1 The equipment required to perform pupil testing is minimal: all you need is a millimeter ruler or pupillary gauge and a transilluminator (which is preferred over a disposable penlight due to the intensity of the light).

The four components of pupillary testing:

1. Observing the pupil shape, location, and size
2. Pupillary reaction to light
3. Swinging flashlight test
4. Pupillary reaction to a near stimulus

Observing pupil shape, location, and size

A normal patient’s pupils should be round, symmetrical, and centered within the iris. The red reflex provided when viewing through the direct ophthalmoscope can be helpful when comparing the two eyes. Non-round pupillary shape can occur as a result of a surgical complication, posterior synechia from intraocular inflammation, or iris atrophy from age, ischemia, inflammation, or trauma.

Other gross observations for abnormalities could include evidence of corectopia (displaced pupil), polycoria (multiple pupils), leukocoria (white pupil, which can be an ominous sign of a serious ocular form of cancer known as retinoblastoma), or iris heterochromia (difference in iris colors between the two eyes). Although pupil testing provides gross observations in these areas, the slit lamp

See Pupils on Page 3

Figures 1. Measuring pupil size.
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Pupils

Continued from page 1

can be used to examine the pupil and iris in more detail.

Measurement of pupil size should occur under normal lighting conditions, measuring to the nearest 0.5 mm using a millimeter ruler (also called a PD ruler or PD stick) or pupillary gauge while the patient fixates on a distant, non-accommodative target (Figure 1). To avoid stimulating the accommodative response and consequential constriction, the ruler should be held away from the visual axis of the patient.

It can be particularly challenging to accurately measure the size of a patient’s pupils if his irises are dark. If needed, the clinician can view the patient’s pupils through the direct ophthalmoscope, and measure the size of the red reflex. In addition, the ophthalmoscope can also be used as a dim flashlight to measure pupils while looking from outside the instrument. In either situation, it is imperative that both pupils be illuminated equally and simultaneously.

Under normal illumination, the average adult’s pupil size measures around 3.5 mm but can range from 1.0 mm to 10 mm and decreases as one ages due to senile miosis. Pupils should be within 1 mm in size of each other. Any difference in pupil size between the two eyes is known as anisocoria (Figure 2). Anisocoria can be physiologic (which occurs in approximately 20 percent of normal patients), pharmacologic, or pathologic in nature.

How do you know if the anisocoria is a problem? And, if it is problematic, is it the bigger pupil or the smaller pupil that you need to be worried about? In order to differentiate physiologic anisocoria from a pathologic or pharmacologic cause, pupil sizes should be re-measured in bright and dark lighting conditions, isolating the parasympathetic and sympathetic pathways.

If the amount of anisocoria is the same in both the bright lighting conditions and the dark, then the anisocoria is physiologic. If there is a greater amount of anisocoria in the bright light, and the larger pupil is not constricting like it should, you are likely dealing with a parasympathetic pupil problem. Some of the more common big pupil problems include Adie’s tonic pupil, cranial nerve III palsy, and pharmacologic dilation.

If there is a greater amount of anisocoria in the dark, and the smaller pupil is not dilating like it should, you are likely dealing with a sympathetic pupil problem. Potential causes of small pupil problems include Horner’s syndrome, Argyll-Robertson pupils, and pharmacologic constriction.

Whenever anisocoria is suspected, it’s always a good idea to ask the patient if he has taken any new medications recently or if he may have gotten something in his eye. Also, be on the lookout for other clues such as ptosis or EOM involvement which might help.

### Four components of pupillary testing

- Observing the pupil shape, location, and size
- Pupillary reaction to light
- Swinging flashlight test
- Pupillary reaction to a near stimulus

**Under normal illumination, the average adult’s pupil size measures 3.5 mm but can range from 1.0 mm to 10 mm and decreases with age due to senile miosis**
Pupillary reaction to light
The pupillary light response consists of both an afferent (optic nerve, CN II) and efferent (oculomotor nerve, CN III) pathway. Under normal conditions, when light is shone into one eye, it will cause a direct response in that eye to constrict, and a consensual response in the opposite eye to also constrict.

When observing a pupil’s direct and consensual responses to light, the set-up should be normal to dim room illumination with the patient fixating on a distant non-accommodative target. Standing off to one side, the clinician should direct the transilluminator into the right eye (held approximately one inch away) and hold for two to four seconds. Make sure the light is pointed directly into the pupil—avoid holding the light too low because you do not want it directed at the patient’s cheek and watch for stray light entering the opposite eye. Constriction OD would indicate the right eye’s direct response to light. Constriction OS (with the light shone into the right eye) would indicate the consensual response of the left eye. Both of these responses indicate the integrity of the afferent pathway on the right side (Figure 3).

The procedure is repeated several times while observing and grading the magnitude (quantity) of change and rapidity (quality) of change. The magnitude is graded on a scale of 1 (small change) to 3 (large change). In terms of quality, a fast response is indicated with “+” and slow response is indicated with “–.” The procedure is then repeated with the transilluminator directed into the left eye, looking for a direct response OS and a consensual response OD.

Swinging flashlight test
The purpose of the swinging flashlight test is to compare the strength of the direct pupillary response with that of the consensual response in the same eye. In a dark room, with the patient fixating on a non-accommodative distant target, the light beam is directed into the right eye and held for two to four seconds, then quickly moved to the left eye and held for two to four seconds. This process should be repeated for at least three to four cycles.

When moving the light between the patient’s eyes, use a slight u-shaped motion, making sure to avoid the transilluminator crossing the patient’s visual axis, which may stimulate accommodation. It is critical that the magnitude and duration of the light be kept the same for each eye. Observe the response of the pupil receiving the light, the degree or rapidity of pupillary escape, and the response and size.

The acronym PERRLA is often used to record data from pupillary testing

PE: pupils equal
R: round
RL: reactive to light (direct and consensual)
A: responsive to accommodation (near target)
of the pupil not receiving the light. A normal patient should show equal direct responses between the two eyes, equal consensual responses between the two eyes, and equal direct and consensual responses of the same eye. In addition, the rate and amount of constriction should be the same for both pupils.

When the consensual response is greater than the direct response in the affected eye, then the patient is classified as having a relative afferent pupillary defect (RAPD, APD, Marcus-Gunn pupil), signifying unilateral or asymmetric damage to the anterior visual pathway. When the light beam is directed into the patient’s eye with the RAPD, you will notice a reduced direct response in that eye, along with a reduced consensual response in the opposite (unaffected) eye. When the light beam is directed into the unaffected eye, both eyes will constrict normally. When classifying a RAPD, it is important to specify which eye. It is important to carefully look for very subtle RAPDs because they can vary in magnitude.

RAPD causes include any unilateral or asymmetric damage to the anterior visual pathway, such as severe retinal disease, optic nerve disease or compromise, or a mass/lesion behind the eye. Severe but bilaterally equal disease will not cause an RAPD. An RAPD cannot be caused from disorders of ocular media or refraction, even if extreme.8

Important practical considerations to remember:
- A patient’s visual acuity does not necessarily correlate with the magnitude of the RAPD, although it is always a good idea to look carefully for one in cases of significantly reduced visual acuity in one eye.
- RAPDs do not cause anisocoria; the pupils look the same size because of the normal consensual response.
- You need to have only one functioning pupil to be able to test for a RAPD in either eye.

**Pupillary reaction to a near stimulus**

When a patient fixates on a near target, three things should happen automatically: convergence, accommodation, and pupillary constriction.1 This response can be tested by instructing the patient to slowly alternate fixation between a distant target and a near target. This measurement is rarely added to routine pupil testing because the near reflex is always present when the direct light reflex is intact. In other words, if a normal direct reaction to light is observed, then there is no need to check the near response.

If a patient’s pupil does fail to respond to light but the near response is intact, then this signifies that the afferent pathway is interrupted and the efferent pathway is intact. This condition is also known as light-near dissociation, and it can be evident in certain midbrain lesions, amaurotic pupils, or aberrant regenerations.2

**Putting it all together**

If all of the above results are normal, then your patient has normal pupillary function. The acronym PERRLA is often used when recording pupils.
- PE: pupils equal
- R: round
- RL: reactive to light (direct and consensual)
- A: responsive to accommodation (near target)

The A at the end can be left off if the near response was not tested. It is also necessary to document the absence (-) or presence (+) of a relative afferent pupillary defect and in which eye if positive.

Pupillary testing is an important component of the eye exam. Careful observation can reveal important information about the autonomic nervous system and anterior visual pathways.3

**References**

Identifying signs of congenital eye health problems

The common causes and symptoms of congenital visual impairment

By Corinthia Worrell, CGT

Where does a visual impairment begin? Vision disorders can be influenced by a combination of genetic factors, environmental conditions, and lifestyle choices. When taking these into account, beginning with proper prenatal care is a good place to start. Although some disorders cannot be cured, complications and symptoms, including pregnancy complications, can be reduced.

Understanding ROP

The more premature a delivery, low birth weight, and other health factors increase the risk of possible visual complications to include retinopathy of prematurity (ROP), a disruption of eye development; intraventricular hemorrhage (IVH), blood vessels within brain that burst and bleed into hollow chambers normally reserved for cerebrospinal fluid and into the surrounding tissues; hydrocephalus, an abnormal increase in the amount of cerebrospinal fluid within the cranial cavity causing enlargement of the skull and forehead; and neonatal infections.

Treatment includes the use of lung surfactants to reduce the risk of respiratory distress, blood transfusions to improve blood pressure and blood count, spinal tap to drain fluid, and/or placement of a ventriculoperitoneal (VP) shunt to drain fluid from the brain.

With ROP, eye development can be disrupted, and normal vessels may stop growing or begin to grow abnormally from the retina. These vessels are fragile and can leak, and scar tissue may develop and pull the retina away from the inner surface of the eye. Severe symptoms of ROP include abnormal eye movement, crossed eyes, severe nearsightedness, or white-looking pupils (leukocoria).

Severe cases of ROP include plus disease, which is a major complicating factor at any stage. This is characterized by vascular dilation and tortuosity of the blood vessels that may lead to total retinal detachment, vitreous and anterior chamber haze, iris vascular engorgement, and immature blood vessels growing over the lens, restricting pupil dilation, although these symptoms usually appear later in development. Patients with severe cases of ROP are at greater risk for developing strabismus, cataracts, glaucoma, and becoming more highly myopic. Early detection or treatment can help prevent vision loss later in life.

Stages I to II of ROP usually improve with no treatment, and the disease resolves on its own without further progression and could eventually develop into normal vision. Treatment for stages III and up for ROP include laser therapy, intravitreal injections (such as Avastin [Bevacizumab, Genentech]), which are usually reserved for very aggressive cases, cryotherapy, and, for more severe cases (stages IV and V), scleral buckle and/or vitrectomy.

Today, with higher survival rate of smaller and more premature...
Many eye diseases have no early symptoms, and you may see no change in the patient’s vision until the disease has become advanced.

infants, cases of ROP have increased, but with thorough eye examinations, early treatment can improve a baby’s chances for normal vision.

More vision disorder risk factors
Other risk factors for vision disorders include: cerebral palsy, albinism, epilepsy, autism, and developmental disabilities. Neurological disorders, such as traumatic brain injury or cortical visual impairment, can also affect vision due to trauma of the brain, not the eyes. The degree of impairment depends on onset, location, and intensity; it can range from severe impairment to blindness. Asphyxia (lack of oxygen to the brain), hypoxia (lack of oxygen in the body cells, tissue, or blood) and ischemia (not enough blood supply to the brain) can also cause brain defects and permanent vision loss.

Children with visual impairments can show symptoms that might mimic others, such as “blindism” (self-stimulatory behavior, rituals), which is often mistaken for autism, and children with neurological vulnerabilities (e.g., seizure disorders, prematurity associated with bleeds, agenesis of the corpus callosum, etc.) may be at increased risk. These similarities can often result in misdiagnosis.

Other visual impairment such as nystagmus (rapid involuntary eye movement, usually side to side) can be sensory and can develop as a result of poor vision. Nystagmus can also develop as a result of a neurological problem, and nystagmic patients may experience problems with depth perception. Sudden onset of nystagmus may be a sign of a serious medical condition, including severe head trauma, toxicity, stroke, inflammatory disease, or other conditions that affect the brain. Immediate medical attention is necessary.

Some common causes of visual impairment include significant refractive error (excessive or unequal myopia, hyperopia, and astigmatism), strabismus, amblyopia, and binocular visual impairment. A comprehensive eye exam is recommended at six months of age to ensure the eyes perform as a team and there is normal eye development. Amblyopia and strabismus are most effectively treated when detected early. Eye exams can also detect systemic diseases such as high blood pressure and diabetes.

It is important to understand vision problems and symptoms. A head tilt might indicate double vision; excessive tearing and red or encrusted eyelids may indicate

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blocked tear ducts or infection. Pupil defects could be a sign of eye cancer, nerve damage, tumor, or defect inside the eye; and an eye turn may be a sign of poor muscle control. Many eye diseases have no early symptoms, and you may see no change in the patient’s vision until the disease has become advanced.

Adapting to a visual impairment
Most children who are visually impaired have low vision. They use their vision for learning along with tactile and auditory adaptations. This may include increased contrast and color highlighting, lighting enhancement, and reading standard print with the use of hand-held or stand magnifiers that can be used for near tasks or enlarged print. Technological equipment such as closed circuit televisions (CCTVs) or screen enlargement programs for computers can be used as well as monoculars and telescopes for distance viewing. As technology is improving, many visually impaired children rely on auditory information for some part of their learning. Books on CD, spoken output from the computer, and use of tape recorders for memos provide quick means of access.

Children who are blind will depend on tactile and auditory methods for learning. They may use Braille, tactile material such as raised maps, speech access, and auditory descriptions. Braille can be written and read using portable note-takers with Braille displays or computer output. Children who have been blind since birth might find it difficult to understand verbal descriptions; therefore, direct contact with materials or objects is beneficial because they cannot gain this information through pictures.

Children with visual impairments may also benefit from orientation and mobility instruction, independent living skills, career development, use of assistive technology, use of functional vision, and communication and social skills. It is also important to experience some type of routine physical activity program to improve fitness and provide confidence. Physical activity can also develop motor skills needed for daily living and mobility tasks.

Although vision loss can result from disease, trauma, or congenital or degenerative conditions that cannot be corrected by conventional means, such as refractive correction or medications, preventive eye care is the first line of defense against vision problems. Regular eye exams with an eyecare professional and annual physical exams may offer more treatment options to provide a better visual outcome in the future.

Zoe Zavala
Zoe was born with congenital nystagmus. She also has juvenile diabetes. She does not let her disability get in the way. She wrote a story about her journey and spoke in front of her entire school at a dinner event raising money for programs for the blind.
How staff can prep for ICD-10

By Mary Pat Johnson, COMT, CPC, COE, CPMA

By now you have heard and read a lot regarding ICD-10 changes coming in October. Let’s discuss some of the changes in the new diagnosis coding system and how you can prepare for the transition.

The ICD-9 coding system is 30 years old and felt to be outdated. Some codes are obsolete. The additional specificity in ICD-10 provides codes for more accurate payment for new procedures, and the hope is that they will lead to fewer rejected and improper claims as well as better understanding of new procedures and improved disease management.¹ Not only are there many more codes than the ICD-9 system (about 69,000 ICD-10 codes compared to about 14,000 ICD-9 codes), the format of the codes and some of the rules and conventions for assigning the codes have changed.

The biggest concern in most practices is that the conversion to ICD-10 will disrupt the claims process and, by extension, cash flow. This change goes beyond the claims process and affects more than the billers. Here’s a quick look at how moving to ICD-10 will affect different roles within the office.

- **Doctors.** They need to better document in order to select and support correct codes. Some doctors assume that the office’s EHR program will take care of this. While the EHR should be loaded with the full selection of ICD-10 codes—and it may even be able to map over from previously reported ICD-9 codes to narrow the code choices—it should not be relied on as the final answer.

- **Administrators and managers.** They will oversee implementation and education and managing the report for CMS bonus programs (such as PQRS).

- **Technicians and scribes.** They will need to rethink how they interview patients and document in charts.

- **Reception and front desk staff.** They will face new forms, changes to payer policies, and requirements for precertification.

- **IT staff.** They must handle updates to the computer.

- **Outside billing companies.** They must insure they are compliant.

**Techs: all about documentation**

Often technicians ignore the details of coding, presuming someone in the practice is responsible for coding and billing. However, both the procedure and diagnosis codes are based on what is documented in the record. With the dramatic increase in the number of code options, it is obvious that the objective is to be more specific in your code selection, not less. The use of vague, non-specific codes is discouraged, and the code selection is very detailed.

Detailed coding begins with thorough, correct charting, so documentation is a good place to focus your ICD-10 preparation. Consider common diagnoses and how they are recorded in the medical records. It is not unusual to see the impression listed as “cataract,” “glaucoma,” “diabetes,” or “corneal abrasion.” The use of very specific ICD-10 codes requires more detailed information regarding the condition, such as which eye(s) are affected, severity, and other factors such as insulin or prior care for that condition.

To properly select an ICD-10 code, the diagnosis or impression in the chart should read more like:

- **Nuclear sclerotic cataract, both eyes** (ICD-10 code H25.13)
- **Primary open angle glaucoma, both eyes, mild stage** (ICD-10 code H40.11x2)
- **Type II diabetes with mild NPDR w/o macular edema** (ICD-10 code E11.329), patient

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**TRAINING FOR ICD-10 CODING**

Follow these steps to smooth your way to using ICD-10 codes.

- Read the ICD-10 coding book
- Attend a training session
- Review charts for frequent diagnoses and learn how to apply ICD-10 codes to them.
- Keep resources close at hand

TRAINING FOR ICD-10 CODING
ICD-10
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- on insulin (ICD-10 code Z79.4)
- Injury of the conjunctival and corneal abrasion without foreign body right eye, initial encounter (ICD-10 code S05.01x)
- Many technicians see this level of detail and wonder, “What made you think to ask if the patient was on insulin or if the abrasion had been evaluated previously?” and panic may set in. Don’t go there.

In preparing for ICD-10, doctors and technicians need to change their history-taking and documentation habits so pertinent information is available when it’s time to select a code.

Getting started
Get your hands on the ICD-10 book and attend training. The rules and conventions are spelled out in the introduction of the ICD-10 manual. The book contains language intended to direct you to the correct code, such as “see” and “see also,” “code also” or “code first,” “excludes.” Look for new coding concepts, such as laterality required in some codes, combination codes, required fifth or seventh digits, and “placeholders” prior to the seventh digit in some codes. Review the neoplasm table and the table of drugs as they apply to your practice. Although Chapter 7 focuses on conditions affecting the eye and adnexa, familiarize yourself with the other chapters of the book that contain codes pertinent to eye care, such as neoplasms (Chapter 2), endocrine and nutrition conditions (Chapter 4) and injuries (Chapter 19).

There are many sources of training available, including online training, recorded or live webinars, conferences and seminars, and in-office training. Ophthalmic-specific courses are preferred.

Following your introduction to the book and initial training, review a sample of medical records. Consider running a report from the practice management system to find the top 25 diagnoses used by each doctor. Focus your attention on charts containing those conditions. Determine if there is enough detail, as documented, to assign an ICD-10 code. If charting is insufficient, follow up with training for technicians on history taking and knowing what questions to ask. Include scribes in this training. As the physician continues the conversation with the patient, it up to the scribes to ensure that portion of the history is recorded. In reviewing your charts, begin assigning ICD-10 codes where possible. Work in a small group and double check each other’s answers. Use this exercise to both improve your understanding of coding and improve the way you think about charting. As you gain accuracy and confidence in coding, expand the chart sample from the most common diagnoses to some of the less common conditions your practice treats, such as infections and injuries.

Arm yourself with resources. Often an electronic code search yields information more quickly than searching through ICD-10 book. For your smartphone or tablet, app stores have a number of options (make sure you are familiar with the CMS implementation). There are many sources of training available, including online training, recorded or live webinars, conferences and seminars, and in-office training. Ophthalmic-specific courses are preferred.

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Planning for implementation
Here’s a checklist to prepare for ICD-10 implementation.

- Rally the troops. If the practice does not already have a team in place, now is the time to rally the go-to people. A lead technician or technician supervisor should be part of that team.
- Schedule first-level training. The sooner, the better if you haven’t already had training.
- Put that training to work.
  - Review small samples of charts with all the resources available to you to assess current documentation and where improvements may be needed.
  - If forms or templates need revising to improve documentation, take the necessary steps to do so now.
  - As documentation improves, begin coding a small sample of charts each day using the ICD-10 system.
- Practice, practice, practice.
- Check your progress. CMS has announced three week-long testing periods during which physicians and other providers and suppliers can submit ICD-10 codes on claims and receive acknowledgment of where the claim was received and accepted vs. received and rejected. No remittance advice will be generated.

References
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