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Committee on Practice and Ambulatory Medicine and Section on Ophthalmology
AMERICAN ASSOCIATION OF CERTIFIED ORTHOPTISTS
AMERICAN ASSOCIATION FOR PEDIATRIC OPHTHALMOLOGY
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AMERICAN ACADEMY OF OPHTHALMOLOGY

POLICY STATEMENT

Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of All Children

Eye Examination in Infants, Children, and Young Adults by Pediatricians

ABSTRACT. Early detection and prompt treatment of ocular disorders in children is important to avoid lifelong visual impairment. Examination of the eyes should be performed beginning in the newborn period and at all well-child visits. Newborns should be examined for ocular structural abnormalities, such as cataract, corneal opacity, and ptosis, which are known to result in visual problems. Vision assessment beginning at birth has been endorsed by the American Academy of Pediatrics, the American Association for Pediatric Ophthalmology and Strabismus, and the American Academy of Ophthalmology. All children who are found to have an ocular abnormality or who fail vision assessment should be referred to a pediatric ophthalmologist or an eye care specialist appropriately trained to treat pediatric patients.

INTRODUCTION

Eye examination and vision assessment are vital for the detection of conditions that result in blindness, signify serious systemic disease, lead to problems with school performance, or at worst, threaten the child's life. Through careful evaluation of the ocular system, retinal abnormalities, cataracts, glaucoma, retinoblastoma, strabismus, and neurologic disorders can be identified, and prompt treatment of these conditions can save a child's vision or even life. Examination of the eyes should be performed beginning in the newborn period and at all well-child visits. Visual acuity measurement should be performed at the earliest possible age that is practical (usually at approximately 3 years of age). Early detection and prompt treatment of ocular disorders in children is important to avoid lifelong permanent visual impairment.

TIMING OF EXAMINATION AND SCREENING

Children should have an assessment for eye problems in the newborn period and then at all subsequent routine health supervision visits. These should

be age-appropriate evaluations as described in subsequent sections. Infants and children at high risk of eye problems should be referred for specialized eye examination by an ophthalmologist experienced in treating children. This includes children who are very premature; those with family histories of congenital cataracts, retinoblastoma, and metabolic or genetic diseases; those who have significant developmental delay or neurologic difficulties; and those with systemic disease associated with eye abnormalities. Because children do not complain of visual difficulties, visual acuity measurement (vision screening) is an important part of complete pediatric eye care and should begin at 3 years of age. To achieve the most accurate testing possible, the most sophisticated test that the child is capable of performing should be used (Table 1).^{1,2} The frequency of examinations recommended is in accordance with the American Academy of Pediatrics "Recommendations for Preventive Pediatric Health Care."² Any child unable to be tested after 2 attempts or in whom an abnormality is suspected or detected should be referred for an initial eye evaluation by an ophthalmologist experienced in the care of children.

PROCEDURES FOR EYE EVALUATION

Eye evaluation in the physician's office should include the following:

Birth to 3 Years of Age

1. Ocular history
2. Vision assessment
3. External inspection of the eyes and lids
4. Ocular motility assessment
5. Pupil examination
6. Red reflex examination

3 Years and Older

1 through 6, plus:

7. Age-appropriate visual acuity measurement
8. Attempt at ophthalmoscopy

TABLE 1. Eye Examination Guidelines*

Ages 3–5 Years			
Function	Recommended Tests	Referral Criteria	Comments
Distance visual acuity	Snellen letters Snellen numbers Tumbling E HOTV Picture tests –Allen figures –LEA symbols	1. Fewer than 4 of 6 correct on 20-ft line with either eye tested at 10 ft monocularly (ie, less than 10/20 or 20/40) or 2. Two-line difference between eyes, even within the passing range (ie, 10/12.5 and 10/20 or 20/25 and 20/40)	1. Tests are listed in decreasing order of cognitive difficulty; the highest test that the child is capable of performing should be used; in general, the tumbling E or the HOTV test should be used for children 3–5 years of age and Snellen letters or numbers for children 6 years and older. 2. Testing distance of 10 ft is recommended for all visual acuity tests. 3. A line of figures is preferred over single figures. 4. The nontested eye should be covered by an occluder held by the examiner or by an adhesive occluder patch applied to eye; the examiner must ensure that it is not possible to peek with the nontested eye. Child must be fixing on a target while cross cover test is performed.
Ocular alignment	Cross cover test at 10 ft (3 m) Random dot E stereo test at 40 cm Simultaneous red reflex test (Bruckner test)	Any eye movement Fewer than 4 of 6 correct Any asymmetry of pupil color, size, brightness	Direct ophthalmoscope used to view both red reflexes simultaneously in a darkened room from 2 to 3 feet away; detects asymmetric refractive errors as well.
Ocular media clarity (cataracts, tumors, etc)	Red reflex	White pupil, dark spots, absent reflex	Direct ophthalmoscope, darkened room. View eyes separately at 12 to 18 inches; white reflex indicates possible retinoblastoma.
6 years and older			
Function	Recommended Tests	Referral Criteria	Comments
Distance visual acuity	Snellen letters Snellen numbers Tumbling E HOTV Picture tests –Allen figures –LEA symbols	1. Fewer than 4 of 6 correct on 15-ft line with either eye tested at 10 ft monocularly (ie, less than 10/15 or 20/30) or 2. Two-line difference between eyes, even within the passing range (ie, 10/10 and 10/15 or 20/20 and 20/30)	1. Tests are listed in decreasing order of cognitive difficulty; the highest test that the child is capable of performing should be used; in general, the tumbling E or the HOTV test should be used for children 3–5 years of age and Snellen letters or numbers for children 6 years and older. 2. Testing distance of 10 ft is recommended for all visual acuity tests. 3. A line of figures is preferred over single figures. 4. The nontested eye should be covered by an occluder held by the examiner or by an adhesive occluder patch applied to eye; the examiner must ensure that it is not possible to peek with the nontested eye. Child must be fixing on a target while cross cover test is performed.
Ocular alignment	Cross cover test at 10 ft (3 m) Random dot E stereo test at 40 cm Simultaneous red reflex test (Bruckner test)	Any eye movement Fewer than 4 of 6 correct Any asymmetry of pupil color, size, brightness	Direct ophthalmoscope used to view both red reflexes simultaneously in a darkened room from 2–3 feet away; detects asymmetric refractive errors as well.
Ocular media clarity (cataracts, tumors, etc)	Red reflex	White pupil, dark spots, absent reflex	Direct ophthalmoscope, darkened room. View eyes separately at 12 to 18 inches; white reflex indicates possible retinoblastoma.

* Assessing visual acuity (vision screening) represents one of the most sensitive techniques for the detection of eye abnormalities in children. The American Academy of Pediatrics Section on Ophthalmology, in cooperation with the American Association for Pediatric Ophthalmology and Strabismus and the American Academy of Ophthalmology, has developed these guidelines to be used by physicians, nurses, educational institutions, public health departments, and other professionals who perform vision evaluation services.

Ocular History

Parents' observations are valuable. Questions that can be asked include:

- Does your child seem to see well?
- Does your child hold objects close to his or her face when trying to focus?
- Do your child's eyes appear straight or do they seem to cross or drift or seem lazy?
- Do your child's eyes appear unusual?
- Do your child's eyelids droop or does 1 eyelid tend to close?
- Have your child's eye(s) ever been injured?

Relevant family histories regarding eye disorders or preschool or early childhood use of glasses in parents or siblings should be explored.

Vision Assessment

Age 0 to 3 Years

Vision assessment in children younger than 3 years or any nonverbal child is accomplished by evaluating the child's ability to fix and follow objects.^{3,4} A standard assessment strategy is to determine whether each eye can fixate on an object, maintain fixation, and then follow the object into various gaze positions. Failure to perform these maneuvers indicates significant visual impairment. The assessment should be performed binocularly and then monocularly. If poor fix and following is noted binocularly after 3 months of age, a significant bilateral eye or brain abnormality is suspected, and referral for more formal vision assessment is advisable.⁵ It is important to ensure that the child is awake and alert, because disinterest or poor cooperation can mimic a poor vision response.

Visual Acuity Measurement or Vision Screening (Older Than 3 Years)

Various tests are available to the pediatrician for measuring visual acuity in older children. Different picture tests, such as LH symbols (LEA symbols) and Allen cards, can be used for children 2 to 4 years of age. Tests for children older than 4 years include wall charts containing Snellen letters, Snellen numbers, the tumbling E test, and the HOTV test (a letter-matching test involving these 4 letters).⁶ A study of 102 pediatric practices revealed that 53% use vision testing machines.³ Because testing with these machines can be difficult for younger children (3–4 years of age), pediatricians should have picture cards and wall charts available.

Photoscreening

Using this technique, a photograph is produced by a calibrated camera under prescribed lighting conditions, which shows a red reflex in both pupils. A trained observer can identify ocular abnormalities by recognizing characteristic changes in the photographed pupillary reflex.⁷ When performed properly, the technique is fast, efficient, reproducible, and highly reliable. Photoscreening is not a substitute for accurate visual acuity measurement but can provide significant information about the presence of sight-

threatening conditions, such as strabismus, refractive errors, media opacities (cataract), and retinal abnormalities (retinoblastoma). Photoscreening techniques are still evolving. (For further information, see also the American Academy of Pediatrics policy statement, "Use of Photoscreening for Children's Vision Screening."⁸)

External Examination (Lids/Orbit/Cornea/Iris)

External examination of the eye consists of a penlight evaluation of the lids, conjunctiva, sclera, cornea, and iris. Persistent discharge or tearing may be attributable to ocular infection, allergy, or glaucoma, but the most common cause is lacrimal duct obstruction. It often manifests during the first 3 months as persistent purulent discharge out of 1 or both eyes. Topical or oral antibiotics should be given, and lacrimal sac massage should be attempted. Because these same findings are often seen in congenital glaucoma, failure to promptly resolve after treatment or the presence of cloudy or asymmetrically enlarged corneas should prompt ophthalmologic referral for additional evaluation.

Unilateral ptosis can cause amblyopia by inducing astigmatism, even if the pupil is not occluded. Patients with this condition require ophthalmic evaluation. Bilateral ptosis may be associated with significant neurologic disease, such as myasthenia. Additional investigation by a child neurologist and pediatric ophthalmologist is warranted.

Ocular Motility

The assessment of ocular alignment in the preschool and early school-aged child is of considerable importance. The development of strabismus in children may occur at any age and can represent serious orbital, intraocular, or intracranial disease. The corneal reflex test, cross cover test, and random dot E stereo test are useful in differentiating true strabismus from pseudostrabismus (see Appendix 1). The most common cause of pseudostrabismus is prominent epicanthal lid folds that cover the medial portion of the sclera on both eyes, giving the impression of crossed eyes (esotropia). Detection of an eye muscle imbalance or inability to differentiate strabismus from pseudostrabismus necessitates a referral.

Pupils

The pupils should be equal, round, and reactive to light in both eyes. Slow or poorly reactive pupils may indicate significant retinal or optic nerve dysfunction. Asymmetry of pupil size, with 1 pupil larger than the other, can be attributable to a sympathetic disorder (Horner syndrome) or a parasympathetic abnormality (third nerve palsy, Adie syndrome). Small differences can occur normally and should be noted in the chart for reference in case of subsequent head injury. Larger pupil asymmetries (>1 mm) can be attributable to serious neurologic disorders and need additional investigation.

Red Reflex Test (Monocular and Binocular, Bruckner Test)

The red reflex test can be used to detect opacities in the visual axis, such as a cataract or corneal abnor-

mality, and abnormalities of the back of the eye, such as retinoblastoma or retinal detachment. When both eyes are viewed simultaneously, potentially amblyogenic conditions, such as asymmetric refractive errors and strabismus, also can be identified. The test should be performed in a darkened room (to maximize pupil dilation). The direct ophthalmoscope is focused on each pupil individually approximately 12 to 18 inches away from the eye, and then both eyes are viewed simultaneously at approximately 3 feet away. The red reflex seen in each eye individually should be bright reddish-yellow (or light gray in darkly pigmented, brown-eyed patients) and identical in both eyes. Dark spots in the red reflex, a blunted dull red reflex, lack of a red reflex, or presence of a white reflex are all indications for referral. After assessing each eye separately, the eyes are viewed together with the child focusing on the ophthalmoscope light (Bruckner test, see Appendix 1). As before, any asymmetry in color, brightness, or size is an indication for referral, because asymmetry may indicate an amblyogenic condition.

Visual Acuity Measurement (Vision Screening)

Visual acuity testing is recommended for all children starting at 3 years of age.⁶ In the event that the child is unable to cooperate for vision testing, a second attempt should be made 4 to 6 months later. For children 4 years and older, the second attempt should be made in 1 month. Children who cannot be tested after repeated attempts should be referred to an ophthalmologist experienced in the care of children for an eye evaluation. Appendix 1 provides a detailed explanation of the techniques available for visual acuity measurement in children.

Ophthalmoscopy

Ophthalmoscopy may be possible in very cooperative 3- to 4-year-olds who are willing to fixate on a toy while the ophthalmoscope is used to evaluate the optic nerve and retinal vasculature in the posterior pole of the eye.

RECOMMENDATIONS

1. All pediatricians and other providers of health care to children should be familiar with the joint eye examination guidelines of the American Association for Pediatric Ophthalmology and Strabismus, the American Academy of Ophthalmology, and the American Academy of Pediatrics.
2. Every effort should be made to ensure that eye examinations are performed using appropriate testing conditions, instruments, and techniques.
3. Newborns should be evaluated for ocular structural abnormalities, such as cataract, corneal opacities, and ptosis, which are known to result in vision problems, and all children should have their eyes examined on a regular basis.¹
4. The results of vision assessments, visual acuity measurements, and eye evaluations, along with instructions for follow-up care, should be clearly communicated to parents.²
5. All children who are found to have an ocular abnormality or who fail vision screening should

be referred to a pediatric ophthalmologist or an eye care specialist appropriately trained to treat pediatric patients.

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APPENDIX 1. TESTING PROCEDURES FOR ASSESSING VISUAL ACUITY

The child should be comfortable and in good health at the time of the examination. It is often convenient to have younger children sit on a parent's lap. If possible, some preparation before the actual testing situation is helpful, and parents can assist by demonstrating the anticipated testing procedures for their child. Children who have eyeglasses generally should have their vision tested while wearing the eyeglasses. Eyeglasses prescribed for use only

while reading should not be worn when distance acuity is being tested.

Consideration must be given to obtaining good occlusion of the untested eye; cardboard and paddle occluders have been found inadequate for covering the eye because they allow “peeking.” Commercially available occluder patches provide complete occlusion necessary for appropriate testing.¹ Vision testing should be performed at 10 feet (except Allen cards) and in a well-lit area. When ordering wall charts, be sure to indicate that a 10-foot testing distance will be used.

Visual Acuity Tests

Snellen Acuity Chart

When performing visual acuity testing, test the child’s right eye first by covering the left. A child who has corrective eyeglasses should be screened wearing the eyeglasses. Tell the child to keep both eyes open during testing. If the child fails the practice line, move up the chart to the next larger line. If the child fails this line, continue up the chart until a line is found that the child can pass. Then move down the chart again until the child fails to read a line. After the child has correctly identified 2 symbols on the 10/25 line, move to the critical line (10/20 or 20/40 equivalent). To pass a line, a child must identify at least 4 of the 6 symbols on the line correctly. Repeat the above procedure covering the right eye.

Tumbling E

For children who may be unable to perform vision testing by letters and numbers, the tumbling E or HOTV test may be used. Literature is available from the American Academy of Ophthalmology (*Home Eye Test*, American Academy of Ophthalmology, PO Box 7424, San Francisco, CA 94109, 415/561-8500 or <http://www.aaopt.org>) and Prevent Blindness America (*Preschoolers Home Eye Test*, Prevent Blindness America, 500 East Remington Rd, Schaumburg, IL 60173, 847/843-2020 or <http://www.preventblindness.com>) for home use by parents to prepare children for the tumbling E test. This literature contains the practice Es, a tumbling E wall chart, and specific instructions for parents.

HOTV Test (Matching Test)

An excellent test for children who are unable to perform vision testing by verbally identifying letters and numbers is the HOTV matching test. This test consists of a wall chart composed only of Hs, Os, Ts, and Vs. The child is provided an 8½ × 11-inch board containing a large H, O, T, and V. The examiner points to a letter on the wall chart, and the child points to (matches) the correct letter on the testing board. This can be especially useful in the 3- to 5-year-old who is unfamiliar with the alphabet.

Allen Cards

The Allen card test consists of 4 flash cards containing 7 schematic figures: a truck, house, birthday cake, bear, telephone, horse, and tree. When viewed at 20 feet, these figures represent 20/30 vision. It is important that a child identify verbally or by matching all 7 pictures before actual visual testing. Testing should only be performed with the figures that the child readily identified. Perform initial testing with the child having both eyes open, viewing the cards at 2 to 3 feet away. Present 1 or 2 figures to ensure that the child understands the testing procedure. Then begin walking backward 2 to 3 feet at a time, presenting different pictures to the child. Continue to move backward as long as the child directly calls out the figures presented. When the child begins to miss the figures, move forward several feet to confirm that the child is able to identify the figures at the shorter distance. To calculate an acuity score, the furthest distance at which the child is able to identify the pictures accurately is the numerator and 30 is the denominator. Therefore, if a child were able to identify pictures accurately at 15 feet, the visual acuity would be recorded as 15/30. This is equivalent to 30/60, 20/40, or 10/20. To perform this test in the same way as for HOTV testing, a “matching panel” of all of the Allen figures may be prepared on a copy machine.

LH Symbols (LEA Symbols)

The LH symbol test is slightly different from the Allen card test in that it is made up of flash cards held together by a spiral binding. The flash cards contain large examples of a house, apple, circle,

and square; these should be presented to the child before formal vision testing to see if they can be correctly identified. Unlike the Allen cards, the LH symbol test contains flash cards with more than 1 figure per card and with smaller figure sizes so that testing may be performed at 10 feet. Recorded on each card is the symbol size and visual acuity value for a 10-foot testing distance. The visual acuity is determined by the smallest symbols that the child is able to identify accurately at 10 feet. For example, if the child is able to identify the 10/15 symbol at 10 feet, the child’s visual acuity is 10/15 or 20/30.

If it is not possible to perform testing at 10 feet, move closer to the child until he or she correctly identifies the largest symbol. At this point, proceed down in size to the smallest symbols the child is consistently able to correctly identify. The vision is recorded as the smallest symbol identified (bottom number) at the testing distance (top number). For example, correctly identifying the 10/15 symbols at 5 feet is recorded as 5/15 or 20/60. Likewise, identifying the 10/30 symbols at 2 feet is 2/30 or 20/300 (both the bottom and top numbers can be multiplied or divided by the same number to give an equivalent vision.) A “matching panel” is provided with the LH test and may be helpful in testing very young children. At least 3 of 4 figures should be identified for each size or distance.

Testing Procedures for Assessing Ocular Alignment

Corneal Light Reflex Test

A penlight may be used to evaluate light reflection from the cornea. The light is held approximately 2 feet in front of the face to have the child fixate on the light. The corneal light reflex (small white dot) should be present symmetrically and appear to be in the center of both pupils. A reflex that is off center in 1 eye may be an indication of an eye muscle imbalance. A slight nasal displacement of the reflex is normal, but a temporal displacement is almost never seen unless the child has a strabismus (esotropia).

Simultaneous Red Reflex Test (Bruckner Test)

This test can detect amblyogenic conditions, such as unequal refractive errors (unilateral high myopia, hyperopia, or astigmatism), as well as strabismus and cataracts. When both eyes are viewed simultaneously through the direct ophthalmoscope in a darkened room from a distance of approximately 2 to 3 feet with the child fixating on the ophthalmoscope light, the red reflexes seen from each eye should be equal in size, brightness, and color. If 1 reflex is different from the other (lighter, brighter, or bigger), there is a high likelihood that an amblyogenic condition exists. Any child with asymmetry should be referred for additional evaluation. Examples of normal and abnormal Bruckner test appearances are available from the AAP. “See Red” cards are available for purchase at <http://www.aap.org/sections/ophthal.htm>.

Cross Cover Test

To perform the cross cover test, have the child look straight ahead at an object 10 feet (3 meters) away. This could be an eye chart for older children or a colorful noise-making toy for younger children. As the child looks at a distant object, cover 1 eye with an occluder and look for movement of the uncovered eye. As an example, if the occluder is covering the left eye, movement is looked for in the uncovered right eye. This movement will occur immediately after the cover is placed in front of the left eye. If the right eye moves outward, the eye was deviated inward or esotropic. If the right eye moves inward, it was deviated outward or exotropic. After testing the right eye, test the left eye for movement in a similar manner. If there is no apparent misalignment of either eye, move the cover back and forth between the 2 eyes, waiting about 1 to 2 seconds between movements. If after moving the occluder, the uncovered eye moves in or out to take up fixation, a strabismus is present. Any movement in or out when shifting the cover indicates a strabismus is present, and a referral should be made to an ophthalmologist.

Random Dot E Stereo Test

The random dot E stereo test measures stereopsis. This is different from the light reflex test or the cover test, which detects physical misalignment of the eyes. Stereopsis can be absent in patients with straight eyes. An ophthalmologic evaluation is necessary to detect the causes of poor stereo vision with straight eyes. To perform the

random dot E stereo test, the cards should be held 16 inches from the child's eyes. Explain the test to the child. Show the child the gray side of the card that says "model" on it. Hold the model E in the direction at which the child can read it correctly. Have the child touch the model E to understand better that the picture will stand out. A child should be able to indicate which direction the legs are pointing. Place the stereo glasses on the child. If the child is wearing eyeglasses, place the stereo glasses over the child's glasses. Make sure the glasses stay on the child and the child is looking straight ahead. The child should be shown both the stereo blank card and the raised and recessed E card simultaneously. Hold each card so you can read the back. The blank card should be held so you can read it. The E card should be held so you can read the word "raised." Both cards must be held straight. Do not tilt the cards toward the floor or the ceiling—this will cause darkness and glare. Ask the child to look at both cards and to point to or touch the card with the picture of the E. The E must be presented randomly, switching from side to side. The child is shown the cards up to 6 times. To pass the test, a child must identify the E correctly in 4 of 6 attempts.

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