

## 33. Screening for Visual Impairment

### RECOMMENDATION

Vision screening to detect amblyopia and strabismus is recommended once for all children prior to entering school, preferably between ages 3 and 4. Clinicians should be alert for signs of ocular misalignment when examining infants and children. Screening for diminished visual acuity with Snellen visual acuity chart is recommended for elderly persons. There is insufficient evidence to recommend for or against screening for diminished visual acuity among other asymptomatic persons, but recommendations against routine screening may be made on other grounds (see *Clinical Intervention*).

### Burden of Suffering

*Preschool Children.* Undetected vision problems are common in preschool children, with an estimated prevalence of 5–10%.<sup>1</sup> About 2–5% suffer from amblyopia (“lazy eye”; loss of vision due to disuse) and strabismus (ocular misalignment) which, aside from congenital conditions, usually develop between infancy and ages 5–7.<sup>2–4</sup> In the newborn, risk factors for developing strabismus or amblyopia include a family history of ocular malformations, anisometropia (a large difference in refractive power between the two eyes, more than 4 diopters in sphere and/or 2 diopters in astigmatism), congenital cataracts, ocular tumors, premature birth, or birth to a mother who suffered from infection such as rubella, genital herpes, or toxoplasmosis during pregnancy. Since normal vision from birth is necessary for normal binocular development, failure to detect and treat amblyopia, marked anisometropia, or strabismus at an early age may result in irreversible visual deficits. Resulting permanent amblyopia and cosmetic defects may lead to later restrictions in educational and occupational opportunities.<sup>5,6</sup> Patients with amblyopia are at increased risk of blindness from loss of vision in their good eye.<sup>6a</sup>

*School-Aged Children.* Data are limited regarding the prevalence of uncorrected refractive errors and previously undiagnosed vision problems in elementary school-aged and adolescent children. A community-based examination of all first- to third-grade children in 1984 found visual acuity

of 20/30 or better in the better eye in 94–95% of the schoolchildren; 7%, 9%, and 9% of children in first, second, and third grades, respectively, had glasses prescribed. Two percent of children for whom glasses were prescribed were not wearing them.<sup>7</sup> Refractive errors, which often become manifest during school age, rarely carry any serious prognostic implications. Experts disagree on whether an uncorrected refractive error that would be detected by screening has any adverse effects on academic performance in school-aged children.<sup>7,8</sup>

*Adolescents and Adults.* Refractive errors are the most common visual disorder in the adolescent and adult population. In a study of undetected eye disease in a primary care population (94% African-American), 21% of patients ages 40–59 were diagnosed with an eye disease of which they were not aware.<sup>9</sup> The majority of these cases, however, were not detected by acuity screening (e.g., glaucoma or diabetic retinopathy), most were mild or previously diagnosed, and few required immediate treatment. There are no data to determine the incremental benefit of routine screening of adults to detect early refractive errors compared to waiting for patients to present with complaints of vision problems.

*Elders.* Visual impairment is a common and potentially serious problem among older people. Personal safety may be compromised; the risk of falling is increased.<sup>10</sup> The rate ratio for fatal car crashes in the elderly is lower in states where vision testing is required for persons over 65 than in states where it is not required.<sup>11</sup> While a reduction in visual acuity may be noticed by an individual, underreporting is common. One small study of patients attending a geriatric day care center showed that one third had unrecognized severe visual loss.<sup>12</sup> Surveys have revealed that up to 25% of older people are wearing inappropriate visual correction.<sup>13</sup> The Baltimore Eye Survey reported that more than half of the 5,300 persons screened had improved vision after refraction and appropriate corrective lenses.<sup>14</sup> In the Beaver Dam Eye Study, visual acuity with current correction was worse than 20/40 in 5% of persons aged 65–74, and was worse than 20/40 in 21% of those 75 years of age or older; the proportion with correctable poor acuity was not reported.<sup>15</sup> A 1995 study found that uncorrected vision problems are common among nursing home residents. Among 499 residents, 17% had bilateral blindness (acuity 20/200) and 19% had impaired vision (<20/40); a substantial proportion of vision problems in this population could have been remedied by adequate refractive correction or treatment of cataracts.<sup>15a</sup>

The most common causes of visual impairment in the elderly include presbyopia, cataract, age-related macular degeneration (ARMD), and glaucoma (see Chapter 34). In persons over age 75 years, 5% have exudative macular degeneration, and 5% have glaucoma.<sup>16–18</sup> The prevalence of

cataract increases with age. In persons aged 55–64 years, the Beaver Dam Eye Study found 33% with early cataract and 6% with late cataract; in persons over 75 years these prevalences were 37% and 52%.<sup>17</sup> The frequency of visually significant cataract is higher in women than in men.<sup>17</sup> The causes of blindness vary by race, with whites being more commonly afflicted with macular degeneration and blacks having a higher prevalence of untreated cataract and open-angle glaucoma.<sup>19</sup>

### Accuracy of Screening Tests

*Preschool Children.* Despite the importance of early childhood screening for strabismus and amblyopia, detecting occult visual disorders by screening tests in children under 3 years of age has generally been unsuccessful. Obstacles to screening include the child's inability to cooperate, the time required for testing, and inaccuracy of the tests.<sup>20,21</sup> Some of the techniques for this age group, such as preferential looking, grating acuity cards, refractive screening, and photographic evaluation, have not yet been proven effective.<sup>22,23</sup>

Screening tests for detecting strabismus and amblyopia in the 3–5-year-old child include simple inspection, cover test, visual acuity tests, and stereo vision assessment. Although it is widely recommended,<sup>24</sup> reports are not available of sensitivity or specificity of the cover test performed by primary care providers. Visual acuity tests for children include the Snellen chart, the Landolt C, the tumbling E, the Allen picture cards, grating cards, and others.<sup>25</sup> The specificity of any acuity test for detecting strabismus or amblyopia is imperfect as other conditions may be the cause of the diminished acuity. Snellen letters are estimated to have a sensitivity of only 25%–37%.<sup>26</sup> Refractive screening is not a test for strabismus or amblyopia per se, but may be used to identify amblyogenic risk factors (e.g., anisometropia, or severe hyperopia [farsightedness]).<sup>27</sup>

The Modified Clinical Technique (MCT) includes retinoscopy, cover testing, quantifying ocular misalignment, Snellen acuity, color vision assessment, and external observation.<sup>28</sup> Preferential looking (PL) has been substituted for Snellen acuity in the MCT without loss of predictive power of the MCT but with increase in percentage of young children who were able to complete the test.<sup>23</sup> The MCT, despite a high sensitivity and specificity, cannot be used routinely by primary care physicians for screening because it takes on average about 12 minutes to perform and requires skills and instrumentation not typically found in this setting.

Stereograms such as the Random Dot E (RDE) have been proposed as more effective than visual acuity tests in detecting strabismus and amblyopia.<sup>25,29</sup> The test, in which the child wears Polaroid glasses while viewing the test cards, takes about 1 minute. The RDE has an estimated sensitivity

of 54–64%, specificity of 87–90%, positive predictive value of 57%, and negative predictive value of 93%.<sup>30,31</sup>

An evaluation of a preschool vision screening program comprising visual inspection, acuity assessment, and evaluation of stereoacuity, found a combined negative predictive value of 99% for amblyopia, strabismus, and/or high refractive errors.<sup>32</sup> A similar program, evaluated with limited use of definitive examinations, reported a positive predictive value of 72% for screening.<sup>33</sup> A positive screening test does not ensure adequate follow-up. In one practice-based study, nearly half of parents of children who had a positive screen were unaware of that result 2 months later; 15% of children referred to a specialist did not make or keep the subsequent appointment.<sup>34</sup>

*School-Aged Children.* The public school system in most states has taken on the responsibility of vision screening in school-aged children and making referrals to eye care specialists. In 1992, all but 12 states had mandatory or regulated screening of elementary school-aged children. Screening of visual acuity is generally accomplished with standard Snellen vision charts. Although referral criteria and procedures vary widely, school screening may have a false-positive rate of 30% or more.<sup>35,36</sup>

*Elders.* Asking screening questions about visual function has yielded mixed results when compared to use of a Snellen acuity chart. The question “Do you have difficulty seeing distant objects?” had sensitivity of 28% in detecting visual acuity worse than 20/40.<sup>37</sup> “(When wearing glasses) Can you see well enough to recognize a friend across the street?” had sensitivity of 48%.<sup>38</sup> A similar question showed lower sensitivity for visual impairment as part of the HANES 1971–72 survey.<sup>39</sup> A brief questionnaire using an additive score formed from three similar questions was found to have sensitivity of 86% and specificity of 90% for visual acuity worse than 20/40 in a combined sample of 248 persons aged 45 years and older selected at random from a community population, and a convenience sample of 118 diabetics from the Wisconsin Epidemiologic Survey of Diabetic Retinopathy.<sup>40</sup>

Impaired visual acuity is readily detected by use of a Snellen chart. Cataracts are detectable by ophthalmoscopy, even by relatively inexperienced health professionals. There are few data on sensitivity and specificity of these examinations in the primary care setting. Funduscopy may reveal characteristic changes of ARMD. While these abnormalities are readily recognized by ophthalmologists and optometrists trained in funduscopy, no studies of the sensitivity of funduscopy by primary care physicians were found in a computerized literature search.<sup>41</sup> Case reports support the usefulness of the Amsler grid to detect early detachment of the retinal pigment epithelium at a point when immediate treatment may be beneficial, but compliance with testing is poor.<sup>42,43</sup>

### Effectiveness of Early Detection

*Preschool Vision Problems.* There is fair evidence based on animal models, and case series and case-control studies in humans, that early detection and treatment of amblyopia and strabismus in infants and young children improves the prognosis for normal eye development.<sup>24,44–49</sup> The success of intervention may be dependent on age, with increased likelihood of attaining normal or near-normal vision with earlier detection and treatment; the older the patient, the longer the duration of treatment needed. In a prospective study of visual acuity screening in matched cohorts of over 700 preschool children, those who were screened had significantly less visual impairment than the controls when reexamined 6–12 months later.<sup>50</sup>

*Vision Problems in School-Aged Children, Adolescents, and Nonelderly Adults.* There is little evidence that early detection of refractive errors is associated with important clinical benefits, compared with testing based on symptoms. A common justification for regular screening in school-aged children is the concern that undetected vision problems are an important cause of academic difficulty, but there is no evidence that routine screening has important benefits in terms of academic performance.<sup>51,52</sup>

*Vision Problems in Elders.* Refractive errors are readily correctable with eye glasses or contact lenses. Following refraction and correction, 54% of subjects in the Baltimore Eye Survey improved their visual acuity by at least one line on the Snellen chart and 8% improved by three lines or more. While the impact on physical and social function of these improvements is unknown, it has been demonstrated that restoration of vision following cataract surgery leads to subjective improvements in a variety of vision-related functions, as well as improvements in objective measures of physical and intellectual function.<sup>53</sup>

Although ophthalmologists use differing criteria to determine the optimal time to remove cataracts, a general rule is that surgery should be considered when an otherwise well patient feels that there is a significant impairment to daily life caused by the vision loss. While there are theoretical reasons to believe that earlier referral to an ophthalmologist is desirable for assessment of retinal disease prior to obliteration of the view of the fundus by advancing cataract, in practice most individuals will complain of visual loss and be treated before this occurs.

Randomized clinical trials have shown a beneficial effect of argon laser photocoagulation of choroidal neovascular membranes in selected cases of ARMD.<sup>54</sup> Controlled trials with other wavelengths of light (e.g., krypton) are currently underway. Medical therapy for ARMD, with zinc supplements or interferon, has been reported as case series, but it has not yet been evaluated more rigorously.<sup>55,56</sup>

### Recommendations of Other Groups

The Canadian Task Force on the Periodic Health Examination (CTF)<sup>57</sup> concluded that there is fair evidence to recommend visual acuity testing of preschool children. The American Academy of Ophthalmology (AAO),<sup>58</sup> American Optometric Association,<sup>59</sup> American Academy of Pediatrics (AAP),<sup>60</sup> and Bright Futures<sup>61</sup> each recommend examining newborns and infants for ocular problems and screening visual acuity and ocular alignment at age 3 or 4 in children, and every 1–2 years thereafter through adolescence. New guidelines for vision screening in children, outlining which tests to use and criteria for referral, have been developed by the AAP Section on Ophthalmology, in conjunction with the AAO and the American Association for Pediatric Ophthalmology and Strabismus.<sup>62</sup> The American Academy of Family Physicians (AAFP) recommends that all children be screened for eye and vision abnormalities at 3–4 years of age and that clinicians remain alert for vision problems throughout childhood and adolescence.<sup>63</sup>

Periodic comprehensive eye examinations including acuity testing are recommended for all adults by the American Optometric Association and by Prevent Blindness America (formerly National Society to Prevent Blindness)<sup>59</sup> and for adults over age 40 by the American Academy of Ophthalmology.<sup>65</sup> The CTF<sup>41</sup> and the AAFP<sup>63</sup> advise routine screening of visual acuity only for individuals age 65 and over. AAFP recommendations on vision screening are currently under review.

### Discussion

No prospective trial has directly assessed the benefits of routine preschool vision screening, but animal models and observational studies provide fair evidence that earlier detection and treatment improves the outcomes in children with strabismus and amblyopia. Screening and early referral is recommended for infants and preschool children in the primary care setting. The optimal age for screening cannot be determined from direct evidence. The recommendation to screen at ages 3–4 years is based primarily on expert opinion, and reflects a compromise between the inability of younger children to cooperate fully with screening and the goal to detect and treat the conditions as early as possible.

Screening older children, adolescents, and adults is less likely to detect vision problems that require early intervention. Although routine screening in asymptomatic persons may detect some persons with early refractive errors, these are readily corrected when patients become symptomatic. It is not certain that the incremental benefit of early detection (compared to evaluation when patients complain of change in vision) is sufficient to justify the costs and inconvenience of routine testing. Any patient with ocular symptoms, however, should be advised to see an eye care specialist.

Vision problems are more prevalent in persons over 65, and they are more likely to lead to serious consequences such as accidental injuries. Questioning elderly patients about vision problems is less sensitive than directly assessing visual acuity. Although the effect on functional outcomes of periodic screening with Snellen chart acuity testing in the elderly has not been directly assessed, there is fair evidence that routine screening leads to improvements in measured acuity, and there is little chance of serious harm from screening. The role of routine screening with funduscopy by the primary care provider is less certain. Funduscopy is likely to be more sensitive than acuity testing for detecting persons with exudative ARMD, especially those with early disease, who may benefit from photocoagulation therapy. The sensitivity and specificity of funduscopy by primary care providers for ARMD is unknown, however.

#### CLINICAL INTERVENTION

Vision screening for amblyopia and strabismus is recommended for all children once before entering school, preferably between ages 3 and 4 years ("B" recommendation). Clinicians should be alert for signs of ocular misalignment when examining all infants and children. Stereoacuity testing may be more effective than visual acuity testing in detecting these conditions.

There is insufficient evidence to recommend for or against routine screening for diminished visual acuity among asymptomatic schoolchildren and nonelderly adults ("C" recommendation). Recommendations against such screening may be made on other grounds, including the inconvenience and cost of routine screening, and the fact that refractive errors can be readily corrected when they produce symptoms.

Routine vision screening with Snellen acuity testing is recommended for elderly persons ("B" recommendation). The optimal frequency for screening is not known and is left to clinical discretion. Selected questions about vision may also be helpful in detecting vision problems in elderly persons, but they do not appear as sensitive or specific as direct assessment of acuity. There is insufficient evidence to recommend for or against routine screening with ophthalmoscopy by the primary care physician in asymptomatic elderly patients ("C" recommendation).

The draft update of this chapter was prepared for the U.S. Preventive Services Task Force by Joseph N. Blustein, MD, MS, and Dennis Fryback, PhD, based in part on materials prepared for the Canadian Task Force on the Periodic Health Examination by Christopher Patterson, MD, FRCP, and John W. Feightner, MD, MSc, FCFP.

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