Techniques for Pediatric Vision Screening

The detection of amblyopia and high refractive error remains a major goal of pediatric vision screening. Recent studies have demonstrated that the effectiveness of amblyopia treatment begins to decline after the fifth birthday (1), and that the depth of anisometropic amblyopia increases with age (2,3), making earlier detection more imperative. Fortunately, instrument-based screening has evolved that allows efficient detection of amblyopia risk factors at early ages, and these technologies are becoming increasingly effective and more widely accepted. When screening preschool and older children, direct detection of visual impairment using acuity-based screening remains the gold standard; threshold guidelines for referral following such screenings have changed as well. As a result, previous statements from the American Association for Pediatric Ophthalmology and Strabismus (AAPOS) regarding preschool vision screening are in need of updating. The purpose of this statement, then, is to update guidelines for preschool vision screening using optotype- and instrument-based methods.

Direct measurement of visual acuity using standardized eye charts remains the preferred method for vision screening, unless the child is not reliably able to perform such a test. The AAPOS Vision Screening Committee recommends instrument-based screening for children ages 1 to 3 years because children in this age group are usually unable to cooperate with optotype-based screening. Screening vision with optotype-based tests may be accomplished in children as young as 3 years. However, instrument-based screening remains an acceptable alternative for ages 3 to 5 years. The vast majority of children are able to perform optotype-based screening with a high degree of success and reliability by age 5 years.

Optotype-Based Vision Screening

The selection of age-appropriate and clinically proven optotypes is crucial when visual acuity screening is performed on children. Recommended formats for preschool children include matching picture optotypes, such as LEA Symbols, or HOTV letters, presented as either an entire line of optotypes with a "surround bar" or as single optotypes surrounded by 4 individual "crowding bars." As soon as a child is comfortably able to verbally identify letter optotypes, charts using Sloan Letters, which present full lines of letters in a standardized format, should be used. (Sloan Letters charts match national and international guidelines for standardized eye charts and replace traditional Snellen charts, which do not adhere to the guidelines). (4,5)

The use of "critical line" screening is a reasonable and efficient alternative to having a child read the entire visual acuity chart. (6) In "critical line" screening, a child must correctly identify the majority of optotypes on a line that matches the optotype size a child should be able to pass according to the child's age. In this format, once the screener confirms that the child can

successfully identify a line of large optotypes with both eyes open, the screener moves directly to the line that matches the child's age for monocular screening. The child is referred when the majority of optotypes are not identified on this line. Further testing with smaller optotype sizes is not required. While testing each eye individually, the eye not being tested should be completely occluded and it is recommended that this be accomplished using an adhesive occluder patch to adequately prevent peeking. If a child will not tolerate adhesive occluder patches, occluder glasses are commercially available.

Visual acuity thresholds: Like optotype format selection, visual acuity pass/refer thresholds are age-dependent. Most optotype formats present 5 optotypes per critical line, and passing the screening requires correctly identifying a majority of those optotypes.

Ages 36-47 months: Critical line testing for referral is worse than the 20/50 line.
- Must correctly identify the majority of the optotypes on the 20/50 line to pass.

Ages 48-59 months: Critical line testing for referral is worse than the 20/40 line. - Must correctly identify the majority of the optotypes on the 20/40 line to pass.

Ages 60+ months: Critical line testing for referral is worse than the 20/32 line.*
- Must correctly identify the majority of the optotypes on the 20/32 line to pass.

* Or the 20/30 line if the acuity chart does not have a 20/32 line.

Instrument-Based Vision Screening

Photoscreeners and autorefractors have evolved extensively over the past decade. Several instruments are now commercially available. These devices estimate the refractive error of the child by means of automated software. Some also have algorithms to estimate ocular alignment and, therefore, detect manifest strabismus. The estimates of refractive error and eye alignment made by the screening instrument are compared to pre-programmed referral criteria unique to the instrument to determine if a child passes or should be referred as a result of the screening. It should be emphasized that these instruments are designed to detect risk factors for amblyopia rather than amblyopia itself or structural ocular abnormalities.

Automated photoscreening devices and handheld autorefractors have undergone extensive validation studies in pediatric ophthalmology offices (7-11) and in field settings (12-17). . The magnitude of refractive error and other risk factors for amblyopia development, that should be detected using automated preschool vision screening devices, has recently been updated and published (18). These recommendations are made with the expectation that vision screening will occur several times during a child's formative years and reflect a desire for high specificity in the youngest children and high sensitivity in older children. A randomized crossover study that directly compared an earlier photoscreening device (MTI Photoscreener) with traditional testing of acuity in children aged 3-5 years demonstrated marked superiority of the MTI Photoscreener to traditional office-based screening (19). As a result of these and other studies, photoscreening and autorefraction have now been recognized by the United States Preventative Services Task Force (USPSTF) as appropriate methodology for vision screening of children aged 3-5 years (20). The American Academy of Pediatrics has issued a policy statement supporting the use of these technologies for preschool vision screening (21). Automated photoscreening and autorefraction have been assigned a CPT code (99174), with a corresponding

RVU value that can be used by primary care providers when billing insurers for this service. Thus, previous statements by AAPOS classifying photoscreening as "experimental" should no longer be considered correct.

Several models of automated photoscreeners and autorefractors are commercially available. Most work relatively similarly and provide estimates of refractive error and, in some cases, ocular alignment. The variable most influencing the sensitivity and specificity of these devices to detect amblyopia risk factors is the referral criteria that are programmed into the instrument by the manufacturer or the operator. Several instruments allow the operator to choose referral criteria based upon the age and the estimated prevalence of refractive pathology in the screened population, to produce desired levels of sensitivity and specificity. Altering the referral criteria to improve sensitivity will produce a corresponding increase in the referral rate, and increase the number of false positive referrals (22-24). Likewise, raising the referral criteria to decrease the referral rate will improve specificity but decrease sensitivity. Thus, it is imperative that the pediatric ophthalmologists who are advising primary care providers about their choice of automated screening instruments, be familiar with the basic concepts of sensitivity and specificity and how various instruments perform with respect to referral criteria input.

While there has been continuing refinement of photoscreening devices (25), new technologies are being developed which seek to directly detect decreased visual acuity or amblyopia rather than amblyopia risk factors (26-27). These instruments tend to have less published validation, but show promise as appropriate screening instruments. The AAPOS Vision Screening Committee actively supports the further development and validation of promising technologies.

Conclusion

It is critical that children undergo frequent age-appropriate vision screening, either by optotype- or instrument-based methods, in order to detect or prevent amblyopia before its development becomes irreversible. The testing methodologies described here provide a set of current guidelines to be followed when screening children. While other methodologies are sometimes utilized, most of these have poor, if any validation, and are therefore not recommended. It is suggested that additional resources be instead directed towards expanding the number of children screened and the frequency of screening. Children referred from a screening, and children with persistent concerns despite a "passed" screening, should be referred for a prompt comprehensive examination including cycloplegic refraction by an eye care provider specially trained and experienced in treating children. It is understood that, of necessity, recommendations undergo revision as technology develops and standards of care evolve. AAPOS wishes all children be evaluated regularly in order to provide and maintain good vision for a lifetime.

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