Advances in the Management of Amblyopia

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This Focal Points is dedicated to the memory of our esteemed colleague and friend, Ronald V. Keech, MD, who wrote the first Focal Points module on amblyopia in 2000.

This icon in text denotes video clips in the online edition.

http://one.aao.org/CE/EducationalProducts/FocalPoints.aspx
Learning Objectives

Upon completion of this module, the reader should be able to:

- Implement evidence-based medical therapy when diagnosing and treating amblyopia
- Improve treatment outcomes by advocating for early, appropriate screening programs

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Contents

Introduction 1
Etiology 2
Classification 2
Definition, Diagnosis, and Clinical Features 3
Screening for Amblyopia: Goals and Techniques 3
Treatment 4
• Risk of Recurrent Amblyopia 6
• Refractive Errors and the Amblyopic Eye 6
• Cost Effectiveness of Treatment 6
• Overcoming the Barrier of Noncompliance 6
Future Trends 8
Conclusion 8
Clinicians’ Corner 9

Introduction

Amblyopia is a reduction of vision in 1 or both eyes due to a failure of normal neural development in the immature visual system. It is the most common cause of monocular vision loss in children and young adults. The Focal Points module “Practical Management of Amblyopia” [Keech, 2000] is an excellent summary of information for the practicing ophthalmologist faced with a child needing treatment. At the time of the writing of the earlier Focal Points module, knowledge about amblyopia was largely gleaned from individual ophthalmologists’ cumulative practice experiences over many years, their resulting expert clinical consensus, and single-site studies. In recent years, amblyopia has become a topic of great interest in public health policy and discussions, beyond the domain of the treating ophthalmologist’s office. Multicenter prospective, randomized amblyopia screening and treatment trials in the United States and European countries have created a new body of evidence upon which to base clinical practices of screening, diagnosis, and treatment for amblyopia. Health policy recommendations and legislative initiatives on vision screening...
for amblyopia in children have come from a variety of sources, prompting debate on how best to spend public resources in addressing this problem.

This module reviews the current body of scientific evidence regarding amblyopia. Such knowledge is important in order to (1) effectively practice evidence-based medicine and (2) provide information and advocacy in one’s own practice and community where concerns are likely to be raised by school officials, legislative representatives, and interested parents. In his earlier Focal Points module, Dr. Ronald Keech observed that the greatest impact on reducing the prevalence of amblyopia would be made by improved screening tools used in large populations of children. Today, his belief is shared by a large and diverse group of scientists, researchers, and advocates hoping to eradicate this permanent, yet treatable cause of vision loss.

Etiology

From birth until “visual maturity,” normal visual development relies on clear and equal images transmitted from the eyes to the central nervous system. The brain’s visual centers (striate cortex and lateral geniculate) develop rapidly in the first few months of life, the “critical period” of visual development. Neuronal connections continue to develop, though at a progressively slower rate, until later in childhood (8 years of age or older). Significant disruptions of the visual image (blur or suppression) can result in permanently decreased vision, which is amblyopia. Restoration of visual input to the developing neuronal substrates before visual maturity can result in improved vision.

Classification

Amblyopia is usually classified on the basis of its associated clinical condition. Two basic conditions set up the developing visual system for failure and result in amblyopia—abnormal binocular interaction (eg, strabismus) and blur/distortion of the visual image due to uncorrected refractive errors or media opacities. In the case of uncorrected refractive errors and conditions causing visual deprivation (media opacities such as lens opacity or corneal scarring), amblyopia may be bilateral and/or asymmetric if the condition exists in both eyes. Not surprisingly, multiple or “mixed” mechanisms often are involved. However, classification is an important construct, as it often implies specific treatment.

The specific types of amblyopia, classified on the basis of the associated condition, are strabismic amblyopia, refractive amblyopia, and amblyopia caused by deprivation. Strabismic amblyopia is the most common type of amblyopia, occurring in at least 40% of children with manifest strabismus (usually esotropia). The amblyogenic factors that cause refractive amblyopia are listed in Table 1. Visual deprivation from ptosis, generally with a margin-to-reflex distance of ≤1 mm (Figure 1), dense central cataracts (Figure 2), or other structural abnormalities of the pediatric eye that reduce vision can also result in visual loss from amblyopia.

Table 1. Amblyogenic Factors to Be Detected by Screening

<table>
<thead>
<tr>
<th>Condition</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anisometropia (spherical or cylindrical)</td>
<td>&gt;1.5 D</td>
</tr>
<tr>
<td>Any manifest strabismus</td>
<td></td>
</tr>
<tr>
<td>Hyperopia &gt;3.50 D in any meridian</td>
<td></td>
</tr>
<tr>
<td>Myopia magnitude &gt;3.00 D in any meridian</td>
<td></td>
</tr>
<tr>
<td>Any media opacity &gt;1 mm in size</td>
<td></td>
</tr>
<tr>
<td>Astigmatism &gt;1.5 D at 90° or 180°, or &gt;1.0 D in oblique axis (&gt;10° eccentric to 90° or 180°)</td>
<td></td>
</tr>
<tr>
<td>Ptosis ≤1 mm margin reflex distancea</td>
<td></td>
</tr>
<tr>
<td>Visual acuity: per age-appropriate standards</td>
<td></td>
</tr>
</tbody>
</table>

*aMargin-reflex distance is the distance from the corneal light reflex to the upper lid margin and is a standard objective measurement of ptosis.

**Focal Points: Module 7, 2010**

Best-corrected Snellen visual acuities in amblyopic eyes range from mild deficits (20/25) to severe vision loss (≤20/400). The most severe vision loss due to amblyopia can be found in cases of untreated pattern deprivation (blur from media opacities) during the first 3 months of life, in which vision may be reduced to hand motion or even light perception. The accepted definition of clinically significant amblyopia is best-corrected visual acuity (BCVA) ≤20/40 or a difference of 2 lines of Snellen acuity between the amblyopic eye and the normal eye. In addition to visual acuity measurements, clinical characteristics of amblyopia include: (1) no change or even improvement in BCVA through a 3.0 neutral density filter and (2) improvement in vision when tested with single optotypes.

Measuring BCVA is central to diagnosing and assessing treatment efficacy in amblyopia. In verbal and/or literate children, Snellen and Snellen-equivalent charts (tumbling Es, HOTV) are optimal. The linear Snellen test is the gold standard, as single optotype or picture tests may overestimate visual acuity. Children who are unable to comprehend lines of optotypes can be tested with single optotypes. However, "crowding bars" to surround the optotype should be used for better detection of amblyopic vision loss. In less mature children, symbols (Lea Symbols testing, Allen figures) may be used. In preverbal or nonverbal children, vision can be assessed indirectly by preferential looking techniques. A 2-octave deficit is the threshold for diagnosing amblyopia, with an octave defined as a doubling of the spatial frequency (eg, 20/20 to 20/40). Observation of unequal or poor fixation behavior is also evidence of amblyopia, and this behavior can be assessed with or without a manifest strabismus.

**ONLINE VIDEO:**
Induced Tropia Test, 3 min 53 sec

**Screening for Amblyopia: Goals and Techniques**

The World Health Organization has proposed a 10-point list of criteria for selecting diseases appropriate for public health screening programs:

1. The disease is an important health problem.
2. The natural history of the condition is well characterized.
3. There are suitable examination techniques to detect and diagnose the problem.
4. Facilities exist that allow for diagnosis and treatment of the disease once it has been detected.
5. The latent/asymptomatic stage is of a suitable nature/duration to allow for detection.
6. The tests are acceptable to the population being tested.
7. Effective treatment exists for the disease.
8. Policy has been agreed upon as to who requires treatment.
9. The cost of finding each case is balanced with the overall impact on public health.
10. Case finding should be continuous process.

Amblyopia meets the first 2 criteria (addressed earlier in this module). Ophthalmologists have long accepted the issue of effective treatment (#7), and the latest evidence regarding treatment efficacy is discussed in this module. The remaining criteria represent some of the...
most promising activity with regard to reducing vision loss from amblyopia on a large scale.

Guidelines exist for screening children for amblyopia. Consensus has been reached by the Committee on Practice and Ambulatory Medicine of the American Academy of Pediatrics (AAP), American Association of Certified Orthoptists (AACO), American Association of Pediatric Ophthalmology and Strabismus (AAPOS), and American Academy of Ophthalmology (the Academy). Primary care physicians (PCPs) should be the primary resource for screening, as infants and young children typically follow a regimen of “well baby” and “well child” check-ups. They are too young to respond to or cooperate with measurement of vision or screening tools that might be utilized outside of a medical setting, so screenings in the medical home are one of the only ways to detect congenital and structural disorders of the eyes as well as infantile strabismus. PCPs should also perform preschool vision screenings. However, as many as 60% of all PCPs for children do not perform the recommended preschool screenings. Interventional studies—attempts to improve compliance with screening guidelines through educational support in the PCP’s office—have not proven efficacious. So, while ophthalmologists should advocate for amblyopia screening in the child’s medical home, reality dictates turning to other resources for timely detection of amblyopia in the preschool and school-age populations.

Many different modalities have been proposed to accomplish mass screenings that are both cost effective and have an appropriately high sensitivity and specificity. The Vision In Preschoolers (VIP) Study Group, funded by the National Eye Institute (NEI), is the first cross-sectional multicenter trial to compare several different screening modalities in an attempt to determine the best test for screening. In their Phase I study, “licensed eye care professionals” (mostly optometrists) tested 2588 preschool children enrolled in Head Start programs for objective measures of amblyogenic factors with autorefractors and photorefractors, noncycloplegic retinoscopy, and subjective measures of vision in preliterate children. Refractors included the Retinomax autorefractor, SureSight vision screener, MTI PhotoScreener, iScreen PhotoScreener, and the Power Refractor II. Subjective measures included Lea symbols distance visual acuity, HOTV distance visual acuity, random dot E stereoaucuity test, and the Stereo Smile II stereoaucuity test. A cover-uncover test was also performed. Each child received a “gold standard examination” after screening, and the results of the screenings and examinations were compared. Two autorefractors, the SureSight vision screener and the Retinomax autorefractor, were on par with noncycloplegic retinoscopy and Lea Symbols testing, detecting approximately 2 of 3 children with an amblyogenic factor. Sensitivity improved to 80% to 90% for these tests when only criteria for Group 1 (most severe) targeted disorders were used for referral criteria. Targeted disorders in the VIP study were similar, but not identical, to the amblyogenic factors agreed upon by the AAPOS Vision Screening Committee (Table 1). There is likely to be adjustment of the screening criteria set for autorefractors with further study, as evidenced by a 2007 article employing the SureSight vision screener in a field test with lay personnel. It was found that increasing the astigmatism cut off to ≥2.2 D (from ≥1.75 D) achieved a reduction in referral rate from 11% to 6% and improved the positive predictive value of the screening from 30% to 43%. Autorefractors may become more common as the method of choice for mass amblyopia screenings.

One of the more controversial issues involving amblyopia screening is the question of screening versus comprehensive examinations for all children. AAP, AAPOS, and the Academy have endorsed screening by the PCP to detect eye disease and amblyogenic factors in children. When a child fails a vision screening, there is significant family history of eye disease in childhood, or predisposing factors such as prematurity and genetic disease are present, referrals should be made to an ophthalmologist experienced in working with children. The recommendation of screening rather than a comprehensive exam for every child is based on the concerns about expenditure of medical funds for complete examinations in the 80% to 90% of all children who do not need eye care in their first decade of life.

Treatment

The principle of treating amblyopia involves clearing any image blur and encouraging use of the amblyopic eye through preventing use of the better-seeing eye. Data on treatment of amblyopia from multicenter randomized controlled clinical trials can assist the prescribing ophthalmologist. The Pediatric Eye Investigative Group (PEDIG), funded by the National Eye Institute (NEI), has recruited pediatric ophthalmologists and other eye care professionals from around the United States to participate in prospective, randomized multicenter clinical studies designed to allow an adequate sample size to definitively answer questions about treating amblyopia. The following summarizes these studies to date.

Though occlusion therapy has long been the accepted standard for treatment of unilateral amblyopia, the details of how to patch were often debated as a matter
of personal preference on the part of the prescribing ophthalmologist. Two early PEDIG amblyopia treatment studies tested the efficacy of different patching regimens. Part-time versus full-time occlusion (6 hours per day versus all day, respectively) was studied for severe strabismic, anisometropic/refractive, or combined mechanism amblyopia (20/100 to 20/400) in children 3 to 7 years of age (see Table 2 for eligibility and exclusion criteria). There was no difference in response to treatment between the 2 groups, with an average of 4.7 lines of improvement in the full-time patch group and 4.8 lines in the part-time patch group after 4 months. In a study published in 2008, part-time patching for severe amblyopia (2 hours per day instituted after glasses wear for up to 16 weeks) was again found to result in improvement of visual acuity in the amblyopic eye by a mean of 3.6 lines. In another study by PEDIG, researchers evaluated a part-time patching regimen consisting of 2 hours versus 6 hours per day for moderate amblyopia (20/40 to 20/80) in children between 3 and 7 years of age with anisometropic/refractive, strabismus, or combined mechanism amblyopia (Table 2). No difference in efficacy was detected, with a mean of 2.4 lines of improvement after 4 months in both groups. These studies show that both part-time and full-time occlusion can produce similar results in the eye with severe amblyopia and patching can be prescribed initially at 2 hours per day for the moderate amblyope.

Therapy preventing use of the sound eye can be achieved by defocusing the sound eye, usually with atropine drops (Figure 3). PEDIG compared the efficacy of daily atropine penalization (1 drop of 1% atropine sulfate) to patching (6 hours per day) in children 3 to 7 years of age with strabismic and/or anisometropic amblyopia (Table 2). If patients were hyperopic in the sound eye, and amblyopia had not been successfully treated within 16 weeks of starting the atropine, the spectacle lens in the sound eye was reduced to plano for 2 months prior to the 6-month outcome exam to further blur the sound eye. (Children with myopia ≥0.50 diopters (D) in either eye were excluded from this study.) After 6 months, no significant difference was found in outcome, with BCVA in the amblyopic eye being 20/30 or ≥3 lines improved from baseline in 79% of the patching group and 74% of the atropine group. Two years after treatment, no difference was found in BCVA of sound or amblyopic eyes.

<table>
<thead>
<tr>
<th>Table 2. Eligibility and Exclusion Criteria for PEDIG Amblyopia Studies</th>
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<tbody>
<tr>
<td><strong>Eligibility criteria:</strong></td>
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<tr>
<td>Age &lt;7 years</td>
</tr>
<tr>
<td>Able to measure visual acuity with the Amblyopia Treatment</td>
</tr>
<tr>
<td>Study visual acuity testing protocol, using single-surround HOTV optotypes*</td>
</tr>
<tr>
<td>Amblyopia associated with strabismus, refractive error/</td>
</tr>
<tr>
<td>anisometropia, or both as specified for different protocols</td>
</tr>
<tr>
<td>Visual acuity in the amblyopic eye ≥20/40 and ≥20/100 in</td>
</tr>
<tr>
<td>studies of moderate amblyopia</td>
</tr>
<tr>
<td>Visual acuity in the sound eye ≥20/40</td>
</tr>
<tr>
<td>Inter-eye acuity difference ≥3 logMAR lines</td>
</tr>
<tr>
<td>No more than 2 months of amblyopia therapy in the past</td>
</tr>
<tr>
<td>2 years (any treatment more than 2 years ago was acceptable)</td>
</tr>
<tr>
<td>Refractive error corrected for at least 4 weeks</td>
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</tbody>
</table>

| Exclusion criteria:                                           |
| Presence of an ocular cause for reduced visual acuity         |
| Prior intraocular surgery                                     |
| Myopia (spherical equivalent of −0.50 diopters or more) in    |
| either eye                                                    |
| Down syndrome                                                 |
| Known skin reaction to patch or bandage adhesive, or allergy  |
| to atropine or other cycloplegics                             |

*Excluded all patients younger than 2 years and many patients younger than 3 years. Adapted from the Pediatric Eye Disease Investigator Group (PEDIG) trials.

Figure 3 Atropine penalization in a child with esotropia. a. Near fixation with the amblyopic left eye. b. Distance fixation with the sound (penalized) right eye.
between the 2 treatment groups, although the amblyopic eye remained on average 1.8 lines worse than the normal eye. This treatment effect persisted to the 10-year-old examination, reported in 2008. Another PEDIG study evaluated daily vs weekend atropine for moderate amblyopia from 20/40 to 20/80. After 4 months, no difference in visual improvement was found between the 2 groups. Additional information about the use of atropine penalization in moderate amblyopia was obtained from a PEDIG trial of weekend atropine with randomization to additional optical blur of the sound eye with a plano versus no additional optical blurring. Results reported in 2009 showed no substantial benefit at 18 weeks when optical penalization was added to weekend atropine in this group of children ages 3 to 7 years. These long-term data show that daily atropine and patching for 6 hours/day are equivalent treatment options, and that if pharmacologic blurring is used for treatment, initial treatment can begin with just weekend use of atropine for moderate amblyopia.

**Risk of Recurrent Amblyopia**

In children less than 8 years of age who were treated successfully with atropine or patching, 24% of children had recurrence of amblyopia within 1 year of treatment cessation. There was no difference between atropine and occlusion treatment groups in recurrence risk. The data suggested that abrupt cessation of patching ≥6 hours per day was associated with a higher risk of recurrence. Of note, a large single site retrospective study published in 2006 found an almost identical risk of recurrence in children less than age 10: 27% recidivism 1 year after treatment cessation.

**Refractive Errors and the Amblyopic Eye**

To find out if correcting refractive errors alone improves vision in the amblyopic eye, PEDIG studied children 3 to 7 years of age with previously untreated anisometric amblyopia. They found that amblyopia resolved with refractive error correction alone in 27% of patients. Treatment outcomes were not related to age, but better outcomes were associated with better baseline BCVA and lesser amounts of anisometropia. In cases of bilateral ametropic amblyopia where the mean binocular BCVA was ≤20/40 in both eyes in the presence of 4.00 D of hyperopia by spherical equivalent, 2.00 D or more of astigmatism, or both, binocular BCVA improved to a mean of 20/25 or better within 1 year of spectacle correction in children 3 to 10 years of age. Thus, initial amblyopia treatment can begin with correction of anisometropia alone.

Another question regarding treatment is whether or not to recommend treatment in “older” children. PEDIG studied children ages 7 to 17 years, randomizing the younger patients (7 to 12 years) to optical correction alone versus optical correction combined with atropine or patching, and the older patients (13 to 17 years) to optical correction alone versus optical correction and patching. One-fourth of the children treated with optical correction alone improved (defined as an improvement of 2 or more lines in Snellen acuity) – similar to the previously cited study by PEDIG in children less than 7 years of age. Half of the 7- to 12-year-old patients treated with patching or atropine improved. In the 13- to 17-year-old children, a history of previous treatment predisposed to a lower response rate to patching: 47% response rate for no previous treatment versus 16% response rate with a history of previous treatment. These data showing that even older patients can show improvement in VA in the amblyopic eye represents a significant change from previous consensus opinion about when amblyopia treatment becomes useless.

**Cost Effectiveness of Treatment**

To perform a cost-utility analysis of treatment, researchers referred to the Academy’s Preferred Practice Pattern guideline for amblyopia (Figure 4). Amblyopia treatment resulted in a gain of dollars per quality-adjusted life-years ($/QALYS) ranging from $2053 to $2509. Studies indicate that $/QALY of <$20,000 are especially cost effective. Thus, in this analysis, amblyopia treatment is highly cost effective.

**Overcoming the Barrier of Noncompliance**

Despite all the evidence concerning the efficacy of treatment, clinicians treating children for amblyopia realize that noncompliance remains a major barrier to successful treatment. In the PEDIG study comparing atropine and patching, parental surveys indicated that atropine penalization had a higher degree of acceptability than patching. Given the study results showing comparable clinical efficacy of atropine and patching in many children, parental preference may be considered when treatment plans are devised. An alternative option is available when initial treatment has failed due to noncompliance. The news about the efficacy of minimum patching (2 hours per day) and weekend atropine penalization to initiate treatment allows physicians to offer
surgery were excluded from study. However, such children may have amblyopia in addition to (and secondary to) their ocular abnormality, and the component of VA loss due to amblyopia may be amenable to treatment. Such cases must be approached on an individual basis, with a treatment plan and endpoint for treatment success or cessation of treatment based upon each individual’s circumstances and response to treatment. Finally, it is important to prevent vision loss in the sound eye through appropriate monitoring for reverse amblyopia and the prescription of polycarbonate lenses for protection from trauma. Most clinicians monitor children undergoing amblyopia treatment at least once every 2 months, with more frequent monitoring required in younger children and in situations where the penalization or occlusion regimens are more intense.
Future Trends

A treatment modality usually reserved for adults is being evaluated for anisometropic amblyopia: refractive surgery. This is a particularly attractive idea in children with optical blur who are unable or unwilling to wear refractive error correction. No large-scale studies have been performed, but smaller series have demonstrated the safety and feasibility of performing LASIK or photorefractive keratectomy (PRK) in children’s eyes under general anesthesia. This modality, combined with the evidence that optical correction alone can result in improved vision in a certain percentage of amblyopic children, holds promise for future improvements in outcomes for recalcitrant cases.

Additionally, future PEDIG studies will likely provide information about different treatment options for amblyopia: Bangerter foils, atropine versus patching for residual amblyopia, and reduced plus lenses with atropine for penalization therapy. Evaluation of nerve fiber layer thickness in amblyopia may indicate structural problems in amblyopic eyes.

Conclusion

With recently published trials in amblyopia that were well designed, randomized, and controlled, ophthalmologists have new opportunities to advocate for effective screening and offer treatment options to families based on evidence, not opinion or anecdotal experience. The Academy’s Preferred Practice Pattern for amblyopia has incorporated many of these studies to create a comprehensive treatment algorithm. Certain principles have withstood the scrutiny of study: earlier detection and treatment yield the best chance for improvement, most unilateral amblyopia requires penalization therapy, and amblyopia often recurs. However, some ideas have not been substantiated. We now know that more patching or penalization is not necessarily more efficacious as an initial treatment plan, though treatment failures may warrant subsequent “ramping up” of treatment intensity. Some older children will respond to treatment even after the “age of visual maturity” has passed, and some children with anisometropic amblyopia will achieve resolution of amblyopia with spectacles alone. The data from the PEDIG amblyopia treatment trials give prescribing providers more flexibility to vary treatment regimens, with more tools and a greater understanding of principles involved in effective amblyopia treatment. This creates greater hope of finding the right tool to accomplish the task of assuring that the most common cause of permanent vision loss during childhood is reduced in future generations.

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Clinicians’ Corner provides additional viewpoints on the subject covered in this issue of Focal Points. Consultants have been invited by the Editorial Review Board to respond to questions posed by the Academy’s Practicing Ophthalmologists Advisory Committee for Education. While the advisory committee reviews the modules, consultants respond without reading the module or one another’s responses. –Ed.

1. What is your preferred initial treatment for amblyopia, and does it vary by age or type of amblyopia?

Dr. Davitt: If the patient has any significant refractive error, I would first make sure that it is corrected. In my experience, many patients with refractive amblyopia, in particular, demonstrate at least some improvement in their amblyopia with spectacles alone. In a younger child, I often prescribe glasses with plans to re-evaluate in 3 months, suggesting to the parents that additional amblyopia treatment with occlusion therapy or atropine penalization may be necessary if the amblyopia isn’t significantly resolved. This gives the child opportunity to accept spectacle wear as a habit prior to initiating additional treatment. I find that some children reject spectacle wear if occlusion therapy is initiated at the same time. In older, school-aged children, I might be more likely to initiate spectacles and occlusion therapy and/or atropine penalization with the recognition that intervention is more urgent. I prefer to start with occlusion therapy in patients whom I believe will tolerate it, suggesting that parents have a minimum goal of 2 hours per day. If the child demonstrates improvement after a 3-month interval, I usually continue that level of treatment. If no improvement is noted, I then have the opportunity to ramp up the number of hours of occlusion or switch to atropine penalization if I suspect noncompliance. In a child more than 7 to 8 years of age, I am more likely to “pull a full-court press” initially, using all modalities I have at the same time (spectacles, occlusion, and atropine penalization).

Dr. Mets: My preferred “generic” treatment is 1 to 2 hours of patching per day. It varies by age, density of amblyopia, and type of amblyopia. For younger, preverbal children, I tend to start at 1 hour per day. For an older child, who has amblyopia 20/100 or worse, I start at 2 hours per day with the explanation to the parents that we will...
Clinicians' Corner

probably have to increase the patching hours, but we will tailor by the subsequent measurement of visual acuity. I would like to “engage” the process and then increase the patching, but I do not increase to more than 6 hours/day per the PEDIG study. I always start with an adhesive patch to establish the process and then move to a felt, hanging patch, if the child wears glasses. If the child is intractable, then I suggest a “patching weekend” (a plan shared with me by my former partner, Mark Greenwald, MD). The family devotes a weekend to establish the patching regimen. They provide plenty of love, hugging, and so on, but the patch stays on for 4 to 5 hours on Saturday and Sunday. A weekend is chosen so that there can be several adults to share this task.

2. How has your management of amblyopia changed over the past 10 years?

Dr. Davitt: Over the years, I have found that I am recommending much less initial full-time occlusion for treatment of amblyopia. My impression is that I’m getting better compliance with similar results. Parents seem happier that they are able to achieve the goal I set for them and are less likely to give up on therapy. Part-time occlusion also allows me to monitor the children over greater intervals, which is helpful to parents (because of work and travel issues) and to my office flow (allowing me to see more patients). My use of atropine penalization has also changed slightly over the years. I find that I am more frequently using atropine when I need to accomplish 2 goals at once: (1) relaxing accommodation in the fixating eye to encourage spectacle wear, and (2) encouraging a fixation switch to the amblyopic eye at near fixation.

Dr. Mets: Overall I patch fewer hours since the reports from the PEDIG studies became available. In preverbal children, I depend more on Teller acuity card (TAC) testing, which I find most helpful, particularly in congenital cataracts, but also in other forms of amblyopia. Also, I have added the use of atropine 1% penalization on Saturday and Sunday, in addition to patching, in some refractory cases. These patients must be capable of quantitative vision measurement. I also use atropine for maintenance therapy in older children. Again, atropine 1% on Saturday and Sunday works well in these situations.

3. How would you determine if amblyopia is present in a preliterate child?

Dr. Davitt: If a patient cannot perform visual acuity testing using Snellen letters, I then proceed with vision testing using more simple testing methods appropriate for the child’s developmental stage. I would next attempt testing with HOTV matching. If the child was unable to do this, then I would move to using Allen symbols, either verbally or with matching. In the child who is unable to participate in recognition acuity testing, I look for a fixation preference. Determining the fixating eye is easy if the child has strabismus. In the nonstrabismic child, I find the induced-tropia test (using a 10 to 12 diopter prism to induce vertical strabismus) particularly helpful in determining which eye may have a fixation preference. Forced preferential looking with Teller cards is also an option, although I rarely find that this method uncovers a fixation preference that I couldn’t elicit using the induced tropia test alone. I typically reserve Teller cards for detecting change in the visual acuity of a preliterate child over time or for estimating a visual acuity if needed for obtaining services for the child.

Dr. Mets: The first judgment is by fixation preference, if there is a tropia present and by the 10 prism diopter base-down fixation test if there is no strabismus. Then, I follow with the TAC test until the child is no longer interested (about 13 to 14 months of age in a normal child), but usually longer in a developmentally delayed child. Our techs have gotten very good with the TAC test and we perform it routinely.

4. Do you use amblyopia treatment for children with unilateral vision loss due to severe optic nerve or macular abnormalities?

Dr. Davitt: I do initiate amblyopia treatment in children with unilateral vision loss due to severe optic nerve or macular abnormalities even when conventional wisdom suggests that the prognosis for significant improvement is poor. In cases of unilateral optic nerve hypoplasia, visual prognosis cannot always be accurately predicted by the apparent size of the nerve. In cases of macular abnormalities, sometimes paramacular areas provide far better vision than would be expected. Therefore, I
6. At what age do you discontinue amblyopia treatment, and how often do you follow patients after treatment has been discontinued?

Dr. Davitt: When thinking about discontinuing treatment, I am not as focused on age as I am on how stable the patient’s vision has been. Conversely, I am just as likely to attempt amblyopia treatment in an older child, especially with anisometropic amblyopia, who has never had treatment before as I am to discontinue amblyopia treatment in a much younger child whose vision has been stable despite continued therapy. Follow-up after discontinuation of therapy would be at shorter intervals for younger patients (3 months and then 6 months) and longer for older patients (4 to 6 months and then 1 year).

Dr. Mets: If they are “successful” patients with amblyopia treatment, meaning they have at least 20/40 (legal driving vision) in the amblyopic eye, I usually have them “maintain” amblyopia treatment until age 10 years, but sometimes with only 1 hour per week of patching. Then, I see them in 4 to 6 months, depending on how much they are patching.

5. Do you taper amblyopia therapy?

Dr. Davitt: I typically taper amblyopia therapy once visual acuity appears to be maximized. When using occlusion therapy, I often cut the time of occlusion by half while maintaining the same follow-up intervals. Patients seem to understand the thought process behind this if I equate tapering occlusion therapy to a patient who wore braces wearing a retainer following successful therapy. For children who have begun to fight occlusion therapy, I suggest to the parents that they can discontinue treatment but may need to restart it if vision regresses at the follow-up exam. When using atropine penalization, I also gauge how much difficulty the parents are having at administering the drops. If compliance is not a problem, I often taper daily atropine to weekend-only atropine.

Dr. Mets: I do taper. When I think I have gotten as much improvement as possible, the vision is stable on several visits, and the child is in the second half of the first decade of life, I taper. My maintenance dose is 1 hour, 3 days a week (3 hours/week). An alternative is atropine 1% on Saturdays and Sundays.

7. When patients ask at what age they should bring in their newborns for an eye exam, how do you answer?

Dr. Davitt: I ask the parents if they suspect there is a problem with their child’s vision. If there is a question of leukocoria or absent red reflex, I would recommend that they be seen right away. If constant strabismus is present, I would also recommend that they be seen right away to rule out cranial nerve palsies, need for amblyopia treatment, etc. However, more typically a parent is concerned that their child doesn’t appear to be tracking as well as expected, or the parents are noting intermittent strabismus. In this case, I often ask them to bring their child in at 6 months (corrected age if premature), as the range of what is normal with regards to fixation and stability of alignment is much narrower at that age, and the results of the examination are more likely to be definitive than if performed at an earlier age.
Clinicians’ Corner

Dr. Mets: If there is a history of retinoblastoma or congenital cataracts, I ask to see the child in the first or second week of life. If there is a history of accommodative esotropia in siblings, I like to see the child at 3 to 4 months. Sometimes there can be a high hyperopia with no deviation. If the parents note any strabismus, I see them right away. If everything seems fine to the parents and there is no family history of childhood eye disease, I suggest around 4 or 5 years but am happy to see any child if the primary provider has concerns.

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