

Clinical & Refractive Optometry is pleased to present this continuing education (CE) article by Dr. Janis Miller Lightman entitled **A Systematic Approach to Successful Occlusion Therapy for Amblyopia**. In order to obtain a 1-hour Council of Optometric Practitioner Education (COPE) approved CE credit, please refer to page 76 for complete instructions.

A Systematic Approach to Successful Occlusion Therapy for Amblyopia

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ABSTRACT

When faced with the daunting task of patching their child's non-amblyopic eye, parents require specific direction and advice. In most cases, eyecare providers have never actually had to patch their own child and are unable to provide the kind of guidance that parents deserve. Simply telling a parent to place a patch over the better eye is not enough. As the natural inclination of the amblyope is to use the eye with better visual acuity, resistance to patching is normal and may even be considered part of the definition of amblyopia. Concurrently, the physical discomfort of placing an occlusive device over the eye, and/or taped to the skin, will evoke resistance on the part of the child. By providing detailed, practical tips, optometrists can better direct the occlusion therapy, thereby assisting in the achievement of the amblyope's maximal visual potential. A brief discussion of amblyogenesis will assist the practitioner in educating the amblyope's parents and caregivers, furthering the chances of compliance.

UNDERSTANDING AMBLYOPIA

A basic comprehension of visual development may be necessary for many parents to begin considering compliance with patching therapy. For this reason, a review of the normal sequence of the neurological development of vision is essential. While most parents may desire a brief explanation of the critical periods of development, others may require a more in-depth analysis of the latest research. A review of the plastic nature of vision, during the earliest months and years of life, will encourage parents that patching the more normal eye will not only force the amblyopic eye to see, but will also be safe for the better eye when done correctly. Knowing that early intervention will

facilitate the attainment of the child's maximal visual acuity, families can make proactive efforts to correct a reversible problem.

Amblyopia is defined as "reduced vision in one or both eyes that cannot be improved solely by optical correction, and that is not directly caused by any congenital or acquired ocular structural abnormalities, including trauma or disease."¹ Amblyopia may be due to visual deprivation, strabismus, or refractive error. Correction of the primary source of visual dysfunction is thought to lead to appropriate visual maturation. However, because of ocular dominance patterns, the brain preferentially will process the most orderly visual information and suppress the less orderly or blurred images from the fellow eye. Remediation of visual deprivation, whether through the use of corrective lenses, surgery, and/or patching, is a prerequisite to the development of normal visual function in this vulnerable population.

Classical studies of vision development, performed by Hubel and Weisel in the 1960s, demonstrated that there is a critical period of development of the visual pathway. During this interval of time, visual pathway development is both labile and reversible in nature.² Both electrophysiologic and behavioral studies of vision indicate that this critical period has two phases, a rapid infantile phase lasting from birth to approximately ten months of age, and a slower phase lasting until around nine years of age.³ During these periods, both the density of neuronal synapses and the volume of the occipital lobe increase dramatically and then level off.⁴ Therefore, intervention during the earliest weeks and months of life is crucial to facilitate attainment of maximal visual potential.

During this critical period, the visual pathway develops two separate, and eventually integrated, pathways. These pathways are composed of "building blocks" or groups of neurons with highly specified functions. Eventually, these two pathways, each processing their distinct bits of information, combine to process simultaneously, in a parallel fashion. This integration of pathways is known as "parallel processing." The parallel nature of this system involves two groups of retinal ganglion cell neurons projecting their axons posteriorly through the optic nerve to the lateral geniculate nucleus. These two groups are called

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parvocellular (P) or small-cell and magnocellular (M) or large cell. These cells layer themselves alternately in a lamellar fashion within the striate cortex of the lateral geniculate body. While there is some intermixing of visual information at the level of the striate cortex, most of the bits of information are sent distinctly to the extra-striate cortex and on to higher levels of the visual system. Specifically, the M system diverges to the dorsal segment of the striate cortex, the parieto-occipital region, and the P system travels to the temporo-occipital region of the brain.⁵

Each set of neurons responds to specific kinds of visual stimuli. M neurons are sensitive to direction, speed, flicker, and motion in depth over a large range of binocular image disparities, such as in coarse motion stereopsis.⁶ The M pathway is also called the “where” system as it is the predominant system for localizing and tracking objects. Similarly, the “what” system is characterized by P neurons responding to color, precise orientations of patterns, and shapes. The P system is responsible for responding to fine and static binocular image disparities. M neurons develop first and are normally fully functional between three and six months after birth. P neurons emerge around the fourth month of life and gradually mature within the first 10 to 12 months of life.

The establishment of binocularity occurs over this early period of life, as the separate pathways mature and integrate their functions. Initially, the M pathway responds to targets that are moving in a temporal to nasal direction in the visual field. This is demonstrated by the optokinetic nystagmus response elicited monocularly and also evidenced by smooth pursuit movements. During the three- to six-month postnatal period, this response broadens to include targets moving in the opposite direction as well. Binocularity is demonstrated by the infant’s attraction to stereoscopic targets, fusional vergence movements in response to a horizontal prism held before one eye, and aversion to nonfusible stimuli.⁷ Prior to this period, it is common to see a small degree of variable angles of ocular misalignment that eventually resolve into a nearly orthophoric posture.

While approximately 98% of infants develop normal M neuron connections during this critical period, the other 2% are unable to establish full alignment, conjugate eye movements, and maximal binocularity. Over time, these infants continue to show asymmetric horizontal pursuits beyond six months of age and into adulthood. These same infants also display a latent fixation nystagmus. Upon fixation of a small stationary target, the eyes tend to drift nasally, with respect to the fixing eye. Detection of this minuscule nystagmus is especially difficult in young children, as their voluntary attention is tenuous at best. Thus the earliest signs of amblyopia are often missed by caregivers.

Plasticity of the Visual System

The most basic aspects of visual function must develop prior to the emergence of the more sophisticated elements of vision. When visual deprivation occurs before the age of four months, the development of low-resolution M neurons is compromised. With failure to turn on the M system comes a further disruption in the P system’s development.

The prevailing clinical standard of care is to provide surgical and optical intervention as early as possible in an affected infant’s life. Thus, by providing some normal visual experiences during the critical period, between birth and 16 weeks of life, the ill effects of deprivation are reversed. It has been shown that the “turning on” of the visual pathway is in fact even more important than its staying “turned on.” This concept is called “plasticity” or lability and is the cornerstone of amblyopia therapy.

COMMUNICATING WITH CAREGIVERS

In speaking with parents and caregivers of amblyopes, the clinician faces several challenges. Firstly, communicating the importance of the therapy directly to the child and, secondly, educating the parents in plain, nonscientific terms the purpose of this difficult task. Furthermore, the use of jargon may scare a child and intimidate a parent, which in itself is nonconstructive.

With so much attention being paid to the “lazy eye,” the child may develop a negative or resentful feeling toward the amblyopic eye. The term “lazy,” when used for other reasons at home implies that the child is just not trying and may deserve a reprimand. By renaming the amblyopic eye as “blurry,” the child will want to try to help it. Using the words “help” or “wake up” is often an effective way to communicate that the eye is okay and simply needs some help. For a child with a nurturing personality, this can be an effective approach. In this same vein, the patch can be called a “helper,” which allows the non-amblyopic eye to rest from all its work. Most children understand naps and will be somewhat willing to allow their eye to take a nap for a while.

To explain the critical nature of vision development to parents, the clinician may want to use terms such as “growing time, maturation time, or time of most development.” The terms “flexible” or “elastic” may relate the essence of pliability to parents and caregivers in a more concrete way. By explaining that the visual system can develop or “turn on” as well as “shut itself off,” the concept of suppression can be taught.

“The highway model” appears to work well with many children. By explaining that there is a little road that carries pictures from the eye to the brain, or back of the head, a child can imagine little cars, carrying pictures of things along the visual pathway. Children often appear to understand that the road needs to be built before the cars can travel on it. They also understand that the cars can drive faster when there are more lanes on the highway. Similarly,

their pictures can get back into their brain faster if more lanes are built on the road in their head (the visual pathway). Thus, in the child's mind, the patch becomes a piece of equipment used to build the highway.

GENERAL HINTS FOR SUCCESSFUL PATCHING

Once both the caregiver and child understand a little bit about amblyopia, they are ready for these concrete suggestions regarding patching:

1. Begin patching therapy as young as possible. Do not delay unless absolutely necessary.
2. Patch the better eye early in the morning.
3. Be dedicated. Do not skip days or the child will think that patching is optional.
4. Stress to both the child and parent that patching is therapy and not a punishment.
5. Skipping patching rewards manipulative behavior. Being busy or lazy is no excuse.
6. Reward easy patching with incentives (favorite activities or things).
7. The parent with the calmer or more relaxed personality should be in charge of the patching regimen. Anxiety on the part of the caregiver breeds resistance on the part of the child.

Patching Time Management

It is important to convey that the child has the caregiver's full attention and understanding during this difficult time. *For a young child, being forcibly "blinded" by occluding the functional eye, is a very difficult and often horrifying event in a child's life.* Therefore, the caregiver must approach the initial patching period with both compassion and empathy. However, this approach may be a challenge for many caregivers who are concerned with enforcement and compliance with therapy. Thus, the patching itself is a very complicated task for families.

Holding and hugging the child as soon as the patch goes on is an indication that the patch is for the child's benefit as opposed to a punishment. It also serves as a method to immobilize the arms to prevent the child from immediately ripping off the patch. Using a "bear hug" position, whereby the child's arms are securely held under the parent's arms, provides both comfort and security to the child while acting as tolerable arm restraints. It may become necessary for the parent to hug a baby or toddler in this way for the first 30 to 60 minutes of patching each day.

If this approach is inadequate, arm restraints may be fashioned from cardboard or rolled up magazines and taped to the arms with skin tape. Restraints allow for use of the hands while preventing the elbow from bending, thus stopping the child from reaching the patch and removing it.

After the initial adaptation period, it is usually possible to free the child somewhat. However, when the child is

unrestrained, keeping his/her hands busy at all times is essential. Favorite toys and activities should only be allowed during compliant patching. Close parental attention is crucial for success. Parents must be forewarned that *they should expect to get nothing else done during the entire patching time each day.* As vision develops, the patch becomes less of a hindrance to the child and the level of parental attention diminishes.

Improving Adherence to Patching Schedules

While each amblyogenic pathology confers its own level of visual deprivation, it is well established that occlusion of the fellow eye, for some period of time each day, will force the amblyopic eye to improve functionally. In cases of dense amblyopia, resulting from visual deprivation due to congenital cataract, corneal leukoma, or congenital glaucoma, intensive full-time patching therapy is often prescribed. The fellow eye is patched all but one or two waking hours in an effort to elicit the establishment of maximal foveal vision in the affected eye. In cases of refractive and strabismic amblyopia, patching schedules are often more lenient and may require only half of the waking hours be involved with patching. Once alternation of vision is established, alternate patching may be instituted in order to equalize the visual acuity between the two eyes. Eventually, patching times decrease to allow for the establishment of binocularity.

Determination of the patching schedule is therefore specific to the degree of amblyopia, the underlying condition causing the amblyopia, as well as the child's age and usual activities. For a very young, post-cataract patient, full-time patching, with one to two hours off, is always prescribed, whereas for a child with an accommodative esotropia, six to eight hours of patching may be enough. Over time, the practitioner may even decrease the hours of patching, as a child begins school and shows progress in his/her visual acuity measurements and compliance. Patching in a safe and controlled environment will further the child's comfort and confidence. It is best not to patch the eye and then send the child out to face school, the playground, or difficult social situations. Thus, patching at home until vision is well established is often the safest approach, especially for school-age children.

The rationale for the amount of patching must be explained carefully to the parents. Most parents are interested in patching timetables in terms of hours, as well as the expected long-term commitment in terms of months or years. Thus, parents need to know that visual development continues until around age seven or eight, and that some amount of patching may need to continue until at least this age. This allows parents to mentally prepare themselves for a long-term commitment to therapy. However, it is also important to point out that the onset of patching therapy should never be delayed until ages four to seven, because

by that time the amblyopia is so dense that patching is ineffectual. By emphasizing the greater return of early intervention, the optometrist can guide families to greater compliance and better results.

Patching schedules should be followed as closely as possible to ensure maximal attainment of visual potential. By conveying to the child that the “doctor says” the patch must go on at a certain time and the “doctor says” the patch may be removed at some later time, the child learns that patching is an official thing, not something to be manipulated. By delegating patching to the world of “prescriptions and medicines,” the child learns that compliance is important. Just as parents teach their children that their horrible-tasting antibiotic will make their ear not hurt, in a similar fashion amblyopic children learn to accept that the patch will help “wake up their sleepy eye.”

The action of placing the patch on the eye, at a specific time each day, provides the structure and patterning that young children require. Removal at the prescribed time also reinforces these concepts and assures the child that relief is at hand each day. Patch removal should be nonchalant. The parent may point to the clock and say, “This is the time the doctor says to take off the patch.” This further reinforces patterning, scheduling, and following a doctor’s orders.

For young children, patching early in the day establishes the day’s schedule. Since this is the time of maximal attentiveness, and maximal visual acuity results are achieved. For school-age children, patching either before or after school may be a necessity due to safety concerns related to playground activities. Patching during sedentary activities, such as reading, watching television, and eating, is more easily accepted by the amblyope. As vision increases and the resistance to patching dissipates, more strenuous activities like bicycle riding and sports may be permitted, depending upon the child’s visual acuity and confidence with the patch in place.

Once again, resistance to patching often uncovers true amblyopia. Thus resistance is expected. Instructing parents to never remove the patch when a child asks for removal is important. More importantly, the patch should never be removed when a child is screaming, whining, or crying. If these manipulative tactics work, the child will constantly employ them and amblyopia therapy will be totally lost. This is an example of classic operant conditioning: if a child screams and the patch is removed, the child will become conditioned to this undesirable behavior. Always wait five to ten minutes after a tantrum for patch removal so that the child will not associate the tantrum with the ending of therapy. This waiting period must be adhered to, even after the prescribed patching time has been met. It is better to prolong a patching session than to give in to the demand for patch removal. Additionally, never celebrate patch removal.

Instruct parents to avoid phrases such as, “Yeah, it’s time to take the patch off!” This sends a message that the parent also thinks the patch is undesirable. Casual recognition of patch removal and compliance with a schedule is key.

To aid in the discomfort that may accompany patch removal, it is helpful to apply a warm compress to the skin to loosen the adhesive. Older children may be allowed to slowly remove their own patch to lessen the discomfort on the skin. Anecdotally, some parents report that they apply vitamin E to the area that was patched to aid in the healing of irritated skin.

OTHER CHILDREN IN THE AMBLYOPE’S LIFE

Siblings, friends, and strangers are unwanted obstacles to amblyopia therapy compliance. Younger siblings often pull off the sibling’s patch and eyeglasses. They must be instructed that this behavior is unacceptable. Older siblings may taunt and tease, as may neighborhood children and schoolmates. Educating siblings, teachers, and neighborhood parents that sensitivity to the amblyope’s therapy is key to visual and psychosocial development. While malicious behavior is less common, it is more likely that a sibling may simply distract a parent from attending to the amblyope, thereby allowing the child to partially or fully remove the patch. Therefore, educating families with multiple children to be even more vigilant is essential.

To add to the frustration, while out in public, strangers often unwittingly call attention to the child’s patch or eyewear, thereby inducing the child to remove the corrective equipment. The child feels singled out and uncomfortable when grown-ups comment on the patch or spectacles. When these strangers convey pity, the child naturally becomes even more self-conscious. In this way, negative stereotypes are unfortunately forced upon the child who responds by removing the patch or glasses in a fit of anger. Parents must once again reinforce the positive nature of patching to both the stranger and the child.

Positive influences for patching include arranging for the amblyope to meet and play with other children who require eye patching. Allowing the young child to patch a favorite doll or stuffed animal each day is a comforting activity. Providing role models who were successful with patching may be helpful for preschoolers and kindergarteners. Arranging for family members who wore a patch to mentor the amblyope can be helpful. Additionally, the optometric practice may arrange for a “patching picnic” to be attended by all of the families in the practice who are involved in patching. If one practice has very few families in this category, the local optometric society could arrange such an event. Thus, children, parents, caregivers, and providers can get together in a more comfortable and relaxed environment, while sharing the frustrations and challenges of their unifying task.

CHILDCARE, PRESCHOOL, AND ELEMENTARY SCHOOL

Parents should be encouraged to find a caregiver for their child who understands the importance of patching. An easygoing, pleasant, salaried caregiver is often more effective than a parent in administering amblyopia therapy. In a large group setting, such as a preschool or nursery school, identifying one caregiver who is responsible for the patching schedule often leads to a sense of comfort for the child. Consistency and rapport are very important during the patching time, as is the caregiver's sensitivity to the child's feelings of being different from others. The assigned caregiver will need additional time to care for the patched child each day. However, caregivers often note that in a group setting with highly stimulating activities, patching is more easily accepted than in the home. In general, it appears that paid caregivers may experience less resistance to patching on the part of the child than do parents. The caregiver should be provided with a full supply of patches to ensure compliance.

During the initial period of patching, the child's visual function is limited to the current visual potential in the amblyopic eye. To most amblyopes, the experience of blur is not only frightening but also humbling. A child, while wearing a patch, may desire to sleep or refrain from activities. If the child does fall asleep, effective therapy is not occurring. Caregivers need to provide the child with safe and visually stimulating activities, such as coloring or playing with small toys, in order to make the therapy work.

For children ages five to eight, the patch should be placed on the eye first thing in the morning, well before school time, to help avoid any association between the patch and school. As the patch is clearly undesirable, to the amblyope, it is best not to associate the negative patch with the positive school. Patching clearly adds an obstacle to the learning process for the child, and the teacher must be educated about this aspect of the therapy. In the elementary school setting, teachers are encouraged to allow a child to sit in the front of the class and provide large print text. While extra assistance and attention may be needed for the child during patching, elementary level teachers cannot be expected to be the "patching police"

during lesson time. This task must be accomplished by family support and could possibly be assigned to a teacher's aid (if present). Safety precautions, such as polycarbonate spectacle lenses for sports activities, should be prescribed to avoid unwarranted injuries on the playground.

CONCLUSION

As amblyopia may be "responsible for loss of vision in more people younger than age 45 years than all other ocular diseases and trauma combined,"⁸ it is essential that its remediation be seen as a public health issue. The commitment of healthcare personnel resources to provide maximal amblyopia support needs to be a reality. By providing education to families through existing pediatric support avenues, as well as increasing pediatric patients access to eyecare in both a preventative and supportive role, these numbers may eventually decrease. Families cannot simply be told, "Patch your child and come back in six months." This direction needs to be supported by frequent, recurrent visits with the eyecare team (every 4 to 12 weeks), and must be reinforced at every health care encounter. The practical techniques described above may make the patching experience less difficult and eventually a successful source of pride for both parent and child. □

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