Essay

Treating the Trinity of Infantile Vision Development: Infantile Esotropia, Amblyopia, Anisometropia

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ABSTRACT

The optometric literature has begun to emphasize pediatric vision and vision development with the advent and prominence of the InfantSEE™ program and recently published research articles on amblyopia, strabismus, emmetropization and the development of refractive errors. There are three conditions with which clinicians should be familiar. These three conditions include: esotropia, high refractive error/anisometropia and amblyopia. They are serious health and vision threats for the infant. It is fitting that this trinity of early visual developmental conditions be addressed by optometric physicians specializing in vision development. The treatment of these conditions is improving, but still leaves many children handicapped throughout life. The healing arts should always consider alternatives and improvements to what is presently considered the customary treatment for these conditions. This is especially true since the current treatment leaves room for improvement. This paper considers research that suggests and/or promotes an alternative treatment strategy that addresses these three conditions.

KEY WORDS

amblyopia, anisometropia, high refractive errors, Infantile esotropia, vision therapy for infants

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INTRODUCTION

One of the most troublesome and long recognized groups of conditions facing the ophthalmic practitioner is that of esotropia, amblyopia, and high refractive error/anisometropia.[1-7] The recent institution of the InfantSEE™ program is highlighting the need for early vision examinations in order to diagnose and treat amblyopia. Conditions that make up this trinity of infantile vision development anomalies include: amblyopia, anisometropia (predominantly high hyperopia in the amblyopic eye), and early onset, constant strabismus, especially esotropia. The techniques we are proposing to treat infantile esotropia are also clinically linked to amblyopia and anisometropia.

The majority of this paper is devoted to the treatment of infantile esotropia since it is considered the most complex of the three conditions and is the one that is the most resistant to treatment. We will suggest a treatment paradigm that could be at odds with the current recommended care for infantile esotropia. In our opinion, the current recommended treatment regimen may cause more harm than benefit.

General considerations of the development of refractive status and emmetropization

Emmetropization is the phenomenon where the eyes change during the early years of life to attain an emmetropic or near emmetropic refractive condition. The process of emmetropization has been postulated to be due to such mechanisms as choroidal stress[8] and/or potential feedback loops between the eye and various internal and external environments.[9] It has also been suggested that the autonomic (parasympathetic) system is involved in this process. McBrien and Barnes[10] found that parasympathetic dominance may actually hinder

emmetropization and that if there is an imbalance between the sympathetic/parasympathetic systems, then one or both eyes might become more hyperopic. They suggest that parasympathetic domination causes tension on the ciliary body to remain high, thus pressure on the sclera is diminished and the hyperopia continues to develop. Wildsoet,[11] in a study with chicks, hypothesized two separate mechanisms; the local (eye) and higher (central nervous system) mechanisms both contribute to emmetropization. Local processing occurs directly within the retina of the eye, the sclera, and the choroid, with additional feedback to the lens and cornea. In addition, higher neural structures stimulate accommodation in the lens and cornea, with the local feed to the sclera and choroid. A review of emmetropization may be found by Yackle and FitzGerald. [12]

Development of binocularity- strabismus and anisometropia

Most babies are not visually aligned at birth. They generally present as having exotropia and poor ocular alignment.[13] Newborns also do not demonstrate stereopsis or cortical fusion, nor can they converge their eyes until about 13 weeks of age. If convergence is demonstrated at 13 weeks, stereopsis and cortical fusion will usually also be present. It should be noted that girls develop stereopsis at a faster rate than boys.[14] The 4-month milestone appears to be a critical time for the development of binocularity. If binocularity is present by that time, then theoretically, every day that binocularity is present, it will continue to develop and be retained. However, if alignment is disrupted, binocularity may not develop. The longer the development of binocularity is disturbed, the more challenging it is to recover and restore.

Accommodative ability is poor in the newborn, becoming adult-like at 4 months of age. Fixation is developed somewhat earlier and necessarily guides accommodation since the object of regard must first be foveated in order to effectively stimulate accommodation.[15] It is hypothesized that foveal fixation of either one or both eyes, triggers a neuro-transmitter to stimulate retinal growth hormones at the local level; this then causes the eye growth that is a major characteristic of emmetropization. This model could explain the response of both chicks and monkeys to plus or minus lenses in one eye. Some animals develop anisometropia and inequality between the two eyes when inappropriate lenses are worn over one eye. If this inequality (anisometropia) is present, it often leads to problems with the development of binocularity.

Types of Eso deviations

Esotropia is by far the most common strabismus that develops during infancy. It typically manifests at two major times in a child's life. The first is usually at 4-6 months and the suecond is between the ages of 2 and 3 years.[1,13,16] This first condition has sometimes been improperly termed congenital esotropia in the literature, where the deviation is manifested before age 6 months.[4] However, the term congenital is actually a misnomer, as congenital refers to a condition existing at birth, regardless of the cause. These cases of congenital esotropia are typically not present at the moment of birth, but develop by the age of 6 months.[16-19] A better term would be early infantile esotropia. This type of esotropia is the most frequently encountered and accounts for 28-54% of childhood esotropias.[20] The clinical course of infantile esotropia is that usually the eye begins to intermittently turn, first one eye then the other. This eye turn, over time, tends to then become constant which often leads to suppression and/or amblyopia.

The associated signs of infantile esotropia are significant and include: onset before 6 months, dissociated vertical deviation, inferior oblique over action, and nystagmus (latent or manifest).[16, 20-23] The magnitude of the angle is typically large, is not associated with a high AC/A, and is not related to high refractive errors.[21,24-26]

The second major time that esotropia emerges is around 2 to 3 years of age.[20,21,24,26] Here, the child begins to engage in near point activities and to pay attention to near point detail. Accommodation is stimulated to focus and identify the near object. The cross-linkage between accommodation and vergence that has developed produces a convergence response, resulting in an eso posture. If fusion is poorly or mal-developed, if uncorrected high hyperopia is present or if there is a high ACA, it is possible that the child will not only suppress an eye but demonstrate an eso posture. The eso posturing and suppression may combine with the cross-linkage between accommodation and convergence to manifestly turn the eye inward. When these two interdependent processes are not developed appropriately, the result can be accommodative esotropia. It is usually intermittent at first, manifesting only with near activities, but has the potential to become constant when left untreated. Amblyopia is still a concern for accommodative esotropia but less of a concern than for the infantile esotrope. For amblyopia to develop in the later onset esotropia, (accommodative) constant unilateral strabismus should be noted. The older the child the constant esotropia is manifest, the more likely that appropriate visual development has been achieved with each eye, and the less likely that amblyopia will be seen.

Amblyopia

Amblyopia is defined as the loss of visual acuity in one or both eyes that is not corrected by refraction and is not attributable to obvious structural or pathological conditions.[4] Amblyopia is the most serious of the functional vision problems in infants and children, but infantile esotropia is the most complex. It has been estimated that as many as 40% of children with infantile esotropia develop amblyopia.[25] It is the 4th most frequent cause of blindness in the United States, and it is responsible for more loss of sight in those under 20 than all other eye diseases combined. It is also the leading cause of monocular vision loss in the 20 to 70+ age group.[17] This is truly a serious public health problem, and it is critical that the optometric profession address this condition with early diagnosis and intervention.

Amblyopia has two major causes: constant unilateral strabismus and high uncorrected refractive error. The former can be associated with a combination of eccentric fixation and deep suppression.[4,26] Although high myopia can, in some cases, lead to amblyopia, the major refractive condition associated with amblyopia is hyperopic anisometropia. The eye that sees poorly is almost always the one with the higher refractive status. High cylinder in one or both eyes can also lead to meridional amblyopia.

Refractive status: High hyperopia and astigmatism

Many children with infantile esotropia and amblyopia also have significant hyperopic refractive errors. Von Noorden[26] reported that 46.4% infantile esotropes measured up to 2 D of hyperopia, while a further 41.8% had 2.25 to 5 D of hyperopia. However, only 6.4% of these children had more than 5.25 D of hyperopia. The incidence of myopia is even smaller, at just 5.6% of these patients.

Children tend to start their lives as hyperopes, and through the process of emmetropization, the amount of refractive status decreases. In most instances the higher the refractive status, the faster emmetropization occurs.[27] The higher the hyperopia at 6 months of age, the faster the movement towards plano by 12 to 17 months of age. Astigmatism was also found to reduce in the same manner as the plus. The higher the astigmatic condition, the quicker it reduces. Another study by Ehrlich et al.,[28] reported rapid emmetropization after 9 months of age, with a rate of change that was highly dependent upon the initial powers of hyperopia and astigmatism. Astigmatism reduction was found to be much quicker than spherical reduction. Small to moderate amounts of With the Rule (WTR) astigmatism was more prevalent than Against the Rule (ATR) at 9 months. The WTR cylinder tended to change faster than the ATR cylinder. Finally, another study by Pennie, et. al.,[29] found that not all ocular components change equally during the emmetropization process. The anterior chamber depth and axial length are the two ocular structures that tend to change in emmetropization. Astigmatism and spherical equivalent tended to reduce steadily towards emmetropia.

Refractive status: Anisometropia

Recent studies have looked at anisometropia in children 1-4 years of age. In a longitudinal study, it was reported that anisometropia of less than, or equal to, 1 D tends to fluctuate.[30,31] When this happens, it is benign and is not a sign of developing amblyopia. This implies that a child who exhibits an anisometropic measure should be examined several times and not prescribed an anisometropic prescription until the clinician is sure that the anisometropia is actually present and that the measures are not changing. Only 30% of anisometropes at age 1 year remain anisometropic at age 4 years.[32] Children can even develop transient anisometropia as part of the emmetropization process itself.

Of those who remained anisometropic, only 25% became amblyopic. Because there was no clear cut relationship between anisometropia and amblyopia, it is impossible, only with information on the refractive condition, for the clinician to predict amblyopia in the children whose anisometropia fluctuated. Only those whose refraction did not change were at risk for developing amblyopia. This suggests that no spectacles for anisometropia should be given until the aniso has been found on several subsequent examinations. When, however, the child has more than 3 D of anisometropia at 1 year, anisometropia will tend to be present at 10 years of age.[32] There is no proof that an earlier prescription of glasses prevents either strabismus or amblyopia.[30,31] Therefore, care should to be taken in prescribing high amounts of plus (especially full plus and/or full amounts of anisometropia) to toddlers.

The normal emmetropizing feedback loops of the eye appear to require good fixation and good visual acuity. The amblyopic eye, freed from feedback regulation of its growth, may, through random drift, become anisometropic.[33] A significant proportion of adult non- strabismic anisometropic subjects may have developed their anisometropia slowly as a result of a prior strabismic motor problem or abnormal fixation.

The effect of monocular lenses to induce aniso in infant monkey eyes demonstrated that fixation was different for the plus and minus lenses.[34] Monkeys who had a minus lens over one eye tended to fixate with the plano (uncorrected) eye at all distances, because less

accommodative effort was needed at all distances. Monkeys who had a plus lens over one eye preferred to fixate with that same eye, possibly because less accommodative effort was needed. Therefore, the eye that allowed the least positive accommodative effort, became the fixating eye.

The growth rate between the two eyes wearing the inappropriate lens was necessarily different in the monkeys. The eyes tended to grow in a direction that compensated for the induced refractive differences in the eye wearing the inappropriate lens. For example, several of the monkeys raised with the plus lenses (artificial myopia) experienced increased hyperopia in the fixating eye, while the monkeys reared with the minus lenses (artificial hyperopia) showed an increase in myopia in the non-fixating eye. Upon removal of the added lens power, the eyes tended to rebalance.

Hung, et al.,[34] also noted that ocular alterations produced by spectacle lenses in monkeys provides strong evidence for the idea that spectacle lenses worn by human infants can influence both absolute refractive error development and interocular balance of refractive errors. The authors also note that it could be argued that full optical correction of refractive errors in very young children could preclude the normal reduction in refractive error that occurs during maturation.

An eye must be moved so that the object of regard is aligned with the fovea to function normally. Accommodative responses decrease dramatically with even slight eccentricity of fixation. Central fixation allows the recognition of blur that, in turn, results in eye growth and emmetropization. The high hyperopia monocularly or binocularly may, in many cases, be due to a lack of visual exploration (fixation) of an infant or toddler. This lack of exploration through eye movements would negatively impact the accommodative response and emmetropization. Fixation, then, drives accommodation, rather than accommodation driving fixation; motoric alignment of the eye, it is argued, then, is the basis of visual sensory development. Abrahamsson, et al.,[32] state, "anisometropia is a secondary phenomenon….there is a common tendency to develop anisometropia after the onset of strabismus. The non-fixing eye ceases to emmetropise, and subsequently the child develops anisometropia… may have developed their anisometropia slowly as a result of a prior strabismic problem…" Emmetropization of the non-fixing eye is arrested and the child subsequently develops an anisometropia since the emmetropization of the fixing eye continues.

It is rare to see amblyopia in truly alternating strabismics. One also does not typically see significant differences in refractive error in alternating strabismics. The common thread between these two conditions is alternating fixation. If the young esotrope learns to alternate, we have the potential to dramatically reduce the occurrence of amblyopia. This can be achieved through ergonomic and prophylactic guidance of the child's visual development utilizing conservative partial lens power, symmetrical prescriptions, binasal or sectorial occlusion, supplemented with penalization and vision therapy. This philosophy is in direct opposition to the unilateral patching philosophies of the past.

To summarize then, it is interesting to note that both anisometropia and amblyopia are commonly associated with constant unilateral tropia. Anisometropia and amblyopia are not associated with alternating tropia. Therefore, to decrease the likelihood of amblyopia (either from esotropia or anisometropia), the clinician should develop equal and alternating fixation of each eye. Clinically, we know that if fixation is developed in each eye, the likelihood of amblyopia or high anisometropia is greatly diminished. This will effectively decrease amblyopia from both the tropia and the anisometropia.

Fixation equality will also improve ones chances of treating infantile esotropia. Infantile esotropia can be thought of as a lack of adequate fixation development, first monocularly and then binocularly. The equality of fixation is the more desirable condition as binocularity is developing. Equal fixation discourages the occurrence of anisometropia and unilateral infantile esotropia and will encourage the development of stable binocularity.

Current treatment

Currently suggested optometric treatment for infantile esotropia begins with full plus cycloplegic lenses, patching, vision therapy/ orthoptics, prisms, and surgery.[35] Within optometry there is controversy as to lens prescribing regimens for high refractive conditions and infantile esotropia. Whatever lens regimen is followed, if lenses/prisms alone do not ameliorate the strabismus, viewpoints between professionals and professions may differ significantly as to the next course of treatment.

If functional binocularity with non-surgical optometric care is chosen, optometric practitioners will consider a course of optometric vision therapy before considering surgical intervention. If non-surgical therapies are not demonstrating favorable improvement, then consultation with an ophthalmic surgeon may be recommended. Ophthalmologists typically choose surgical intervention as their next treatment after lenses or monocular patching. Surgery usually is performed for cosmetic alignment and does not improve amblyopia. In fact, amblyopia is more prevalent in the after surgery

group than those who had no surgery.[16,24,25] This is usually due to the discontinuation of occlusion therapy and the post surgical development of a small angle esotropia.

Does the current treatment of infantile esotropia (full cycloplegic refractive measure, direct patching, and surgery) cause more harm than good? Even though accommodation is not the major etiology of this strabismus, the assumption with this course of treatment is that accommodation drives convergence. Is it not more reasonable to consider that fixation develops, and in turn, stimulates accommodation, allowing vergence to develop? The heavy reliance on plus prescriptions for esotropia is because we do not consider the development of fixation in the development of binocularity. Skeffington[36] quoted Lancaster, who was writing about the clinical care of binocular conditions: "He sees an exophoria and says that the lateral rectus muscles are pulling too hard, or the medial rectus muscles are not pulling hard enough, which is true. But he jumps to the naïve conclusion, that the former muscles are too strong or that the latter are too weak….the muscles are probably faithfully carrying out the orders brought to them by the nerves…are merely transmitting the impulse from the nuclei…issuing such orders to contract or relax as the messages from the supra nuclear centers call for. It is not the extraocular muscles that create the problem, but the central nervous system".

Helveston[16] clearly indicates that the extra-ocular muscles or nuclei are not the problems most of the time. A model, presented by Helveston and long held by developmental optometry, is that, of all the anatomical sites possible to cause infantile esotropia, the cortex is the most likely. As has been stated, infants are not born with straight eyes; they rapidly develop cortical binocularity around the 14th week of life. This process is referred to as orthotropization. The infant who exhibits strabismus at the 4 to 6 month level has not completed this process of orthotropization. Prescribing a full cycloplegic prescription for the infantile esotrope could, as Hung, et. al., has noted, interfere with the emmetropization process, indirectly leading the child to continue to be hyperopic.[34] Even more significant is the possibility that a full cycloplegic prescription could drive the emmetropization process in the opposite direction and would result in more hyperopia being found when subsequent examinations are performed. This, in turn, might lead the clinician to prescribe even more plus and thus continue the cycle of growing hyperopia.

Vision therapy for esotropia often involves visuomotor programming activities in an attempt to coordinate the ocular motor system and the visuomotor system (eye-hand and body movement).[35] We suggest movement activities involving the neck, arms, legs, and body be performed, along with very wide excursions of the extra ocular muscles in all directions, especially laterally. This encourages both sensory and motor fusion. Emphasis should be on labyrinthine (vestibular) stimulation and ocular motor control. The addition of bi-nasal occlusion is also helpful to encourage alternation between the eyes and reduce visual input to a manageable level. Therapy procedures should also first encourage accurate fixation before vergence.

Efficacy of therapy

The success of vision therapy and/ or surgery for esotropia is mixed in the ophthalmic literature.[1-7,16,17,20-23,35-42] Success rates may vary, depending on many diagnostic factors including: direction, frequency, correspondence, presence or absence of eccentric fixation, and the presence or absence of suppression.[2] Strabismus treatment efficacy studies by either optometry or ophthalmology have also not been well designed. These studies from both professions are typically retrospective, do not follow a double blind paradigm, nor do they institute placebo treatments. However, even with the lack of prospective, double-blind studies, optometric non-invasive results for all strabismus types are reported to be as good, or better, than surgical outcomes, and the optometric literature has individual case reports showing significant improvements from vision therapy.[1,37-40] This lack of well-designed treatment efficacy studies is troublesome. It makes determining the most appropriate, effective treatment strategy difficult and potentially confusing for the doctor, parent, and patient.

Recent studies have reported that vision therapy improves stereopsis and acuity in amblyopes.[39,40] It was also noted that monocular occlusion alone only improves visual acuity, but does not improve stereopsis.[39] This becomes a very interesting concern when one considers that full-time monocular direct patching alone may actually be guiding patients away from developing stereopsis that might otherwise develop with the addition of vision therapy activities. Consequently, we feel that fixation and oculomotor activities are vital components of a treatment plan, perhaps even more so in infantile esotropia than in amblyopia.

Review and efficacy of surgical care

It is reported that strabismus surgery accounts for 11% of all the eye surgery in the United States. This amounts to 700,000 surgeries per year and was exceeded only by cataract surgery.[41] The surgeries of choice for esotropia are either a graded bimedial recession, or a three/four muscle procedure where both medial recti are recessed and one or both of the lateral recti are

resected.[4,16,21,43] When a bi-medial recession is performed; both medial recti are removed from the globe and reattached more toward the equator of the globe. Von Noorden recommended that the surgery be performed as early as possible, but no later than 24 months.[26] He felt that it is possible to achieve functionally useful vision after this age, but that there is a much better outcome prior to this age.

It is interesting to examine the surgical intervention success rates for infantile esotropia. We must keep in mind that the definition of success can vary with the two professions. Von Noorden[16] felt that the best success that one could hope for from surgical intervention was subnormal binocular vision, a condition in which the patient appears to be orthotropic, has motor fusion, unilateral foveal suppression, poor stereo (<120 arc sec) and normal retinal correspondence. However, he also noted that while this achievement of subnormal binocular vision has a potential to occur, it is also not as likely as what he termed a functional outcome. Von Noorden's functional outcome differs significantly from an optometric functional outcome in that he defined this as a residual small angle strabismus, gross stereopsis, peripheral fusion, and a monocular area of suppression when viewing with two eyes. This leaves many successful functionally cured patients with interesting outcomes such as monofixation, amblyopia, and suppression. Apparently, the surgeons do not consider that the closer the alignment of the eyes, without fusion, the more demand there is for the system to suppress and possibly develop amblyopia.

Using this definition of functional success, Scheiman and Ciner[44] reviewed the surgical outcomes for esotropia and found that, of a sample of 1473 procedures, there was only a 15% functional cure rate and a 43% cosmetic cure rate. Scheiman, Ciner and Galloway[42] performed another review of the literature 2 years later and found that only 22% of a sample of 1286 infantile esotropes was able to achieve at least some binocularity. The cosmetic success was 63% of 2113 patients.

Several studies have also reported the best functional results (subnormal binocular vision) based upon when the first surgery was performed for infantile esotropes. Scheiman, Ciner and Galloway [42] reviewed seven studies. There was a 71% cosmetic success rate when surgery was performed before 12 months of age, a 30% cosmetic success rate when surgery was performed between 12-24 months, and 12% cosmetic success rate when it was performed after 24 months of age. A cosmetic cure is defined as less than 8^-10^ of heterotropia. The authors are cautious to note that these success rates refer to the ophthalmological definition of functional success and not to the optometric definition.

These differences in success rates are strikingly different in the aforementioned studies. When one factors in the concept of binocularity into the definition of success, one arrives at a much different interpretation. The optometric definition for a successful cure for strabismus has been categorized as equal, clear, comfortable binocular vision, with reasonable stereopsis, and a lack of eye turn.[6] This is certainly a more stringent criterion that does not enter into the literature of studies on surgical success.

Helveston[16] asked the interesting question: what would happen if we did not attempt to align the eyes surgically or otherwise treat patients with congenital esotropia? The answer to this was surprising. He noted that Calcutt[45] found that, if infantile esotropes were left alone without surgery, that only 6% of them developed amblyopia; of the ones who had surgery, 35-41% developed amblyopia.

First do no harm: The dangers of surgery

The Hippocratic Oath says to first do no harm and to abstain from whatever is deleterious and mischievous... "abstain from every voluntary act of mischief and corruption...." Most surgical interventions carry risks with them, and esotropia surgery is not immune. Some of the rare but very serious risks include: scleral perforation, post-operative retinal detachment, cellulitis, endophthalmitis, or a lost or slipped muscle. Other more frequently encountered adverse surgical outcomes can lead to poorer quality of life, such as amblyopia, under or over corrections, inferior oblique over action, accommodative esotropia, and dissociated vertical deviations.[26,42]

It is also not uncommon to have multiple surgeries. A recent study by Keskinbora and Pulur[43] showed that of 214 patients who had bilateral medial rectus recessions, 21% (45 children) required a second surgery to correct a residual deviation, 15% (32 children) required another surgery to correct consecutive exotropia (exotropia that was created by the first surgery), and 18% (39 children) had surgery for oblique muscle over action and DVD. In other words, 54% had another surgery to correct for problems that came about after the first surgery. One might wonder why a procedure that is deemed necessary for the benefit of the child results in what many would consider a poor result in approximately 50% of the cases.

Case example

The following case describes an infantile esotrope that received the standard treatment without results, but

responded quickly and completely too alternative treatment.

An 18-month-old female presented with a history of a constantly crossed left eye. The child had been previously examined and treated by an ophthalmologist. The ophthalmologist had stated there was no internal or external ocular pathology at that examination. Equal plus spheres for distance were prescribed, based upon the full cycloplegic refraction. The distance retinoscopy was incorporated into a bifocal for the child (+1.75 spheres with +1.00 add). The parents were informed that the lenses might straighten the eye, but if, after six months the eye was not straight, surgery would be recommended. The parents had not returned for the six month evaluation, and subsequently presented to optometry when the child was 18 months old.

Optometric case history revealed that the pregnancy and birth were unremarkable, and the baby was delivered vaginally at full term. No significant health problems other than the eye turn had been noted. The strabismus was first noted sometime before 6 months of age, and, as the child grew older, the tropia increased in frequency and amount until it became constant. The parents reported that they had delayed returning to the ophthalmologist, since they were not interested in strabismus surgery except as a last resort, and that they were seeking a second opinion.

Visual acuity could not be determined, but there was equality of the retinoscopic reflex. External and internal eye structures were unremarkable. Eye movements were full, but notably jerky. Distance retinoscopy was approximately +1.50 OU and +2.25 OU at near.

Vision therapy was offered and the parents accepted this option. Fourteen weeks of therapy was administered, and the child was then released from active, in-office treatment. During the course of treatment, the lens prescription was periodically reduced until the lenses were removed from full-time wear. Periodic direct patching was instituted at first, and then changed to bi-nasal occlusion. Therapy included crawling towards bright lights, gross motor activities, and various saccade and pursuit activities.

The patient was then evaluated as part of her comprehensive optometric care program before starting elementary school. The eyes continued to be straight, each with excellent visual acuity demonstrated by each eye. The distance refractive measure to first 20/20 was +0.75 OU. The child became an outstanding student and athlete. She was all state in two sports and later earned a full, five-year athletic scholarship to a major university. The patient is now a mother and a successful business woman.

This case demonstrates that surgical treatment is not the only method to pursue. But it also brings to mind two questions: 1) Why did the child's eyes straighten, 2) Why did the refractive error diminish in a relatively short period of time (when it had not improved under the previous treatment regimen)? And 3) Would surgery have been detrimental to her by hindering development or affected her ability to be as successful as she is today?

Recommended treatment protocol

We recommend the following treatment be considered as an alternative to the current instituted care for infants who are at high risk for the related conditions of amblyopia, anisometropia, and esotropia:

1. Give a conservative and symmetrical spherical lens prescription based upon binocular dynamic retinoscopy that demonstrates equality of ocular performance. This, we believe, has the best chance to provide an opportunity to foster emmetropization, appropriate visual development and create movement in the visual system.
2. Use binasal or sectorial occlusion to prevent unilateral amblyopia and foster alternating fixation.
3. Incorporate monocular and binocular fixation activities that use saccade and pursuit therapy with hand involvement. These activities should include wide excursions with emphasis laterally to maximize symmetrical innervations (initially improving and equalizing fixation between the two eyes).
4. You should also stimulate the labyrinthine/proprioceptive and kinesthetic systems to integrate the extra ocular muscles with righting reflexes. The better the two eyes move together in a versional movement, the more likely that vergence will develop normally. Example techniques for those children old enough to benefit from these activities include balancing activities tied in with eye-hand coordination and placing the child on a large beach ball while incorporating eye-hand integration activities.
5. We should also stimulate the periphery to encourage the development of enlarged fusional fields as well as magnocellular function that help to develop peripheral fusion.

It is our belief that if the infant is identified and appropriate procedures are instituted during the first year of life, then surgery will not need to be considered. In the event that this approach does not solve the problem then surgery can still be performed within the two year window. This would provide an opportunity for the best possible surgical outcomes.

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