VISION THERAPY for a preschool child with ACQUIRED ACCOMMODATIVE ESOTROPIA

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Abstract

This is a case report of a therapy plan used in the management of a child with acquired accommodative esotropia. Conventional protocol, which included the appropriate lenses and occlusion therapy, was followed. However, the uniqueness of this case was the effectiveness of vision therapy for a preschool child and its marked enhancement of binocular functions.

Key Words

preschool vision therapy, acquired accommodative esotropia, amblyopia, occlusion, hyperopia

Von Noorden defines acquired esotropia as an eso deviation with an onset after 6 months of age. In his discussion, it is viewed as non-accommodative.[1] However, Parks subscribes to a number of etiologies, including accommodative.[2] Acquired accommodative esotropia standardly occurs between 1 and 5 years of life.[3] Some authors extend the age range at each end. For example, Baker and Parks believe it can occur from 6 months to 7 years.[4] The most frequent presenting age is between 2 to 3 years.[5] Deviations can be categorized as accommodative, partially accommodative, or non-accommodative.[6]

Classically, acquired accommodative esotropia is associated with increased accommodative demand, which readily occurs when the child inspects the world in a more precise manner.[7] Visual alignment can be present at an earlier period when binocularity is being established and exacting focus isn't a requirement.[8] However, in time, the child will encounter the dilemma of either maintaining alignment by detuning focus, or succumb to the need for clarity, resulting in decompensation with a strabismus. The former results in binocular amblyopia with some binocular intact skills,[9-11] while the latter, in the absence of alternation, yields monocular amblyopia and fewer, if any, binocular abilities.[4] The amblyopic eye is further compromised by its alteration of accommodative function.[12]

The child with hyperopic binocular amblyopia and anisometropia usually has one eye with better visual acuity (VA).[13] However, this will be dependent upon the amount of hyperopia, the degree of anisometropia, the existence of alternation,[14] and the time of onset and persistence of the deviation.[6] The depth of the amblyopia will be directly related to the type of anisometropia. In the case of the accommodative esotrope, the more hyperopic eye will bear the greater reduction in acuity. Some authors believe the anisometropia is a consequence, and not the cause, of the deterioration into a strabismic state.[15] If this be the case, the accommodative esotrope's more anisometropic eye will bear the greater burden of reduced visual acuity and reduced general visual performance.[14]

Therapeutic Considerations

A number of basic elements need to be considered in assessing the prognosis and subsequent treatment plan. These include:

1. the existence of undesirable adaptations at or soon after the onset of strabismus
2. the prognostic relationship between an intermittent vs. constant strabismus
3. the establishment of binocularity and level of resulting fusion
4. the presence of amblyopia
5. the combined relationship of amblyopia and strabismus
6. the integrating of these various factors into a treatment plan

7. criteria determining successful treatment.

Each of these will now be discussed.

Pratt-Johnson and Tillson consider the onset of an esotropia as an ocular urgency or daytime emergency. They note the prognosis for a successful resolution of the patient's deviation is directly dependent upon the initiation of prompt treatment.[6] It is essential to obtain motoric alignment and sensorial bifoveal function as rapidly as possible so that the undesirable sensorial adaptations have a minimal time to become established.[16,17] Ideally, a deviation should be corrected at its onset.

Prognostically, an intermittent deviation is more desirable than a constant deviation. It is believed better results are achieved if the patient is remediated when the former state is present, but certainly not later than the first few months of the latter.[6] The longer an undesirable neurological adaptation exists, the more ingrained it becomes, especially during the most plastic periods of visual development.[18] In many instances this can lead to neurological mis-wiring and doom the patient to faulty cortical binocular function.[18] Pratt-Johnson et al express the belief that within a week, once the esotropia is evident, the VA can drop to the equivalent of 20/200 in a 3-year-old.[6]

Electrophysiological and neurological research readily shows the effects of ocular cortical dominance and its suppressive characteristics.[14] Proper neurological wiring should take place during the more critical periods of binocular visual development, i.e., from 2 to 6 months of age.[19,20] Between the 3rd and 5th month of life, stereoacuity has a rapid development with a pattern of peripheral to central.[21-24] Researchers have employed varied testing methods to evaluate steroacuity. Their results conform to Schanel-Klitsch et al's general conclusions that different results and success rates are a product of the various tests and procedures.[25] For example, using a gross test of stereopsis, Romano measured 3000 seconds of arc (sec/arc) in children between 3 and 5 years of age.[26] Birch found 3- to 4 1/2-year-olds capable of 40 sec/arc.[27] Ciner found her subjects of this age capable of 100 sec/arc, while improving to 60 sec/arc within the next six months.[28]

During the earlier part of this binocular development period, the infant is still dealing with near space and large targets. Thus, focus isn't a major factor. The accommodative response usually develops in the 4th month,[29] but, as Atkinson notes, infants' accommodative responses can be quite complicated, ranging from excessive accommodation to a measurable lag.[30] Large targets, general Gestalt, pupil size[31] and depth of focus[32] can play a major role in the infant's binocular development in the absence of complete clarity, thus helping the masked potential acquired accommodative esotropia from manifesting itself. Schmidt, in three different studies, gave evidence to the sustained existence of stereoacuity in the presence of substantial blur.[33-35] The sum of these factors play an essential role especially during the sensitive period, yielding an infant who has built appropriate neurological connections for binocularity, though he/she can become an acquired accommodative esotrope when focusing demand increases with age.

Ciuffreda et al[14] note the involvement of cortical neurons and the resulting effect on contrast sensitivity when anisometropic amblyopia is present. Patients with strabismic amblyopia display a loss of cortical connections. Amblyopia is intrinsically associated with inappropriate stimulation, binocular competition, and binocular inhibition. The patient with anisometropia and strabismus presents with a combination of these factors. Direct occlusion would seem to attack the first of the three elements, while anti-suppression and monocular fixation activities in a binocular field (MFBF) would center more on the latter two factors. Press implies this by suggesting that MFBF techniques be used in the intermediate aspects of amblyopia therapy.[36] The building of fusional ranges and bifoveal skills would provide the ultimate result of the therapy plan.[7]

The ideal treatment plan for the patient with acquired accommodative esotropia should follow a sequence which includes appropriate spectacle Rx, occlusion, equalization of monocular visual skills and acuities, anti-suppression techniques, motor alignment, development of fusion and, if possible, central stereopsis.[14,37,38]

There appears to be some debate as to the methodology of prescribing the ideal Rx. The classical school initiates full plus power and continues to track a prescription for any increase in plus.[2] However, the aspect of emmetropization can play a part in modifying the lens power prescribed.[39] In the case of the hyperopic child, the eye seeks less hyperopia over time. Thus, the final prescription must ideally be a compromise that considers the lens power that allows alignment and still permits the emmetropization process to continue. If this is not possible, the more classic strategy should be taken.

Flom characterizes a functional cure as attaining clear, comfortable, single binocular vision at all distances.[38] A deviation can manifest only 1% of the time, provided that the patient is bifoveal. The use of a small amount of prism is acceptable.[40] Manley added stereo performance of 67 sec/arc.[41] Thus, according to these authors, success requires more than a cosmetic cure. Anecdotally, in the mid-'70s Forrest and FitzGerald found equal prescriptions mirrored binocular alignment and function.

Case Report and Implementation of Treatment Plan

A male Hispanic patient was first examined at the Infants' Vision Clinic of the University Optometric Center on January 26, 1994. At this time he was 3 years and 3 months of age. The chief concern was a left esotropia of one week onset. The magnitude of the turn had increased since first being noticed by his mother. Apparently the child appeared to have diplopia which resolved, for he seemed to initially spatially misjudge things (e.g., toys and food) for a few days. There was no history of trauma or health problems. The patient was a full-term birth to mid-30-year-old parents. The pre- peri- post-term histories were unremarkable. Milestones were met without incident. Significant family ocular history was the mother's high myopia.

External and internal ocular health examinations were negative. Pupillary responses were present and there was no afferent defect. There were no limitations of the extra ocular muscles. The patient displayed an intermittent left esotropia of 25Δ at a distance and 30Δ at near. The initial static non-cycloplegic refraction was:

(= represents "combined width")

OD +5.50 = -1.00 x 90

OS +6.50 = -1.00 x 90.

The above finding was worn by the patient for a few minutes and a subsequent delayed static was done, yielding the following result:

OD +5.50 = -0.50 x 90
OS +6.50 = -0.50 x 90.

Further testing was done with the patient wearing the following lenses:

OD +5.00 sph
OS +6.00 sph

The patient was aligned at both distance and near with these lenses. Reach/grasp/release responses were determined by having the patient view a near target and then a target at varying intermediate and far distances. He maintained alignment at each location. Gross second degree fusion was probed at near, using the Bernell Anaglyphic Flashlight Three Figure Test[a] at near. The patient displayed fusion without suppression by simultaneously being aware of the ball, girl and elephant. Fixation probes, using monocular light touching, yielded central fixation with the OD, but temporal past pointing, using the OS. Similarly, the best corrected distance visual acuity (VA) was 20/80 in the OD and 20/200 in the OS. This same relationship existed at near: OD 20/40 and OS 20/100.

The assessment was a recent onset of an acquired accommodative esotropia and a long-standing bilateral amblyopia which was more deeply seated in the OS. The patient had maintained alignment by sacrificing clarity for binocularity. When he did sample for detail, he would fixate with his OD. This explained the bilateral amblyopia with the better VA in the OD. With the onset of increased demand for better clarity, his binocular system decompensated, resulting in the initial diplopia and subsequent suppression.

The initial treatment plan included lenses to establish clarity and binocular alignment. Ideally, this would foster improved VA and reestablish some binocularity. Thus, the following prescription was prescribed for full-time use: OD +5.00 sph; OS +6.00 sph. He was also scheduled for a progress and cycloplegic/dilated fundus evaluation (DFE) visit the following month.

The next visit occurred two months later. The parents reported that the eyes were straight with the Rx in place. Corrected VA with the existing Rx on the picture chart was OD 20/30 and OS 20/80. Digital tensions were equal and moderately soft. The dilated fundus evaluation was unremarkable. The cycloplegic refraction was OD +5.00 sph and OS +5.50 sph. The eyes were aligned even with the full effect of the cycloplegic drops. In the assessment, the VA improvement and binocular alignment were noted. The therapy plan included no Rx change; however the amblyopia in the OS was to be more aggressively managed. The goal was to attain equal visual acuities. The patient's parents were instructed to initiate direct occlusion of the OD for 45 minutes twice a day. During these periods the patient was to do tasks (such as threading, lacing, placing pegs in the pegboard and pennies in a bank), using maximum visual guidance.

The patient returned for a progress visit six weeks later. The corrected distance VA using the greater cognitively demanding Tumbling E chart was OD 20/40, OS 20/40, and OU 20/30. With the Rx in place, the patient was aligned at distance and near even with increased accommodative demand. He passed the aforementioned Three Figure Test at distance and near. He proceeded to pass the following tests: Keystone Basic Binocular Test Plates 6 and 9,[b] Stereofly, Wirt Animals A and B, Wirt Circles 1-4,[a] and the Random-dot TNO Plates II and III.[c] These tests were given in the above order of increasing demand. The first two have gross peripheral stereo demand. Both Wirt test performances were at the 140 sec/arc level. By passing the Random-dot, the patient displayed true.binocular capabilities. The refraction was OD +5.50 sph and OS +6.00 sph.

The patient had responded well to the treatment plan. The positive aspects included the maintenance of motor alignment, the improved VA with summation (better VA OU than monocularly), and central fusion. He still had some lingering adaptations in the slightly reduced VA in each eye, and some reduction in binocular performance. Since equal acuity does not necessarily indicate equal performance, the next elements of the treatment plan included the enhancement of monocular skills, the attainment of equal performance of monocular skills in a binocular setting, and increased binocular ranges and fusional quality. The patient had attained equal monocular VAs. Consequently, direct occlusion therapy was discontinued. He remained with his existing Rx. We recommended more formal vision therapy and our Preschool Therapy Program was discussed; however, due to the patient's schedule, this option could not be initiated. A progress visit was scheduled for two months.

The patient did not return until some six months later, on November 9, 1994. His corrected VA, using the picture chart, was OD 20/30, OS 20/30, and OU 20/20. Eye grounds were negative. The cover testing revealed ortho at distance and near and the nearpoint of convergence (NPC) was 1"/2" with the OS out. There were no extra ocular muscle limitations. The dry refraction was OD +5.50 = -0.50 x 90, and OS +6.25 sph. Due to unforeseen circumstances, no other tests were able to be performed at this visit. The Rx was not changed, and he was scheduled for a three-month cyclo/DFE visit.

On this next visit, the history remained unchanged. Binocular alignment and performance tests were unaltered. Using the Tumbling E chart, corrected distance VA was OD 20/25+ and OS 20/40. The OS VA improved to 20/30+ when the Rx was reduced by half a diopter and to 20/25- when reduced by a full diopter. However, the latter resulted in an increased esophoria at near. A cycloplegic refraction indicated OD +5.00 sph and OS +5.50 sph. The assessment noted the need to reduce the OS to +5.50 sph which yielded better VA while maintaining alignment. Further Rx reduction of the left lens caused an esophoria. The treatment plan was implemented with an alteration of the OS temporarily to +5.50 sph, and the patient entered our Preschool Vision Therapy program provided by the Infants' Vision Service. The patient was scheduled for weekly 45-minute sessions.

The initial goals were to improve monocular acuity, equalize performance skills and spectacle lenses. When the patient started active vision therapy and could be routinely monitored, the left lens was reduced to a +5.00 sph, resulting in an equal spectacle prescription. Progress was evaluated throughout therapy.

The thrust of the first two sessions centered on improving the VA in the OS. Monocular (OS) eye-hand procedures included filling in O's, Wayne Saccadic Fixator (WSF),[d] pencil mazes, chalkboard tasks of connecting dots and tracing over letters. Home therapy included procedures similar to those done in the therapy sessions.

Monocular fixation tasks in a binocular field (MFBF) were also introduced in the second session. No deep suppressions were evident when the OS was the fixing

eye. This was a very positive sign indicating improved monocular performance in a binocular world, and the reduction of cortical inhibition.

Home activity was routinely monitored. This was done by having the patient bring in samples of his home activities and a weekly home compliance sheet. On this sheet the amount of time spent on each task each day was noted.

The corrected VA and alignment was assessed at the start of the third session. VA was OD 20/20- and OS 20/30+2. Cover tests were ortho at distance and 5-8Δ esophoria at near. The continuance of MFBF procedures and the introduction of diplopia awareness and motor fusion and recovery were the main elements of the next few sessions, both in office and at home. As performance improved, the demand was increased.

The fifth therapy session continued to stress the above described areas and the increase of fusional ranges. Lustre and Red/Green flashlight tag at varied distances were added to the home activities. The following visit, the patient's progress was assessed. With correction, he was orthophoric at distance and slightly esophoric at near. The NPC was probed with and without accommodative targets and encouragement. The test was repeated a number of times with similar results, i.e., break at 3" with both eyes out. There were no extra ocular muscle limitations.

The next two sessions stressed motor fusion, diplopia awareness, binocular alignment and sensory fusion at varied working distances in space, using targets of increasing demand. MFBF techniques were continued. The patient displayed no suppressions and his eye-hand performance and response speed were good.

The ninth and tenth sessions served essentially as progress and dismissal visits. All tests were done with the patient's Rx in place. Distance VA was 20/20 OD, OS and OU. Over refraction OU was Plano. Cover tests were ortho at all distances. NPC was 1" OS out without suppression. Response to the stereofly was 1" localization to the float. He passed all Wirt animals and numbers and TNO Random-dot stereogram through 60 sec/arc. Without his Rx there were no positive responses to the Random-dot test; however, he presented a cosmetic alignment. Automated refraction indicated the following:

OD +5.00 = -0.25 x 001
OS +5.00 = -0.25 x 151

Obviously, there had been a marked improvement in VA (which had increased and essentially equalized), stereo abilities, and ocular alignment. At this juncture the patient was dismissed with the following instructions:

1. wear the Rx full time
2. continue the red/green lustre therapy at home
3. return for a progress visit in three months.

The patient returned on 11/11/95 for a progress evaluation. He was now in kindergarten and preferred to wear his Rx full time. His mother reported the eyes were straight at all times. Corrected VA was 20/20 at distance and near in each eye and OU. Cover tests with Rx were ortho at distance and 4Δ esophoria at near. NPC was 2", OS out, with suppression. The Hirschberg method, without correction, was ortho at distance and near. However, without the Rx, a small angle (4Δ to 5Δ) left esotropia was elicited on cover/uncover testing. Over refraction was -0.50 x 90 in each eye. Corrected, he passed all Wirt animals and numbers. The patient's lenses were badly scratched so that he was advised to get new lenses, keeping his existing Rx of +5.00 sph OU, and to return in six months, or immediately if a turn reappeared.

Summary

Although attendance was erratic and some compliance questionable, this patient made very good progress in a Preschool Vision Therapy Program. His amblyopia and strabismus were eliminated. The swiftness of treatment and the existence of appropriate neurological wiring served as key initial elements. The treatment plan included the use of an Rx to help the patient gain alignment, occlusion therapy followed by more active therapy. The patient presented with some binocular skills which were greatly enhanced by MFBF procedures, and resulted in the elimination of the amblyopia. Though the VA improved, the MFBF procedures eradicated the inhibitory elements of the amblyopia. Motor and sensory fusion were then reestablished to appropriate levels. Currently he wears an equal power Rx and exhibits normal bifoveal stereopsis. Even without his Rx, he can maintain a cosmetic alignment at both distance and near.

This case shows the efficacy of early intervention in acquired accommodative esotropia using a combination of lenses, occlusion, and vision therapy. Vision therapy procedures emphasized:

1. eye-hand coordination
2. anti-suppression
3. monocular fixation in a binocular field (MFBF)
4. motor fusion
5. flat fusion
6. stereopsis.

The effectiveness of early therapy cannot be overstated. Also of note is the cost effectiveness of the treatment; the patient received only 10 therapy sessions, some of which were more evaluation than full therapy sessions. However, they served as a means of providing needed guidance in the overall treatment plan and successful development of equal acuity, normal stereoacuity, and binocular alignment.

Sources

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