A Case In Point

Auditory Biofeedback Used to Enhance Convergence Insufficiency Therapy

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Introduction

There is widespread agreement that the most appropriate treatment strategy for convergence insufficiency (CI) is vision therapy or orthoptics.[1,2,3] Cooper and Duckman[2] reviewed the literature and found that despite differences in therapy programs 94% of patients treated showed relief of symptoms. In spite of this high success rate there are CI patients for whom therapy is difficult and often prolonged.[4–6] These patients generally have had the condition for a long period of time and demonstrate a rather intense or deep suppression. Alternative approaches for these difficult cases include wide angle fusional stimulation,[4] base in prism and plus lenses for near[5] and surgery.[6] It is the first phase of vision therapy in particular which is often difficult or time consuming for these individuals. This phase of therapy for CI usually involves the normalization of the vergence and accommodative systems as well as building excesses into these functions.[2] The success of the techniques commonly employed to reach these objectives, however, depends very much upon the patients' sensory fusion status. This is because the feedback phenomena such as SILO, localization, parallax, diplopia and suppression cues, which are used to facilitate vision therapy, are all dependent upon sensory fusion. Those patients with moderate to severe, longstanding, CI are often not capable of making use of these feedback phenomena and, therefore, experience difficulty getting started in vision therapy.

Auditory biofeedback therapy (ABFT), which has been applied to strabismus,[7–9] eccentric fixation,[10] nystagmus,[11] and accommodative anomalies,[12] offers a unique form of feedback which is independent of the visual sensory system. In fact, it has been demonstrated that auditory biofeedback is effective even in the absence of binocular sensory information.[7] In addition, ABFT provides consistent, non-biased, continuous feedback which is not the case with conventional feedback cues used in vision therapy. We, therefore, hypothesize that ABFT should shorten and enhance the initial phase of vision therapy for moderate to severe, longstanding CI patients with deep suppression. The following case report is a demonstration of ABFT used for this purpose.

Case history

The patient, a 29-year-old male structural engineer, noticed a gradual decrease in distance vision during the previous six months. In spite of a significant amount of near work P.L. denied any asthenopic complaints. He had changed jobs approximately one year prior to the examination and the new assignment involved significantly more close work. He was last examined 2 years ago and received his current prescription. P.L. has worn glasses for 7 years. The medical history was negative and at the time of the examination no medication was being taken. There was no previous history of ocular surgery or vision therapy.

Examination

With his current glasses, OD: −2.00 sphere, OS: −2.25 sphere, distance visual acuity was OD 20/40, OS 20/30. Near corrected visual acuity was OD: J1+, OS: J1+. Cover test revealed a 2 p.d. exophoria at distance and an intermittent (deviated approximately 75% of the time) alternating, 20 p.d. exotropia at near. The near point of convergence was receded with a break at 75 cm and recovery at 1 meter. No diplopia was reported. Even with a red glass in front of the right eye the patient had difficulty reporting diplopia until the examination room was made completely dark. At that point P.L. reported crossed diplopia which could be neutralized with 18 diopters of base in prism. Stereopsis testing with the Randot test revealed 200 seconds of arc. The deviation was comitant and pupillary responses normal.

Refraction indicated an increase in myopia along with a small against-the-rule astigmatism, OD −2.75 0.25 × 90 (20/20), OS: −2.50 −0.50 × 90 (20/20). The dis-

tance Von Graefe finding was 3 exophoria with abduction ×/12/8 and adduction 6/14/8. Near testing was 20 exophoria, abduction 16/20/16, adduction 2/4/−2. The patient had an NRA of +1.00, PRA of −2.50. Accommodative facility testing revealed inability to clear +2.00 monocularly or binocularly. There was no problem with −2.00 lenses. MEM retinoscopy showed against motion OD, and OS and the amplitude of accommodation was 7D, OD and OS.

Treatment

The patient was diagnosed as having a convergence insufficiency with secondary accommodative excess. The increased myopia was considered to be secondary to the convergence insufficiency and we decided not to make an Rx change until after therapy.

The relationship between the blurred distance vision and the nearpoint problem was explained to the patient and in spite of being asymptomatic at near, P.L. was interested in vision therapy as an approach to his problem.

A combined in-office/home therapy program was initiated and P.L. was seen on a weekly basis for 4 weeks. Initial techniques employed included: accommodative rock monocularly with loose lenses, Brock string, pencil push-ups, red green glasses for suppression reduction, Polaroid glasses with a mirror, and the Quoit Vectogram. P.L. showed very inconsistent responses, being unable to utilize visual feedback cues (SILO, localization, parallax, and diplopia) to monitor his progress because of deep suppression. Therapy was, therefore, frustrating and unproductive with the patient losing motivation and interest.

At this point auditory feedback therapy was initiated. The patient was restrained by a chin and headrest. Binocular eye movements were recorded using the photoelectric limbus tracking technique previously described in the literature.[7] The eye movement monitor was calibrated prior to each session by having the patient successively fixate three 20/40 letters, monocularly. The calibration procedure was accomplished in 2–3 minutes with an accuracy of 0.5° around the central fixation target. The eye movement signal was fed into an auditory system whose output was a tone which varied in pitch relative to eye alignment. Orthophoria posture produced a low pitch, while over or under convergence resulted in an increasing tone frequency. Each visit consisted of six, 3 minute sessions, with a 1–½ minute rest between sessions.

The nearpoint target was set up initially at a 1 meter distance. At this distance the target was within the near point of convergence of the patient. The task was to fixate the 20/40 letter and to try and reduce the pitch of the tone. He was permitted to overaccommodate (target blurred), but was instructed to try and keep the tone low and simultaneously clear the letter. As P.L. gained control the target was moved closer in 25 cm steps until a 25 cm distance was achieved. Other activities were added. These included jump fixation from 2 meters to 25 cm and jump vergence at 25 cm using loose base out prisms.

Results

Contrary to the poor results obtained over a 4-week period using conventional vision therapy, the ABFT results were dramatic. P.L. was seen on 5 consecutive days for ABFT. During the first visit he showed a very limited ability to alter the tone, although this ability improved slightly at the end of the first session. The most important change was that P.L. reported spontaneous diplopia for the first time at the initial visit. By the third session he had gained enough control for us to move the target to 50 cm. He was able to keep the tone to a minimum for the full 3 minute session. On the following two visits jump fixation from distance to near and jump vergence with loose prism were introduced. P.L. demonstrated excellent performance on both of these techniques. By the 5th session ABFT no longer presented a challenge to the patient. Our findings at the end of the 5th visit (one week) showed a 10–12 p.d. exophoria with the near cover test, the NPC was 4″/6″ with a penlight and 6″/12″ with a red glass. Von Graefe phoria at near was 18 exophoria, abduction: 14/28/20, adduction: 12/16/−2. The NRA was +1.00, PRA −2.50. The clown vectogram (Bernell) was introduced, and for the first time P.L. was able to appreciate and utilize the feedback cues. His adduction range was ×/12/6 on the clown. ABFT was discontinued and a program of conventional vision therapy was initiated to eliminate the remaining vision problems. Techniques used included: Bernell tranaglyphs, the aperture rule, Keystone eccentric circles. This program proceeded routinely and within five visits (2 weeks apart) the patient was dismissed for 3 months.

A new Rx was prescribed at the end of therapy — OD: −2.25 − 0.25 × 90 (20/20), OS: −2.50 − 0.50 × 90 (20/20). The post therapy evaluation showed an NPC of 2″/4″ with a penlight and red glass, the near lateral phoria was 14xp, Abduction: 12/22/16, Adduction: 16/32/16; NRA: +2.00, PRA: −2.00, binocular and monocular accommodative facility was normal for +2.00 and −2.00 lenses.

Discussion

One of the basic principles of vision therapy is that the changes which occur with treatment are the result of learning.[1] To maximize this learning process vision therapy procedures are designed to provide useful feedback for the patient. Thus, an effective therapy

technique will always present the patient with information about the appropriateness of his responses. The patient thus becomes aware of errors and can make the necessary changes in response.

In the case presented, convergence insufficiency was long-standing and the suppression very deep, compromising the patient's ability to use visual feedback cues and preventing learning. Five sessions of ABFT in a one week period produced dramatic changes. The patient quickly learned to control the intermittent exotropia, became aware of diplopia whenever the eyes deviated and most importantly was then able to benefit from a conventional vision therapy program. Thus, for a moderate to severe convergence insufficiency with deep suppression, ABFT represents an approach that can significantly shorten the initial phase of vision therapy. Furthermore, we believe that ABFT might be used routinely at the beginning of therapy for all convergence insufficiency patients in order to facilitate the development of convergence. It could be used along with a Brock string, for instance, to add auditory feedback to the visual feedback about eye alignment available from the Brock string.

A previous report[13] also discussed the application of ABFT for convergence insufficiency. Our approach, however, is less complex, the calibration technique taking only 10% of the time reported by Afanador. He calibrated the system over a 2° by 10° visual field to enable reading of paragraphs. We calibrated our system for one fixation point which took only 2–3 minutes. The auditory signal we used was less complicated as well, yet provided adequate feedback information for the patient. These two simplifications increase the technique's value for clinicians. Furthermore, Afanador suggested that ABFT be used as the sole treatment procedure for CI therapy. We believe that ABFT represents a tool which can shorten and enhance the initial phase of therapy for convergence insufficiency. It should, therefore, complement rather than replace the traditional approach for such patients. **AOA**

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