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Case Report

Case Report: Prism and Low-Energy Laser Application for Acute Non-Accommodative Esotropia

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Abstract

Significance: Due to increasing near-distance work and screen time, the prevalence of acute onset Esotropia (ET) is increasing among children. A non-invasive and effective method for restoring binocular vision is in demand in ophthalmology and optometry.

Purpose: We illustrate a new method with a combined application of low-energy laser and prism adaptation to restore binocular vision in an 11-year-old girl who developed acute acquired esotropia.

Case Report: An 11-year-old girl presented with her mother, noting her eyes had inward drifting. The cover test showed alternate esotropia, varied from 30D, equally in far and near distances. We applied fifteen sessions of prism exercise and anti-suppressive therapy with a low-energy laser. We encouraged her to do lateral rectus muscle exercises, as well. The treatment course resulted in the improvement of ET to mild esophoria. This finding was stable in the one-year follow-up; However, the esotropia rarely recures after physical and emotional stress.

Conclusion: There are various methods to manage acute onset esotropia. To improve brain plasticity and retrain the visual system to fuse the images from both eyes, we demonstrated that prism adaptation exercise combined with low-energy laser therapy is a practical approach. In addition, this treatment can be applied together with surgery or botulinum toxin injection to improve binocular vision and decrease the residual ET. To our knowledge, this case is the first reported esotropia managed by a combination of Low-energy laser and prism exercises.

Keywords: *Acute Acquired Esotropia; Esotropia; Low-Energy Laser Treatment; Prism*

Introduction

Acute acquired comitant esotropia (AACET) has been characterized by the same angle of deviation in all gazes causing diplopia while normal ocular motility is maintained [1]. In the absence of systemic or neurological disorders, it is frequently due to breakdown of visual fusion mechanisms. In AACET, monocular signals get imbalanced before the point of summation; therefore, the brain is unable to combine

images from two eyes. Consequently, suppression mechanisms become active to prevent diplopia although the fusion mechanisms remain intact for binocular vision [2].

AACET has been classified into three types: 1- Swan type esotropia occurs when a previously well-functioning fusion mechanism is interrupted due to monocular occlusion or loss of vision in one eye, 2- Franceschetti type is a relatively large-angle esotropia characterized by mild hypermetropia and diplopia, and is frequently related to physical or psychological stress, and 3) Bielschowsky type exhibits equal deviation at near and distance fixation, appears in patients with varying degrees of myopia, and has been implied to be due to uncorrected myopia combined with excessive near-distance work [3,4].

In this paper, we presented a patient with type 3 AACET who was treated with a non-surgical approach consisting of low-energy laser application and prism exercises (Figure 1). To the best of our knowledge, this is the first case on management of esotropia (ET) by the combination of low-energy laser application and prism exercises.

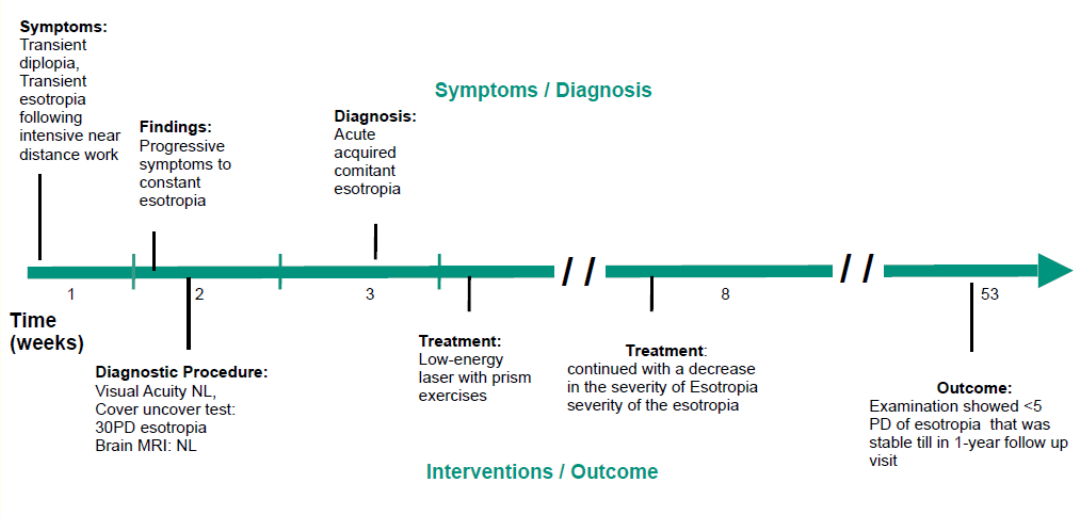

Figure 1: *An 11-year-old girl who presented with constant alternative esotropia. She was treated with 15 sessions of prism exercises together with 10 sessions of Low-energy laser application.*

Case Report

An 11-year-old girl was referred to us because of inward eye drifting for almost four weeks duration (Figure 2). Her personal and familial medical histories were unremarkable. She did not have any history of strabismus surgery or infantile ET.

On ophthalmological examination, the best corrected distance and near visual acuities were 20/20 in both eyes. The far and near-distance alternate prism and cover tests revealed 30D constant alternating ET. The range of motion was completely normal in all extraocular muscles. There was no vertical deviance. The cycloplegic refraction was OD: -1.00 - 0.2515° and OS: -0.25-0.50173°. The stereo butterfly random arc test showed 200 seconds of arc. The color vision (Ishihara plate) was normal. Slit-lamp examination of the anterior segments of the eye, macula and optic nerve were normal. Neurological examination, thyroid function tests and brain magnetic resonance imaging were also normal.

Figure 2: *Acute acquired non-accommodative esotropia in an 11-year-old girl who presented with 30 PD of esotropia.*

The patient was diagnosed with type 3 AACET, and was assigned to a therapy program consisting of low-energy laser application and prism exercises.

The treatment session started with laser application in a dark room. We applied an infra-red, flickering laser designed for the ocular use (http://www.dealmed.ru/apparat_lazerny_spekl_m.html) and employed an average radiation spot power of 0.5 mW/cm^2, a frequency of 30 Hz, and a wavelength of 0.6328m (Figure 3). This setting was chosen according to the instruction provided by the manufacturer. The patient looked at the laser source from the distance of 25 cm with one eye for three minutes and then repeated the procedure with the other eye. Finally, she repeated the session by looking to the laser binocularly.

In the second practice, the patient sat in a dim-lighted room and looked at the light of a candle from the distance of 40 cm with her right and left eyes separately for 5 seconds; then, she was instructed to look at the target binocularly and merge both images as much as she could. This practice was repeated for 5 - 10 minutes.

For the final step, the patient wore a trial frame with base-out 15 PD prisms in front of both eyes. She attempted to view the target in the same manner as in the previous stage. The prism power was sequentially decreased by 1 PD. The patient was encouraged to look at the target and maintain binocular vision and merge the images from two eyes when the prism power was decreased sequentially.

The third exercise was following a flickering target that drifted to the temporal sides to strengthen her lateral rectus muscles. She practiced lateral rectus exercises in all sessions.

Each session of therapy lasted approximately one hour, practiced in the clinic every other day, and the patient also self-practiced ten minutes a day. For her home practice, she was instructed to look at a light of a candle as she practiced in the clinic. She was instructed to limit her phone screen time and prescribed +1 glasses for her near task to help the ciliary body to be more relaxed. The laser therapy and prism exercises were done for 10 and 15 sessions, respectively.

During the early days of practice, the patient could not maintain binocular vision without prisms. Her ability of fusion improved gradually after one week. She had less than 5D of esophoria on her final examination (Figure 4). The stereopsis as measured by Random dot

Figure 3: *Ocular laser device used. The picture was adapted from Dealmed with permission (http://www.dealmed.ru/apparat_lazerny_spekl_m.html).*

stereo Butterfly was 200 sec of arc. This outcome was sustained till the twelve-month follow-up visit; however, her parents reported that they noticed milder degrees of apparent deviation when the patient was under physical or psychological stress.

Figure 4: *The patient after one course of low-energy laser therapy and prism exercises. Less than 5 PD esotropia was detected 1 year after the treatment.*

Discussion and Conclusion

AACET is a rare disorder and has been linked to excessive use of smartphones and tablets in children and adolescents [5,6]. Current management of AACET includes botulinum toxin application and surgical intervention [7-10]. Both management methods have various shortcomings; therefore, a non-surgical approach based on the pathophysiology of the disorder, as we have described in this paper, may be useful.

In strabismus, it has been known that suppression of one eye is an adaptive response mediated by the inhibitory interactions in the primary visual cortex [9]. This suppression may lead to amblyopia in long term. It has been reported that low-energy laser beam can improve the function of the retina and optic nerve and increase the visual acuity in amblyopic and strabismic eyes [11,12]. Therefore, we aimed to potentially inhibit suppression of vision and enhance neuroplasticity of the brain; we stimulated the eyes with a low-energy laser. We preferred monocular laser stimulation at the first stage to ensure equal stimulation of two visual pathways since we supposed that two visual pathways may not be stimulated equally if the patient looked at the laser beam binocularly.

The impact of prism on visuo-motor after-effects have been known for over a century. Prisms also have a therapeutic value in the facilitation of binocular vision in small-angle deviations [7]. Adaptation to prisms takes five minutes during a simple pointing session. Furthermore, it has been demonstrated that prism adaptation prior to surgery improves stereopsis and reduces the postoperative recurrence rate [14-16]. Therefore, in addition to inhibition of suppression with low-energy laser therapy, we employed prism exercises to stimulate and enhance the ability of the brain to fuse images from both eyes to restore binocular vision and reduce diplopia. The brain has been trained to combine the images from two eyes both during and after the exercise sessions, and the tone of central nervous system suppression and the angle of strabismus decrease spontaneously. We believe that treatment sessions may be repeated every three months to achieve better results in refractory cases.

Our approach is a non-invasive method and may primarily be used if the patient or the parents refuse surgery or if the risk for surgical complications is high. However, our approach requires more follow-up office visits compared to surgery; therefore, both the clinician and patient must be willing for the treatment to achieve a successful outcome.

Although surgical correction and botulinum toxin injection give faster results, they have some disadvantages. Inadequate or excessive correction is a significant limitation of surgery, and the need for repeated injections is the limitation of botulinum toxin injections. In fact, our technique may be combined either with surgery or botulinum toxin injection to address under-correction and maintain orthotropia for the optimal treatment of AACET.

Clearly, there is a demand for further research to investigate this subject.

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The study was conducted in accordance with the principles of the 1964 Declaration of Helsinki, revised in 2000. The patient's parents signed their informed consents according to the policies of the Medical Council of Islamic Republic of Iran.

Disclosures and Conflict of Interest

None of the investigators have financial interests in any companies or products described in this study. The author receive no funding for this study.

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