Diagnosis and Treatment of Binocular Vision Disorders - Clinical Observations in Optometric Practice Based on Three Different Case Studies.

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Summary

The following study presents three different case studies of binocular vision disorders, along with a description of the vision therapy applied, an assessment of its effectiveness, and conclusions. The case studies included a child with near intermittent exotropia and convergence insufficiency, a child with non-strabismic amblyopia, and a senior with oblique strabismus.

Keywords: vision therapy, vision training, strabismus, amblyopia, prisms, diplopia.

INTRODUCTION

Binocular vision disorders (BVD) refer to a range deficits, that impair proper binocular cooperation. This group includes concomitant and paralytic strabismus, accommodation and convergence dysfunction and amblyopia (low vision) [1]. BVD affects approximately 4-8% of the population and impair depth perception and affect other cognitive functions, such as visual attention, motor skills and body balance [2,3].

Due to the variety of types of strabismus, various types of vision therapy are implemented, including visual training, spectacle lenses, prisms, color and polarizing filters as well as exercises targeting skeletal muscles, body balance and coordination [4].

METHODS

The clinical observations presented in this study were selected from among patients, that visited the optometric practice in Dr Nawrot - Vision Center in Zawiercie during a student internship of Sebastian Foit, a student in Optometry specialty within the Biophysics program at the University of Silesia in Chorzów. All of the optometric examinations were performed with the assistance and oversight of dr. Paweł Nawrot (PhD), optometrist, specializing in treatment of BVD cases.

Patient No. 1. Convergence insufficiency with intermittent exotropia at near

Case history: Young girl, 7 y.o. About 2 years ago, the pediatrician first noticed that her left eye was turning outward. Her parents said, that it is very noticeable when she is deep in though or tired. Measurements: Mild hyperopia, no correction required; VA sc OD/OS 1.2 at distance and OD/OS 1.0 at near; convergence insufficiency with high intermittent exotropia at near and accommodative dysfunction. Detailed results are placed in Table 1 in the Results section.

Treatment: Vision training was practiced by the patient at home for 4 months, about 20-30 minutes daily. In the 1st phase of vision training, exercises were prescribed to improve eye movements, targeting, accommodation facility, and near point of convergence with suppression control. In the 2nd phase, near-point of convergence training with suppression control was continued, and sensory-motor fusion training was added using a Wheatstone-type mirror stereoscope and Tranaglyphs.

Patient No. 2. Non-strabismic, moderate amblyopia OS with suppression.

Case history: Young boy, 7 y.o.. He started attending kindergarten a year later due to developmental delays. The patient learns slowly and reluctantly, has trouble remembering things, can count to a maximum of 10, and does not speak clearly. He owns glasses since he was 2 years old (Figure 1), but

he does not wear them because he gets a headache shortly after putting them on.

Figure. 1. Current eyeglass prescription of Patient No. 2.

	Sfera	Cyl.	Oś	Pr.	Baza	Vis	BinVis
OP	+0.75					1,0-2	1,0+1
OL	+5.00	-1.00	45			0,2+2	

Measurements:

Figure 2. Maximum subjective refraction (without cycloplegia).

	Sfera	Cyl.	Oś	Pr.	Baza	Vis	BinVis
OP	+0,75	-0,25	170			1,0	1,0
OL	+6,75	-1,00	45			0,5+2	

The glasses (Figure 2) were not prescribed due to discomfort in the trial frame. Mild hyperopia of OD (~+1.50 D) and high hyperopia of OS (+7.50 D) (both are axial ametropia) after cycloplegia. Other results: mild basic exophoria; OS suppression at distance (Worth Test), fusion with binocular rivalry in darkness at near, suppression 70% of the time in light (Worth flashlight); no stereopsis. Detailed parameters are listed in Table 2 in the Results section.

Treatment: A daily disposable, silicone-hydrogel contact lens was applied on the OS (+6,00/-0,75, ax 50°) and the vision therapy was prescribed. The 1st phase included monocular amblyopic and targeting exercises. In the 2nd phase, antisuppression and fusional vergence ranges training were introduced.

Patient No. 3. Constant, oblique diplopia.

Case history: Woman, age: 61 y.o. Referred by an ophthalmologist. She has been experiencing constant double vision, with a slight skew, for the past 8 years. Over the past year, she underwent vision therapy, but did not notice any significant improvement. She received prism glasses, but she cannot see single in them, objects are closer, but despite this, she prefers not to wear them at all.

Mesaurements: Myopic astigmatism (cylinder ~3.00 D), anisometropia (~1.50 D); constant vertical diplopia; constant right eye exotropia (20 PD) and constant right eye hypotropia (10 PD) at distance, constant right eye exotropia (6 PD) and constant right eye hypotropia (4 PD) at near.

Treatment: New refractive correction and oblique prisms were fitted (Figure 3 & 4). Two pairs of glasses were prescribed (at distance and at near).

Figure 3. Distance glasses prescription of Patient No. 3.

Sfera	Cylinder	Oś	Pryzmat	Baza	VIS	Bin. VIS
-0,25	-2,50	83	7,00	168	0,9+2	1,0+2
-1,50	-2,50	103	7,00	348	0,9+2	

Figure 4. Near glasses prescription of Patient No. 3.

	Sfera	Cylinder	Oś	Pryzmat	Baza
OP	+1,75	-2,50	83	2,00	154
OL	+0,50	-2,50	103	2,00	334

RESULTS

Patient No. 1. No outward deviation of OS, even when tired. The patient did not report any symptoms. The visual parameter values before and after training are presented in Table 1 below.

Table 1. Selected visual parameters of Patient No. 1 before and after vision training.

Visual parameter	Before training	After training
Near Point of Convergence (break/recovery)	12 cm/25 cm	No break
Exophoria at near	25 PD	14 PD
Fusional vergence ranges BO at near	4/6/4 PD	20/25/18 PD
Fusional vergence ranges BI at near	16/25/18 PD	16/20/18 PD
Accommodation facility (binocular)	6 cpm	15 cpm
Near Point of Accommodation	8 cm	8 cm
Ocular mobility (NSUCO)	4/4/3/4	5/5/5/5

Patient No. 2.

Table 2. Selected visual parameters of Patient No. 2 before and after vision training.

Visual parameter	Before training	After training
Visual acuity of the visually impaired eye	0,6+2	0,9-2
Fusion at near	OS suppression	Fusion with rivalry
Fusion at distance	OS suppression	OS suppression
Stereopsis at near	none	100”
Stereopsis at distance	none	400”
Fusional vergence ranges BO at near	6/8/4 PD	10/14/8 PD
Fusional vergence ranges BI at near	6/10/8 PD	10/12/10 PD

Patient No. 3.

The prescribed glasses enabled the patient to achieve stable fusion during both optometric tests and functional activities, such as standing and walking. This stability was maintained in the primary position of gaze as well as in peripheral looking. Prisms were prescribed in the form of prismatic lenses rather than Fresnel prisms after first showing the patient what a Fresnel prismatic lens looks like.

CONCLUSIONS

Patient No. 1, who underwent active vision training at home, significantly improved her parameters of accommodative facility, convergence amplitude, and fusional convergence ranges (BO). Besides, her visual efficiency also increased - the patient reported that it was easier for her to focus on writing and reading. This case showed that active home-based vision training is an effective method for improving binocular vision in individuals with convergence insufficiency, including intermittent exotropia [5].

Patient No. 2 illustrates the limited effectiveness of amblyopia and suppression training when it is performed infrequently and irregularly. This case demonstrates the importance of exercise regularity and the introduction of subsequent training phases until success is achieved.

Patient No. 3 is an example of how quickly help can be provided to someone struggling with constant diplopia. Properly selected prism glasses are able to eliminate a problem that made it difficult to move safely and confidently or to reach for a cup of tea.

Management of binocular vision disorders includes many different methods, both passive and active. Which method will be most effective and recommended depends on many factors, such as: the initial level of binocular vision, visual acuity, coexisting diseases, previous management, and the patient‘s capabilities and commitment [6].

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REFERENCES

[1] Á. García-Munoz, S. Carbonell-Bonete, P. Cacho-Martínez; *Symptomatology associated with accommodative and binocular vision anomalies*. Journal of Optometry; 2014; Volume 7; Issue 4; p. 178-192.

[2] A. Przekoracka-Krawczyk, P. Nawrot, T. Kopyciuk, R. Naskrecki, Implicit motor learning is impaired in strabismic adults, Journal of Vision, 2015 Aug 1;15(11):6.

[3] A. Przekoracka-Krawczyk, P.Nawrot, M. Czaińska, K. P. Michalak, Impaired body balance control in adults with strabismus, Vision Research, 2014 May:98:35-45.

[4] M. Scheiman, et al.; *Randomized clinical trial of treatments for symptomatic convergence insufficiency in children*.; Archives of Ophthalmology; 2008; Volume 126; Issue 10; p. 1336-1349.

[5] P. Nawrot, K. P. Michalak, A. Przekoracka-Krawczyk, Does home-based vision therapy affect symptoms in young adults with convergence insufficiency? Optica Applicata, Vol. 43, Issue 3, pp. 551-566.

[6] M. Scheiman & B. Wick; *Clinical Management of Binocular Vision: Heterophoric, Accommodative, and Eye Movement Disorders;* Lippincott Williams & Wilking; 2008.