

LITERATURE REVIEW

Current Eye & Vision Science Literature

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Brautaset R, Wahlberg M, Abdi S, Pansell T. Accommodation insufficiency in children: are exercises better than reading glasses? *Strabismus* 2008;16:65-69.

This study from Sweden sought to examine whether +1.00 D reading adds or training with +/-1.50 D flippers would be more effective in the treatment of accommodative insufficiency in children. To be eligible for the study, subjects had to have an amplitude of accommodation less than $15 D - (0.4)(age)$ and asthenopic symptoms. There were several other inclusion criteria, including normal near point of convergence, normal visual acuity, distance phorias between 2Δ exo and 2Δ exo, near phorias between 6Δ exo and 4Δ eso, fusional vergence reserve at least twice the amount of the phoria, and normal stereopsis. Subjects had less than 1.00 D of hyperopia, less than 0.50 D of myopia, and/or less than 0.50 D of astigmatism.

Subjects underwent eight weeks of treatment. There were 10 subjects in the group that wore +1.00 D reading adds. All ten wore the glasses for the eight weeks. Fourteen subjects started in the flipper treatment group. Nine of the fourteen completed the eight weeks of flipper training. The average age of subjects was 10.3 years in both groups at the start of the study.

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The powers of the flipper lenses were +/-1.50 D. Subjects were instructed to fixate a vertical row of 6/9 equivalent letters at 40 cm and do two daily training sessions of nine minutes each. The nine minutes were composed of alternating between one minute of flipping and one minute of rest. It was not stated whether flippers were used monocularly or binocularly or both.

Both treatments resulted in statistically significant improvements in amplitude of accommodation as measured by near point of accommodation with RAF rule. Amplitude increased 1.58 D on average after use of plus lenses and 3.57 D from the flipper training. The mean increases in flipper rates were 1.25 cycles per minute after use of plus lenses and 1.51 cycles per minute after flipper training, but these changes were not statistically significant. There was essentially no change in lag of accommodation as measured by Nott retinoscopy, an average numerical change of -0.04 D after use of plus lenses and of +0.02 D after flipper training.

The authors also reported degree of asthenopia before and after treatment based on a Visual Analogue Scale. Subjects were asked "If 0 equals no problem when doing near work and 10 equals the worst degree of problems, what number would you grade your problems at near work to be now?" For the plus lens wearing group, the asthenopia scale finding averaged 7.3 before treatment and 2.6 after treatment. For the flipper training group, the average scale number was 8.1 before treatment and 1.8 after treatment. Both changes were statistically significant. Based on their previous work, the authors suggested that a scale score of 2 or less can be considered normal.

The authors suggested that because the asthenopia scale score average was only a little below 2 after treatment in the flipper group, treatment should be continued for longer than eight weeks as in the study. They also suggested that because the improvement in asthenopia scale score was greater in the flipper group in the eight weeks of the study, the length of time

needed for treatment may be less with flipper training than with the use of plus lenses.

The flipper training in this study was only done with +/-1.50 D flippers. In a typical vision therapy program for accommodative insufficiency, treatment generally involves increasing flipper powers as treatment progresses and includes other training procedures in addition to flippers.¹⁻³ Therefore, it seems likely that the improvements in a typical vision therapy program for accommodative insufficiency would be greater than reported in this study. Also, it would be interesting to know if results with plus lenses would be better with appropriately individualized prescriptions rather than an arbitrary +1.00 D.

Chiesi C, Chiesi L, Cavallini GM. Evaluation of refraction in a statistically significant sample: changes according to age and strabismus. Journal of Pediatric Ophthalmology and Strabismus 2009;46:266-272.

This paper reports on refractive findings in a large population of patients in an ophthalmological orthoptics referral clinic at Modena University in Italy. The records of 12,534 patients between the ages of 0.5 and 20 years were studied. Refractive findings were taken by streak retinoscopy with three drops of 1% cyclopentolate.

Patient records were separated into "orthophoria" and strabismus groups. There were 7,784 with orthophoria and 4,750 in the strabismus group. The strabismus category was divided into an esodeviation group (greater than 4 prism diopters of eso) and an exodeviation group (greater than 8 prism diopters of exo). The method and test distance for those measurements were not stated. There were 3,026 patients in the esodeviation group and 1,724 patients in the exodeviation group. It appears that there were also some patients with high phorias included in the two strabismus groups, but it is unclear how many. Although not stated, it would thus appear that the orthophoria group included non-strabismics from 8 prism diopters exo to 4 prism diopters eso.

The results of the analyses can be summarized as follows:

- a. The mean spherical equivalents were +1.10 D in the orthophoria group, +1.13 D in the exodeviation group, and +3.22 D in the esodeviation group.
- b. Based on their plotted frequency distributions, the most common spherical equivalent refractions

were about +2 D in the orthophoria group, +2 D in the exodeviation group, and +5 D in the esodeviation group.

- c. The percentages of patients with more than 2 D of hyperopia were 32.0% in the orthophoria group, 31.4% in the exodeviation group, and 71.3% in the esodeviation group.
- d. The mean refractive errors at one year of age were +2.38 D in the orthophoria group, +2.18 D in the exodeviation group, and +2.91 D in the esodeviation group.
- e. The mean spherical equivalents over 18 years of age were -1.87 D in the orthophoria group, -0.81 D in the exodeviation group, and +1.86 D in the esodeviation group.
- f. The mean spherical equivalent decreased in plus with age and moved into minus at 11 years of age in the orthophoria group and at 14 years of age in the exodeviation group, but decreased in plus only about a diopter from 1 year of age to over 18 years in the esodeviation group.
- g. Mean amount of astigmatism was not significantly different in the three groups.
- h. The percentages of patients with 1.00 D or more anisometropia were similar in the three groups.
- i. The mean amount of astigmatism was greater in patients with 1.00 D or more anisometropia (1.42 D) than in patients with less than 1.00 D of anisometropia (0.83 D).
- j. Amount of astigmatism was greater in patients with higher spherical equivalents. For example, mean astigmatism was 1.72 D at a spherical equivalent of -7 D and 1.54 D at a spherical equivalent of +7 D compared to 0.76 D at -1 D and 0.84 D at +1 D.
- k. The percentages of patients showing with-the-rule astigmatism and against-the-rule astigmatism did not differ in the three groups.

The authors noted that the large percentages of patients with 1 D or more of astigmatism and anisometropia as well as the large percentage of patients with strabismus were due to the referral nature of the clinic. A conclusion reached by the authors was confirmation of the association of hyperopia and esodeviation and of the "limited influence" of "refractive trend" on the "pathogenesis" of exodeviation (pp. 270-271). This study is intriguing because of the very large numbers of patients. However, because of its cross-sectional rather

than longitudinal nature and some ambiguity in the categorization of patients for analysis, there should be some caution in the interpretation of all the results of the study. The authors suggested that further study was needed to examine how factors such as amblyopia and consideration of accommodative and non-accommodative types of esodeviations would affect the results.

Vitale S, Sperduto RD, Ferris FL III. Increased prevalence of myopia in the United States between 1971-1972 and 1999-2004. Archives of ophthalmology 2009;127:1632-1639.

This paper reports on an apparent increase in prevalence of myopia over about a three decade period of time. Data were from the ongoing National Health and Nutrition Examination Survey (NHANES). The NHANES is survey designed to be representative of the civilian non-institutionalized United States population. It is conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention.⁴ Study participants were interviewed in their own homes and additional testing was done in a mobile facility. The 1971-1972 data for prevalence of myopia from NHANES were published over 25 years ago.⁵ Data from NHANES for 1999-2004 were compared to those for 1971-1972 to look for an increase in myopia prevalence.

Right eyes were used analysis for both time periods, and survey participants were 12 to 54 years of age. The classification of myopia was made by the following procedure in 1971-1972. If presenting visual acuity was 20/20 or better, a minus power spherical equivalent on lensometry established the presence of myopia. If presenting visual acuity was 20/25 to 20/40, pinhole visual acuity and lensometry were performed. The amount of improvement in visual acuity with pinhole was converted to a correction factor added to the lensometry reading. Retinoscopy was performed when presenting visual acuity was 20/50 or worse. The presence of myopia was defined as a minus power spherical equivalent from retinoscopy.

An attempt was made to define myopia in the same way in 1999-2004, but there were some differences. Instead of retesting visual acuity with pinhole in cases where presenting acuity was 20/25 to 20/40, visual acuity was remeasured with those participants wearing lenses based on autorefractometry. And in cases where visual acuity was 20/50 or worse,

autorefractometry (Nidek ARK-760) was done instead of retinoscopy.

In the 1971-1972 data, there were 4,436 participants who could be classified as myopic or non-myopic in the right eye. In the 1999-2004 data, there 8,339 participants for whom such a classification could be made. For these persons, the overall prevalence of myopia was 25.0% for 1971-1972 and 41.6% for 1999-2004. Data were analyzed by age and race. The age divisions were 12-17, 18-24, 25-34, 35-44, and 45-54 years.

For black participants, overall prevalence of myopia was 13.0% in 1971-1972 and 33.5% in 1999-2004. The prevalence for black participants was more than twice as much in 1999-2004 than in 1971-1972 for all age groups, except 45-54, where it increased from 17.3% to 34.3%. The increases in prevalence were statistically significant for each age group. For white participants, total prevalence increased from 26.3% in 1971-1972 to 43.0% in 1999-2004. For whites also, each age group showed a statistically significant increase in prevalence.

Myopia was classified as mild if it was less than 2.0 D, moderate if it was 2.0 to 7.9 D, and severe if it was 7.9 D or greater. Each of these categories showed statistically significant increases from 1971-1972 to 1999-2004: from 13.4% to 17.5% for mild myopia, from 11.4% to 22.4% for moderate myopia, and from 0.2% to 1.6% for severe myopia.

The study also examined change in prevalence for those participants with 12 or more years of formal education. The 12-17 age group was, of course, not included in that analysis, but each of the other age groups showed a statistically significant increase in prevalence: from 31.4% to 42.6% for 18-24 year olds, from 32.3% to 51.6% for 25-34 year olds, 39.3% to 49.4% for 35-44 year olds, and 39.5% to 51.8% for 45-54 year olds. The authors noted that it is possible that the total years of education could have increased among those with 12 or more years because the data collected for years of education were categorical only.

Pondering whether the change from retinoscopy to autorefractometry may have introduced a systematic bias in the data, the authors noted that: "A 1 D shift of the 1999-2004 spherical equivalent distribution would be required to eliminate the discrepancy between the 1999-2004 and 1971-1972 surveys." They suggested that: "This degree of systematic mismeasurement seems highly unlikely." (p. 1638) The authors concluded

that their data suggest an increase in the prevalence of myopia in the United States.

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