

## TRANSACTIONS

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# EUROPEAN STRABISMOLOGICAL ASSOCIATION

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#### Abstract

We evaluated the incidence and type of visual abnormality found in 400 reading disabled children, referred to our department by a Reeducation Centre for children with communication problems. All children underwent a complete ophthalmologic and orthoptic examination including anterior and posterior segment evaluation, visual acuity for distance and near, cycloplegic refraction, near point of accommodation and convergence, cover test, binocular functions, eye dominance and eye movements. Reading strategy was tested in 65 children. 52.75% of the children presented some degree of visual dysfunction previously unknown. Although visual dysfunction is rarely the cause of reading difficulties, it may exacerbate the problem. We therefore feel that all children with reading problems should have a complete ophthalmologic and orthoptic investigation prior to any reeducation for their reading problems.

### Keywords

Reading problems, visual dysfunction

#### Introduction

Children with reading problems at school present a diverse group. There may be multiple reasons for their difficulties. It is important that they undergo a complete multidisciplinary assessment <sup>1</sup>. Since 1991, the University Hospital of Antwerp has a Reeducation Centre for children with communication problems. Each child is assessed by a clinical psychologist, a speech therapist, an occupational therapist, a physiotherapist and an oto-rhino-laryngologist. All reading disabled children are referred to our department for a complete ophthalmologic and orthoptic examination. We will report the incidence and type of visual abnormality that has been observed in these children.

#### Materials and Methods

We examined 400 reading disabled children between June 1993 and December 2000, 255 males, 145 females. The mean age was 8.6 years, and ranged between 6 and 15 years. 325 children were right handed (81.25%), 61 were left handed (15.25%), and 14 were ambidextrous (3.5%). All children were reading at least 6 months behind their expected reading age and were all in good health. All had a complete ophthalmologic and orthoptic examination. The anterior and posterior segment evaluation was done by an ophthalmologist. The monocular and binocular visual acuity, with best correction, was measured for distance and near. The refractive power, was determined with and without cycloplegia. The near point of accommodation and convergence was measured with a RAF ruler, using the push-up method. Possible strabismus, manifest or latent, was evaluated with the prism cover test for distance and near. Smooth pursuit and saccadic eye movements were tested by photo-oculography on the Vision Monitor (Metrovision) system in both horizontal and vertical directions. Reading strategy was tested (since October 1999) with the same method. All children had to read a text on the computer screen at 50 cm distance appropriate to their reading level determined by the Rehabilitation Centre. Fusion amplitude was measured with a prism bar for distance and for near. On the synoptophore the foveal fusion range was tested with a small object (visual angle 2°), and paramacular fusion with a larger object (visual angle 6°). Stereo acuity was examined with the circles of the Titmus test. The ocular dominance or "reference eye" was determined using the Dunlop test on the synoptophore as described by Stein and Fowler<sup>2</sup>, using the macular-sized house slides (F69 and F70).

#### Results

Funduscopy was found to be abnormal in only one child (0.25%), Stargardt disease was diagnosed. The anterior segment was normal in all children.

Visual acuity for distance was normal (1.0-0.8) in 323 children (80.75%), 35 children (8.75%) had a visual acuity between 0.8 and 0.6, 26 children (6.5%) between 0.6 and 0.4, 11 children (2.75%) between 0.4 and 0.2, and 5 children (1.25%) had a visual acuity below 0.2. The visual acuity for near was normal in all children.

Measuring the *refractive error* under cycloplegia, we found 26 children (6.5%) with emmetropia, 26 children (6.5%) with myopia and 348 children (87%) with hypermetropia, of which 217 children (54.25%) had hypermetropia of less than 1.5 D. Ninety-five children (23.75%) had hypermetropia between +1.5 and +3.0 D, 23 children (5.75%) between +3.0 and +4.5 D, and 13 children (3.25%) more than +4.5 D. Nineteen children (4.75%) had myopia between -0.5 and -1.5 D, 5 children (1.25%) between -1.5

and −3.0 D, and 2 children (0.5%) more than −3.0 D. Twenty-four children (6%) had astigmatism of more than 1.0 D and thirteen children (3.25%) had anisometropia of more than 1.0 D.

The near point of accommodation was normal in 356 children (89%), 15 children (3.75%) had an accommodation near point of less than 10 D, and in 29 children (7.25%) the accommodation could not be tested.

A manifest *strabismus* was found in 14 children (3.5%), 12 had an esotropia, 2 an intermittent exotropia. Fifty-four children (13.5%) had an esophoria, and 127 (31.75%) had an exophoria at near.

The eye movements in the form of smooth pursuit and saccadic refixation were normal in 355 children (88.75%), 45 children (11.25%) showed abnormal eye movements. Concentration played an important role in the outcome of the measurements. Reading strategy showed excessive saccades, regressions and vertical movements in all tested children (65).

The near point of convergence was up to 6 cm in 352 children (88%), 40 children (10%) achieved a 10 to 15 cm near point, and 8 children (2%) had poor convergence (>15 cm). Good fusional convergence amplitude of more than 40  $\Delta$  was found in 165 children (41.25%), 160 children (40%) had a fusion range from 40 to 20  $\Delta$ , and 53 children (13.25%) less than 20  $\Delta$ . Fusional divergence amplitude was normal (> 10  $\Delta$ ) in 274 children (68.5%), 114 children (28.25%) had a fusion range of less than 10  $\Delta$ . All the 12 esotropic children (3%) had suppression.

The convergence foveal fusion range on the synoptophore was normal (> 20°) in only 55 children (13.75%), 113 children (28.25%) had fusion from 20° to 10°, and 220 children (55%) less than 10°. The divergence foveal fusion range was more than 5° in 134 children (33.5%), and was less than 5° in 254 children (63.5%).

The convergence fusion amplitude for the larger objects was more than 20° for 130 children (32.5%), between 20 and 10° for 160 children (40%) and less than 10° for 98 children (24.5%). The divergence fusion capacity for the larger objects was more than 5° in 233 children (58.25%) and less than 5° in 155 children (38.75%).

Stereo acuity of 60 seconds of arc or better was found in 341 children (85.25%), 33 children (8.25%) had stereopsis between 80 and 140 seconds of arc, and 15 children (3.75%) had stereopsis worse than 200 seconds of arc. The 12 esotropic patients (3%) had no stereopsis.

A fixed or stable reference eye was found in 245 children (61.25%), 124 children (31%) had an unfixed reference eye, and 31 children (7.75%) did not understand the test.

### Discussion

In the literature, there is controversy regarding the significance of visual dysfunction in children with reading problems. Some authors feel that accommodation, visual acuity, refractive errors, fusion range, eye movements and convergence insufficiency are not significantly correlated with reading problems<sup>3,4</sup>. Others disagree and find a higher incidence of these anomalies in children with reading disabilities<sup>5-7</sup>. Most studies are about children with dyslexia, we examined children with all types of reading problems. In our study, 211 children (52.75%) presented some degree of visual dysfunction. The majority, 138 children (34.5%) had a significant refractive error ( $> \pm 1.5$  D), an exophoria at near (31.75%) and an unfixed reference eye (31%). Poor fusion range (13%-64% depending on the test used), reduced convergence (11.25%), unstable eye movements (11.25%) and low vision acuity (10.5%) was found in a minor percentage.

### Conclusion

Children attending a rehabilitation centre for communication problems may have visual dysfunction. Although visual dysfunction is rarely the cause of reading difficulties, it may exacerbate the problem. We therefore feel that all children with reading problems should have an ophthalmologic and orthoptic investigation, including cycloplegic refraction, prior to any reeducation for their reading problem. Children with reading disabilities need a multidisciplinary approach. The responsibility of the ophthalmologist and the orthoptist lies in optimising the conditions to facilitate the reading process.

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