Introduction

The main aim of this research was to determine whether any differences in refractive error or binocular vision related outcome measures exists between reading impaired children versus controls. A secondary aim was to determine whether any correlation exists between these clinical outcome measures and an objective assessment of reading ability using an infra-red tracking system.

Methods

- Subjects:
  - 100 students aged 6-16 years old recruited from three local school boards.
  - N = 50 (IEP group), 30 male. Medicated, strabismic and dyslexia cases excluded.
  - N = 50 (control group), 27 male.
  - Controls taken only from patients presenting for their annual eye examination. Additional 29 IEP cases reporting previous exams all indicating no prior cycloplegia

- Protocol:
  - One examiner (primary author, PG).
  - Reading assessment done prior to clinical testing (using the Visagraph III system).
  - Familiarization session done prior to study recording (Visagraph protocol).
  - Full eye examination with cycloplegia done (see Figure 2 for all tests done).
  - All testing (Visagraph and BV tests) done with presenting Rx in place.

- Points of note:
  - At least 87% of the controls and IEP cases had 20/25 or better unaided acuity.
  - Familiarization session done first prior to study recording (Visagraph protocol).
  - All testing (Visagraph and BV tests) done with presenting Rx in place.

- Visagraph III System used in a quiet room for reading assessment with student reading “in their head” with a test of comprehension administered.
- Test started at last grade level completed, with the grade level being reduced until 80% or better reading comprehension achieved.
- Reading speed, regressions per 100 words read and number of eye movements made to read 100 words were recorded.
- Vergence facility was tested for using 12BO/3BI flippers and all vergence amplitudes were done in free space with a prism bar (base in first) at near.
- +/-3DS flippers used to assess monocular and binocular accommodative facility.
- Prevalence of binocular vision anomalies, including strabismus, amblyopia, convergence insufficiency and uncorrected refractive errors amount to conservatively 10% of the general population (as high as 30% in near environments and 50% with near vision tasks).

Results

- Association between Reading Speed, Cycloplegic Refractive Error and Oculomotor Function in Reading Disabled Children versus Controls

- IEP and controls clearly show significant differences in several binocular vision related clinical outcome measures in addition to symptom related scores.
- Low vergence facility test results combined with high symptom scores in particular displayed good ability to separate IEP and control subjects.
- A significantly greater amount of hyperopia was present in the IEP group versus the control group.
- The higher the hyperopia (with vast majority of subjects were not corrected) the worse the reading performance (reduced speed, increase regressions and extra eye movements).
- Given these high correlations, it would appear sensitive that children with reading based reading difficulties (which make up 80% of all IEPs in Canada) be thoroughly examined for binocular vision anomalies and have a cycloplegic refraction performed. This is especially vital as binocular vision deficits (especially non-strabismic disorders) are for the most part highly treatable.

Discussion

- IEP children exhibit significantly greater binocular vision anomalies, significantly greater binocular vision symptoms and significantly greater hyperopia compared to controls.
- Routine eye examinations appear to be insufficient in detecting subtle binocular vision anomalies linked to reading difficulties.
- A full binocular vision evaluation (including an assessment of vergence and accommodative function in addition to cycloplegia) and objective assessment of reading is strongly advised for all reading based learning impaired children.

Conclusion

- We would like to acknowledge Graefe’s Archives of Clinical & Experimental Ophthalmology for useful reviews during publication.

References

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