Interventions in Visually Impaired Children

Chair: F.N. Boonstra, PhD
Co-chair: to be determined

Nienke Boonstra finished her specialisation in ophthalmology in 1989. She started to specialize in paediatric ophthalmology in 1987. During her specialisation she studied fusional vergence in microstrabismus in children and defended her thesis in 1997. In 1991 she started to work at Bartiméus, Institute for the Visually Impaired, and focussed on the visual development of children with or without visual impairment and on the use of low vision aids in children. She also works on the subject of genetic causes of developmental anomalies in visual impairment (FEVR and genetic causes of Cerebral Visual Impairment, CVI). Research in the use of low vision aids is performed in collaboration with Behavioural Science Institute (Radboud University) in this collaboration she started two PhD projects in 2009. Research in Ophthalmogenetics is performed in collaboration with the Department of Human Genetics, Radboud University Nijmegen, in this collaboration she started a PhD project in 2011. Research in the development of the visual system is started in Donders institute for cognitive neuroscience, in this collaboration she started two PhD projects in 2013, one postdoc in 2014 and one RCT in 2014 and the organisational work for the guideline CVI in 2016.

Symposium abstract

Children with visual impairment have several developmental delays. Often there is a delay in visual development and a delay in fine motor skill development. These delays may have consequences for participation in society. When differences between normal development and visual impairment are described and quantified, interventions to reduce these differences can be developed and applied. The reduction of differences will increase the chance of successful participation for visually impaired children. In this symposium the differences between normally sighted and visually impaired children will be described and for different groups of visually impaired children different interventions will be presented such as:

- The reduction of developmental delay in high hypermetropia (Nienke Boonstra)
- Reduction of crowding in visual impairment (Bianca Huurneman)
- The use of bifocals in children with Down syndrome: the reduction of developmental delay in accommodation in down syndrome (Christine de Weger)
- The use of perceptual learning in a delay in visual development in visually impaired children (Anja Palmowski-Wolfe).

Each of these presentations will be structured in a global framework: First the difference between normally sighted children and visually impaired children will be described, after this the intervention and its goal and, finally, the outcome of research and possibilities for implementation.

1. Hypermetropia and motor delay in visually impaired children.

F.N Boonstra[1,2], A.J. van Sorge[3]
1. Radboud University Medical Centre Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Department of Cognitive Neuroscience, Nijmegen, The Netherlands; 2. Bartiméus, Institute for the Visually Impaired, Zeist, The Netherlands; 3. Department of Ophthalmology Leiden University Medical centre, Leiden, The Netherlands

Introduction Children with high degrees of hypermetropia are at increased risk of developing strabismus and amblyopia. The principal symptoms may not be present in the first years of life, during which years important milestones in visual and motor development occur. Unrecognized hypermetropia in preschool children may contribute to school learning difficulties even in children whose cognitive abilities are average or above.
Methods: Children with hypermetropia of more than 4 dioptres, who were referred to our institute for visually impaired children, were included. Patient characteristics such as gestational age, birth weight and additional impairments such as hearing loss, motor and mental retardation and visual acuity, visual field and age at first examination were recorded
Results: 480 visually impaired children with hypermetropia of more than 4 dioptres were included. In 27% of these children a delay in motor development was recorded. The characteristics of the group with hypermetropia and motor delay was be specified and compared to a group of children with hypermetropia less than 4 dioptres.
Conclusion In children with hypermetropia of more than 4 dioptres motor delay is frequently found. The relation between hypermetropia and motor development will be explained. Possible interventions in order to prevent problems at school are presented.

2. Bifocals in Down, a study on the effect of bifocals in Children with Down Syndrome

C. De Weger-Zijlstra [1,2], F.N Boonstra[1,2], H.H.L.M. Goossens[1]

1. Radboud University Medical Centre Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Department of Cognitive Neuroscience, Nijmegen, The Netherlands; 2. Bartiméus, Institute for the Visually Impaired, Zeist, The Netherlands

Background: Near vision is reduced in most children with Down Syndrome (DS). This is an additional barrier achieving their maximum potential in development. DS is one of the most common genetic anomalies, occurring in about 14.6 in 10000 live births in the Netherlands in 2007. In the last two decades many research has been performed to study the differences in ocular findings between children with and without DS.

Some previous smaller studies by J.M. Woodhouse et al (Cardiff U.K. 2001-2009) and K. Nandakumar and S.J. Leat (Toronto Canada 2009-2010) showed that bifocal correction could be a tailor-made treatment for children with DS. By means of our multicentre randomised controlled trial (RCT) we aim to establish whom to prescribe bifocals and to identify possible prognostic determinants (at start, baseline measurement before therapy with bifocals) for improvement of visual acuity at near.

Methods: A multicentre randomised controlled trial (RCT) in 15 participating locations in the Netherlands. In order to be able to show differences between the effect of usual care and the new intervention, the bifocals, we included 110 children, 2-18 years old, with DS and accommodation deficit, who had not worn bifocals before. Bifocals were prescribed for children (n= 55) in the intervention group and single vision glasses for distance were prescribed in the control group (n=55). We studied the effect of these two interventions on visual acuity at near and at distance, on accommodation and occurrence of strabismus and on task readiness (monitoring executive functions).

Results: Baseline measurements and measurements after 6 months: refractive errors, near visual acuity, distance visual acuity and accommodation deficit, will be presented and differences between the intervention and the control group will be described.

3. Combined Visuomotor and Near-Acuity Letter Training Improves Visual and Reading Performance in Children with Infantile Nystagmus

Bianca Huurneman[1], F.Nienke Boonstra[1,2], and Jeroen Goossens[1]
[1] Radboud University Medical Centre, Donders Institute for Brain, Cognition and Behaviour, Cognitive Neuroscience Department, Nijmegen, the Netherlands
[2] Bartiméus, Institute for the Visually Impaired, Zeist, the Netherlands

Introduction/aim: Infantile nystagmus (IN) is associated with reduced visual acuity, increased crowding, and poor to absent stereopsis. We aimed to investigate whether computerized perceptual learning, based on near-acuity letter and visuomotor training, could improve vision in 6-11 year old children with infantile nystagmus (IN).
Methods: Thirty-six children with IN participated of which 18 had idiopathic IN and 18 had oculocutaneous albinism. Children were divided in two age- and diagnosis-matched training groups: a crowded training group and an uncrowded training group. Children completed 10 training sessions in 5 weeks (grand total of 3,500 trials). Children with normal vision (n = 11) were included to collect test-retest data. Outcome measures were: near and distance visual acuity, crowding extent and intensity, stereopsis, reading performance (reading acuity, critical print size, maximum reading speed and acuity reserve), and oculomotor behaviour (fixational eye movements, foveation characteristics, and saccade execution on a trained and non-trained task).
Results: Children showed robust near and distance visual acuity improvements after training, which ranged from 0.10-0.15 logMAR. The crowded training group showed larger near visual acuity improvements than the uncrowded training group. We also observed improvements in stereopsis. Both training groups showed improved (spatial) reading performance and could read faster with smaller letters after training. There were no changes in eye movements on the trained task, but there were some changes in saccadic eye movements on the saccade task. These changes were, however, almost equal to test-retest changes in normal controls.
Conclusion: These results demonstrate that our novel training paradigm benefits both visual and reading performance in children with IN. Furthermore, our results suggest that improvements in visual performance are primarily due to improved sensory processing rather than improved 2D-oculomotor behaviour. Learning curves did not reach a plateau yet, indicating that longer training may result in larger improvements.

Disclosure: None.

4. Perceptual learning using NeuroVision/Revital

A. Palmowski-Wolfe
University of Basel, Basel

Background: Perceptual learning (PL), that is repetitive performance of certain visual tasks, has been suggested to improve vision in adults and children.. NeuroVision/Revital so far is the only FDA approved treatment for amblyopia.

Content: 1998 Polat et al demonstrated facilitation in the single cell response of the cat visual cortex when a garbor patch stimulus at low contrast was flanked by high contrast garbor patches of the same orientation at a certain distance from the target- while those orthogonal caused inhibition. This lead to the development of NeuroVision/Revital which uses garbor patches in various orientations, near the contrast threshold, combined with flanking garbor patches. This leads to a 2.5 fold improvement regarding the trained task and also Snellen acuity. Training is performed twice per week for 30 minutes over a three month period: the first sessions improve, the last stabilize vision. As no changes were found in the eye, this improvement is attributed to an improvement of neuronal connections in the brain. Work from other PL tasks suggest, that attention and improved fixation can also play a role. This training has been shown effective in adults and children with amblyopia. It has been exploited commercially to prolong the time until reading glasses are needed, to improve contrast sensitivity and vision following LASIK and cataract surgery, as well as to improve vision without glasses in low myopia. It may be applied in retinal disease (AMD, retinal dystrophy) and also in congenital nystagmus.

Implications: PL is a promising training to improve vision in adults and children. At present NeuroVision is still expensive and not covered by the health insurance in Europe. In children under about 8 yrs this training can be boring and may thus not be completed. Here other tasks might be developed that are more appealing to children.