

Orthoptic Findings and Visual Fixation

in children in general and in children with surgically treated hydrocephalus

Akademisk avhandling

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av

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This thesis is based on the following papers:

- I. Aring E, Andersson Grönlund M, Andersson S, Hård A-L, Ygge J, Hellström A. Strabismus and binocular functions in a sample of Swedish children aged 4–15 years. *Strabismus 2005; 13:55-61.*
- II. Aring E, Andersson S, Persson E-K, Hård A-L, Uvebrant P, Ygge J, Hellström A. Strabismus, binocular functions and ocular motility in children with hydrocephalus. *In Press, Strabismus.*
- III. Aring E, Andersson Grönlund M, Hellström A, Ygge J. Visual fixation development in children. *Submitted, Graefe's Archive for Clinical and Experimental Ophthalmology.*
- IV. Aring E, Andersson S, Hellström A, Ygge J. Abnormal visual fixation in children with hydrocephalus. *In manuscript.*



GÖTEBORGS UNIVERSITET

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Background: The ocular motor system is complex and dependent on the cooperation of many different areas of the brain. Ocular motor functions may be disturbed by various factors resulting in strabismus, and abnormal fixational behaviour, which may interfere on a multitude of visual functions. To study binocular functions orthoptic methods may be used and when studying visual fixation eye-trackers may be used. However, previous orthoptic studies often lack precise definitions, and studies of visual fixation behaviour in children are rare. In a multidisciplinary study of children with surgically treated hydrocephalus (HC), a variety of functions, including ophthalmologic and orthoptic functions were to be studied.

Aim: The aim of this study was to obtain results of commonly used orthoptic tests and visual fixation behaviour in a sample of children, for use as comparison in studies of different patient groups, and to compare these results, with the same variables in a population based group of children with surgically treated HC. We also wished to study the effects of the onset and the aetiology of HC, associated neurological impairments and the ventricular width on orthoptic variables and visual fixation behaviour.

Materials and methods: *Papers I and III:* The comparison group consisted of children aged 4–15 years from different schools and pre-schools in the area of Göteborg. *Papers II and IV:* The HC group consisted of a population-based group of children aged 7–12 years, with surgically treated HC. All children in both groups were evaluated with the same test battery of orthoptic test commonly used in clinical practice. An infrared eye-tracker (Orbit) was used to evaluate visual fixation behaviour.

Results: *Paper I:* In the comparison group, five children (3.5%) had heterotropia, and one child had abnormal ocular motility. Heterophoria was found in 37 children (26%) and was four times more common at near than at distant fixation. The near point of convergence was ≤ 6 cm in 97% of the children, and 97% had stereo acuity of 60" or better. The results of the AC/A calculations with the methods used were regarded as unreliable in this age group. No anomalous head postures or nystagmus were observed.

Paper II: Heterotropia (69%), abnormal head posture (41%), nystagmus (44%), and motility abnormalities (60%) were significantly more common in children with HC ($p < 0.001$) than in the comparison group. Children with overt HC at birth had a significantly higher frequency of orthoptic abnormalities compared to children developing HC during the first year of life.

Paper III: In the comparison group, both fixation time ($p = 0.02$) and fixation density around the centre of gravity of fixation ($p < 0.01$) increased with increasing age, while number of intruding saccades decreased ($p < 0.01$) with increasing age. Blinks and drifts could not be shown to be age dependent.

Paper IV: As a group children with HC had shorter fixation time ($p < 0.01$) and higher frequency of drifts ($p < 0.01$) than the comparison group. However, children with myelomeningocele (MMC), did not differ from the comparison group in these variables, while children with associated neurological impairments, were more affected than those without.

Conclusion: We have obtained results from commonly used orthoptic tests, and described the fixation behaviour, in children. Fixation stability improves with age in children in general. Children with HC with aetiologies other than MMC, a group with more associated neurological impairments, had more abnormal fixation behaviour than those with MMC. However, regarding orthoptic abnormalities children with MMC were equally affected indicating the vulnerability of the binocular system in children with HC.

Key words: Strabismus, abnormal head posture, drifts, intrusive saccades, meningomyelocele