

# ADD/ADHD and Ocular Conditions

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## ABSTRACT

It has been reported that children with ADHD are three times more likely to have convergence insufficiency than other children. Additionally, it is widely regarded that a child with ADHD often has learning difficulties. This paper reviews 50 children seen in the Orthoptic Department at The Royal Far West Children's Health Scheme who had been diagnosed with ADHD. Each child underwent an orthoptic screening prior to commencing prescribed stimulant medication. Visual acuity, cover-test, ocular movements, binocular single vision, convergence and the notation of an ocular history were all undertaken during screening. In some cases, accommodation, pupil reactions and colour vision were also assessed. Results show that 22% of children screened had convergence insufficiency, indicating that this ocular condition is quite prevalent amongst the paediatric ADHD population.

**Key Words:** Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder, Royal Far West Children's Health Scheme, Convergence Insufficiency, Learning Difficulties

## INTRODUCTION

Attention Deficit Disorder (ADD) may be defined as 'a persistent and frequent pattern of developmentally inappropriate inattention and impulsivity, with or without hyperactivity'.<sup>1</sup> The National Institute of Mental Health refers to Attention Deficit Hyperactivity Disorder (ADHD) as a family of related chronic neurobiological disorders that interfere with an individual's capacity to regulate activity level (hyperactivity), inhibit behaviour (impulsivity), and attend to tasks (inattention) in developmentally appropriate ways.<sup>2</sup> At the Royal Far West Children's Health Scheme (RFWCHS), located in Manly, Sydney, a vast number of children with ADD/ADHD are seen each year by a multidisciplinary team comprising orthoptics, occupational therapy, social work, physiotherapy, psychology, speech therapy, dietetics and a paediatrician.

The aetiology of ADD/ADHD is extremely varied. Some believe that it is hereditary or genetic,<sup>3,4,5</sup> whilst others feel that it is due to a disorder of the brainstem,

thalamus, frontal lobe<sup>3</sup> or a shift in cerebral dominance to the right brain.<sup>6</sup> Neuropsychological deficits, pre- and post-natal hazards, disruption to a behavioural inhibition system<sup>7</sup> and inadequate amounts of certain fatty acids<sup>7</sup> have also been cited as potential aetiologies of ADD/ADHD. Whatever the cause, ADHD is dimensional, not categorical. However, there are those who still believe that ADHD is just a myth or label for exuberant children faced with intolerant or inadequate caregivers. Commonly, children with ADHD have inappropriate language skills and find it difficult to take other people into account. Communication should comprise listening and understanding, which the child with ADHD cannot do adequately. This then leads to socialisation and relationship problems and subsequent behaviour problems, all of which are multifactorial, dependent on environment,<sup>8</sup> genetics and personality. Children with ADHD are highly visual rather than auditory - they are very easily distracted and therefore do not learn properly.

At RFWCHS, diagnosis of ADHD is made from a combination of observation and a core number of checklist areas being present. Formal questionnaires (DSM-IV/ADHD Rating Scale IV-Home Version (University of Massachusetts Medical Centre),<sup>9</sup> detailed objective testing, a carefully taken history, presentation and outside reports all contribute to the paediatrician's diagnosis of the condition. If appropriate, either Dexamphetamine or Ritalin (stimulant medication) is prescribed by the paediatrician. It is thought that these medications stimulate neurotransmitters and bio-chemicals in the under-aroused areas of the brain that involve planning, foresight, weighing of alternative responses and inhibiting actions when alternative solutions might be considered.<sup>2</sup> Stimulants do not cure ADHD - they help the child to make the best of their abilities with regards to education, relationships and behaviour until some resolution comes with maturity.<sup>5</sup>

The Australian National Health Strategy Report (2000)<sup>10</sup> stated that ADHD was the most common developmental variation affecting 1.2% of Australian children.<sup>6</sup> Though a number of children will 'grow out of it', 60% will carry some degree of ADHD with them into adulthood.<sup>5</sup> In the USA, ADHD is the most commonly diagnosed disorder of childhood, estimated to affect 3 to 5% of school-aged children, and occurring three times more often in boys than girls.<sup>2</sup> Similarly, in New Zealand, it is estimated that 6.7% of children and 2 to 3% of teenagers suffer from ADHD.<sup>11</sup> Working groups concerned with ADD/ADHD are becoming more and more prominent in the community. The Orthoptic Association of Australia has addressed this with their Learning Difficulties Committee and the Central Sydney Area

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Health Service has developed a best practice model for assessment and management of ADHD for children, adolescents and family health services.<sup>12</sup>

The diagnostic features of excess in ADHD are impulsivity, hyperactivity, distractibility, drivenness, insatiability and attentional bias.<sup>6</sup> It presents as a complex developmental impairment and co-morbidity of other disorders is recognised.<sup>4,5,11,13</sup> Children with ADHD have been found to commonly have learning difficulties (25-50% of children), Oppositional Defiant Disorder (40-67%), Conduct Disorder (20-56%), Anxiety Disorders (25%) and major depression (0-30%).<sup>11</sup>

Few specific ocular disorders have been reported in conjunction with ADD/ADHD. It is known that side-effects of Ritalin are headache,<sup>1,14,15</sup> blurred vision, dizziness, hypersensitivity reaction with conjunctivitis, rash and hives,<sup>14</sup> and nervous habits such as tics.<sup>15</sup> Poor dark adaptation,<sup>7</sup> an inability to voluntarily inhibit saccades,<sup>16</sup> and poor performance on tasks involving sustained attention variables in both visual and auditory domains<sup>17</sup> have all been reported. Studies have also shown that children with unmedicated ADHD make more errors on spatial working memory tests.<sup>16</sup> Evian<sup>18</sup> reports seeing very jerky midline movements with motor overflow of the head, overshooting and undershooting of the saccadic and pursuit movements, and reduced depth perception.

A study reported in 2000 from the Shiley Eye Centre at the University of California, San Diego (UCSD),<sup>19</sup> found that convergence insufficiency (CI) was also often co-morbid with ADHD. Convergence Insufficiency (CI) was defined as 'a physical eye problem that makes it hard to keep both eyes pointed and focused at a near target, making it difficult to maintain concentration when reading'.<sup>19</sup> Similarly, Lyle and Jackson<sup>20</sup> describe CI as 'the inability to obtain and/or maintain adequate convergence, without undue effort'. Additionally, CI may be considered as reduced convergence in the presence of orthophoria or a heterophoria, generally producing asthenopic symptoms, and may be accompanied by reduced accommodation or near vision. Dr David Granet, et al,<sup>19</sup> at the Shiley Eye Centre, reported that children with ADHD were three times more likely to have CI than other children. When looking at the ADHD population, they found an incidence of convergence insufficiency of almost 16%. In the USA, convergence weakness has been found to be a disorder that generally affects less than 5% of children.<sup>19</sup> In Australia, it has been reported to affect about 5% of children and up to 10% of adults.<sup>21</sup> In view of Granet's findings, a study was undertaken at RFWCHS of 50 children, known to have ADHD, to determine if CI is indeed a common finding amongst the paediatric ADHD population.

### METHOD

Written consent for any screening or medical procedure undertaken at RFWCHS is obtained as part of the client registration procedure, and verbal consent is implied at the time of screening. Each of the 50 RFWCHS children underwent an orthoptic screening

in the Orthoptic Department prior to commencement of either Ritalin or Dexamphetamine. Some children have since undergone a follow-up assessment, at least six months after starting medication. For each child, a cover-test was performed at both near and distance (1/3 metre and 6 metres respectively). Visual acuity was also measured at both distances, using the Snellen Linear Chart, with some children needing to match the letters on a board held on their lap. Near vision was tested by either matching Snellen linear or single letters or reading Curpax text type.

Ocular movements were performed using the standard "H" pattern at near and convergence was measured with either the RAF Rule or in free space if the child could converge to closer than 5 centimetres. Binocular Single Vision (BSV) was measured using either the TNO Stereo Test or the Titmus Stereo Test. Glasses were worn for all tests when appropriate. Standard overhead fluorescent lighting was used, with an additional overhead 60 watt lamp for near tests.

Additional ocular signs and symptoms reported by the family were also noted, along with the child's age, date of birth and the type of stimulant medication prescribed. As this was a retrospective study, it was found that the measurement of accommodation had not always been recorded as part of routine orthoptic assessment. Additionally, accommodation cannot accurately be measured with the RAF Rule on children under the age of eight years, which discounted an extra group of children. The assessment of pupils and colour vision (using the Ishihara Colour Vision Test) were also undertaken on the majority of children.

### RESULTS

The age range of children seen was from 2 years 11 months to 15 years 2 months, with the average age being 8 years 7 months. The majority of children were placed on Dexamphetamine (88%) with only 6 children being prescribed Ritalin (12%).

Cover-testing at near revealed 44% of children were orthophoric or exophoric, 8% esophoric, one had an intermittent esotropia (2%) and one had a constant exotropia (2%). Distance cover-test results were slightly different, with 90% being orthophoric, 4% exophoric or exotropic and one had an intermittent exotropia (2%). Overall, 46 of the 50 children (92%) had no manifest or intermittent squint for near or distance.

Colour vision was assessed in 29 children, with 26 showing no obvious abnormality and 3 having a red/green colour defect. Of the 12 children who had their accommodation measured, 66.7% had age appropriate results, 8.3% were over age-appropriate levels and 25% were under accommodating. These 12 children had accommodation measured if they had previously been prescribed reading glasses, other test results were reduced, such as near vision or convergence, or if the family had reported ocular signs/symptoms, such as excessive blinking or headaches. Of those 41 children who had their pupils tested, all were found to have normal direct and consensual responses to a bright torchlight.

The results of ocular movement assessment were such that 92% showed no apparent defect, 6% had a "V exo" pattern (increase in exo deviation in elevation) and one child (2%) had a bilateral inferior oblique over-action. Results of visual acuity testing showed that the majority of children (76%) had vision right and left eyes that was 6/6 or better and N6 or better. A further 14% had 6/9, N6 or better right and left eyes. Two children had vision of 6/36, N18 in one eye and at least 6/12 N8 in the other. One of these children had hypermetropic astigmatism with refractive amblyopia and, with appropriate glasses and occlusion, vision improved to 6/9 N5 either eye. The other child had a constant exotropia and subsequent strabismic amblyopia in that eye.

Titmus Stereo and TNO Stereo testing found that the majority of children (70%) had BSV of 60" of arc or better. Two children did not have a level of BSV recorded – one child was unco-operative and the other had a manifest exotropia at both near and distance.

Apart from this same child with the constant exotropia who did not demonstrate any convergence ability (2%), convergence near point results ranged from 15cms to full convergence. A significantly large group (46%) of the children could converge fully into their nose, 24% had convergence of 5cms or better and 20% were between 5 and 8cms. A further 2% had a convergence break point between 8 and 10cms and the remaining 6% between 10 and 15cms.

Amongst the 50 children screened, the 4 with an intermittent or constant squint were not included when considering the presence of a CI. Results showed that 35 children (70%) had a near point that was between 5cms and full convergence (Table 1). The remaining 11 children were considered to have a CI, 10 of whom (20%) received treatment at RFWCHS and additional orthoptic exercises for home use. Initial convergence near points of those treated ranged from greater than 5cm to 15cm, although one child did had full convergence but poor accommodation. The remaining one child with reduced convergence (2%) did not receive treatment due to poor co-operation. Overall, children in this RFWCHS study were considered to have a CI (22%) if they were struggling to reach at least 5cm, had asthenopic signs/symptoms, their accommodation was reduced for their age, had orthophoria or heterophoria for near and distance, or a combination of any of these.

| CONVERGENCE NEAR POINT                          | NUMBER OF CHILDREN |               |
|---|--------------------|---------------|
| Children with a manifest or intermittent squint | 4                  | (8 %)         |
| Between Full to Nose and 5cms                   | 35                 | (70 %)        |
| Between 5cm and 15cms                           | 11                 | (22 %)        |
| <b>TOTAL NUMBER OF CHILDREN</b>                 | <b>50</b>          | <b>(100%)</b> |

TABLE 1: Convergence Near Points of Children Without Manifest or Intermittent Squint.

It is interesting to note that, prior to being seen at RFWCHS, 2 children had been prescribed reading glasses by their local eye care practitioner. After orthoptic screening, they were both found to not need their glasses. Particularly, one of these children had been given reading glasses with prisms – without the glasses, this child had 6/5 N5 vision either eye, a tiny esophoria for near, orthophoria for distance, almost full convergence, age appropriate accommodation and BSV of 60" of arc. Additionally, he was asymptomatic.

**DISCUSSION**

The Shiley Eye Centre found an increase of convergence insufficiency (approximately 16%) in children with attention disorders.<sup>19</sup> This has also been the finding in this current study, with 22% of children considered to have a CI and, overall, 20% receiving treatment. Of course, dependent on the definition of 'convergence insufficiency', others may find differing results to these two studies.

Unlike Evian,<sup>18</sup> however, abnormalities of the pursuit system were not observed, although perhaps the standard procedure used was not detailed enough to show such defects. Additionally, Evian also noted that reduced depth perception was a common finding amongst children with ADHD. Depth perception results of this study do not mirror those of Evian, with the majority of children (70.8%) having BSV of at least 60" of arc. In fact, one child had an improvement of BSV from 120" to 30" of arc after commencing Dexamphetamine. In the case of this same child, the family also reported that since medication, he was now mixing better with his peers, had more appropriate language and socialisation skills and performance at school had much improved.

An area that was not addressed in this current study was the measurement of a fusion range for each child. It is well known that one can have straight eyes, good convergence and age appropriate accommodation, yet still be symptomatic. Often such cases are found to have poor fusional ability - this is an area that could be addressed in further studies. Additionally, further study should include treatment, and continued effect of this, whilst still on medication.

It has been shown that CI is more prevalent amongst a paediatric population with ADHD. Convergence insufficiency is known to make it difficult to perform prolonged near work and maintain interest in such tasks. The ADHD child is widely recognised as having learning difficulties, with weaknesses in reading, writing, spelling and maths – perhaps the convergence system should be investigated more fully in these children to assist them in learning and achieving to their full potential.

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