

ADHD and Vision Therapy- A Review

Chandan Kumar Sinha^{1*} and Babli Sharma²¹Consultant Optometrist, Mahabir Eye Care Center, Nepal²Consultant Optometrist, Dhir Hospital Dhir Hospital and Eye Institute, India***Corresponding Author:** Chandan Kumar Sinha, Consultant Optometrist, Mahabir Eye Care Center, Nepal.**Received:** June 19, 2023**Published:** June 26, 2023© All rights are reserved by **Chandan Kumar Sinha and Babli Sharma.****DOI:** 10.31080/ASOP.2023.06.0649**Abstract**

Attention deficit hyperactivity disorder is one of the most frequently diagnosed Childhood Psychiatric disorders, with worldwide prevalence rates estimated at 5.3%. Behavioral manifestations of visual perceptual problems, particularly color perception have been associated with ADHD: collectively, the preceding findings indicate the need for further investigation of visual function and its regulation by the attentional process in ADHD. ADHD children have problems with selective attention (suppressed responses to irrelevant stimuli with responses to irrelevant stimuli and sustained attention to maintain concentration for a long time). In addition, their overall attention-concentration capacity is insufficient, resulting in low performance in tasks requiring a higher level of attention-concentration ability. Attention concentration ability is also related to visual function. Vision plays a very important role in everyday life as a sense of receiving and processing about 70% of information from outside. The prevalence of vision problems is 15.6% in children with ADHD, which is much higher than that (8.3) in normal children. Frequent vision problems in children with ADHD can lead to problems with the color classification of depth perception. The prevalence of ADHD in children with convergence insufficiency is about three times higher than the prevalence of ADHD in the general US population. In the study done by Cho., *et al.* For children with inattention type o ADHD, intermittent exotropia accounted for 12.2% and esotropia accounted for 2.0%. The incidence of strabismus was 18.3% in all subjects which was much higher than the general incidence. Therefore strabismus appears to be one of the major characteristics of visual function disorder in children with ADHD. Optometric vision therapy has been applied to the broad spectrum of visual and non-visual functions and disorders, such as convergence, reading, dyslexia, ADHD, sports performance, and concussion. Despite varied etiologies and treatment modalities associated with ADHD children, the primary obligation of the optometrist is to assess and manage visual function. Vision therapy has been introduced as a method for improving visual perception. This review will focus primarily on published data regarding ADHD, vision therapy, and convergence insufficiency.

Keywords: ADHD; Vision Therapy; Convergence Insufficiency**Introduction**

Attention deficit hyperactivity disorder is one of the most frequently diagnosed childhoods. Psychiatric disorders, with worldwide prevalence rates estimated at 5.3% [1]. A longitudinal study shows that approximately 65% of children with ADHD

continue to show symptoms in adulthood [2,3]. Despite of high prevalence and detrimental impact of ADHD, its underlying pathophysiology remains unclear [4]. Current theories posit that executive function deficits account for many of the poor outcomes in ADHD, which are supported by the evidence of delayed maturation

and functional anomalies in the prefrontal striatal circuitry that underpins the executive functioning. However accumulating evidence attests to anomalies in other cortical circuits in ADHD, including the visual network suggesting that executive dysfunction may not be the dominant neurobiological characteristic [5]. This review will focus primarily on published data regarding ADHD, vision therapy, and convergence insufficiency.

Behavioral manifestations of visual perceptual problems, particularly color perception have been associated with ADHD: collectively, the preceding findings indicate the need for further investigation of visual function and its regulation by the attentional process in ADHD [6]. Adhd children have problems with selective attention (suppressed responses to irrelevant stimuli with responses to irrelevant stimuli and sustained attention to maintain concentration for a long time) [7]. In addition, their overall attention-concentration capacity is insufficient, resulting in low performance in tasks requiring a higher level of attention-concentration ability [7].

Attention concentration ability is also related to visual function [8]. Vision plays a very important role in everyday life as a sense of receiving and processing about 70% of information from outside [9]. The prevalence of vision problems is 15.6% in children with ADHD, which is much higher than that (8.3) in normal children. Frequent vision problems in children with ADHD can lead to problems with the color classification of depth perception [10]. The prevalence of ADHD in children with convergence insufficiency is about three times higher than the prevalence of ADHD in the general US population [10].

ADHD is classified into three main subtypes equal type, hyperactivity type, and inattention type [11]. The equal type is characterized by impulsivity and hyperactivity as well as inattentiveness and distractibility. Hyperactivity is the most common type. It is characterized by impulsivity and hyperactivity without inattentiveness or distractibility. The inattention type is characterized by attentiveness or distractibility without hyperactivity [11].

In the study done by Cho., *et al.* For children with inattention type o ADHD, intermittent exotropia accounted for 12.2% and esotropia accounted for 2.0%. the incidence of strabismus was

18.3% in all subjects which was much higher than the general incidence. Therefore strabismus appears to be one of the major characteristics of visual function disorder in children with ADHD. Rouse., *et al.* also reported that the prevalence of ADHD increases in children with convergence insufficiency [12]. Children with convergence and accommodation abnormalities may be misdiagnosed as having ADHD because their concentration may be decreased or they have difficulty concentrating while listening to lectures and reading material [13]. Therefore it is essential to distinguish the difference between visual impairment and ADHD.

Vision therapy is a term without a uniform definition that typically refers to non-surgical, non-pharmacologic methods used by a subset of optometrists and occupational therapists directed at improving visual perception and processing. Optometric vision therapy has been applied to the broad spectrum of visual and non-visual functions and disorders, such as convergence, reading, dyslexia, ADHD, sports performance, and concussion [14].

Despite varied etiologies and treatment modalities associated with ADHD children, the primary obligation of the optometrist is to assess and manage visual function. It is in this capacity that optometrists can have a visually significant impact on the lives o these children. A child diagnosed with ADHD may after optometric intervention be found to have a visual disorder that is primarily responsible for the child's disruptive behavior. Hyperactivity may result from aberrant visual input and or visual information processing. For a child with visual problems that coexist with a true organic disorder, management of the visual problem will benefit the child's overall ability to function with the condition.

Several studies have elucidated a link between vision problems and ADHD. ADHD has been found associated with astigmatic refractive error [15,16]. Other groups have found an association between convergence insufficiency and ADHD [17,18]. This is a significant finding, as CI affects between 2.25% and 8.3% of elementary school children [19,20]. Additionally, symptoms of CI are closely related to symptoms of ADHD and those symptoms decrease after vision therapy to improve vergence movements [21]. These symptoms include difficulty completing school work and inattentiveness during reading among others [17]. The complex relationship of vision to ADHD is further evidenced by

the finding of early deficits in visual sensory integration using the event-related potential measure in the visual cortex of children with ADHD [22] as well as deficient blue color perception in adults with ADHD [23].

In ADHD children, the frequency of visual perception problems with color distinction and depth perception is higher than that in general children [10], and they show behavioral characteristics similar to those of children with vision problems [18]. Vision therapy has been introduced as a method for improving visual perception [24]. Vision therapy affects the visual system, including the eyes and brain, through physical and physiological visual perception treatments to solve problems that occur in the cognitive process of visual perception as well as in vision. It is a training course that promotes change and improves eye function [25]. Vision therapy is applied to people with stereo acuity and sensory fusion, unlike general vision correction which focuses on improving visual acuity [26] and it focuses on solving visual function problems.

This is the difference regarding vision therapy and it could provide safe and efficient intervention without side effects for ADHD children. Vision therapy uses not only a lens but also a method of improving visual function through visual perception activity programs including prisms and physical activity [27].

VT includes suppression therapy (ST), binocular fusion reinforcement training (BFRT), extraocular muscles reinforcement training (EMRT), tracking reinforcement training (TFT), peripheral vision perceptual training (PVPT), stereo acuity function therapy (SFT), amblyopia therapy (AT), computer vision therapy (CVT), vision therapy based virtual environmental model (VTVM). The ultimate goal of vision therapy is not only to improve visual acuity through these treatments but also to achieve clear and comfortable binocular vision [25].

Furthermore, convergence insufficiency is known to affect attention studies have shown that children with ADHD have a higher prevalence (nearly 10%) of CI than normal children. The symptoms of CI can make it difficult for a patient to concentrate. Also, some of the symptoms of ADHD overlap with the symptoms of NSBVD. Therefore, it is recommended that any child with NSBVD should be assessed for attention problems and any child

with attention problems should be assessed for the presence of CI. ADHD is also associated with other types of NSBVD, most commonly accommodative insufficiency, and amblyopia.

Conclusion

It seems that vision therapy can be used to improve visual perception and symptoms of children with ADHD tendencies and visual problems. It is necessary to diagnose the refractive error and NSBVD beyond the normal vision assessment in OPD settings. There is a chance of misdiagnoses of NSBVD, particularly CI as ADHD. The similarity of symptoms between ADHD AND NSBVD is the most important reason for misdiagnosis. Therefore there should be proper binocular evaluation for the patient with ADHD-like behavior particularly with attention problems. More studies and research should be conducted on related topics. Practitioners should be motivated and timely updated. If not now, then when?

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