

Relationship between Attention Deficit Hyperactivity Disorder and Ocular Convergence Insufficiency: Future Perspectives

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Abstract

Recent studies suggest that the ocular convergence insufficiency (OCI) and the attention deficit hyperactivity disorder (ADHD) present a superposition of signs and symptoms which can be correlated. In this context, OCI may guide the clinical diagnostic of ADHD in children, teenagers and adults. Different authors propose that the search for signs and symptoms of OCI must be performed during the diagnostic process of ADHD, since it is an easy and low-cost examination procedure. The aim of this short communication is to discuss this subject and to present future perspectives on this theme.

Keywords: Attention Deficit Hyperactivity Disorder (ADHD); Ocular Convergence Insufficiency (OCI); Ocular Motility Disorders; Learning Disorders

General Information

Attention Deficit Hyperactivity Disorder (ADHD) is considered a common health problem in children, teenagers [1] and adults [2], with worldwide prevalence of 5.3% in school-aged children [3], reaching 50% in the adulthood [2]. Several works have been showing that the circuits related with attention control are altered in individuals with ADHD [4,5], suggesting modulations on the fronto-striatal-cerebellar axis [3,4], as well as on cortex association areas [4], frontal lobe and subcortical areas [3], which modulate cognitive and behavioral circuits. Traditionally, the basal ganglia inhibitory circuits are in part responsible for the preparation and unconscious programming of four strategies: (1) somatomotor; (2) oculomotor; (3) cognitive and (4) limbic [6], in some extent explaining the complex clinic presentation of ADHD.

Ocular convergence movement is defined as the ability in performing an eyes conjugated abduction while aiming at an only target (Figure 1) [2,7]. Ocular Convergence Insufficiency (OCI) represents a multifactorial problem of binocular vision, characterized by the inability in performing this conjugated movement (Figure 2) [8]. Described for the first time in 1855, OCI has been addressed in several studies aiming at estimating its etiology, prevalence, clinical signs and diagnostic [8]. In a functional perspective the OCI is related to attention levels [9], cognition, memory and behavior [10] processed in basal ganglia circuits [6], which may result in mutual decompensation.

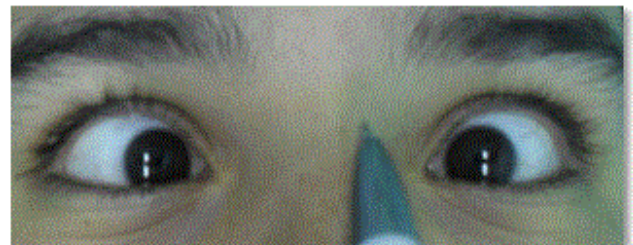


Figure 1: Movement of normal ocular convergence in a woman adult.

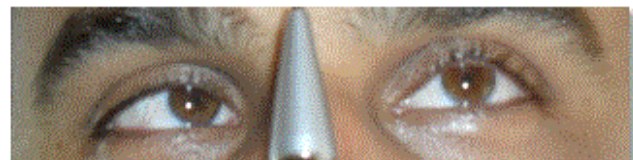


Figure 2: Ocular convergence insufficiency in a man adult.

Since the first papers [11] and in recent studies [2,10,12-19], OCI has been suggested to have significant correlation with ADHD, as well as frequency and severity of learning, reading or attention disorders.

For over a decade, some diagnostic criteria for ADHD [2] and OCI [9] have been showed to be correlated [10]. Since then this subject became of great relevance for researchers worldwide [2,10,12-22]. Therefore, the possibility of a relation between ADHD and OCI has been discussed [10,19,22-24]. A 12-weeks vision therapy for OCI correction showed a significant decrease in symptoms related to ADHD in more than a thousand children [23,24].

More recently, it was validated a clinical assessment for OCI in children with ADHD considering the presence of this ocular disorder as a relevant marker for ADHD diagnostic [22].



Figure 3: Evaluation of near point ocular convergence with optometric ruler in a child (Bernell[®]).

This ocular evaluation is simple, cheap, safe and does not offer risks, being easily performed with a pen. We suggest that every individual (children, teenagers and adults) with ADHD suspect should have their ocular convergence assessed, and those who present a convergence proximal point equal or greater than 5 centimeters (Figure 3) [19,21,23,24] must be treated before any drug intervention [25].

References

1. Granet DB, Gomi CF, Ventura R, Miller-Scholte A (2005) The relationship between convergence insufficiency and ADHD. *Strabismus* 13: 163-168.
2. Barkley A, Murphy KR, Fischer M (2010) ADHD in adults: What the science says. Guilford Press, New York, USA.
3. Genro JP, Roman T, Rohde LA, Hutz MH (2012) The Brazilian contribution to Attention-Deficit/Hyperactivity Disorder molecular genetics in children and adolescents. *Genet Mol Biol* 35: 932-938.
4. Biederman J (2005) Attention-deficit/hyperactivity disorder: a selective overview. *Biol Psychiatry* 57: 1215-1220.
5. Bush G, Valera EM, Seidman LJ (2005) Functional neuroimaging of attention-deficit/hyperactivity disorder: a review and suggested future directions. *Biol Psychiatry* 57: 1273-1284.
6. Kandel ER (2013) Principles of Neural Science. (5th edtn), McGraw-Hill, New York, USA.
7. Cunha T, Pinto S, Sargo J, Mendanha L, Lança CC, et al. (2013) Insuficiência de convergência e atenção visual: estudo exploratório em estudantes do ensino superior. *Saúde Tecnológica* 9: 5-10.
8. Cooper J, Jamal N (2012) Convergence insufficiency-a major review. *Optometry* 83: 137-158.
9. Barnhardt C, Cotter SA, Mitchell GL, Scheiman M, Kulp MT (2012) Symptoms in children with convergence insufficiency: before and after treatment. *Optom Vis Sci* 89: 1512-1520.
10. Borsting E, Rouse M, Chu R (2005) Measuring ADHD behaviors in children with symptomatic accommodative dysfunction or convergence insufficiency: a preliminary study. *Optometry* 76: 588-592.
11. Cooper J, Duckman R (1978) Convergence insufficiency: incidence, diagnosis, and treatment. *J Am Optom Assoc* 49: 673-680.
12. Munoz DP, Armstrong IT, Hampton KA, Moore KD (2003) Altered control of visual fixation and saccadic eye movements in attention-deficit hyperactivity disorder. *J Neurophysiol* 90: 503-514.
13. Grönlund MA, Aring E, Landgren M, Hellström A (2007) Visual function and ocular features in children and adolescents with attention deficit hyperactivity disorder, with and without treatment with stimulants. *Eye* 21: 494-502.
14. Rouse M, Borsting E, Mitchell GL, Kulp MT, Scheiman M, et al. (2009) Academic behaviors in children with convergence insufficiency with and without parent-reported ADHD. *Optom Vis Sci* 86: 1169-1177.
15. Loe IM, Feldman HM, Yasui E, Luna B (2009) Oculomotor performance identifies underlying cognitive deficits in attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry* 48: 431-440.
16. Mahone EM, Mostofsky SH, Lasker AG, Zee D, Denckla MB (2009) Oculomotor anomalies in attention-deficit/hyperactivity disorder: evidence for deficits in response preparation and inhibition. *J Am Acad Child Adolesc Psychiatry* 48: 749-756.
17. Chung SA, Chang YH, Rhiu S, Lew H, Lee JB (2012) Parent-reported symptoms of attention deficit hyperactivity disorder in children with intermittent exotropia before and after strabismus surgery. *Yonsei Med J* 53: 806-811.
18. Poltavski DV, Biberdorf D, Petros TV (2012) Accommodative response and cortical activity during sustained attention. *Vision Res* 63: 1-8.
19. Martins ACG (2017) Ocular convergence insufficiency: an important problem in children with attention deficit and hyperactivity disorder. *Rev Ped SOPERJ* 17: 225-229.
20. Wilmer JB, Buchanan GM (2009) Nearpoint phorias after nearwork predict ADHD symptoms in college students. *Optom Vis Sci* 86: 971-978.
21. Borsting E, Mitchell GL, Kulp MT, Scheiman M, Amster DM, et al. (2012) Improvement in academic behaviors following successful treatment of convergence insufficiency. *Optom Vis Sci* 89: 12-18.
22. Varela Casal P, Lorena Esposito F, Morata Martínez, I, Capdevila A, Solé Puig M, et al. (2018) Clinical Validation of Eye Vergence as an Objective Marker for Diagnosis of ADHD in Children. *J Atten Disord*.
23. Lee SH, Park CM, Park SC, Maples WC, Shin HS (2015) Effectiveness of vision therapy for children with symptomatic convergence insufficiency with or without attention deficit hyperactivity disorder. *Vision Dev Rehab* 1: 229-242.
24. Lee SH, Moon BY, Cho HG (2014) Improvement of Vergence Movements by Vision Therapy Decreases K-ARS Scores of Symptomatic ADHD Children. *J Phys Ther Sci* 26: 223-227.
25. Pelham WE, Gnagy EM, Greiner AR, Hoza B, Hinshaw SP, et al. (2000) Behavioral versus behavioral and pharmacological treatment in ADHD children attending a summer treatment program. *J Abnorm Child Psychol* 28: 507-525.