CASE STUDY

Improvement in Subjective, Academic and TOVA Measures in a Child with ADHD Following Upper Cervical Chiropractic Management

Nick Bagnaro D.C.[1]

ABSTRACT

Purpose of study: The case study is to report the improvement of an 11 year old boy with Attention Deficit Hyperactivity Disorder (ADHD) and neck pain utilizing the NUCCA Upper Cervical Chiropractic Technique, neurological exercises and nutritional support.

Clinical Features: An 11 year old male presented with primary health concerns of ADHD with noted difficulties in concentration, completion of schoolwork, preparation for tests and reading comprehension. The patient also presented with daily neck pain for 3 years since having his head physically twisted by a teacher attempting to get him to pay attention in class.

Intervention and Outcomes: The patient was treated for 3 months with the NUCCA upper cervical technique being monitored with 2 office visits per week for 3 months. Daily nutritional supplementation, dietary changes and chiropractic neurological exercises 6 days per week were also utilized. ADHD symptoms reduced, Test of Variables of Attention (TOVA) and academic performance improved.

Conclusion: In this case study NUCCA chiropractic care, dietary changes, and neurological exercises improved the parameters of attention and quality of life for this child suffering with ADHD.

Key Words: *ADHD, NUCCA , upper cervical chiropractic, vertebral subluxation, TOVA, nutritional supplementation, chiropractic neurology*

Introduction

Attention deficit hyperactive disorder (ADHD) is a condition known to cause bouts of inattention, hyperactivity, impulsivity, poor academic performance and disruptive social behavior. It is has been shown to effect 5% of children and 4% of adults.[1] Recent studies have shown that the number of children being diagnosed has increased substantially causing alarm that the medical community maybe over diagnosing and thereby over medicating children.[2]

Although medication has been shown to help in the management of symptoms in children with ADHD, research shows that academic performance is not improved in the medium and long term and may have harmful effects given the typical way the medications are used in the community and the adverse side effects caused by the medications.[3,6]

1. Private Practice of Chiropractic, Tulsa, OK

The increase in the number of patients taking these medications is also troubling because the long-term effects of these treatments have not been determined and science has yet to prove how this treatment could be effective. Multiple surveys of parents often show over 40% would rather give the children less medication or wish there was a way to help their children other than with medication.[2,4,5]

ADHD can be grouped in with other conditions such as dyspraxia, dyslexia and learning disabilities known as developmental delay syndromes (DDS's).[10] Of particular interest to chiropractors is that research has revealed a strong correlation between children with DDS's and postural disorders, sensory-motor and coordination disorders, kinesthesia and motor dis-coordination of postural and ocular muscles.[11,12]

The purpose of the NUCCA chiropractic technique is to reduce the subluxation of the skull, cervical spine and postural distortions known as the Atlas Subluxation Complex.[7] In addition to relieving biomechanically induced neurological insult, NUCCA has also been demonstrated to reduce hypertension.[8]

Although the purpose of chiropractic care is primarily to correct the spinal subluxation, there have been multiple case reports and anecdotal evidence of chiropractic care improving the quality of life for those suffering with ADHD.

Barras and Cuthbert demonstrated an improvement in 157 children who showed improvement in 8 psychometric tests and 20 areas of cognitive function compared with their values before treatment.[13]

In another study, Brzozowske compared 12 children utilizing chiropractic to 12 children utilizing medications. The study concluded that chiropractic treatment was between 20%-40% more effective than the medication. Over half of the medication group suffered personality changes, insomnia and loss of appetite. This study also reported that although the medication initially improved hyperactivity and attentiveness, it did not improve gross or fine motor coordination. Also, as the study progressed, the medication dosage had to be increased due to its effectiveness diminishing. The chiropractic group improved in gross and fine motor coordination as well as hyperactivity and attentiveness.[14]

Giesen saw improvement in behavior and motor skills in 5 out 7 children in his study.[15] Lastly, Pauli was the first to publish a study showing 9 adults who improved their ADHD scores on the Test of Variables of Attention (TOVA) and 88% had scores normalize after 2 months of utilizing the Network Spinal Analysis chiropractic technique.[16]

With a growing body of research and case studies, chiropractic is beginning to establish itself as an alternative for those looking to manage ADHD without medications.[9]

Case Study

History

An 11 year old Caucasian male diagnosed 2 years earlier by a psychologist with ADHD. He was prescribed Concerta and was later taken off the medication by his guardians due to side effects of loss appetite and turning him into a social "zombie". The patient had suffered with neck pain since having his head forcibly twisted by his teacher to get him to pay attention three years prior. The patient was adopted by his grandparents who were referred to our clinic by a registered nurse. The patients' parents had struggled with drug addiction and lived out of state.

His diet was suboptimal with high amounts of processed foods, sugary drinks (soda and sports drinks) and low in fresh fruits and vegetables. His appetite was otherwise normal since discontinuing Concerta.

The patient had difficulty in school with noted problems in concentration, organization, test preparation, getting assignments in on time and understanding concepts. He utilized a tutor to help him academically.

Examination

Standing Postural Examination showed the patients right hip was lower than left by 1 ½ degrees and that his torso was leaning to the left frontal plane 1 ½ degrees when measured with hip calipers. These findings are consistent with Atlas Subluxation Complex Syndrome (ASC).

Neurological Exam revealed relative weakness (when compared to opposite extremity) of hand extensors on the left, finger abduction on the left and dorsiflexion of the foot on the left. Rombergs, Tandem Gait and straight line walking test caused patient to sway strongly to the right. The cerebellum tests finger-to-nose, piano playing and alternating hand were all positive with noticeably reduced coordination in left hand compared to right.

NUCCA X-ray series revealed an out-of-pattern Type 2 Subluxation Complex. The characteristics were a Right 1 laterality with no head tilt, and 2 ½ degree lower angle on the right and the neck 3 ¼ degrees off vertical into the left frontal plane with a 1/16 high plane line. The vertex film showed posterior 5 ½ rotation of atlas and a C-2 spinous process rotated 6 degrees to the right. The patients lateral showed a mild loss of cervical curve and forward head position but was otherwise unremarkable. The patients' guardian also filled in a detailed diet report tracking his normal eating habits for a week and behavioral evaluation forms.

Lastly a TOVA examination was performed which objectively tests the patients' variables of attention. The TOVA is a continuous performance test that provides reliable information about an individual's sustained attention, speed and consistency of responding, and behavioral self-regulation which are critical aspects of attention and executive functioning known to be compromised in persons diagnosed with ADHD and other conditions of the central nervous system.[9]

Intervention

Based on the examination findings it was determined that the patient had an Atlas Subluxation Complex Syndrome. He was

placed on a plan of care in which he would be evaluated two visits per week for three months and given the low force, contact specific NUCCA spinal correction on visits where he objectively showed the presence of the subluxation.

The patient received 18 NUCCA adjustments before he began to maintain the alignment of the skull and neck. He received a total of 20 spinal adjustments over the three month course of care. A post adjustment x-rays series was taken following the first adjustment and showed the correction to the skull and neck to be adequate with the neck and skull being returned to the vertical axis and the rotation of the atlas reducing and rotation of C-2 spinous reducing nearly to neutral.

He was also given exercises to increase his mental focus, motor strength, coordination, balance and postural core muscle strength which he was to perform 6 days per week at home. The patients exercise protocols were updated every 10 days and became increasingly more complicated and challenging as the program progressed. The exercises required about 30-45 min/day to complete.

The patient was given a dietary guideline to increase lean protein, vegetables, and fruits and limit sugar, additives, preservatives and other "junk' foods. He was also given a supplementation regiment which included fish oil, vitamins and minerals, probiotics and digestive enzymes.

The patient and his guardians were verbally followed up with during his visits to ensure they were complying with recommendations in regard to diet, supplementation and exercises. They also filled out a numerical scale indicating his progress with the symptoms of ADHD and neck pain on each visit.

At the end of the three month period, the patient was reevaluated utilizing the Behavioral Evaluation, neurological tests and the TOVA evaluation.

Outcomes

At the end of the three months the patient had began to maintain his upper cervical alignment for up to a week. He reported a complete and total resolution in neck pain following his first NUCCA correction. He would have intermittent pain over the course of care that would resolve immediately upon his receiving a NUCCA spinal adjustment. When the cervical pain returned it was never greater than $1/10^{th}$ its pre treatment levels according to the patients self reporting on each office visit.

His neurological imbalances had improved to within normal limits and his balance had improved substantially when reexamined. The behavioral evaluation was completed by his guardian who reported an improvement in academic performance, attitude and concentration although he still has some difficulty getting assignments turned in on time. His guardian also noted that the patients' teachers and tutors had also noticed improvements in his behavior in class and academic performance. Notably, the patient continued with NUCCA treatment and dietary recommendations for 3 more months and reported that his grades had improved from C's and D's on his previous report card to A's and B's.

The TOVA reevaluation showed an improvement with his overall Attention Performance Index score dropping to a -.46, which was down from a -3.96 score three months earlier. This places him nearly into the Normative Range of test samples (which would be a score of 0 or above) determined by the software developer guidelines.

The patient objectively improved in three out of four categories the TOVA measures including response time variability, commission errors and omission errors. The fourth factor, patients response time, decreased mildly by four points but was still within normal range.

For errors of omission, commission, reaction time, and variability, any score above 85 is considered normal. After 3 months of care the patient scores improved into the normal range in the omission and commission categories indicating a substantial decrease in inattention and impulsivity. Variability improved but not into the normal range (Table 1).

Discussion

The improvement in academic performance is potentially one of the most important outcomes we can hope to achieve and makes this case particularly interesting. Improving behavior and concentration are good for the patient and family, but seem less important if those improvements cannot translate into better academic outcomes that help the child succeed in life. Again, the large study in Quebec showed that academic outcomes were worse for boys who had Ritalin and girls had worse regulation of emotion.[6] If chiropractic based treatments can continue to improve academic outcomes for these patients, it can be a strong differentiating factor between medical and chiropractic management.

Neuro-scientific research examining the regions of the brain involved in ADHD and other psychiatric disorders show dysfunction in the cerebello-thalamo-prefrontal loop.[17] Executive functions have also been linked to the cerebellum, the basal ganglia and prefrontal regions of the brain.[18]

Although the purpose of chiropractic care was not to diagnose or treat the patient's ADHD, his condition improved both subjectively and objectively and that likely translated into academic improvement. One possible mechanism for these improvements could be improved cranial hemodynamics. We know from previous research on NUCCA that it has been shown to decrease blood pressure thought to be due to relative brain stem ischemia[8] and alter intracranial hemodynamic flow rates and cerebrospinal fluid.[19]

Based on those findings, it is possible that these vascular changes, in addition to reducing neurological interference from the Atlas Subluxation Complex, would improve the function of the patients' brain regions related to executive functions. This possibility is intriguing because research has linked attention and other neurological disorders like dementia[20] and Alzheimers[21] that have both been linked to vascular changes in the brain.[22]

It may be that vascular changes vary with the complexity and degree of the ASC, and manifest in neurobehavioral disorders like DDS's in children while others remain subclinical but

grow worse with time and lead to neurodegenerative conditions later in life.

Another possibility is that the correction of the ASC and the accompanying balancing of the spinal structure, combined with the postural/balance exercises employed in this case may be positively stimulating the spinocerebellum and thereby positively affect the function of the prefrontal cortex. Afferent information from the head and midline structures, namely the spine and postural muscles are the primary source of stimulation to the spinocerebellum.[23] Research has demonstrated that the vermis portion of the cerebellum and is well connected to the speed and efficiency of executive functions carried out in the prefrontal cortex.[24]

Pauli proposes a theory that prefrontal dysfunction leading to altered attentional capabilities seen in patients is related to a diaschetic mechanism involving the cerebellum, and more specifically the vermal region of the cerebellum. However, in those cases, the cerebellar dysfunction is not due to a "hard" lesion, but is itself a diaschetic consequence of dysafferentiation from spinal structures. The latter being most likely due to vertebral subluxations or other postural imbalances, combined with other causes from improper lifestyle.

Diaschisis is defined as a functional depression of brain function at a structurally intact site remote from, but functionally related to, an area of brain lesion. Based on the previous considerations, it may possible that the entrainment of respiration to spinal motion (called the Respiratory wave) mobilizes the entire spinal system; thereby providing a tremendous amount of activation of joint mechanoreceptors and muscle spindles. This then results in activation of spinocerebellar tracts to the vermis of the cerebellum. Such increase in afferentation provides increased activation of neural pathways, which is known to stabilize unstable neurons.[16]

The approach we utilized is designed to promote and restore function, stimulate the brain neurologically by challenging the body with therapeutic exercise and mental challenges, as well as provide a nutritional baseline that would promote health and reduce and remove chemicals (food coloring, preservatives, artificial flavors, additives) that have been known to exacerbate the symptoms of ADHD.[25,26]

Since ADHD is known to be a neurobehavioral disorder, it would be logical to find interventions that improve the function of the nervous system, particularly the central nervous system as a solution to support these patients and hopefully resolve their conditions. From that perspective, upper cervical chiropractic may offer an excellent alternative for these patients.

Conclusion

Although it is impossible to make sweeping conclusions about the link between the Atlas Subluxation Complex being a causative factor of ADHD, we can conclude that this patient has achieved quality of life improvement that has been subjectively reported and objectively measured by the TOVA software, neurological exams and behavioral evaluation.

Due to the rapidly growing number of children that are being diagnosed and medicated and the risks and discontentment among parents whose children take these medications, we hope this report will add to the growing body of knowledge showing that chiropractic should receive further study and recognition as a healthy alternative to medication. The future health and wellbeing of millions of children could be positively affected by healthy lifestyle changes and the consistent correction of the Atlas Subluxation Complex. Further research and clinical trials are needed in this area.

Acknowledgements

Thank you to Christine Bagnaro, D.C. ,Yannick Pauli, D.C for their support.

References

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth edition: DSM-5. Washington: American Psychiatric Association, 2013.
2. Joseph Mathew. Attention-Deficit/Hyperactivity Disorder: Are We Helping or Harming? BMJ 2013; 347:fG172.
3. Sharma A, Couture J. A Review of the Pathophysiology, Etiology, and Treatment of Attention-Deficit Hyperactive Disorder (ADHD). Anne Pharmacother. 2013 Nov 1.
4. Garrison P, Barkley, R. Without Boundaries. Challenges and Hopes for Living with ADHD: An International Survey. World Federation of Mental Health 2010;8.
5. Consumer Reports National Research Center. The Pros and Cons of Treating ADHD With Drugs. Consumer Reports July 2010.
6. Currie J, Stabile M, Jones L. Do Stimulant Medications Improve Educational and Behavioral Outcomes for Children With ADHD? NBER Working Paper No. 19105 June 2013.
7. Thomas, M. NUCCA Protocols and Perspectives 1st Edition. National Upper Cervical Chiropractic Research Association. Monroe, Michigan 2002; xvii.
8. Bakris,G et al. *Journal of Human Hypertension* (2007) 21, 347–352.
9. Hughes S. A Guide to Clinical Interpretation of the Test of Variables of Attention (T.O.V.A.). The TOVA Company 2008.
10. Rosner AL. Infant and child care: an assessment of research. Norwalk, IA: Foundation for Chiropractic Education and Research; 2003.
11. Pauc R. Comorbidity of dyslexia, dyspraxia, attention deficit disorder (ADD), attention deficit hyperactive disorder (ADHD), obsessive compulsive disorder (OCD) and Tourette's syndrome in children: a prospective epidemiological study. Clin Chiropr 2005:189-98.

12. Hulme C, Biggerstaff A, Moran G, McKinlay I. Visual,kinaesthetic and cross-modal judgments of length by normal and clumsy children. Dev Med Child Neurol 1982;24:461-71.
13. Barras M, Cutbert S. Developmental Delay Syndromes: Psychometric testing done before and after chiropractic treatment of 157 Children.
14. Brzozowske WT, Walton EV. The effect of chiropractic treatment on students with learning and behavioral impairments resulting from neurological dysfunction (part 1). J. Aust Chiro Assoc 1980;11(7):13-18. and Part II**:** J. Aust Chiro Assoc 1980;11(8):11-17.
15. Giesen JM, Center DB, Leach RA. An evaluation ofchiropractic manipulation as a treatment of hyperactivity in children. J Manipulative Physiol Ther. 1989; 12(5): 353-
16. Pauli Y. Improvements in attention in patients undergoing network spinal analysis: a case study using objective measures of attention. J Vertebral Subluxation Research. 2007;8 (23):1-7.
17. Middleton FA, Strick PL. Anatomical evidence for cerebellar and basal ganglia involvement in higher cognitive function. Science 1994; 266:458-461.
18. Pennington BF, Ozonoff S. Executive functions and developmental psychopathology. J Child Psychol Psychiatry 1996;37:51-87.
19. Changes in cerebral blood flow patterns and velocities of migraine subjects following an atlas correction: Utilization of phase contrast magnetic resonance imaging to measure cerebral hemodynamic changes before and after a NUCCA atlas correction - A Case Series. Unpublished. UCRF.org Current and Ongoing Research. Accessed 1/21/14.
20. Melillo R, Leisman G. Neurobehavioral disorders of childhood. Kluwer Academic: New York 2004.
21. Sieroff E, Piquard A. Attention and aging. Psychol Neuropsychiatr Vieil 2004; 2(4):257-269.
22. Vascular Dementia. Alz.org Accessed on 1/21/14.
23. Akshoomoff NA, Courchesne E. ERP evidence for a shifting attention deficit in patients with damage to the cerebellum. J of Cogn Neurosci 1994;388-399.
24. Andreasen NC, O'Leary DS et al. Schizophrenia and cognitive dysmetria : a positron-emission tomography study of dysfunctional prefrontal thalamic-cerebellar circuitry. Proc Natl Acad Sci USA 1996;93:9985-9990.
25. Millichap JG, Yee MM. The diet factor in attention-deficit/hyperactivity disorder. *Pediatrics*. 2012 Feb;129(2):330–7. Epub 2012 Jan 9. Review. PubMed PMID: 22232312.
26. Nigg JT, Lewis K, Edinger T, Falk M. Meta-analysis of attention-deficit/hyperactivity disorder or attention-deficit/hyperactivity disorder symptoms, restriction diet, and synthetic food color additives. *J Am Acad Child Adolesc Psychiatry*. 2012 Jan;51(1):86–97.e8.

Table 1. Pre and post TOVA ADHD score, omission, commission, reaction time, variability

ADHD Score		Omission		Commission		Reaction Time		Variability	
Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
-3.90	-.46	<40	**105**	74	**103**	**89**	**85**	62	**79**

Bold indicates a normalized score