CASE SERIES

Improved Language Development Following Network Spinal Analysis in Children Diagnosed with Autism Spectrum Disorder

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Abstract

Objective: To describe the care of two children diagnosed with Autism Spectrum Disorder and the documented changes in their language skills while receiving Network Spinal Analysis (NSA) chiropractic care.

Clinical Features: Two children, under the age of 4 diagnosed with autism spectrum disorder, received NSA care for one year. The specific outcome that was measured was the Preschool Language Scale-4 (PLS-4). The PLS-4 was given four times over a one year period.

Results: Expressive and receptive language delays were assessed before, during, and after NSA care. These children saw an average increase of 24 months of language development in one year, while under NSA care.

Conclusions: The progress documented in this report suggests that NSA care may have positively affected the language development of these children. We support further research in this field.

Keywords: *vertebral subluxation, autism, autism spectrum disorder, language development disorders, Chiropractic, Network Spinal Analysis*

Introduction

Autism is defined as a disorder beginning in childhood marked by the presence of significantly abnormal or impaired development in social interaction and communication and a distinctly restricted repertoire of activity and interest.[1] A range of other nonspecific problems are common, such as phobia, sleeping and eating disturbances, temper tantrums, and aggression, typically self-directed.[2] Most children identified as having autism are reported by their caregivers to demonstrate symptoms within the first two years of life, based on retrospective accounts.[3]

Social and communication impairments are the earliest indicators of autism. These become apparent early in childhood and continue through adulthood. Social impairments in infants with autism include decreased attention to social stimuli, reduced smiling, reduced eye contact, and diminished orientation to name. Three to five year old autistic children have difficulty with social understanding, approaching others spontaneously, imitating and responding to emotions, nonverbal communication, and turn-taking.[4]

Communication deficits are present in an estimated one third to one half of individuals diagnosed with autism.[5] Autistic toddlers have less frequent and less diverse babbling, consonants, words, and word combinations; their gestures are less often integrated with words. Children with autism have difficulty making requests, sharing experiences, and are more likely to exhibit echolalia, the imitation of speech of others.[6]

The use of many conventional gestures such as showing, waving, pointing, and symbolic gestures like head nodding are

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often lacking.[7] Other common characteristics of children with autism include unusual responses to sensory stimuli, motor problems, that include poor muscle tone, poor motor planning, toe walking, atypical eating behaviors, and gastrointestinal symptoms.[8-11]

The cause of autism is still unknown; however, proposed relational causes of autism have been discussed including heredity,[12] environmental factors,[13-15] and in rare cases autism has been associated with agents that cause birth defects.[16] Neurological studies on autistic individuals have indicated involvement of the limbic system,[17] cerebellar and neocortical systems,[18] the parasympathetic, sympathetic nervous system and HPA axis,[19] and neural circuit malformation[20] as potential mechanisms for autism.

The polyvagal theory provides insights into how it is possible that individuals with specific disorders such as autism, in which compromised social behavior is a diagnostic feature, are experiencing neurophysiological states that foster defensive and not social behaviors.[21]

Whatever the etiology, the prevalence of autism continues to increase in the United States and has reached epidemic proportions.[22] The Center for Disease Control (CDC) reports that estimates are 1 in 110 children in the U.S. are diagnosed with autism.[16] California's Department of Developmental Services reports that from December 1987 to 2007 there was a 633% increase in persons with autism in California, this translates to a rate of 12 new children a day, seven days a week, or one new child every two hours.[23]

It is widely agreed that autism is a lifelong disorder.[24] Frequently utilized treatments of autism focus on the management and improvement of symptoms and functioning.[24] Approaches include: educational/behavioral interventions,[25,26] medical interventions,[27] homeopathy,[28] removing the environmental toxins from the child's body through chelation,[29] making dietary changes and environmental changes,[29,30] osteopathy and cranial-sacral therapy,[31,32] chiropractic care,[33-41] and vitamin/mineral therapy.[42,43]

Network Spinal Analysis (NSA) care, developed by Donald M. Epstein, DC, is an evidenced-based approach to wellness and body awareness.[44,45] NSA care is a specialized chiropractic technique. The chiropractor applies gentle forces along the spine to elicit unique sensory and motor responses, as well as redistribution and release of spinal tension. The body is then able to make more energy effective choices and evolve new adaptive strategies.[44] Research on NSA has shown this type of care to have a calming effect on the sympathetic nervous system,[46] and increasing responsiveness and reorganization of the nervous system.[47,48]

The hypothesis for this study is that alterations in function from spinal distortions and vertebral subluxations could lead to the changes seen in receptive and expressive language development of children diagnosed with autism. It has been suggested by Dr. Epstein that increases in defense physiology and spinal distortion lead to changes in the central nervous system and the brain.[44]

Defense physiology or stress response is a term used to refer to the various changes in body function which occur in response to a real or perceived stress or threat. When the body executes the "fight or flight" reaction or stress response, the nervous system initiates, coordinates and directs specific changes in how the body is functioning, preparing the body to deal with what is perceived by the individual as a threat.[49, 50] With the physiology less in defense and the individual more aware of the breath and movement of the spine and body; it is postulated that the frontal lobes of the cerebral cortex and vagal centers are more available to reassess the functioning and integration of the body's physiology and development.[45]

Case Series

Two children who presented with the diagnosis of autism participated in our 12 month study. Each child was assessed independently by clinical psychologists. The diagnostic battery included informal testing measures of parent interview, play observation, review of records, and formal diagnostic tests which included the Bayley Scales of Infant Development II, Vineland Adaptive Behavior Scales, and the Childhood Autism Rating Scale (CARS).

Informed consent to publish the data collected on these children was obtained from the parents, prior to the children undergoing NSA care.

Case One

One male child ("Q") was 3 years 8 months at the start of NSA care. Q received a diagnosis of moderate autism at age 2 years 2 months with severe expressive and receptive language delays as documented by previous speech and language evaluations. Q was also diagnosed with heavy metal poisoning which was believed to be related to his neurological and immune challenges. Q additionally had a history of allergies, ear infections, digestive problems, social interaction difficulties, behavioral problems, teeth grinding, and sleep problems. Q began receiving traditional therapies at age 2 years 3 months, and also began receiving biomedical therapies which included diet modification, chelation and vitamin/mineral, and essential fatty acid supplementation.

Case Two

The other child, female ("S") was 3 years 5 months at the start of NSA care. S received a diagnosis of moderate autism at age 3 years 3 months with severely delayed expressive and a moderate delay in receptive language skills. S also had a history of chronic colds, digestive problems, social interaction difficulties, behavioral problems, and sleep problems. She attended a special needs preschool class, received speech therapy and occupational therapy. No biomedical therapies or treatments were implemented.

NSA Intervention

Both children were evaluated using Epstein's model of neural and spinal integrity.[44] These children received level 1 NSA care an average of one time per week for 12 months. NSA care is a specialized chiropractic technique. The chiropractor applies gentle forces along the spine to elicit unique sensory

and motor responses, as well as redistribution and release of spinal tension. S received a total of 56 NSA sessions over the course of one year and Q received a total of 39 NSA sessions in one years' time. Each NSA session lasted approximately 10-20 minutes, which included the NSA protocols, as needed.[44, 45]

Objective Measures

The PLS-4 was re-administered every 4 months to assess for possible changes in receptive and expressive language skills. The average range for this test is 85-115, with a mean of 100. Reliability data for the PLS-4 show internal consistency reliability coefficients ranging from .81 to .97. Assessment of concurrent validity yielded high correlations, as well as an inter-rater reliability of 99%.[51] An informal interview with the parents was conducted to ascertain subjective changes in their child's lives.

Outcomes

Q's results – See Table 1 for PLS-4 outcomes

Q was administered the PLS-4 test prior to receiving NSA care. Q's Total Language Score was 75 for Standard Score, Percentile Rank of 5, and Age Equivalent of 2 years 6 months, this correlates to a moderate language delay.

At 4 months into care improvements were seen in both the auditory comprehension and expressive communication subtests. Q's Total Language Score had an increase of 5 points on the Standard Score, and an increase of 4 in the Percentile Rank.

Q's mother reported the following after 3 months of NSA care: "Since starting NSA we have seen Q's speech grow from 3-4 word sentences to 6-7 word sentences, and he has begun asking questions for the first time. He is acquiring phrases like, "I'm glad to see you!" and "How are you doing?" and "Come on in!" and he is using them appropriately in context. He is more present and engaging socially with us at home and with his peers at school. Last week for the first time, he spontaneously said, "I love you Daddy!" with no prompting from anyone. His imaginative play is more and more extensive…He often engages his sister to play with him…his self-stimulatory behavior has decreased and is more regulated by himself or cues from caregivers…"

Q's next test revealed continuing improvement in the auditory comprehension and expressive communication subtests. His Total Language Score increased by 10 points to 90 for Standard Score, Percentile Rank of 25. On his last test for this study, the Auditory Comprehension subtest now reflect receptive language skills above the mean in the high average range. On the Expressive Communication subtest Q's scores represent expressive language skills in the average range. Q's Total Language Score was 105 for Standard Score (an increase of another 15 points), Percentile Rank of 63, and Age Equivalent of 5 years 2 months, which is 5 months above his chronological age.

Overall Q has made tremendous strides not only in his speech, but also in his social interactions with family and school mates, however, with so many therapies in place simultaneously, it cannot be said definitively that NSA care was what made that difference.

S's Results – See Table 2 for PLS-4 outcomes

S was administered the PLS-4 test one week prior to NSA care being initiated. S's Total Language Score was 65 for Standard Score, and Percentile Rank of 1, this correlates to a severe language delay. S's scores also show a significant gap between her receptive and expressive language skills. This gap was important to note for care givers, in that, she needed more one on one attention and had difficulty in understanding instructions.

S's first retest showed improvements in both the auditory comprehension and expressive communication subtests. Her Total Language Score increased 15 points for Standard Score, and an increase of 8 in her Percentile Rank. The gap between her receptive and expressive language skills was no longer present.

Subjectively, S's mother reported: "S is continuing to show improvements in her verbal skills, expressing herself more verbally, with an increase in the appropriateness and creativity in her speech. She reported that S will now use phrases that she's heard before in appropriate ways, like "my nose is stuck" when she has a cold.

When in distress, S will produce creative sentences to express herself. She is currently attending a preschool class, is advanced academically in the area of reading with age-appropriate math and writing skills. S has been observed to now help other children in her circle time. Her self-stimulatory behaviors have decreased greatly, only demonstrated in the evenings when tired. Her focus and attention has improved in school, as reported by her classroom teacher. S is very happy in her classroom setting."

S's next test revealed maintaining of improvements on the auditory comprehension subtest; however the expressive communication subtest actually went down. This reflects a decrease of 5 points on S's Total Language Score to 75 for Standard Score, and a Percentile Rank of 5 (decrease of 4 points). S's last test was one year after initiating NSA care. Results for auditory comprehension subtest reflect receptive language skills falling just below the mean in the average range. The auditory and expressive communication subtests have again improved with scores representing a borderline expressive language delay, scores falling just below the average range. Her Total Language Score was 88 for an overall increase of 29 points on Standard Score, Percentile Rank increase of 20, and Age Equivalent of 3 years 9 months, which is 8 months below her chronological age.

In general S experienced huge growth in this year, with significant improvements in speech and in her abilities to interact with others. S had no changes in her diet or additional therapies added during this time.

Discussion

Two children diagnosed with autism spectrum disorder with speech and language delays experienced significantly improved expressive and receptive language skills after beginning NSA care. The observations documented in these case studies provide preliminary evidence that NSA care may improve language skills in children with autism spectrum disorder, and may be of importance for individuals suffering from autism and/or language disorders. Long term studies documenting language development in children with autism show an average increase of 3-4 months per year.[52, 53] The children in this study (Q and S) saw an average increase of 24 months of language development in one year, while under NSA care.

Autism and associated language impairments are hypothesized to be a result of neural and neural connection abnormalities as well as associated autonomic states.[17,18,20,21] The authors suggests that NSA care has the potential to positively affect the brain in children by creating plastic changes in the prefrontal cortex and other cortical and subcortical areas serving as neural substrate for language development. Clinical observations and structured research over the past 20 years has further defined transformations occurring in the brain, nervous system and physiology of people under NSA care.[44, 46-48, 54]

Several chiropractic case studies have also shown various improvements in functioning in children with autism spectrum disorders,[33-40] this is the first study to utilize an objective measurement of speech and language to track these children's progress. Further research and study are required to determine the specific mechanisms, which foster these types of changes that represent functioning beyond the normal expected in this population of children.

The observational nature of this case study precludes definitive conclusions as to the cause and effects. Q received several interventions as well as NSA, and we are unable to determine if the improvements in his language skills are due solely to the NSA care or a combination of modalities. Q was already exhibiting changes beyond what the average child with language challenges is expected to achieve before his NSA care. It is possible that both children would have improved without any interventions.

Conclusion

Due to the small sample size of two, and lack of control group, and randomization process, we cannot exclude the possibility that alternative variables may explain our results. This study would have benefited from correlating changes in neural and spinal integrity with the progress in language skills that was documented. Further studies and research are warranted to determine definitive causative relations.

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Author Disclosure Statement
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References

1. 2011 ICD-9-CM Diagnosis 299.0. ICD9Data.com. www.icd9data.com/2012/Volume1/290-319/295-299/299/299.0.htm. Accessed on May 17, 2014.
2. International statistical classification of diseases and related health problems 10th revision (ICD-10) Version for 2010. World Health Organization. http://apps.who.int/classifications/icd10/browse/2010/en#/F84.0. Accessed on May 17, 2014.
3. Short CB, Schoper E. Factors relating to age of onset in autism. J Autism Dev Dis 1988;18:207-16.
4. Rutgers AH, Bakermans-Kranenburg MJ, van Ijzendoorn MH, van Berckelaer-Onnes IA. Autism and attachment: a meta-analytic review. J Child Psychol Psychiatry 2004;45(6):1123-34.
5. Noens I, van Berckelaer-Onnes I, Verpoorten R, van Duijn G. The ComFor: An instrument for the indication of augmentative communication in people with autism and intellectual disability. J Intellect Disabil Res 2006;50(9):621-32.
6. Landa R. Early communication development and intervention for children with autism. Ment Retard Dev Disabil Res Rev 2007;13(1):16-25.
7. Wetherby AM, Watt N, Morgan L, Shumway S. Social communication profiles of children with autism spectrum disorders late in the second year of life. J Autism Dev Dis 2007;37(5):960-75.
8. Rogers SJ, Ozonoff S. Annotation: What do we know about sensory dysfunction in autism? A critical review of the empirical evidence. J Child Psychol Psychiatry 2005;46(12):1255-68.
9. Ming X, Brimacombe M, Wagner GC. Prevalence of motor impairment in autism spectrum disorders. Brain Dev 2007;29(9):565-70.
10. Dominick KC, Davis NO, Lainhart J, et al. Atypical behaviors in children with autism and children with a history of language impairment. Res Dev Disabil 2007;28(2):145-62.
11. Wakefield AJ, Puleston JM, Montgomery SM, et al. Review article: The concept of entero-colonic encephalopathy, autism and opioid receptor ligands. Aliment Pharmacol Ther 2002;16(4):663-74.
12. Freitag CM. The genetics of autistic disorders and its clinical relevance: A review of the literature; genetics of autistic disorders review. Mol Psychiatry 2007;12:2-22.
13. Newschaffer CJ, Croen LA, Daniels J, et al. The epidemiology of autism spectrum disorders. Annu Rev Public Health 2007;28:235-58.
14. Madsen KM, Hviid A, Vestergaard M, et al. A population-based study of measles, mumps, and rubella vaccination and autism. N Engl J Med 2002;347:1477-82.
15. De Stefano F. Vaccines and autism: Evidence does not support a causal association. Clin Pharmacol Ther 2007;82:756-59.
16. Facts about ASDs. CDC/Department of Health and Human Services. http://www.cdc.gov/ncbddd/autism/facts.html, accessed May 17, 2014.
17. Bauman M, Kemper T. (2005). *Structural brain anatomy in autism: What is the evidence.* In: The neurobiology of autism. 2nd edition (pp. 121-135), Baltimore: John Hopkins University Press.

18. Minshew N, Luna B, Sweeney J. Oculomotor evidence for neocortical systems but not cerebellar dysfunction in autism. Neurology 1999;52:917.
19. Porges S. (2005). *The vagus: A mediator of behavioral and visceral features associated with autism.* In M.L. Bauman and T.L. Kemper (Ed.), The neurobiology of autism (pp.65-78), Baltimore: Johns Hopkins University Press.
20. Courchesne E, Pierce K, Schumann C, et. al. Mapping early brain development in autism. Neuron 2007;56(2):399-413.
21. Porges S. The polyvagal theory: Phylogenetic contributions to social behavior. Physiol Behav 2003;79:503-13.
22. Yazbak FE. Autism in the United States: A perspective. J Am Physicians Surg 2003;8(4):103-7.
23. Cavagnaro A. Autistic spectrum disorders: Changes in the California caseload: an update June 1987 through June 2007. www.dds.ca.gov/autism/docs/AutismReport_2007.pdf. Accessed May 17, 2014.
24. Francis K. Autism interventions: a critical update. Dev Med Child Neurol 2005;47(7):493-9.
25. Baranek G. Efficacy of sensory and motor interventions for children with autism. J Autism Dev Disorder 2002;32(5):397-422.
26. Myers S, Plauche Johnson C. Management of children with autism spectrum disorders. Pediatrics 2007;120(5):1162-82.
27. Chez M, Memon M, Hung P. Neurologic treatment strategies in autism: An overview of medical intervention strategies. Semin Pediatr Neurol 2004;11(3):229-35.
28. Robinson TW. Homeopathic secretin in autism: a clinical pilot study. Br Homeopath J 2001;90:86-91.
29. Patel K, Curtis L. A comprehensive approach to treating autism and attention-deficit hyperactivity disorder: A prepilot study. J Altern Complement Med 2007;12(10):1091-98.
30. Elder J, Shankar M, Shuster J, Theriaque D, et.al. The gluten-free, casein-free diet in autism: Results of a preliminary double blind clinical trial. J Autism Dev Disord 2006;36(3):413-20.
31. Muir M. New body based therapies for autism, ADD, and other childhood disorders. Alt Complement Ther 1997;3(6):401-13.
32. Wanveer T. Autism spectrum disorder: how cranial-sacral therapy can help. Massage Today 2007;7(7):1-4.
33. Amalu W. Autism, asthma, irritable bowel syndrome, strabismus, illness susceptibility: A study in chiropractic management. Today's Chiropractic 1998 Sept/Oct:32-47.
34. Warner S, Warner T. Case report: Autism and chronic otitis media. Today's Chiropractic 1998;28(3):82-5.
35. Aguilar AL, Grostic JD, Pfleger B. Chiropractic care and behavior in autistic children. J Clin Chiropractic Pediatr 2000;5(1):293-304.
36. Khorshid K, Sweat R, Zemba D, Zemba B. Clinical efficacy of upper cervical versus full spine chiropractic care on children with autism: a randomized clinical trial. J Vertebral Subluxation Res 2006; March 9:1-7.
37. Marini N, Marini S. Improvement in autism in a child coupled with reduction in vertebral subluxations; a case study and selective review of the literature. J Pediatr Matern Fam Health 2010; July 5:107-15.
38. Cohn A. Improvement in autism spectrum disorder following vertebral subluxation reduction: a case study. J Pediatr Matern Fam Health 2011;Sept1:87-91.
39. Scelfo T, Chelenyak P. Resolution of autistic symptoms in a child undergoing chiropractic care to correct vertebral subluxations: a case study. J Pediatr Matern Fam Health 2011;Oct 31:106-110.
40. Cleave J, Alcantara J, Holt K. Improvement in autistic behaviors following chiropractic care: a case series. J Pediatr Matern Fam Health 2011;Dec 5:125-31.
41. Levy SE, Hyman SL. Complementary and alternative medicine treatments for children with autism spectrum disorders review article. Child Adolesc Psychiatr Clin N Am 2008;4(17):803-20.
42. Johnson CP, Myers S and the Council on Children with Disabilities. Clinical Report: Identification and evaluation of children with autism spectrum disorders. Pediatrics 2007;120(5):1183-1215.
43. Weber W, Newmark S. Complementary and alternative medical therapies for attention-deficit/hyperactivity disorder and autism. Pediatr Clin North Am 2007;54(6):983-1006.
44. Epstein D. Theoretical Basis and Clinical Application of Network Spinal Analysis NSA: an Evidence Based Document, rev. xi. Longmont, CO: Innate Intelligence:2005.
45. Epstein D. The transition of network spinal analysis care: Hallmarks of a client-centered wellness education multicomponent system of health care delivery. J Vertebral Subluxation Res 2004;5:1-7.
46. Miller E, Redmond P.D. Changes in digital skin temperature, surface electromyography and electrodermal activity in subjects receiving network spinal analysis care. J Vertebral Subluxation Res 1998;2:87-95.
47. Jonckheere E. Letter to the editor; Network spinal analysis. J Altern Complement Med 2009;15(5):469-70.
48. Jonckheere E, Lohsoonthorn P, Musuvathy S. On a standing wave central pattern generator and the coherence problem. Biomed Signal Process Control 2010;4:336-37.
49. De Kloet E.R., Joels M, Holsboer F. Stress and the brain: From adaptation to disease. Nat Rev Neurosci 2005;6(June 2005):463-75.
50. Mc Ewen B.S. Physiology and neurobiology of stress and adaptation: Central role of the brain. Physiol Rev 2007;87:873-904.
51. Zimmerman IL, Castilleja NF. The role of language scale for infant and preschool assessment. Ment Retard Dev Disabil Res Rev 2005;11(3):238-46.
52. Sigman M, Ruskin E. Continuity and change in the social competence of children with autism, down syndrome, and developmental delays. Monogr Soc Res Child Dev 1999;256(64):1-114.
53. Mawhood L, Howlin P, Rutter M. Autism and developmental receptive language disorder – A comparative follow-up in early adult life. I: Cognitive and language outcomes. J Child Psychol Psychiatry 2000;41:547-59.

54. Pauli Y. (2007). Improvement in attention in patients undergoing network spinal analysis: A case series using objective measures of attention. J Vertebral Subluxation Res 2007;August 23:1-9.

Table 1 – PLS-4 Standard Scores for "Q"				
Age Test Date	3;8 12/28/06	4;0 4/20/07	4;4 8/28/07	4;9 1/21/08
AC Standard Score	77	81	89	109
AC Age Equivalent	2;6	3;6	3;9	5;6
EC Standard Score	78	83	92	99
EC Age Equivalent	2;7	3;7	4;0	4;8
Percentile Rank	5	9	25	63
Total Language Score – Standard Score	75	80	90	105

Table 2 – PLS-4 Standard Scores for "S"				
Age Test Date	3;5 12/28/06	3;10 5/8/07	4;1 8/28/07	4;5 12/13/07
AC Standard Score	59	81	81	95
AC Age Equivalent	2;1	2;8	3;6	3;11
EC Standard Score	77	82	73	83
EC Age Equivalent	2;4	2;9	2;11	3;7
Percentile Rank	1	9	5	25
Total Language Score – Standard Score	65	80	75	88