ORIGINAL RESEARCH

# Clinical Efficacy of Upper Cervical Versus Full Spine Chiropractic Care on Children with Autism: A Randomized Clinical Trial

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**ABSTRACT**

**Background:** Children with autism are presented with multiple categories of clinical pictures that affect their social, sensory, speech, and physical development. Parents of autistic children seek all possible therapies available including chiropractic. In this study, the clinical outcome of an upper cervical based chiropractic technique is compared to full spine adjustment in autistic children.

**Methods:** The clinical effects of full spine adjustment for 14 autistic children were evaluated using the Autism Treatment Evaluation Checklist (ATEC). ATEC is a questionnaire about children's development and progress answered by parents. It was developed and is scored, online, by the Autism Research Institute of San Diego, CA. Seven of these children were randomly assigned to be shifted to Atlas Orthogonal upper cervical adjustment. The remaining seven children continued full spine adjustment. Repeated monthly clinical assessments were done for 3-5 months. Pre and post x-ray and leg length analysis was also monitored.

**Results:** The clinical improvement of the autistic children showed in the parent's observations through decrease of ATEC scores. This improvement of ATEC scores was seen in the cases of six of the seven children under upper cervical adjustment and in five of the seven children under full spine adjustment. The total ATEC average improvement in the upper cervical group was 32%, while only 8.3% in the full spine group. Two autistic children under the upper cervical adjustment protocol no longer met the criteria to be considered autistic following the interventions.

**Conclusion:** In this study, the clinical outcome of chiropractic care showed higher efficacy with upper cervical adjustment when compared to full spine adjustment in autistic children. Further studies are recommended.

**Key words:** *Autism, chiropractic pediatrics, chiropractic adjustment, chiropractic technique, autistic children, atlas orthogonal, vertebral subluxation, full spine.*

**Introduction:**

Since the primary problem in autistic children is neurological, it is prudent to research the efficacy of chiropractic care in these children. Functional MRI in patients with autism showed significant differences from normal people in the activity of cerebellar mesolimbic and temporal lobe cortical regions of the brain when processing facial expressions. [1] These differences are most likely neurodevelopmental in origin. There are several different approaches for treatment of autistic children beyond the scope of this paper [2]; some of these will be mentioned later. Diagnosis of this condition is based upon parent's observations of specific behaviors, and an experienced team of clinicians. This team may include a neurologist, psychologist, pediatrician, speech/language therapist, learning consultant, and other professionals who are knowledgeable about autism.

Autistic children usually show an admixture of bizarre behaviors, developmental delay, and developmental deviance.[3] The disorder used to manifest before thirty months of age and was occasionally referred to as infantile autism. Now, there is an increase of autism with increasing incidence in all children of all ages and throughout the world. The deviance of developmental and social behavior in these children are shown in features such as:

(a) Failure to make eye contact, use facial expressions and body postures and gestures to regulate social interaction
(b) Rarely seeking others for comfort and affection
(c) Rarely initiating interactive play with others
(d) Rarely offering comfort to others or responding to others' distress or happiness
(e) Rarely greeting others

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(f) Not building peer friendships in terms of mutual sharing of interests, activities, and emotions despite ample opportunities
(g) Abnormalities in communication and lack of social usage of language
(h) Restrictive, repetitive, and stereotyped patterns of behavior.

In addition to chiropractic care, parents of autistic children seek all possible therapies available. Some of these include: applied behavior analysis, speech/language therapy, auditory integration training, music therapy, sensory integration, vision therapy, nutrition, medication for possible mineral intoxication, and secondary gut infections, and physical therapy.[4]

Anecdotal success of chiropractic care in children with special needs through Kentuckiana Children's Center (KCC), in Louisville, Kentucky, encouraged parents and chiropractors to research the efficacy of chiropractic care in autistic children. The question was then: which is the recommended chiropractic technique in these cases of autism?

**Methods**

Fourteen children under chiropractic care at Kentuckiana Children's Center in Louisville, Kentucky, participated in this study. These children were diagnosed with autism at the Child Evaluation Center at the University of Louisville Medical School. The clinical effects of full spine adjustment for these children were evaluated using the Autism Treatment Evaluation Checklist (ATEC).[6]

A major obstacle in autism research has been the lack of a valid means of measuring the effectiveness of various treatments. Over the years, researchers have published hundreds of studies that attempted to evaluate different biomedical and psycho-educational interventions that were intended to benefit autistic children. Researchers at the Autism Research Institute of San Diego, California, recently developed the ATEC to fill this need. The ATEC is a one-page questionnaire designed to be completed by parents, teachers, or caretakers (Table 1). It consists of 4 subsets: I. Speech/Language Communication (14 items); II. Sociability (20 items); III. Sensory/Cognitive Awareness (18 items); and IV. Health/Physical/Behavior (25 items). Users of ATEC may have it scored free (4 sub scores and a total score) by entering the responses via computer to the ATEC form on the website for immediate scoring.[6]

Parents of autistic children treated at KCC were invited to participate in this research. All children were originally under full spine diversified care. Parents of 15 children agreed to participate in this study. Eight children were randomly chosen to be under upper cervical care. The remaining 7 children were chosen to continue full spine care. There was one dropout case from the first group, in which the parent refused to continue to handle the difficulties of stabilizing her child during x-ray procedures. That made the number of children in each group even (7). All the children were boys except for one girl. She was in the upper cervical group. Repeated monthly ATEC scoring was done for all the children during the 3-month period of this study.

The selected method for upper cervical adjustment used in this study was Atlas Orthogonal (AO). This technique utilizes pre-adjustment /post-adjustment supine comparative leg checks, spinal palpation and a percussion adjusting instrument. The term orthogonal is an adjective meaning "having to do with or involving right angles or perpendicular." Bringing the atlas in a right angle to the spine is the target of AO adjustment. To attain this, the technique recommends four pre-adjustment cervical x-rays and two post-adjustment x-rays be taken immediately after the first adjustment in the cervical area. The x-ray views are lateral cervical, a-p open mouth, frontal (nasium) and horizontal (vertex). Individually, line analysis is used on these films to specifically measure and analyze the misalignment of the occipito-atlanto-axial joints. Post x-rays are taken to see what changes have been made and/or to make any further corrections to the vectors of the adjustment. Ultimately, in its normal position, the cranium should be vertical, the atlas vertebra should be leveled and the cervical spine should be vertical.

Examination procedures also include supine comparative leg length assessments. It is recommended that the patient be positioned supine so the heels of their feet are off the inferior end of the table (approximately six inches). A leg check grid is attached to the bottom of the AO leg check table. The legs are always measured in neutral position and not touched. The supine leg check comparison is performed both before and after adjustment.

Scanning palpation is a vital part of AO evaluation. It is a manual tactile cervical spine examination for objective findings of such conditions as muscular spasms, muscle contractions, edematous swelling or osseous protuberances. Subjective findings will be extreme tenderness, pain, hypersensitivity, hyperirritability, and neurological insult in the positive palpated areas. Findings are graded according to degree of severity. This procedure is conducted immediately before and after spinal adjustment.

The percussion adjustment instrument is used in AO technique. The patient is placed on his side with head support at four inches below the mastoid. A metal stylus is placed between the mastoid and the ramus of the mandible. An adjustment, an impulse imparted to the stylus by a plunger that excites a compressional wave in the stylus, is then delivered to the patient. At the patient-stylus interface, a portion of the wave energy is transmitted to the patient and a portion is reflected back to the plunger. The former portion of energy is enough to direct the atlas vertebra to move to its normal orthogonal position. This has been demonstrated and recorded by videoflouroscopy.

After initial ATEC scoring, each of the children in the study, whose age ranged from four to sixteen, in both groups were examined, x-rayed, and adjusted. The children were then evaluated and adjusted, if needed, twice each week in the 3-month period while ATEC scoring was done each month. Parents were present at all steps of care – examination, x-ray, and adjustment.

ATEC reliabilities and score distribution are based on 1,358 ATEC forms submitted to the Autism Research Institute.[6] In the Pearson Split-Half Coefficient Reliability Study for ATEC, the uncorrected r were as follows: scale I (speech) 0.920; scale II (sociability) 0.836; scale III (sensory/cognitive awareness) 0.875; scale IV (health/physical/behavior) 0.815; and total ATEC score 0.942.

**Table 1.** Autism Treatment Evaluation Checklist (ATEC). A questionnaire developed by Autism Research Institute. It is completed by parents to monitor the clinical changes in their autistic children.

ARI/Form
ATEC-1/11-99

## Autism Treatment Evaluation Checklist (ATEC)

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| Project/Purpose: | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| Scores: I | II | III | IV | Total |

This form is intended to measure the effects of treatment. Free scoring of this form is available on the Internet at: www.autism.com/atec

Name of Child _____ _____ ☐ Male Age _____
Last First ☐ Female Date of Birth _____
Form completed by: _____ Relationship: _____ Today's Date _____

***Please circle the letters to indicate how true each phrase is:***

### I. Speech/Language/Communication: *[N] Not true [S] Somewhat true [V] Very true*

N S V 1. Knows own name
N S V 2. Responds to 'No' or 'Stop'
N S V 3. Can follow some commands
N S V 4. Can use one word at a time (No!, Eat, Water, etc.)
N S V 5. Can use 2 words at a time (Don't want, Go home)
N S V 6. Can use 3 words at a time (Want more milk)
N S V 7. Knows 10 or more words
N S V 8. Can use sentences with 4 or more words
N S V 9. Explains what he/she wants
N S V 10. Asks meaningful questions
N S V 11. Speech tends to be meaningful/ relevant
N S V 12. Often uses several successive sentences
N S V 13. Carries on fairly good conversation
N S V 14. Has normal ability to communicate for his/her age

### II. Sociability: *[N] Not descriptive [S] Somewhat descriptive [V] Very descriptive*

N S V 1. Seems to be in a shell – you cannot reach him/her
N S V 2. Ignores other people
N S V 3. Pays little or no attention when addressed
N S V 4. Uncooperative and resistant
N S V 5. No eye contact
N S V 6. Prefers to be left alone
N S V 7. Shows no affection
N S V 8. Fails to greet parents
N S V 9. Avoids contact with others
N S V 10. Does not imitate
N S V 11. Dislikes being held/cuddled
N S V 12. Does not share or show
N S V 13. Does not wave 'bye bye'
N S V 14. Disagreeable/not compliant
N S V 15. Temper tantrums
N S V 16. Lacks friends/companions
N S V 17. Rarely smiles
N S V 18. Insensitive to other's feelings
N S V 19. Indifferent to being liked
N S V 20. Indifferent if parent(s) leave

### III. Sensory/Cognitive Awareness: *[N] Not descriptive [S] Somewhat descriptive [V] Very descriptive*

N S V, 1. Responds to own name
N S V 2. Responds to praise
N S V 3. Looks at people and animals
N S V 4. Looks at pictures (and T.V.)
N S V 5. Does drawing, coloring, art
N S V 6. Plays with toys appropriately
N S V 7. Appropriate facial expression
N S V 8. Understands stories on T.V.
N S V 9. Understands explanations
N S V 10. Aware of environment
N S V 11. Aware of danger
N S V 12. Shows imagination
N S V 13. Initiates activities
N S V 14. Dresses self
N S V 15. Curious, interested
N S V 16. Venturesome - explores
N S V 17. "Tuned in" — Not spacey
N S V 18. Looks where others are looking

### IV. Health/Physical/Behavior:

*Use this code: [N] Not a Problem [MI] Minor Problem [MO] Moderate Problem [S] Serious Problem*

N MI MO S 1. Bed-wetting
N MI MO S 2. Wets pants/diapers
N MI MO S 3. Soils pants/diapers
N MI MO S 4. Diarrhea
N MI MO S 5. Constipation
N MI MO S 6. Sleep problems
N MI MO S 7. Eats too much/too little
N MI MO S 8. Extremely limited diet
N MI MO S 9. Hyperactive
N MI MO S 10. Lethargic
N MI MO S 11. Hits or injures self
N MI MO S 12. Hits or injures others
N MI MO S 13. Destructive
N MI MO S 14. Sound-sensitive
N MI MO S 15. Anxious/fearful
N MI MO S 16. Unhappy/crying
N MI MO S 17. Seizures
N MI MO S 18. Obsessive speech
N MI MO S 19. Rigid routines
N MI MO S 20. Shouts or screams
N MI MO S 21. Demands sameness
N MI MO S 22. Often agitated
N MI MO S 23. Not sensitive to pain
N MI MO S 24. "Hooked" or fixated on certain objects/topics
N MI MO S 25. Repetitive movements (stimming, rocking, etc.)

Table 2. ATEC Score Distributions in the different developmental and health scales. The higher the subscale and total scores are, the more impaired the subject.

| Centle | Scale I Speech Range: 0-28 | Scale II Sociability Range: 0-40 | Scale III Sensory/Cognitive Awareness Range: 0-36 | Scale IV Health/Physical Behavior Range: 0-75 | Total Range: 0-180 |
|---|---|---|---|---|---|
| *Mild* | | | | | |
| 0-9 | 0-2 | 0-4 | 0-5 | 0-8 | 0-30 |
| 10-19 | 3-5 | 5-7 | 6-8 | 9-12 | 31-41 |
| 20-29 | 6-7 | 8-10 | 9-11 | 13-15 | 42-50 |
| 30-39 | 8-10 | 11 | 12-13 | 16-18 | 51-57 |
| 40-49 | 11-12 | 12-13 | 14-15 | 19-21 | 58-64 |
| 50-59 | 13-15 | 14-15 | 16-17 | 22-24 | 65-71 |
| 60-69 | 16-19 | 16-18 | 18-19 | 25-28 | 72-79 |
| 70-79 | 20-21 | 19-21 | 20-21 | 29-32 | 80-89 |
| 80-89 | 22-24 | 22-25 | 22-25 | 33-39 | 90-103 |
| 90-99 | 25-28 | 26-40 | 26-36 | 40-75 | 104- |
| *Severe* | | | | | 179 |

ATEC score distribution: The purpose of ATEC is to measure change in an individual due to interventions through therapy. This change is the difference between the initial ATEC scores and the later ATEC scores. The score distribution (Table 2) shows the normative data that permit comparison of one individual with others. The lower the scores, the better; the higher the subscale and total scores are, the more impaired the subject is.

**Results**

The clinical improvement of the autistic children was evident from the parent's observations, through decrease of ATEC scores (Tables 3 and 4). This improvement of ATEC scores was seen in six of the seven children under upper cervical adjustment and in five of the seven children under full spine adjustment. The total ATEC average improvement in the upper cervical group was 32%, while only 8.3% in the full spine group. The highest improvements for the children in the upper cervical group were 93%, 62.5%, and 55%. Two of these three children no longer met the criteria to be considered autistic following the interventions. In the full spine group, the average was mild to moderate improvement, with high improvement in two children (60% and 44%). The highest improvement out of all of the children was 93% for the girl in the upper cervical group. Clinical deterioration was shown in two children of the full spine group (-36% and

Table 3. ATEC for Autistic Children Under Full Spine Adjustment

| | Initial ATEC | | | | | Final ATEC | | | | | Improvement %* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | S/L/C | SOC. | S/CA | H/P/B | T | S/L/C | SOC. | S/CA | H/P/B | T | |
| 1. | 4 | 5 | 4 | 3 | 16 | 2 | 3 | 5 | 5 | 15 | 6.25 |
| 2. | 8 | 8 | 20 | 24 | 60 | 8 | 11 | 15 | 20 | 54 | 10 |
| 3. | 3 | 3 | 5 | 12 | 23 | 4 | 4 | 5 | 5 | 18 | 22 |
| 4. | 22 | 17 | 25 | 44 | 108 | 11 | 6 | 16 | 10 | 43 | 60 |
| 5. | 26 | 35 | 33 | 55 | 149 | 22 | 19 | 26 | 16 | 83 | 44 |
| 6. | 6 | 14 | 14 | 40 | 74 | 0 | 10 | 7 | 27 | 44 | -36 |
| 7. | 15 | 9 | 14 | 6 | 44 | 20 | 8 | 13 | 24 | 65 | -48 |

* Total ATEC average improvement is 8.3% S/L/C : Speech/Language/Communication; SOC. : Sociability S/CA : Sensory/Cognitive Awareness; H/P/B : Health/Physical/Behavior; T : Total (ATEC) score

Table 4. ATEC scores for autistic children under AO upper cervical adjustment

| | Initial ATEC | | | | | Final ATEC | | | | | Improvement %* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | S/L/C | SOC. | S/CA | H/P/B | T | S/L/C | SOC. | S/CA | H/P/B | T | |
| 1. | 1 | 8 | 3 | 14 | 26 | 0 | 3 | 2 | 6 | 11 | 55 |
| 2. | 20 | 1 | 7 | 13 | 41 | 20 | 2 | 4 | 13 | 39 | 1.4 |
| 3. | 9 | 8 | 8 | 7 | 42 | 0 | 3 | 3 | 9 | 15 | 62.5 |
| 4. | 4 | 4 | 5 | 8 | 21 | 3 | 10 | 2 | 7 | 22 | -1 |
| 5. | 4 | 3 | 8 | 14 | 29 | 0 | 1 | 0 | 1 | 2 | 93 |
| 6. | 21 | 24 | 23 | 41 | 109 | 21 | 23 | 25 | 36 | 105 | 3 |
| 7. | 1 | 3 | 0 | 16 | 20 | 1 | 3 | 2 | 12 | 18 | 10 |

* Total ATEC average improvement in this group is 32

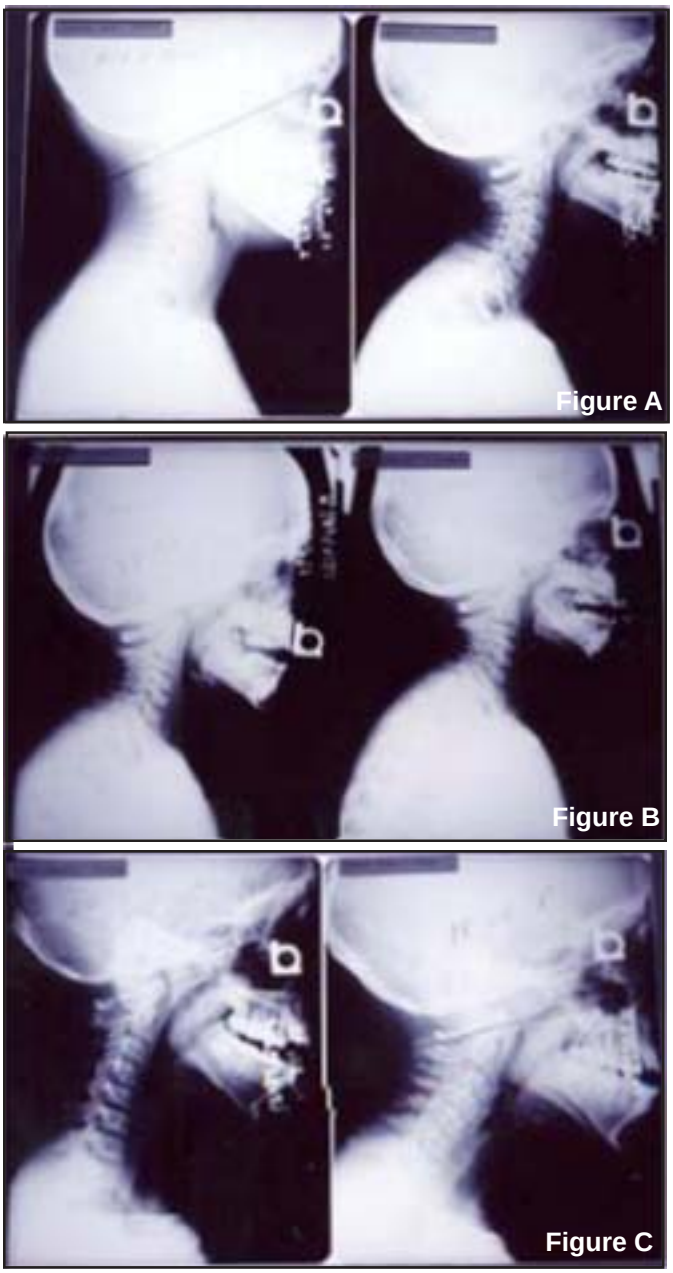
-48%), but only marginal in one child of the upper cervical group (1%).

The most common clinical aspects of improvement were in communication, verbal skills, eye contact, mood, and physical sport skills.

The structure changes on x-ray films showed return of cervical lordosis immediately after the first AO adjustment (Figures A-C). The structural changes on frontal x-ray views (Figures D-F) showed that the line through the cranium returns to the vertical position. The horizontal x-ray views (Figures G-I) showed the disappearance of rotation along this plane and the formation of a 90-degree angle with a vertical line drawn through the center of the skull. Leg length became leveled after each adjustment and became imbalanced only when the patient required another adjustment (Figures J-L).

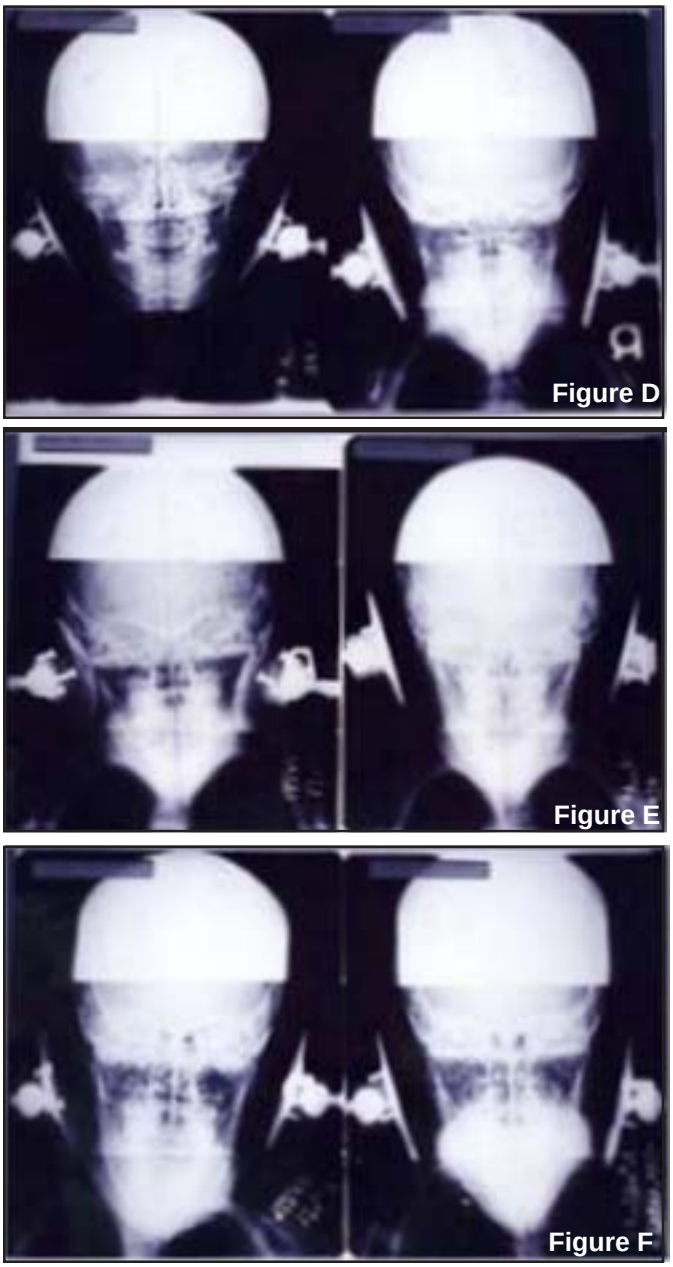
Although the parents were often the translators between the doctor and the children, either verbally or through sign language, difficulties sometimes occurred when getting the child to perform a certain task. In other incidences, a child would blankly stare into space with no response whatsoever to the doctor's command. In these situations, the patient could be gently guided to the proper position to perform the desired tasks

**Pre Adjustment and Post Adjustment Lateral Cervical Radiographs**




Figures A-C show lateral cervical x ray pre adjustment views (left) and post adjustment views (right). These views show the improvement of cervical spine curve of 3 autistic children. These are best viewed electronically.

**Pre Adjustment and Post Adjustment Frontal Radiographs**



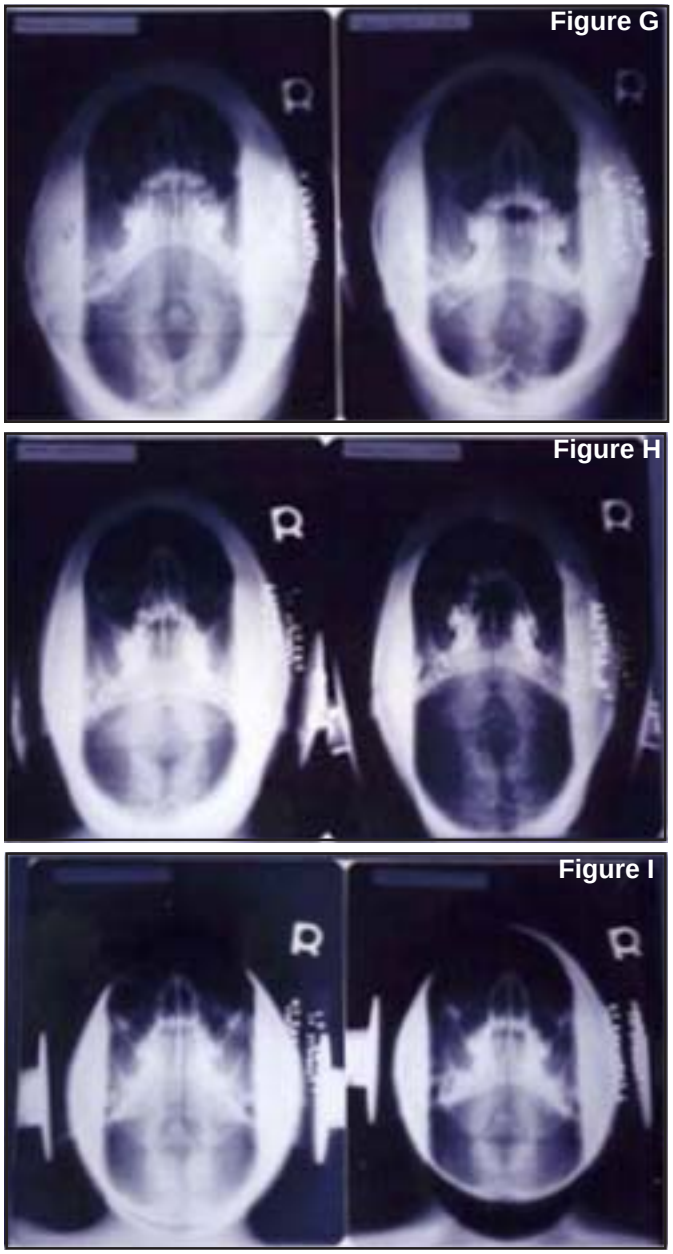

Figures D-F show frontal cervical x ray pre adjustment views (left) and post adjustment views (right). These view show the lines through the cranium return to the vertical position in 3 autistic children. These are best viewed electronically.

(e.g. leg checks or an adjustment). A few of the children displayed aggressive behavior such as pushing, falling, flaying arms in the air, and kicking. These actions were usually momentary. Chiropractic care was resumed when he child was able to continue.

On the other hand, repetitive trunk movements made by the children were used to the doctor's advantage during motion palpation of the spine. It was interesting to see the enjoyment of the children while they were at the office or when a child expressed dismay when it was not yet his turn for care. It was also interesting to see how parents became a very sensitive monitor to their child's skills; they predicted that when their child's skills began to taper off, it was time for another adjustment. X-ray examination proved to be the most difficult procedure for autistic children. There had to be another doctor, chiropractic assistant, or parent available to help with the process. In most instances, the presence of the parent was an important component to keep the child from moving. A few circumstances required that the patient's head be stabilized with another's hand. Lead protection was used every time. Only in one case, as mentioned before, the x-ray procedure made the parent impatient and decided to drop out at the time of the initial x-ray procedure.

Hypersensitivity to light and sound were also observed. Light from the collimator bulb either scared or fascinated the children. Sound from the adjustment instrument had the same effects. Repetition of office procedures eventually allowed the children to become familiar with their surroundings and allowed both the doctors and children to become comfortable with one another.

**Pre Adjustment and Post Horizontal Radiographs**



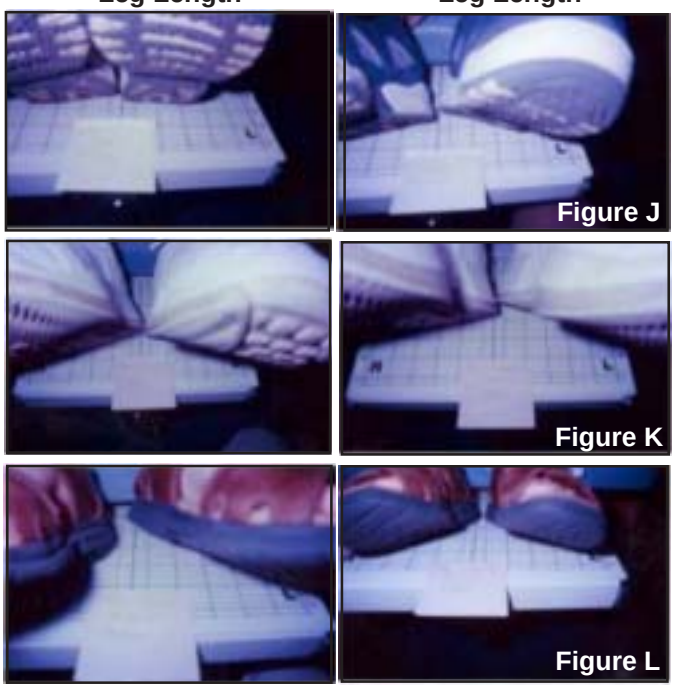

Figures G-I show horizontal cervical x ray pre adjustment views (lef) and post adjustment views (right). These views showthe disappearance of atlas rotations and return to the orthogonal position in 3 autistic children.These are best viewed electronically.

**Discussion**

The positive outcome of chiropractic care for children with special needs in general and with autism in particular encouraged the chiropractors to try different techniques. It was in an incidental use of upper cervical adjustment in one autistic child under full spine care that the enhanced outcome of care was discovered.[5] No other study is available in that regard.

This study is intended to identify the difference in efficacy between upper cervical and full spine adjustment in autistic children. To eliminate variation in clinician's skill in the chiropractic adjustment as a factor, an upper cervical technique using an adjusting instrument was selected. The adjusting instrument in use in AO gives a reproducible standard percussion.

**Supine Leg Assessments**




Figures J-L show supine leg assessments pre adjustment (left) and post adjustment (right) in 3 autistic children.

However, the doctors who performed the adjustment were Board certified in this technique. For monitoring of the outcome measures, ATEC was used for the following reasons:

1 It was designed by experts in biomedical research for the care of autistic children.
2 It has high reliability.
3 Scoring availability on line.
4 It is not copyrighted.

In addition, using ATEC may unify efforts of researchers from different disciplines by using the same monitoring tool. Future combined care and research should include participants from both the chiropractic and the biomedical fields. Also, it makes the outcome of chiropractic care more understandable by non-chiropractic biomedical researchers.

Possible improvements could be made in the area of imaging these patients. Recumbent x-rays may have been more agreeable to some of the children. Other methods of imaging such as CT may be more time efficient and produce the viable images needed to determine the vectors of correction for the occipito-atlanto-axial vertebral subluxation complex.

## Conclusion

The clinical improvement of autistic children under full spine chiropractic care was enhanced four fold when the technique of adjustment was shifted to upper cervical in this study. The instrument use in AO upper cervical technique, which was chosen in this study, may be the ideal for such a complicated condition. Modification of AO protocol may be warranted for better images for these children, such as table x-ray or the use of CT.

Further studies to determine the clinical efficacy of AO upper cervical adjustment is needed to compare the outcome of care in autistic children who never had any other chiropractic technique before to those who had and shifted to this technique. Also, further studies are needed to compare the clinical efficacy on autistic children of different age groups.

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