CASE STUDY

The Role of Chiropractic in Traumatic Brain Injury: A Case Study

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ABSTRACT

Objective: To demonstrate the importance of chiropractic care as an integral part of the healing process of a patient with a Traumatic Brain Injury (TBI).

Clinical Features: A 55 year old female patient presented to the office with a history of two automobile accidents which had both caused a number of physical symptoms including whiplash, loss of range of motion in her right arm, SI joint pain, shoulder pain, hand pain, parasthesias in the upper and lower extremities, and loss of balance. Complicating the healing process was the onset of depression and suicide attempt after the death of her husband, six years after the second automobile accident.

Interventions and Outcomes: Torque Release Technique protocols were used to evaluate and adjust spinal subluxations as it provides a low force adjustment. Adjustments were performed twice weekly over the documented seven months of care. Within one month of care, the patient noted a decrease in symptoms and an improvement in her quality of life. Periodic re-evaluations demonstrated an improvement in physical findings as well as improvement in the function of her autonomic and motor systems as documented by thermal and SEMG scanning.

Conclusion: The results of this case study indicate that patients with traumatic brain injury may benefit from including chiropractic care while healing from their physical and emotional stresses.

Key Words: *Chiropractic, Subluxation, Torque Release Technique, Traumatic Brain Injury, Surface Electromyography, Thermography,*

Introduction

Traumatic Brain Injuries (TBI) have the ability to drastically alter a person's lifestyle both temporarily and/or permanently for the rest of their life. There are physical, biochemical, and emotional stresses that are associated with a TBI. As one of the aims of chiropractic care is to reduce those stresses and find a balance in a person's life, it is a vital component to the healing process of any patient inflicted with a TBI. Care must be taken to evaluate the neurological integrity and spinal stability of the patient and tailoring the technique to be utilized to what the patient can tolerate.

The purpose of this case study was to document the healing process of a patient with a TBI and to demonstrate the role that chiropractic played in this process. Prior to beginning care, the chiropractor and patient discussed the goals for the patient with those goals being subluxation reduction, symptom reduction, and increased quality of life. Over a documented seven months of care, the doctor and patient observed success in all three areas as demonstrated by physical exam findings, results of surface electromyography thermal scanning and patient subjective reports.

Case Report

History

A 55-year-old female patient presented to the author's office with significant neurological and neuromuscular symptoms due to a severe brain injury. The patient had a history of two car accidents within two years. The first was a head on collision, and the second, one year later, involved a half-ton truck accelerating into her parked car.

Immediately after the first car accident, the patient experienced a loss of range of motion in the right arm, severe

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whiplash, right SI pain, and a lump grew in her right breast due to seatbelt injury. The lump was later removed surgically. Pain began bilaterally in the scapulae and radiated to the right deltoid. At this time, the patient began chiropractic care at a different office and had her cervical spine adjusted manually. There was no relief in pain symptoms; however there was an 80% improvement in arm range of motion.

After the second car accident, the patient experienced mild whiplash, a loss of range of motion in her left arm, bilateral pain in the shoulders with certain movements, bilateral pain in hands, tingling sensation in the upper and lower extremities, and a loss of balance. Post-traumatic stress disorder was diagnosed by her medical doctor. Damage to the right occipital lobe caused disturbed vision characterized by floaters, bilateral blind spots, and vision that fluctuated in and out especially when tired. The patient walked either with a cane in her right hand or a walker and described the sensation as "feeling as if walking on a curb with the right foot up and the left foot down". After chiropractic care and physical therapy, the patient re-gained 90% of range of motion; however there was very minimal change in other symptoms.

The patient first presented to the author 9 years after the 2nd accident. She was experiencing dizzy spells occurring when bending over, moving too quickly or rising up from a sitting or lying position. Other problems included pain in the right SI area that could be irritated by simple every-day tasks, pain between the scapulae, sore neck and shoulder muscles, pain that radiated from shoulders into mid-thoracic region with bilateral lateral flexion of the neck, an antalgic lean to the right, and symptoms previously reported due to both motor vehicle accidents.

Her medical physician was currently treating the patient for different health issues. She was on medications for menopause that later caused fibroids and vaginal bleeding, according to the patient. She was also experiencing painful and burning urination, spastic colon, and pain in the left lower quadrant that had been suggested to be "bladder or bowel problems".

Six years after the second accident the patient experienced severe depression and attempted suicide after the death of her husband. She was currently on *Paxil* for depression, *Atenolol* for hypertension, *Clonazepam* for panic disorders, *Losec DR* (aka Prilosec) for acid indigestion, and *Mobicox* for pain control.

Exam Findings

Upon examination the following findings were noted:

Range of Motion

Range of motion studies were unable to be recorded with a numerical value due to extreme pain produced by the initiation of movements. The following was the patient's account of the pain:

- Cervical flexion and extension produced pain in the mid-scapular region.
- Left cervical rotation produced pain in the right SCM and mid-thoracic region.
- Right cervical rotation produced pain in the left SCM and mid-thoracic region.
- Bilateral cervical lateral flexion produced pain in the trapezius muscles bilaterally.

- Bilateral cervical Kemp's test produced pain on the opposite side at T1.
- Cervical Distraction and Compression produced pain in the occipital region, scapula, and mid-trapezius muscle.

- Lumbar Range of Motion was unable to be performed due to pain.
- Lumbar Kemp's tests were unable to be performed due to pain.

- Heel/Toe walk was unable to be performed due to pain in low back and lack of balance.

Muscle Tests

	Left	Right*
• Grip	10	10
• Deltoid	4/5	4/5
• Biceps	1/5	1/5
• Triceps	1/5	1/5
• Wrist Extension	1/5	1/5
• Wrist Flexion	1/5	1/5
• Finger Abduction	1/5	1/5
• Finger Adduction	1/5	1/5
• Hamstrings	1/5	1/5
• Quadriceps	1/5	1/5
• Hip Flexion	1/5	1/5
• Psoas	1/5	1/5
• Hip Abduction	1/5	1/5
• Hip Adduction	1/5	1/5
• Gluteus	1/5	1/5
• Foot Dorsi-Flexion	1/5	1/5
• Foot Plantar-Flexion	1/5	1/5

There was muscle hypertonicity observed in the trapezius, bilateral SCM, bilateral rhomboids, and right quadratus lumborum.

Reflexes

Wexler Deep Tendon Reflex Grading Chart

	Left	Right
• Biceps	+2	+2
• Triceps	0	0
• Brachioradialis	+2	+2
• Patellar	0	+2
• Achilles	0	+5

Dermatome Testing

- C4 and C5 increased on the left.
- C6, C7, and C8 increased on the right.
- L4 and L5 increased on the right.

- S1 was tested in the seated position. However, while in the seated position the patient experienced a loss of balance and dizziness; and therefore examiner felt that it was unable to be recorded accurately.

Postural Analysis

With the patient standing and the examiner located posterior to the patient, she presented with a right antalgic lean, right low ear, left low shoulder, right low pelvis, and anterior head carriage of one inch. Patient walks with cane in right hand.

Surface Static EMG Results

An Insight 7000 surface EMG was utilized to assess somatic paraspinal muscle tone and symmetry. Standardized protocols and established normative data were utilized for computer analysis and comparison.

The scan revealed an overall shift in hypertonicity to the left in the cervical spine with severe hypertonicity bilaterally at C1 and moderate hypertonicity bilaterally at C3.

Thermal Scanning Results

An Insight 7000 thermal scanner was used to assess sympathetic nerve function. Standardized protocols and established normative data were utilized for computer analysis and comparison.

- Temperature differences one to two standard deviations greater than the mean were observed at: C5, T1, T2, T8, T9, and S1, indicative of mild asymmetry.
- Temperature differences two to three standard deviations greater than the mean were observed at L4, indicative of moderate asymmetry.
- Temperature differences three to four standard deviations greater than the mean were observed at C4, indicative of severe asymmetry.

Radiological Examination

Lateral Cervical, Flexion/Extension, Lateral Lumbar, and AP Full Spine x-rays were taken. All x-rays were taken from a weight-bearing position.

Findings were as follows: Lateral Cervical showed diminished cervical curve (military neck), mild degeneration and decreased disc space at C5, C6, and C7, retrolisthesis of C4, and approximation of occiput and C1 in the posterior aspect of the spine. Cervical Flexion/Extension series showed little-to-no flexion and decreased extension at all levels.

Vertebral subluxations at multiple levels were diagnosed As follows: Bilateral occiput, C1, C2, C6, C7, T1, T5, T6, T8, T9, T12, L3, L4, L5, and Sacrum.

Summary of Examination

Vertebral subluxations with components of dyskinesia, facilitation, kinesiopathology, neuropathophysiology, and myopathology were observed.

Chiropractic Care

Patient began chiropractic care after appropriate consent was received. The technique utilized throughout was Torque Release Technique with the care plan for this patient being directed according to indicators assessed by Torque Release Technique protocol and palpation. Description of this technique protocol and use of the Integrator instrument has been described previously.[1,2]

TRT is a non-mechanistic, non-linear technique. It utilizes the Integrator Recoil instrument, specially designed to reproduce the different components of the adjustment: thrust, torque, and recoil but at the speed of 1/10,000th of a second.[1] Considering the severity of the neurological integrity of the patient in this study, TRT was an ideal adjusting technique to use.

The examiner felt that the patient required intensive chiropractic care; however due to the nature of the patient's chronic condition and extensive symptoms, a care plan of twice a week was established in order for the patient to adapt to care.

For the first two visits, patient noted dizziness immediately following chiropractic adjustment. After one month of care, patient noted that dizziness had decreased dramatically, specifically when rising from a supine or seated position to standing.

PROGRESS EXAMINATION - ONE MONTH

Static EMG Results

This follow-up scan revealed an improvement in the left shift of hypertonicity to a more balanced pattern of paraspinal muscular activity. The upper cervical hypertonicty has decreased.

Thermal Scanning Results

- Temperature differences one to two standard deviations greater than the mean were observed at T3, L2, and L4. This is indicative of mild asymmetry.
- Temperature differences two to three standard deviations greater than the mean were observed at T2, T9, T11, L1, and L3. This is indicative of moderate asymmetry.
- Temperature differences three to four standard deviations greater than the mean were observed at C3, T10, and L5. This is indicative of severe asymmetry.
- Temperature differences four or more standard deviations greater than the mean were observed at: C1 and T4. This is indicative of very severe asymmetry.

Chiropractic care continued at two times per week.

COMPARATIVE EXAMINATION - 4 MONTHS

Range of motion

Initial examination of the patient's range of motion produced extreme pain and so a numerical value could not be recorded. Noting improvement on the re-examination, all of the following motions were now able to be performed without pain and therefore have a numerical value.

- Cervical extension 50/60
- Cervical flexion 45/50
- Left cervical rotation 60/80
- Right cervical rotation 65/80
- Left cervical lateral flexion 35/45
- Right cervical rotation 35/45

- Bilateral cervical Kemps tests were negative.
- Cervical Distraction and Compression were negative.

- Lumbar extension 5/25
- Lumbar flexion 0/60
- Left lumbar rotation 0/25 with pain in mid-scapular region
- Right lumbar rotation 0/25 with pain in mid-scapular region
- Left lumbar lateral flexion 25/25
- Right lumbar lateral flexion 25/25

- Bilateral lumbar Kemps tests were negative.
- Heel/Toe Walk was unable to be performed due to lack of balance.

Muscle Tests

	Left	Right*
Grip Strength	30	80
Deltoids	4/5	4/5
Biceps	1/5	1/5
Triceps	1/5	1/5
Wrist Extension	5/5	5/5
Wrist Flexion	2/5	2/5
Finger Abduction	2/5	2/5
Finger Adduction	2/5	2/5
Hamstrings	1/5	1/5
Quadriceps	1/5	1/5
Hip Flexion	5/5	5/5
Psoas	0/5	0/5
Hip Abduction	5/5	5/5
Hip Adduction	5/5	5/5
Gluteus	2/5	2/5
Foot Dorsi-Flexion	5/5	5/5
Foot Plantar-Flexion	5/5	5/5

* Indicates right-handedness

Muscle hypertonicity was noted bilaterally in the scalenes, levator scapula, and upper trapezius.

Reflexes

	Left	Right
Biceps	+2	+2
Triceps	+2	+2
Brachioradialis	+2	+2
Patellar	+2	+2
Achilles	+2	+2

Dermatome Testing

- C5, C6, C7, C8, and T1 were increased on the right.
- L3, L4, L5, and S1 were increased on the right.

Postural Analysis

Anterior Head Translation of 1.5 inches, right low ear, left low shoulder, and right low hip were all noted.

Static EMG Results

This exam revealed a return to the left shift in hypertoncity but this is met by an increase in muscular activity on the right - though not to the same degree. A more normal paraspinal pattern appears to be emerging.

Thermal Narrative

- Temperature differences one to two standard deviations greater than the mean were observed at T5, T8, and T9. This is indicative of a mild asymmetry.
- Temperature differences two to three standard deviations greater than the mean were observed at T10 and T11. This is indicative of a moderate asymmetry.
- Temperature differences four or more standard deviations greater than the mean were observed at C1. This is indicative of a very severe asymmetry.

Chiropractic care was continued at two times per week.

PROGRESS EXAMINATION - 6 MONTHS

Static EMG Results

Overall hypertoncity has reduced with only two spinal levels (C1 & T4) showing increased tonicity.

Thermal Scanning Results

- Temperature differences one to two standard deviations greater than the mean were observed at L4 and L5. This is indicative of a mild asymmetry.
- Temperature differences three to four standard deviations greater than the mean were observed at C1 and T5. This is indicative of a severe asymmetry.
- Temperature differences four or more standard deviations greater than the mean were observed at T4. This is indicative of a very severe asymmetry.

Summary of Patient Care

The patient has reported dramatic improvements in her health status as well as ability to accomplish daily activities. Her dizziness has completely resolved. She feels more stable and comfortable when walking, although use of a cane is still mandatory. Muscle strength in her arms, shoulders, and legs have improved and she notes she no longer has pain in her SI joints. The documented improvements in the surface EMG and thermal scans give us an objective measure of a decrease

in paraspinal muscle activity and an improvement in the integrity of the autonomic nervous system respectively.

Discussion

The Brain Injury Association of America defines a brain injury as:

> *"...an insult to the brain, not of a degenerative or congenital nature but caused by an external physical force, that may produce a diminished or altered state of consciousness, which results in an impairment of cognitive abilities or physical functioning. It can also result in the disturbance of behavioral or emotional functioning. These impairments may be either temporary or permanent and cause partial or total functional disability or psychosocial maladjustment."*[3]

There are two general types of brain injuries: traumatic and acquired. A traumatic brain injury (TBI) occurs when an external force causes damage to the head by inducing motion of the brain within the skull. A TBI can affect only one part of the brain or several different areas. The severity of a TBI depends on the type and amount of force that is acquired. Traumatic brain injuries are sub-divided into two categories: primary and secondary. A primary injury occurs at the point of trauma and a secondary injury occurs after trauma and produces effects that continue for long periods of time.[4]

In the case of this patient, the primary injury occurred during the two motor vehicle accidents. The secondary injury was caused by the *effects* of the primary injuries, specifically cellular damage.

Kraus et al. explains how secondary injuries come about through the following neurochemical mediators: excitatory amino acids, endogenous opioid peptides and increased intracranial pressure. Excitatory amino acids are responsible for cell swelling, vacuolization, and neuronal death. Opioid peptides modulate the presynaptic release of EAA (excitatory amino acid) neurotransmitters, thereby exacerbating neurological damage.[4]

Holder and Blum suggest that every level of the spine has an intimate relationship with the limbic system's ability to process and establish a balanced *Brain Reward Cascade*.[5] Furthermore, vertebrates have an opiate receptor brain reward cascade mechanism and the brain reward cascade is dependant on the proper functioning of the dopaminergic and opioidergic reward pathways of the nervous system. These are critical in providing the pleasure drives for eating, love, and reproduction that are elemental in the survival of vertebrates. The "natural reward" of pleasurable sensations involves the release of dopamine, the primary neurotransmitter in the brain reward pathway. The proper functioning of the brain reward pathway and its proper sensations of pleasure are dependent on the genes that regulate the dopamine receptors and the synthesis, degradation, and transportation of dopamine.[6] Opioid peptides cause the release of dopamine in the nucleus accumbens.[7,8] Kyles et al. found that when dopaminergic and opioid systems process nocioceptive information it is mediated spinally.[9]

According to D.D. Palmer in 1910, if the spinal column is free of interference from spinal subluxations then the body is able to adapt to its inner and outer environment to the best of its ability.[10] A subluxation has been defined as a complex of functional and/or structural and/or pathological articular changes that compromise neural integrity and may influence organ system function and general health.[11] Mollendorf states:

> "The vertebral subluxation also interferes with the function of the dopamine receptors in the nervous system, particularly in the dorsal roots of the spinal nerves and the dorsal horn of the spinal cord. This will lead to further altered function and incoordination. This is often seen when obsessive/compulsive or addictive behaviors are used by Educated Brain in response to Innate Intelligence's messages to increase the release of dopamine in the limbic system (including the dorsal roots of the spinal nerves and the dorsal horn of the spinal cord) until the vertebral subluxation can be reduced or corrected."[12]

This author's theory is that due to this patient receiving regular chiropractic adjustments effectively correcting her spine of multiple levels of subluxation, that this allowed her body to properly modulate the opiate receptors. Such restored function thereby reduced pain and decreased the release of EAAs—which would in turn decrease the effects of cellular damage, as well as moderating the release of dopamine and establishing a balanced brain reward cascade system. As a result, pain decreases and quality of life improves.

According to research out of the University of Michigan Health System's Department of Physical Medicine and Rehabilitation, more than 80 percent of individuals that suffered from traumatic brain injuries believed that the alternative approaches to health including chiropractic were effective, even though there has been little medical assessment in most cases.[13]

Conclusion

Based on the results of this case, chiropractic should be considered for patients recovering from traumatic brain injuries. There were three specific goals that the chiropractor and patient set out to achieve before chiropractic care commenced: subluxation reduction, reduction of symptoms, and increased quality of life for the patient. All three goals were accomplished within six months of beginning care. Initially, adjustments were being provided for up to six levels per visit. This author notes that Torque Release Technique protocol indicates the number of levels adjusted per visit should be a maximum of three. Over the course of this patient's care, there were occasional visits when more than three segments were adjusted, due to special circumstances. Keeping in mind the severity of injuries experienced through brain injury, the number of specific individual adjustments continued to be at three to six levels; however a change in subluxation pattern was noted.

A reduction of symptoms was also noted gradually within one month and continued throughout care. An increase in the quality of life was at first thought impossible by the patient but

was soon realized when she was able to perform daily tasks that at one point seemed impossible.

The potential for a chiropractic adjustment to make a change in someone's quality of life should never be underestimated. In this case, someone who had lost hope in life due to severe physical injuries and emotional trauma she had experienced once again discovered that she could enjoy life to her fullest capabilities. The patient continues under chiropractic care at this time.

Further studies showing the effects of chiropractic on the healing process of patients with traumatic brain injuries and studies encompassing a larger group are needed.

References

1. Holder, J. Torque Release Technique Course Notes.
2. Anderson-Peacock E, Reduction of Vertebral Subluxation using Torque Release Technique with Changes in Fertility: Two Case Reports. *J Vertebral Subluxation Res* July 19, 2003 1.
3. Traumatic Brain Injury, www.biausa.org/Pages/types_of_brain_injury.html, Brain Injury Association of America
4. Kraus JF, Black MA, Hessol N, Ley P, Rokaw W, Sullivan C, et al. The incidence of acute brain injury and serious impairment in a defined population. *Am J. Epidemiology* 1984;119(2):186-201
5. Blum, K, Holder J. *The Reward Deficiency Syndrome: A Biogenic Model,* Mattituck, NY: Amerion Ltd. 1997
6. Blum, K, Braverman, J. M, Holder J, et al. *Journal of Psychoactive* Drugs 2000;32 (November supplement).
7. Gessa, G. L., Muntoni F, Collu M, Vargiu L, Mereu G. . Low doses of ethanol activate dopaminergic neurons in the ventral tegmental area. *Brain Research* 1985;348(1):201-203
8. Koob GF. Bloom FE. Cellular and molecular mechanisms of drug dependence. *Science* 1988;242(4879):715-723.
9. Kyles A.E.; Waterman, A.E.; Livingston, A., Antinociceptive effects of combining low doses of neuroleptic drugs and fentanyl in sheep : *American Journal of Veterinary Research* 1993 Sep;54 (9):1483-1488
10. Palmer DD, The Science, Art and Philosophy of Chiropractic, 1910; p.364.
11. Association of Chiropractic Colleges: Issues in chiropractic. Position Statement #1. The ACC Chiropractic Paradigm, Chicago, July 1996, Association of Chiropractic Colleges
12. Moellendorf JG, Innate Intelligence and Chiropractic in the Care of Obsessive/Compulsive and Addictive Behaviors. © 2003 JGM, www.all-about-wellness.com/adhd.htm
13. Hopson K, Brain injury patients now turning to alternative medicine for treatment, Press Release from University of Michigan Health System, April 1, 2003.

CASE STUDY

Complications Following Brain Surgery Improved After Upper Cervical Chiropractic Care: A Case Study

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ABSTRACT

Objective: To evaluate and discuss the effects of upper cervical chiropractic care on a 17-year-old female patient with a loss of balance, speech difficulties and postural distortion following the removal of an astrocytoma from her cerebellum

Clinical Features: The patient is a 17-year-old female that was diagnosed with a cerebellar astrocytoma that was previously removed. The patient presented to the office with significant postural abnormalities, difficulty with balance and difficulty with speech. that began post surgery. The patient presented to the office 4 years after the surgery.

Intervention & Outcomes: A case history and chiropractic examination was performed and it was determined that the patient had a subluxation of the C1 (atlas) vertebra. The patient received chiropractic care following the National Upper Cervical Chiropractic Association (NUCCA) protocol. The duration of care was five months and the patient was seen 28 times. At each visit she was checked for vertebral subluxation and was adjusted a total of 26 times. The patient reported an improvement in her balance from a 6/10 to a 9/10 and experienced a 90% improvement in her speech.

Conclusion: The findings presented in this case suggest that upper cervical adjustments may benefit patients who suffer from post surgical complications.

Key Words: *chiropractic, NUCCA, balance, proprioception, ataxia, cerebellum, subluxation, astrocytoma, cancer*

Introduction

The cerebellum is part of the central nervous system (CNS) that is a relatively large mass posterior to the pons and medulla. It consists of two lateral hemispheres that are connected by a narrow middle part called the vermis.[1] The cerebellum has no direct ability to cause muscle contraction but if harmed or removed, body movements become uncoordinated and abnormal.

This happens because the cerebellum helps to sequence motor activity and makes adjustments in the body's motor patterns. The cerebellum makes changes to movement patterns as they are happening so the body will conform to the signals directed by the cerebral cortex and other parts of the brain.[2] The connection between the motor units of the body to the CNS is also seen in muscle spindles as they enable the CNS to modify or control the activity of the receptors.[3]

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The cerebellum coordinates muscle function at three different levels consisting of the vestibulocerebellum, the spinocerebellum, and the cerebrocerebellum. The vestibulocerebellum is responsible for the body's equilibrium. The spinocerebellum is responsible for coordinating distal portions of the limbs such as the hands and fingers. The cerebrocerebellum functions as a feedback system with the cerebral cortical sensorimotor system to help plan for voluntary body and limb movements before the movements happen.[1]

It has been observed that excessive sway and difficulty with maintaining equilibrium in an upright posture can become a problem for people with lesions in the cerebellum. If there is damage to the anterior lobe of the cerebellum it has been seen to cause anteroposterior body movements.[2] If spinocerebellar input is affected then it can cause a strong lateral sway component to an upright stance. Lesions that would involve the vestibulocerebellar connections cause a multi-directional oscillating movement.[4] These findings support the idea that cerebellar damage causes increased postural sway during stance.[5]

These lesions in the cerebellum have been seen to affect several motor functions and lead to disorders. Cerebellar disorders typically present with ataxia, incoordination of movement, instability of gait, impairment of articulation, and difficulty with eye movement and swallowing.[6] Ataxia is uncoordinated movement that result when the motor control system cannot predict how far the movements need to be and overshoots the mark and rapidly succeeds which is called dysmetria.[2]

Damage to the cerebellar component of the distributed neural circuit leads to impairment of the area containing the lesion, which manifests as ataxia.[6] A study done on 22 children and adolescents looked at single and multi-joint finger and arm movements after cerebellar tumor removal. All the participants were evaluated at a minimum of 3 years after surgery and showed that 54% of the participants had upper limb ataxia.[7] Since intact joint position sense is necessary for normal muscle coordination and timing, there is a loss of balance.[8] Cerebellar lesions in the superior hemispheres may lead to speech deficits known as speech dysarthria. The speech alterations that have been seen are imprecise consonant and vowel sounds, irregular articulatory breakdown, reduced speaking rate and harsh voice quality.[9]

In the early stages of cerebellar degenerative disorder, balance is poor and there is an inability to stand on one leg. As the degeneration progresses a wider base is seen and when ataxia is severe, the ability to walk and stand without assistance decreases.[6]

Case Report

History

A 17-year-old female presented to the office with health concerns that consisted of an astrocytoma that was surgically removed from her cerebellum four years prior. The patient also reported scoliosis, headaches, tremors, fatigue, loss of balance, and dizziness. The patient had originally received a diagnosis of an astrocytoma from a CHECK practitioner when they were looking for reasons for her hand tremors and dizziness. Surgery was performed to remove the tumor from the cerebellum. After the surgery the patient experienced a significant decline in her postural control, her speech began to slow and was slurred and her balance deteriorated. Her balance declined to the point that she was no longer trusted to drive. She also had fatigue and headaches that were debilitating and caused her to vomit. Prior to the current symptoms she was an avid dancer and soccer player. She was also taking no medication. The CHECK practitioner had referred her to the chiropractic office.

Chiropractic Examination

The purpose of the chiropractic examination was to determine if a vertebral subluxation was present at the location of the C1 and C2 vertebrae. This is determined by gathering information about the body through posture analysis using hip calipers, observing leg length in the supine position, manual palpation, thermography, and x-rays. The patient presented with a short left leg of ½ inch when checked in the supine position. There was left cervical rotation restriction with severe right head tilt. She had a low left shoulder of 4.25 degrees and a right low hip of 2.25 degrees. Manual palpation revealed C1 fixation, suboccipital tension, right C4-5 severe tension, thoracic spine curvature and right sacroiliac joint fixation. Weight distribution was determined to be 82 pounds on the right and 63 pounds on the left; an uneven weight distribution of 19pounds.

Thermography measures the infrared heat that is emitted along the spinal column. This gives clinical information about the nervous system in relation to neuromusculoskeletal conditions and is accurate within 1.0-degree centigrade.[10] The use of thermography has been shown to have a very high intra-examiner and inter-examiner reliability.[11]

Leg length is a tool used by chiropractors for the detection of vertebral subluxation. In a study, examiners agreed on the presence of a functional leg length inequality of at least 1/8 inch in 40 of 50 rating pairs indicating good agreement.[12] It has been found to have excellent intra- and inter-examiner reliability and validity relative to anatomic leg length inequality determined by x-ray measurements in asymptomatic patients. The research also suggests that an unloaded leg-length asymmetry is a different situation than an anatomic leglength inequality which indicates neurological interference to the suprapubic muscles.[13]

Hip calipers were used to measure pelvic distortion in the frontal, transverse, and fixed point planes. This is done while also measuring the weight distribution upon each leg. The hip caliper is a tool that is utilized in the National Upper Cervical Chiropractic Association protocol.[14]

Radiographic Results

The x-rays that were taken during the initial visit consisted of a lateral cervical, nasium and a vertex. These x-rays are the

standard for the National Upper Cervical Chiropractic Association protocol. The lateral cervical is used to determine the angle of atlas. The vertex view is mainly used to determine rotation and the nasium view is used to determine atlas laterality and head tilt. The lateral cervical (Figure 1) showed an atlas angle of 40.82 degrees, the vertex (Figure 2) showed right rotation of the atlas of 0.98 degrees and the nasium (Figure 3) showed a head tilt to the right of 2.77 degrees and right atlas laterality of 3.62 degrees. A study was performed to determine the reliability of upper cervical X-ray marking systems and they were deemed to have a very good degree of reliability. The study concluded that there is strong support for the upper cervical X-ray marking system when the measurements being used are done by properly trained professionals.[15]

Chiropractic Intervention

The patient had a total of 28 office visits over a four month period. Of the 28 office visits the patient was adjusted on 26 of those visits. There was only one day in which the patient was adjusted twice. On each visit the patient was checked for vertebral subluxation using leg length inequality, paraspinal thermography, and palpation of the upper cervical spine. When it was determined that a subluxation existed, a specific adjustment to the atlas was accomplished through a low force move. This low force move is used to create a force or resistance at a calculated angle using a contact at the transverse process of C1. The adjustment consists of a triceps pull that transforms potential energy into kinetic energy, which allows the structure of the head and neck to release a misaligned pattern and move into a more proper mechanical position.[16]

The adjustment vector taken was listed as a right atlas, high ¾", Posterior 1", braced on a C headpiece, with a contact point measured at the tip of the mastoid to correct the subluxation. This contact is determined through the x-rays taken upon the initial visit. Once the patient received the adjustment the patient's leg length inequality was evaluated, the hip calipers were used to analyze posture and paraspinal thermography was performed to determine autonomic function. These tools were utilized as post adjustment assessments as well. A re-exam was completed on the 24th office visit.

Outcome

Upon the 24th visit the patient stated that her balance had improved from a 6/10 to a 9/10 since starting care. The rating of a 10/10 would indicate an improvement of perfect balance and a 0/10 would indicate no balance at all. The patient also stated that her speech had improved over 90% since beginning care and that she feels it is smoother and less choppy. The patient said she noticed improvements as early as the second adjustment and she continues to improve with each adjustment. Nasium and Vertex post X-rays showed improvement in rotation, and head listing (Figures 4-5). Atlas laterality showed an increase, but the lower neck and head tilt were reduced indicating a more optimal position of the spine to gravity. It was deemed that the patient should continue with current chiropractic care.

Discussion

The purpose of this case study was to document the relationship between upper cervical specific care and the changes that occurred in a patient that had a loss of balance. The case study showed an improvement in balance through the correction of an atlas misalignment and the neurological compromise related to it. The reestablishment of balance and the 90% improvement in speech was seen over a 5-month period.

In NUCCA, the main clinical focus is the detection and reduction of vertebral subluxations. The reduction of these subluxations will remove interference in the transmission of mental impulses between the brain and body allowing the restoration of proper physiology. Unfortunately, the mechanism that would explain how the reduction of subluxation would restore proper physiology is poorly understood.

Kent has proposed the dysafferentation model of subluxation that may shed light on this question. The dysafferentation model consists of the idea that a vertebra that subluxates will alter normal nociception and mechanoreception. These altered stimuli will lead to abnormal signaling being relayed to the cerebral cortex. As a consequence of altered signaling, biomechanical dysfunction may occur.[17] This can be corrected through spinal adjustments by introducing a mechanical force that may alter segmental biomechanics by releasing trapped meniscoids, releasing adhesions, or by reducing distortion of the annular fibers. It may also achieve a new position of stable equilibrium. These mechanoreceptors are part of a complex system that helps with the body's proprioception.[18]

Proprioception is defined as the afferent input of internal stimuli from proprioceptive fibers within the body screened from the external environment responsible for body segment stability, posture control, and certain conscious sensations. Neuromuscular control is dependent on the proprioceptive component of the sensorimotor system.[19] This can lead to the proposed idea that altered nociception and mechanoreception from subluxation will cause abnormal signaling to the central nervous system, including the cerebellum therefore compromising the central nervous system.

Grostic[20] has proposed the dentate ligament-cord distortion hypothesis that gives insight intothe upper cervical subluxation. He said that the subluxation of the C1 or C2 vertebra could directly produce neurological insult through mechanical irritation of the spinal cord via vascular compromise of the cervical cord. This occurs because of the attachment to the spinal cord by the dentate ligaments.

The dentate ligaments can directly stress and deform the spinal cord. Vascular compromise occurs from minor misalignments of the atlas, which can compromise the vertebral artery. A study done using MRI examined hypersensitive patients and evaluated the relationships between the upper ventrolateral medulla and vertebral arteries. They found compression of the artery in 90.6% of cases.[21] The vertebral arteries branch off to supply blood to the brain including the cerebellum.[1]

A case study reported by a NUCCA practitioner involved the care of a 14-year-old girl who used single words, mumbled incoherently, did not use her left arm or hand in situations considered to be normal and had poor eye contact. After care the patient immediately maintained eye contact, gave full sentences, had appropriate speech, and regained use of her left arm. The study concluded that there is a relationship between upper cervical adjustments and improvement in mental function. [22]

Several chiropractic studies show improvement in cases regarding a loss of balance as one of the complaints. In a study by Brown et al,[23] a patient presented with multiple sclerosis. She complained of numbness from her multiple sclerosis and she would fall frequently due to her balance issues. The NUCCA protocol was followed throughout care. The study followed her through her first eight months of care and she was seen a total of 44 times. She reported a 50% improvement of her overall balance.

A paper by Sweat and Pottenger[24] reports on a 75-year-old female who presented with gait ataxia, strabismus in the left eye, and activity or posture induced seizures. She was placed under Atlas Orthogonal chiropractic care and post adjustment results saw an improvement in her walking. Her walking continued to improve along with her balance to the point that she was able to stand on one foot and an overall improvement in her vision occurred. She also did not have another seizure while under care.

A retrospective analysis by Elster[25] looked at 60 patients with chronic vertigo that were under upper cervical care. The International Upper Cervical Chiropractic Association developed the protocol followed. The patients began treatment at various times over an eight-year period. From the total of 60 cases, 100% of the patients were improved or symptom free.

Conclusion

This case report outlines subluxation-based chiropractic care of a 17-year-old female who was experiencing a loss of balance, difficulty with speech and postural problems following the removal of an astrocytoma from her cerebellum. After a total of five months of care and 26 adjustments the patient's balance improved form a 6/10 to a 9/10 and a 90% improvement in her speech was seen.

This is one case demonstrating an improvement in balance, speech and posture while under chiropractic care. There needs to be further research to determine the relationship and effect the vertebral subluxation has on the cerebellum. The relationship between the vertebral subluxation and the complex process the body uses for proprioception and balance should also be investigated.

References

1. Moore KL & Dalley A *Clinically oriented anatomy.* 5th ed. Baltimore: Lippincott Williams & Wilkins; 2006.
2. Guyton A & Hall J *Textbook of medical physiology.* 11th ed. Philadelphia: Elsevier Saunders; 2006.
3. Fitz-ritson D, The anatomy and physiology of the muscle spindle, and its role in posture and movement: a review. J CCA 1982; 26(4):144-150.
4. Day BL, Steiger MJ, Thompson PD, Marsden Cd. Effect of vision and stance width on human body motion when standing: Implications for afferent control of lateral sway. J Physiol1993; :479-499.
5. Bakker M, Allum J, Visser J, et al. Postural responses to multidirectional stance perturbations in cerebellar ataxia. Exp Neurol 2006; 202:21-35.
6. Schumahmann JD, Disorders of the cerebellum: ataxia, dysmetria of thought, and the cerebellar cognitive affective syndrome. J Neuropsychiatry Clin Neurosci 2004; 16(3):367-378.
7. Konczak J, Schoch B, Dimitrova A, et al. Functional recovery of children and aolescents after cerebellar tumour resection. Brain 2005; 128:1428-1441.
8. Lee H, Liau J, Cheng C, Tan C, Shih J. Evaluation of shoulder proprioception following muscle fatigue. Clin Biomech 2003; 18:843-847.
9. Konczak J, Timmann D. The effect of damage to the cerebellum on senorimotor cognitive function in children and adolescents. Neurosci. Biobehav. Rev. 2007; 31:1101-1113.
10. Brown M, Coe A, DeBoard TD. Mastoid fossa temperature imbalances in the presence of interference patterns: a retrospective analysis of 253 cases. J Vert Sublux Res. 2010;July(15):1-13.
11. Owens, Jr EF, Hart JF, Donofrio JJ, Haralambous J, Mierzejewski E. Paraspinal skin temperature patterns: An interexaminer and intraexaminer reliability study. J Manipulative Physiol Ther 2004; 27(3):155-160.
12. Woodfield HC, Gerstman BB, Olaisen RH, Johnson DF. Interexaminer reliability of supine leg checks for discriminating leg-length inequality. J Manipulative Physiol Ther 2011; 34(4):239-246.
13. Knutson G. Anatomic and functional leg-length inequality: A review and recommendation for clinical decision-making. Part II, the functional or unloaded leg-length asymmetry. Chiropr & Osteopat. 2005;13:12. doi:10.1186/1746-1340-13-12.
14. Noriega A, Chung J, Brown J. Improvement in a 6 year-old with autistic spectrum disorder and nocturnal enuresis under upper cervical chiropractic care. J Upper Cervical Chiropr Res. 2012; :1-7.
15. Jackson BL, Barker W, Bentz J, Gambale AG. Inter- and intra-examiner reliability of the upper cervical x-ray marking system: A second look. J Manipulative Physiol Ther 1987; 10(4):157-163.
16. Goodman R. National upper cervical chiropractic association. [homepage on the Internet]. 2012 [cited 2012 Nov 30]. Available from: http://www.nucca.org
17. Kent C, Models of vertebral subluxation: A review. J of Vertebral Subluxation Res 1996; 1(1):1-7.
18. Pickar JG, Neurophysiological effects of spinal manipulation. Spine J 2002; 2:357-371.

19. Learman KE, Myers JB, Lephart SM, Sell TC, Kerns J, Cook CE. Effects of spinal manipulation on trunk proprioception in subjects with chronic low back pain during symptom remission. J Manipulative Physiol Ther 2009; 32(2):118-126.
20. Grostic JD. Dentate ligament-cord distortion hypothesis. Chiropr Res J 1988; 1(1):47-55.
21. Bakris G, Dickholtz Sr M, Meyer PM, Kravitz G, Avery E, Miller M, et al. Atlas vertebra realignment and achievement of arterial pressure goal in hypertensive patients: A pilot study. J Hum Hypertens 2007; 1-6.
22. Thomas MD, Wood J. Upper Cervical Research Foundation. J Manual Medicine [serial on the Internet]. 2010 [cited 2012 Nov 30].;6 Available from: http://www.ucrf.org/publications
23. Brown J, Chung J, Mccullen B. Upper cervical chiropractic care of a female patient with multiple sclerosis: A case study. J Upper Cervical Chiropr Res 2012; :16-19.
24. Sweat R, Pottenger T. Seizure, ataxia, fatigue, strabismus and migraine resolved by precise realignment of the first cervical vertebra: A case report. J Upper Cervical Chiropr Res 2012; :20-26.
25. Elster E, Sixty patients with chronic vertigo undergoing upper cervical chiropractic care to correct vertebral subluxation: A retrospective analysis. J Vertebral Subluxation Res 2006; :1-9.

Figures

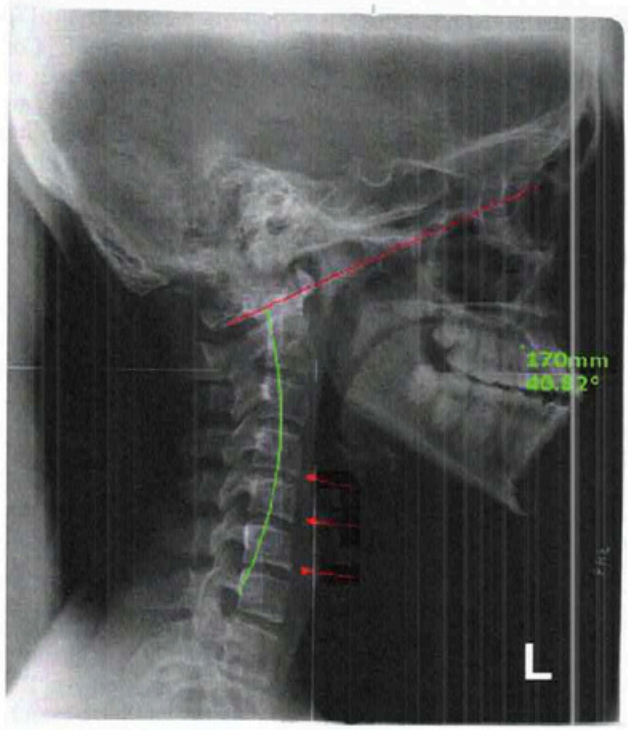

Figure 1. Pre Lateral Cervical View

CASE STUDY

Seizure, Ataxia, Fatigue, Strabismus and Migraine Resolved by Precise Realignment of the First Cervical Vertebra: A Case Report

Roy Sweat DC, BCAO[1] & Tyson Pottenger, DC[2]

ABSTRACT

Objective: To analyze a case which appears to support chiropractic success in treating neurovascular symptoms through adjustment of the first cervical vertebrae.

Clinical Features: The patient was a 75 year old female presenting with gait ataxia, strabismus, fatigue, blood pressure fluctuations, seizures of two weeks duration, and history of concussion with similar symptoms. Previous medical diagnosis and care had been unrewarding.

Intervention and Outcomes: The patient presented to an Atlas Orthogonal chiropractic clinic where she was examined and her atlas vertebra adjusted per the SCALE method. The patient's symptoms were quickly and painlessly reduced and/or resolved.

Conclusion: Results suggest that Atlas Orthogonal care may be responsible for the reduction and elimination of neurological symptoms in this patient. Removal of intracranial insufficiency due to chronic compression of the vertebral artery by misalignment of the first cervical vertebra is a possible explanation for the mechanism of management success. These results suggest that chiropractic care, specifically adjustment of the atlas vertebrae, may be a useful treatment for conditions with neurovascular symptomatology.

Key Words: *seizure, ataxia, fatigue, migraine, vertebral artery, chiropractic, atlas orthogonal, subluxation, manipulation, adjustment*

Introduction

The field of chiropractic is currently recognized as having a very limited scope of practice universally. Chiropractors are seen mostly to treat neck and back pain, but numerous cases of positive results outside of these symptoms are known to occur. The lack of certain explanation for these results is likely the reason chiropractic care is not a more accepted treatment for such conditions. Often, the chiropractor who delivered the care is unsure of exactly how his treatment has prevailed. This uncertainty is brought about by the existence of multiple unproven theories coupled with disagreement within the profession.

The basic definition of a subluxation is a misalignment within the spine causing nerve interference. This disagreement

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exists even concerning the most universal task of a chiropractor: the correction of subluxation.

Originally, chiropractors believed that through manipulation/adjustment they removed nerve interference caused by direct bone-on-nerve compression in the intervertebral foramen (IVF). This theory has been challenged and is no longer considered the most likely explanation.[1] Even with near physiologically impossible stress on a cadaveric spine, the nerve root can still move freely within the IVF.

However, normal motions of lateral flexion, extension, and rotation can decrease the size of the IVF by up to 33% in the cervical and lumbar regions.[2] The Axis (C2) dorsal root ganglion (DRG) is perhaps the most vulnerable to compression due to its size with respect to the Atlas (C1) / Axis IVF. It has been shown to occupy up to an average 76% of foraminal height.[3] Still, even with forced rotation and hyperextension, there was decrease in height, but no direct bone contact to the ganglion.[4] It should be noted that the height ratio of the DRG to IVF will also vary due to the exact position of the DRG. It has been shown that a minority of DRG are located more proximally within the IVF, which is where the narrowest portion of the IVF lies.[5]

Current research suggests the key is in the surrounding tissue within the IVF. In the living spine, the nerve root is surrounded by lymphatic channels, the spinal segmental artery and vein, loose areolar and adipose tissue, and the transforaminal ligaments (TFLs). The TFLs are present in the majority of IVF and hold the nerve roots in a more fixed position then osseous structure would suggest.[6] Due to this confinement, the nerve root may be distorted and compressed without the superficially necessary osseous stenosis.

If there is a spinal misalignment or disc lesion encroaching on the IVF, the nerve root cannot move away from the lesion. Sharpless found that as little as 10 mmHg of pressure applied to 2.5 mm of the nerve root will result in a number of the fibers being blocked from conducting. After 30 minutes, the decrease in conductivity rises to 50%. The pressure required to induce a similar deficit in a peripheral nerve is in excess of 100 mmHg.[7]

The difference in susceptibility to compression has been related to the differences in the coverings of the two types of nerves. Nerve roots are covered by dura mater and are very susceptible to the effects of compression, while peripheral nerves are covered by epineurium and perineurium, making them far less susceptible. It may not, however, be the nerve fiber itself being compressed which causes diminished function. The change may actually be due to hypoxia or microcirculation ischemia of the nerve roots caused by compression in the IVF.[8] Nerve capillaries differ from capillaries in other areas of the body in three significant ways: they are wider, longer, and have much less musculature on the arteriolar side.[7]

The pressure gradient is very slight between the arteriolar and venous sides so it does not take much to decrease blood flow. The increase in metabolic waste caused by stasis in the vessels will draw fluid to the area to balance the concentration gradient. Nerve roots have less lymphatic drainage than peripheral nerves, thus accumulation of fluid is not easily removed.[9] This will lead to the nerve root presenting with a swollen appearance, which is important for any chiropractor claiming to be able to palpate the nerve root, as will be discussed later.

Infarction (loss of blood flow) to any living tissue will eventually cause temporary dysfunction or death to that tissue because all living tissues require nutrient and waste exchange. Infarction to cranial nerves can happen as in nerve roots, but from different means of compression or from insufficiency of larger vessels further from the nerve in question.

Neurovascular compression syndromes are commonly caused by pathological vascular contacts to the cranial nerves[10,11] causing neurological symptomatology. Infarction involving the distribution of the anterior inferior cerebellar artery has been known to cause audiovestibular functional loss including symptoms of vertigo, gait ataxia, sudden deafness,[12,13] spontaneous nystagmus, and eye motion limitation.[14]

Numbness and tingling in the arm, facial droop, and occasional syncope (partial loss of consciousness or awareness of surroundings) have also been related to vascular insufficiency originating in vessels external to the cranium.[15] The carotid arteries, the largest suppliers of blood to the head, have been shown to provoke neurological symptoms when compressed manually, with the potential to trigger nystagmus due to hind brain ischemia.[16]

Truly significant to this study is the potential to cause vascular insufficiency in the cranium leading to neurological symptoms due to spinal misalignment. The vertebral artery, which supplies much of the brain stem and posterior cerebrum, takes an unusual serpentine course in relationship to the skull, first, and second cervical vertebrae.[17] The vertebral arteries at the level of the first and second cervical vertebrae (Atlas and Axis) are particularly prone to mechanical compression due to their intimate relationship and the significant normal range of motion of the vertebra at this area.[18,19]

The best example of the result from vertebrobasilar artery insufficiency (VBAI; lack of blood supply to the basilar artery from the vertebral arteries) is a rare condition known as Bow Hunters stroke in which the vertebral artery is mechanically occluded during head rotation, resulting in stroke.[20] An individual's susceptibility to this condition is usually due to some abnormality of the bony structures in the area which makes arterial compression more likely. During this event, the entire distribution area of the vertebral artery under compression is prone to vascular insufficiency. Figure 1 shows a vertebral artery arteriogram, which displays its distribution pattern.[21] The symptoms of VBAI, however, are reversed by simply turning the head back to neutral and removing the mechanical stress (and, by extension, the stenosis) from the artery.[22]

By examining the severe example seen in Bow Hunter's stroke, we can come to the likely conclusion that lesser compression on the vertebral artery by an atlas misalignment could produce vascular insufficiency to the hind brain as well, with much less sudden and drastic symptoms. In fact, research has shown that there is a significant decrease in

intracranial blood flow from the vertebral artery following cervical spine rotation.[23] Research has also demonstrated the improvement of cognitive function through stint-assisted angioplasty to correct vertebral artery stenosis.[24] Therefore, adjustment of the atlas and relief of mechanical stress on the vertebral artery could potentially cure significant neurovascular symptoms caused by compression over time.

Compression over time, especially after trauma, however, can cause additional problems. The incidence of vertebral artery occlusion has been shown to be significant in patients with cervical spine trauma.[25,26] Further, most patients with vertebral artery occlusion following trauma do not reconstitute flow in the injured vertebral arteries.[27] Finally, and possibly of the greatest importance, thrombosis (blood clotting within a vessel) has been shown to occur in some cases after trauma and resulting rotational fixation.[28] This creates two possible dangers. The first involves the thrombus breaking free (becoming a thromboembolus) and causing a complete occlusion of a distal vessel which could lead to stroke.

The second involves fibrotic changes in response to the injury and presence of clotting which could render the vessel less elastic and more likely to rupture/dissect. Patients with a medical emergency known as vertebral artery dissection (VAD) often have initial symptoms which cause them to seek care from a chiropractic physician, then have a stoke some time after, independent of the chiropractic visit.[29,30] The result is the appearance of a stroke following a chiropractic adjustment.

The chiropractic technique of Atlas Orthogonal focuses directly and specifically on the atlas vertebra and its relationship with the cranium and axis vertebra. The technique can be summarized by three rules: in an optimally aligned spine, the cranium should be vertical, the atlas should be level, and the cervical spine should be vertical. In other words, the atlas should be perfectly perpendicular to the axis of the cranium and cervical spine.[31]

Atlas Orthogonal technique, also known as Stereotactic Cervical Alignment or SCALE, uses specific x-ray analysis, precise measurement, and mathematical calculation to determine the best angle (in three dimensions) to adjust an atlas misalignment.[32] During every office visit, each patient is assessed through supine leg check as well as scanning palpation of the C1 & C2 cervical ganglia as protocol for adjustment that day. A small study, conducted by Sweat, supported the interexaminer reliability of scanning palpation by experienced palpators.[33]

The adjustment is then delivered by a specially designed machine which applies a percussion force of approximately 5 lbs into the flesh over the atlas transverse process.[31] Although the patient can barely detect anything during the adjustment, the force is enough to move the atlas bone back into alignment due to the specificity of the placement and directionality which are calculated for each patient individually. The purpose of this case study is to analyze a case which appears to support Atlas Orthogonal chiropractic success in neurovascular symptoms through adjustment of the first cervical vertebrae.

Case Report

History

The patient was a 75 year old female who presented with gait ataxia (unsteady and uncoordinated movement), strabismus (laziness) in the left eye, and activity or posture induced seizures of two weeks duration. When walking, she had to take a wide stance and would drift left. She suffered from abnormally low energy levels and claimed to become exhausted after no more than walking across a room. Exhaustion or bending in forward flexion induced her seizures. When the seizures occurred, she felt a hot sensation in her upper chest, lost the ability to speak, and developed a painful migraine of the common type (no aura).

She previously saw her family doctor for this condition, but related that she was rushed to the hospital when he discovered her blood pressure to have risen "into the 200s." According to the patient, the hospital took an MRI, CAT scan, and sonogram over a three day period, but the results were unremarkable. She was told by a doctor that she needed physical therapy and anxiety medication. The patient decided that physical therapy was unnecessary because, prior to the onset of her symptoms, she had no difficulty with normal or even prolonged activity. The same was true for the anxiety medication because the patient claimed to have "never been anxious."

The symptoms did not subside so she returned to her family doctor. He then referred her to a neurologist, who told her she needed "eye and ear coordination" and again prescribed anxiety medication. At this point, the patient sought help from a cardiologist because her blood pressure had been going up and down. She could not walk to raise her heart rate so the cardiologist gave her an IV and chemically induced an elevated heart rate while taking blood pressure readings.

Unfortunately, this also induced a seizure. The patient reported that her blood pressure dropped to 40/30 and she was rushed to the hospital again. "Extensive MRIs, CAT scans, and [other tests]" were performed, but again, they "found nothing." The patient noted that the hospital considered giving her a pacemaker, but her blood pressure had normalized enough not to warrant the device.

The cardiologist then referred her to a different neurologist. He visited her in the hospital and discovered she had a history of concussion 10 years prior. Although her current episode was worse than ever before, the patient reported similar episodes in the past dating back to the concussion. The nature of the injury was a fall resulting in the impact of her occiput with the floor. She was unable to talk immediately following the fall and was taken to the hospital. She reported receiving a CAT scan and MRI along with many neurological examinations over the next 3 months. She was "getting a little better" after 3 months had passed so she was dismissed. Since then, however, she has felt like "her concussion" had returned ever so often, leading up to her current episode. According to the patient, the neurologist told her that the seizures were causing gastric reflux, which she felt as the hot sensation in her chest.

Also, he proposed that the concussion had caused her anterior cerebrum, where speech is controlled, to impact the front of her skull, leaving her temporarily unable to speak. Finally, he determined that she had an upper cervical misalignment which he thought was causing the exacerbation of her concussion symptoms. Traditional chiropractic care was not possible because her shoulders were "so touchy" that manual adjustment would send her into a seizure. Therefore, the neurologist referred her for Atlas Orthogonal chiropractic care.

Examination

It was observed that the patient had a high shoulder during postural evaluation and that her left leg was 3/4" shorter than her right upon supine leg check. Upon examination, it was revealed that she demonstrated strabismus (lazy eye) on the left when tracking to her right. Tenderness was also discovered at the first and second cervical nerve roots on the right. During x-ray analysis, swaying was observed in the standing position, though the patient was attempting to stand still. She also could not walk heel-to-toe, instead using a wide stance. After evaluation of her x-rays, it was determined that her atlas was out of alignment (elevated and posterior on the right).

Intervention and Outcomes

Following her first adjustment, the patient's posture was re-evaluated. Her shoulders were now level and her legs were balanced on supine analysis. Her walking had improved as well as her cervical range of motion - specifically rotation, which had been severely decreased "for years." The patient reported an increase in energy. For example, she had not done any ironing since prior to the onset of her recent episode, but did so for 2 hours straight that evening, stopping only "because it was dinner time."

The patient's care was continued. During each visit, she was checked to make sure the adjustment was holding through subjective evaluation, scanning palpation, and supine leg check. Although no adjustment was warranted until 149 days later, further visits saw improvement in her walking including the ability to walk heel-to-toe. Her balance improved to where she could stand on one foot. She noticed a general improvement in her vision - specifically clarity, brightness, and color perception. At first, her left eye began to track properly, but fall back. After time, the eye would track to the right properly and remain there for as long as the patient intended.

The left eye had also been getting tired much more quickly than the right when reading. She improved to being able to read "as long as she wants to" over time. Finally, it should be noted that she had not had a seizure since beginning Atlas Orthogonal care. Table 1 contains a summary of each visit the patient had made up to the present date. Figure 2 graphs the patient's subjective and objective progress over time. It should be noted that the data was graphed by visit rather than time elapsed. As the patient's care continued, the regularity with which she was brought in to be checked became increasingly less, as listed in Table 1.

Discussion

The subjective and objective data obtained shows a clear trend of improvement from the patient's initial condition, to near asymptomatic status. The patient did not seek any additional care other than Atlas Orthogonal and objective measurements yielded consistent results throughout her treatment. The results are especially reliable because the patient was only given a single adjustment to a single bone on any given visit – further implicating Atlas Orthogonal care in the instigation of her recovery. The word "instigation" is used because chiropractic philosophy dictates that the restoration of health is due to the proper function of the body and, indirectly, the chiropractic adjustment.

Mechanism

Symptoms similar to those of the patient's, especially issues with vision and coordination, have been shown to result from vascular insufficiency.[12-15] Insufficiency has been shown to result from pressure on the vertebral artery during rotation at the level of the atlas vertebrae in cases with both abnormal and normal osseous structure.[20,23] Atlas Orthogonal technique claims to correct misalignments in the atlas vertebrae.[31,32] The patient's symptoms were immediately and significantly reduced following her first adjustment according to subjective and objective data.

The adjustment appears to be the most likely cause of her positive response. Further, correction of vertebrobasilar insufficiency caused by misalignment of the atlas vertebra is a possible mechanism for this occurrence. Along with further substantiation of results like these, additional studies should be undertaken to assess the affect of adjustment to vertebral misalignment on microcirculation in nerve roots.

Conclusion

The results suggest that Atlas Orthogonal chiropractic care was likely to have reduced and eliminated the patient's neurological symptoms. The likelihood of these findings is aided by control for external treatments and the immediate significant improvement following the first adjustment. By comparison of symptoms to acknowledged cause and effect relationships, we can further propose that chiropractic adjustment to the atlas vertebra was likely to have relieved compression to the vertebral artery whose insufficiency was causing neurological symptoms in this patient. Large scale study of this mechanism is required to attribute any degree of certainty to these results. More substantiation for the mechanisms of positive results through chiropractic care in general is needed as well.

References

1. Crelin ES. A Scientific Test of Chiropractic's Subluxation Theory: The first experimental study of the basis of the theory demonstrates that it is erroneous. American Scientist. September/October 1973.
2. Hadley LA. Anatomico-roentgenographic studies of the spine. Springfield: Thomas; 1964.
3. Lu J, Ebraheim NA. Anatomic considerations of C2 nerve root ganglion. Spine. 1998 Mar 15;23(6):649-52.

4. Bilge O. An anatomic and morphometric study of C2 nerve root ganglion and its corresponding foramen. Spine. 2004 Mar 1;29(5):495-9.
5. Yabuki S, Kikuchi S. Positions of dorsal root ganglia in the cervical spine: An anatomic and clinical study. Spine. 1996 Jul 1;21(13):1513-7.
6. Bakkum BW, Mestan M. The effects of transforaminal ligaments on the sizes of T11 to L5 human intervertebral foramina. J Manipulative Physiol Ther. 1994 Oct;17(8):517-22.
7. Leach RA. The Chiropractic Theories: A Textbook of Scientific Research. 4th ed. Philadelphia: Lippincott, Williams & Wilkins; 2004.
8. Giles LG. Mechanisms of neurovascular compression within the spinal and intervertebral canals. J Manipulative Physiol Ther. 2000 Feb;23(2):107-11.
9. White AA, Panjabi MM. Clinical Biomechanics of the Spine. 1st ed. Philadelphia: J. B. Lippincott Company; 1978.
10. Tanrikulu L, Hastreiter P, Troescher-Weber R, Buchfelder M, Naraghi R. Intraoperative three-dimensional visualization in microvascular decompression. J Neurosurg. 2007 Dec;107(6):1137-43.
11. De Ridder D, Møller A, Verlooy J, Cornelissen M, De Ridder L. Is the root entry/exit zone important in microvascular compression syndromes? Neurosurgery. 2002 Aug;51(2):427-33; discussion 433-4.
12. Wuertenberger CJ, Rosahl SK. Vertigo and tinnitus caused by vascular compression of the vestibulocochlear nerve, not intracanalicular vestibular schwannoma: review and case presentation. Skull Base. 2009 Nov;19(6):417-24.
13. Lee H, Kim JS, Chung EJ, Yi HA, Chung IS, Lee SR, Shin JY. Infarction in the territory of anterior inferior cerebellar artery: spectrum of audiovestibular loss. Stroke. 2009 Dec;40(12):3745-51. Epub 2009 Sep 24.
14. Lee H, Sohn SI, Jung DK, Cho YW, Lim JG, Yi SD, Lee SR, Sohn CH, Baloh RW. Sudden deafness and anterior inferior cerebellar artery infarction. Stroke. 2002 Dec;33(12):2807-12.
15. Huang BY, Castillo M. Radiological reasoning: extracranial causes of unilateral decreased brain perfusion. Am J Roentgenol. 2007 Dec;189(6):S49-54. Review.
16. Carney AL, Anderson EM, Burns E. Cerebral hemodynamics evaluation. Adv Neurol. 1981;30:335-59.
17. Cacciola F, Phalke U, Goel A. Vertebral artery in relationship to C1-C2 vertebrae: an anatomical study. Neurol India. 2004 Jun;52(2):178-84.
18. Chough CK, Cheng BC, Welch WC, Park CK. Bow hunter's stroke caused by a severe facet hypertrophy of C1-2. J Korean Neurosurg Soc. 2010 Feb;47(2):134-136.
19. Barton JW, Margolis MT. Rotational obstructions of the vertebral artery at the atlantoaxial joint. Neuroradiology. 1975 Aug 7;9(3):117-20.
20. Seki T, Hida K, Akino M, Iwasaki Y. Anterior decompression of the atlantoaxial vertebral artery to treat bow hunter's stroke: technical case report. Neurosurg. 2001 Dec;49(6):1474-6.
21. Wicke L. Atlas of radiologic anatomy. 6th ed. Baltimore: Williams & Wilkins; 1998.
22. Rydevik B, Brown MD, Lundborg G. Pathoanatomy and pathophysiology of nerve root compression. Spine (Phila Pa 1976). 1984 Jan-Feb;9(1):7-15. Review.
23. Mitchell JA. Changes in vertebral artery blood flow following normal rotation of the cervical spine. J Manipulative Physiol Ther. 2003 Jul-Aug;26(6):347-51.
24. Ito Y, Matsumaru Y, Suzuki K, Matsumura A. Impaired cognitive function due to cerebellar infarction and improvement after stent-assisted angioplasty for intracranial vertebral artery stenosis--case report. Neurol Med Chir (Tokyo). 2010;50(2):135-8.
25. Friedman D, Flanders A, Thomas C, Millar W. Vertebral artery injury after acute cervical spine trauma: rate of occurrence as detected by MR angiography and assessment of clinical consequences. AJR Am J Roentgenol. 1995 Feb;164(2):443-7; discussion 448-9.
26. Taneichi H, Suda K, Kajino T, Kaneda K. Traumatically induced vertebral artery occlusion associated with cervical spine injuries: prospective study using magnetic resonance angiography. Spine. 2005 Sep 1;30(17):1955-62.
27. Vaccaro AR, Klein GR, Flanders AE, Albert TJ, Balderston RA, Cotler JM. Long-term evaluation of vertebral artery injuries following cervical spine trauma using magnetic resonance angiography. Spine. 1998 Apr 1;23(7):789-94; discussion 795.
28. Govender S, Kumar KP. Staged reduction and stabilisation in chronic atlantoaxial rotatory fixation. J Bone Joint Surg Br. 2002 Jul;84(5):727-31.
29. Murphy DR. Current understanding of the relationship between cervical manipulation and stroke: what does it mean for the chiropractic profession? Chiropr Osteopat. 2010 Aug 3;18:22.
30. Kerry R, Taylor AJ, Mitchell J, McCarthy C, Brew J. Manual therapy and cervical arterial dysfunction, directions for the future: a clinical perspective. J Man Manip Ther. 2008;16(1):39-48.
31. Sweat RW, Sweat MH. Atlas orthogonal chiropractic program. 6th ed. Atlanta: RW Sweat Foundation; 2007.
32. Carleton J, Hammond R, Obebe JO, Rosa S, Sweat RW, Sweat MH, Moss M. Resolution of cervical complications secondary to motor vehicle accidents by the application of stereotactic cervical alignment (SCALE) methods: statistical review of 54 patients. J of Whiplash & Relate Disord. 2006; 5(1):15-24.
33. Sweat RW, Robinson K, Lantz C, Weaver M. Scanning palpation of the cervical spine interexaminer reliability study. The Digest of Chiro Econom. 1988 Jan/Feb.

Days Elapsed (since 1st Adj.)	Subjective	Leg Check	Scan	Additional Findings	Assessment	Care	Post Scan	Post Leg Check
0	N & S sev P bilat	L short 3/4"	C1,2 sev on R	Trapezius sev spasm bilat	Exacerbated	Initial Exam	N/A	N/A
0	N & S sev P bilat	L short 3/4"	C1,2 sev on R	Trapezius sev spasm bilat	Exacerbated	**Adjustment**	↓ Tender	Balanced
2	N & S mod P bilat	Balanced	C1,2 mod bilat	T5-8 mod tender bilat	Improved	None	N/A	N/A
4	N mild, S mod bilat	Balanced	C1,2 mild bilat	Trapezius mild spasm bilat	Improved	Muscle Therapy	N/A	N/A
6	N mod, S mild bilat	Balanced	C1,2 non-tender	T5-8 non-tender, no spam	Improved	None	N/A	N/A
8	N mild, S mild bilat	Balanced	C1,2 non-tender	T5-8 mild tender bilat	Improved	None	N/A	N/A
12	N mild bilat	Balanced	C1,2 mild bilat	None	Improved	None	N/A	N/A
16	N mild bilat	Balanced	C1,2 mild bilat	None	Improved	None	N/A	N/A
20	N mild bilat	Balanced	C2 mild bilat	None	Improved	None	N/A	N/A
24	N mild bilat	Balanced	C2 mild bilat	None	Improved	None	N/A	N/A
29	N mild bilat	Balanced	C2 mild bilat	None	Improved	None	N/A	N/A
36	N mild, S mild bilat	Balanced	C2 mild bilat	Trapezius mild spasm bilat	Improved	Muscle Therapy	N/A	N/A
43	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
57	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
73	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
107	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
149	N mild on R	L short 1/4"	C2 mod on R	None	Exacerbated	**Adjustment**	↓ Tender	Balanced
150	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
337	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
342	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
344	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
346	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A
353	N mild on R	Balanced	C2 mild on R	None	Improved	None	N/A	N/A

Table 1. Summary of Chiropractic Care. Table 1 contains a summary each office visit up to the date the case was acquired for report. Displayed are the days elapsed since the patient's first adjustment, subjective findings (the patient's condition as she reported it), objective findings (leg check, scanning palpation, and additional findings), overall assessment of her progress (shown as "exacerbated" or "improved"), care provided on that visit, post care scan findings, and post care leg check findings. The data depicts a trend of immediate and lasting improvement in both subjective and objective measure. Also important is the time elapsed between patient visits, which increased as her condition improved. The abbreviations used were as follows: Adj. = Adjustment, N = Neck, S = Shoulder, P = Pain, sev = severe, mod = Moderate, bilat = Bilateral, L = Left, R = Right.

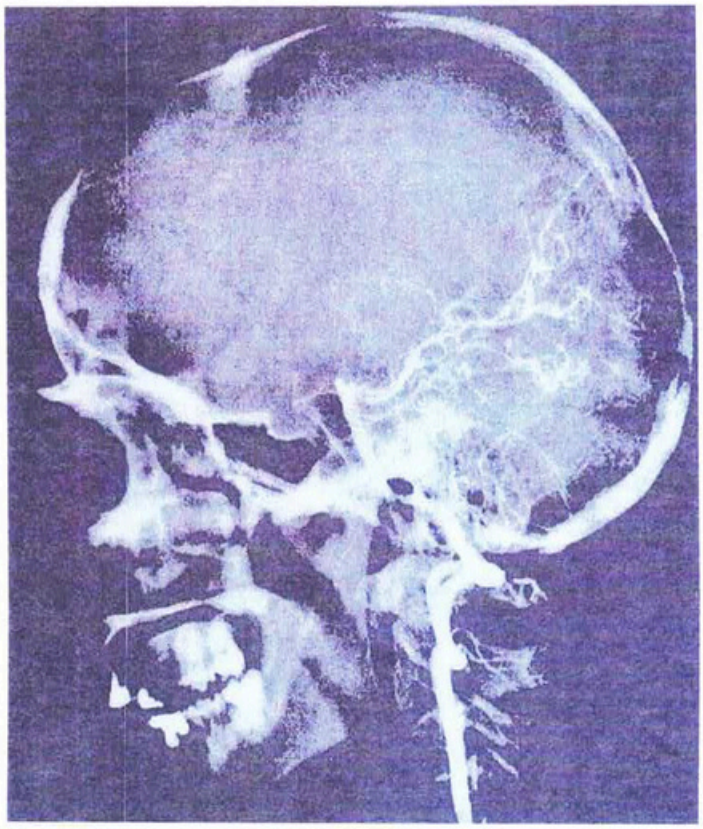

Figure 1. Lateral View of a Vertebral Artery Angiogram. Figure 1 demonstrates the distribution of the vertebral arteries.[21] It is evident that the vertebral arteries supply the brainstem and much of the posterior cerebral cortex. Also visible is the lateral view of the serpentine pathway taken by the vertebral arteries as they navigate the C2, C1, and occipital spinal levels.

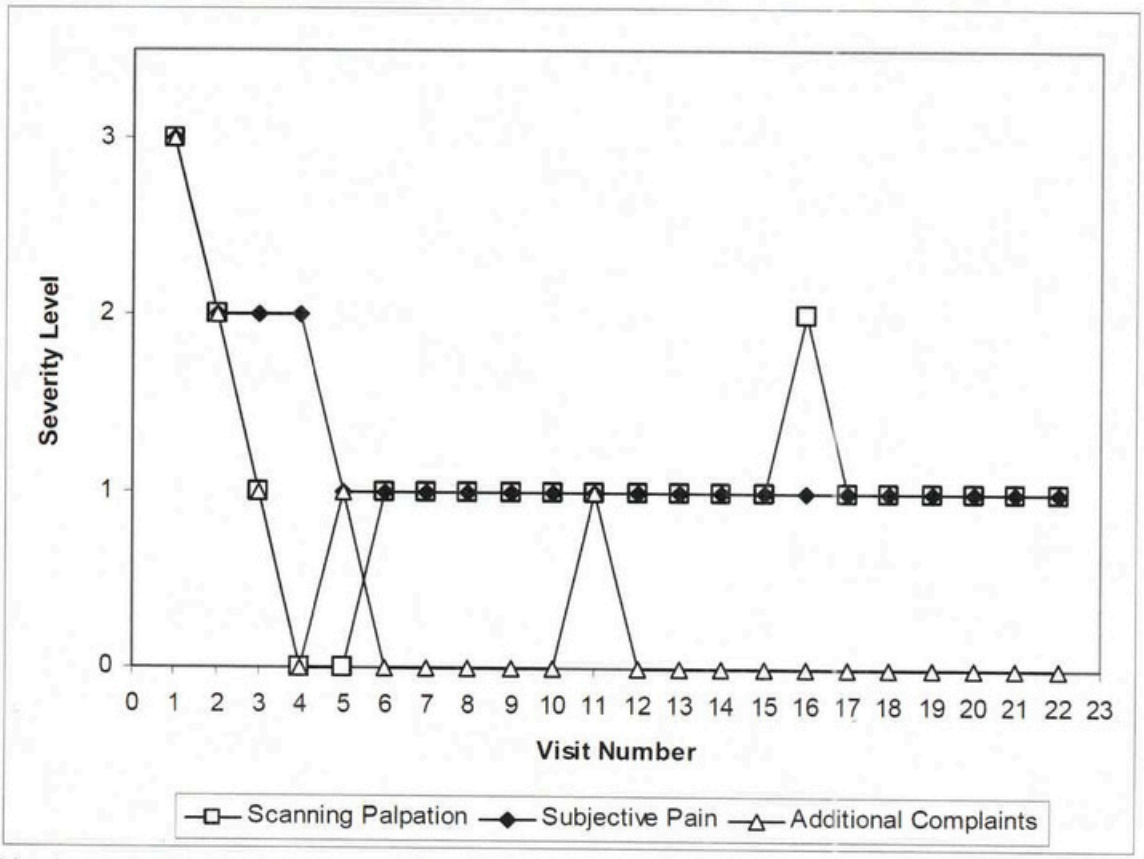

Figure 2. Subjective and Objective Data per Visit. Figure 2 demonstrates the patient's subjective (pain reported & additional complaints) and objective (scanning palpation) progress over time. Scanning palpation is, in actuality, both subjective and objective as both the doctor's observation and the patient's input are combined to produce the severity level. Severity levels of 0, 1, 2, & 3 correspond to "Absent, Mild, Moderate, & Severe" for the categories of scanning palpation, subjective pain, and additional complaints. The data shows an immediate and lasting improvement. It should be noted that the data was graphed by visit rather than time elapsed. Table 1 should be consulted for more detail.