Case Study

Reorganization of the Cervical Curve & Improved Quality of Life Following Network Spinal Analysis Care: A Case Study

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Abstract

Objective: The objective of this study is to report on the reorganization of the cervical curve in a patient undergoing Network Spinal Analysis chiropractic care.

Clinical Features: The patient is a 31-year-old male who presented for Network care with complaints of arthritis in his neck, stabbing pain in ribs and numbness/tingling in both hands. Radiographs were taken which demonstrated an Atlas Plane Angle measurement of 14.7° indicating loss of cervical lordosis.

Intervention and Outcomes: Chiropractic care plan consisted of Network Spinal Analysis care. Based on initial spinal assessment, low force spinal adjustment contacts were applied to enhance spinal and neural integrity and increase somatic awareness. The patient received a total of 61 adjustments over a period of 6 months. After 6 months surface electromyography, thermal scan, radiology and patient's subjective assessment demonstrated significant improvement. Lateral cervical film showed increase in Atlas Plane Angle to 30° and the restoration of the patient's lordotic cervical curve.

Conclusion: This case study reports on the increase of the cervical lordosis in a patient undergoing Network Spinal Analysis care. Improvement in the patient's objective outcomes indicates that while under Network care, the patient's body has undergone reorganization. This case study adds to subluxation-based chiropractic research focused on the restoration of the cervical curve. Further research is warranted to determine the relationship between Network Spinal Analysis adjustments and improvement in the cervical curvature.

Key Words: *Cervical curve, cervical lordosis, chiropractic, Network Spinal Analysis, vertebral subluxation, adjustment, reorganizational healing*

Introduction

The normal position of the spine is one where the vertebrae are vertically aligned in a midline neutral position.[1] A healthy spine has three natural curves: cervical lordosis, thoracic kyphosis, and lumbar lordosis.[2] These spinal curves support specific biomechanical functions, improve balance within the body, serve as attachments for spinal muscles, and protect focal area by transmitting and redistributing forces through the body.[3] Some authors indicate that out of all spinal curves, the cervical curve is a primary curve.[1] Cervical lordosis is developed in utero, and it becomes more apparent in infancy, when the child learns how to lift his/her head.[4,5] The biomechanical functions of cervical lordosis are: distribution of weight, energy efficiency, structural support, and absorbing shock. It has been suggested that cervical spine with normal cervical lordosis can better disperse external and internal forces than the spine with reduced cervical lordosis.[6]

There are a number of approaches to defining normal lordosis.[7] Measurements have been determined through observation and statistical evaluation.[8] One approach uses posterior tangent method for cervical vertebrae from C2 to C7 and estimates that average cervical lordosis ranges from 21.3° to 22.3°.[7] Harrison et al indicate that ideal cervical lordosis is 42° according to circular model.[9] In the same study, average cervical lordosis between C2 through C7 has been estimated at 34° for a given sample. McAviney et al found that a "clinically normal" range for cervical lordosis is 31° to 40°.[7]

According to Pierce, a normal cervical lordosis is +17cm, which is the measurement of the radius of an arc. A straight neck measures +500 and kyphosis measures -17cm.[10]

Theoretically, the cervical curve should have a normal lordosis. Loss of normal lordotic curve may lead to loss of proper biomechanics - the body is no longer able to accommodate, transmit and distribute all forces going through the body.[3] As a consequence of that process, a component of vertebral subluxation complex may be generated.[11] There are several symptoms that have been associated with loss of normal cervical curve. Those are: mechanical neck pain, cervical-brachial neuralgia, vascular headaches, migraine headaches, cervicogenic headache, numbness, vertigo, nausea, airway obstruction, suboccipital pain, occipital neuralgia, paresthesia, muscle spasms, and decreased cervical range of motion.[3,5,12] It has also been suggested that loss of cervical lordosis may have a detrimental effect on the brainstem.[13]

Loss of cervical lordosis has been linked to age - increase in lordosis has been noted in older individuals. There are no prevalent trends for female or male subjects indicating no correlation between sex and cervical lordosis.[7] It has been suggested in the literature that loss of cervical lordosis follows a spasm of the anterior cervical musculature, however, no evidence has been found to support that assertion.[4] Chronic stress, motor vehicle accidents, repetitive micro-traumas, macro-traumas, postural loadings, and whiplash have also been indicated as underlying causes of reduction in cervical curve.[1,13] Another hypothesis involves *buckling* or *snap through*, which causes spinal tissues to assume a different *buckled* position every time after *buckling* had occurred.[4] The reason is that *buckling* happens even 3 times faster than it takes for the spinal muscles to react. In order to go back to their original position, spinal tissues need to be remodeled, otherwise the accumulation of the effects leads to gradual loss of cervical lordosis.[4]

The literature describing conservative methods to improve cervical lordosis is scarce.[4] There are several chiropractic techniques which address the correction of the cervical curve. Those techniques are Chiropractic Biophysics (CBP), Pettibon and Pierce, which use a variety of specific procedures in order to restore cervical lordosis. Those procedures may include: chiropractic adjustments, cervical extension-traction, mirror-image adjusting, 3-point bending, headweight device, and transverse load cervical compression traction.[3,4]

Chiropractic research focusing on the application of the tonal approaches to correct spinal curves is very limited. Specifically, very few studies have been published that would directly present the outcomes of the Network Spinal Analysis care on patient's presenting with decreased cervical lordosis. The objective of this study is to fill this gap and to report on the reorganization of the cervical curve in a patient undergoing Network Spinal Analysis care.

Case Report

Patient History

The patient is a 31-year-old male chef who presented for Network care with complaints of arthritis in his neck, stabbing pain in ribs and numbness/tingling in both hands. The patient indicated that the onset of his neck condition was 8 years prior. The quality of neck arthritis was described as "sharp/shooting", and it was located at C4-C6 vertebrae. Severity of this condition was rated at 6/10 on the numerical scale. The patient stated that neck rotation and "popping" his neck helped. He said that he had never had this condition before and at the time of his visit his neck arthritis was present daily.

The onset of the stabbing pain in ribs and numbness/tingling in hands was on the day of the patient's visit and started when the patient woke up. The patient stated that he had experienced this pain before. Pain was located in mid-back and rated at 8/10 on a numerical scale. The patient said that Advil significantly helped decrease his pain - from 8/10 to 3/10. The onset of numbness/tingling in hands was also on the day of the patient's visit and started when he woke up. The patient stated that he had experienced this pain before as well. Numbness and tingling was present in both hands, however the patient's right hand was worse. The patient said that moving his hands helped with his condition.

The patient's past history revealed a motor vehicle accident, which happened when he was 16 years old. He was under chiropractic care following the accident. The patient also fell out of the tree house when he was 13 years old - he landed on his head and fractured his wrist. The patient stated that he had 20 chiropractic appointments until now. On his initial health questionnaire, the patient admitted that "grinding or cracking" noises were present when he moved his head or neck. The feeling like he needs to "twist, stretch, crack or pop" his neck was also present. The patient rated his posture at 4/10 on a numerical scale and his stress level at 6/10. He stated that his conditions were also interfering with his sleep. The patient was occasionally taking Flexeril to treat pain. He indicated that his health was preventing him from consistent aerobic exercise - he was often getting tired or hurt after his workout. He claimed that if he had optimum health, he would exercise more, sleep better and have increased focus and drive. He associated optimal health and healing with "better sleep and lower pain".

Review of systems revealed that the patient was suffering from: constitutional issues - daytime drowsiness and fatigue (both in the past and present); issues related to ears/nose/throat - ringing in the ears (in the past), snoring and sleep apnea (both in the past and present); respiratory issues - asthma or wheezing (in the present); issues related to heart and circulation - shortness of breath w/activity (in the present); issues related to stomach/intestines - frequent heartburn or indigestion (in the present); issues related to muscles/bones/joints - arthritis; issues related to nervous system - headaches (both in the past and present); and psychological issues - anxiety, depression, insomnia, mood change (in the present).

The patient's surgical history includes tubes in his ears at 6 months of age. The patient has not been hospitalized and does not have any allergies. His family history has high blood pressure and hearing loss. His father had a heart attack.

Chiropractic Examination

The objectives of chiropractic examination were: to evaluate the patient's spine for the existence of vertebral subluxations, to evaluate the patient's neurological function, and to evaluate the alignment of the patient's spine. In addition to the health questionnaire, the following examinations were performed: heart rate variability, surface electromyography (sEMG), thermal scanning, and x-rays. The outcomes were used to monitor the patient's objective improvement under chiropractic care.

Heart Rate Variability

Heart Rate Variability is a qualitative analysis performed to measure and assess the autonomic nervous system. The autonomic nervous system reflects health status of a patient.[14] Because vertebral subluxations have an autonomic component, the analysis of heart rate variability and other factors can be used to evaluate vertebral subluxations.[15]

The study measures various factors which reflect the activity of the patient's autonomic nervous system.[16] Mean Inter-Beat Interval (IBI), Mean Beats Per Minute (BPM), and Standard Deviation of IBI are calculated during *time domain* analysis. Sympathetic Response, Parasympathetic Response, Autonomic Activity and Autonomic Balance are calculated during *frequency domain* analysis.

Heart Rate Variability scan gave the following results for the patient in the *time domain* analysis: Mean IBI = 825.97, Mean BPM = 73, STD of IBI = 77.96. Heart Rate Variability scan gave the following results for the patient in the *frequency domain* analysis: Sympathetic Response = in Normal Range, Parasympathetic Response = in Normal Range, Autonomic Activity = 73.58, Autonomic Balance = 72.22(S).

sEMG Scan

Surface electromyography is used to examine paraspinal and peripheral muscle function. Paired electrodes are used to record muscular activity and compare muscle tension along the spine. According to Kent, paraspinal sEMG scans may be helpful in determining the following: asymmetrical contraction, areas of muscle splinting, severity of the condition, aberrant recruitment patterns, dysponesis, responses to dysafferentation, and response to chiropractic adjustment.[17] An abnormal function of paraspinal muscles has been accepted as a clinical manifestation of vertebral subluxation. As sEMG records paraspinal activity and any changes indicating vertebral subluxations, it has been recognized as a valid and reliable tool to assess vertebral subluxations.[17] sEMG scan compares muscle activity (amplitude and symmetry) with reference values and so: differences between one and two standard deviations indicate mild tension or asymmetry, two to three standard deviations indicate moderate tension or asymmetry, while three or more standard deviations indicate severe tension or asymmetry.

Readings one or more standard deviations below normal means were observed at: T10(R), T12(R), which indicated reduced muscle tension. Readings one to two standard deviations above normal means were observed at: C1(L), which indicated mild elevation of muscle tension. Readings two to three standard deviations above normal means were observed at C1(R), which indicated moderate elevation of muscle tension. Areas of significant asymmetry were noted at the following sites: T2(L), L1(R), and S1(R).

Thermal Scan

Thermal scan is performed to assess skin temperature differences along the spine. The assessment of changes in skin temperature may be used to evaluate the ability of the nervous system to adapt to changes in the internal and external environments. It has been indicated that there is a positive correlation between changes in skin temperature and the function of the autonomic nervous system and that vertebral subluxations may cause thermal asymmetries.[18] The assumption underlying this claim is that in a healthy person skin temperature patterns may change when the environment changes, but will always remain symmetrical, as the body adapts to those environment changes.[18] Any difference in skin temperature exceeding 0.5°C indicates the presence of neurological interference.[19] By recording skin temperature differences and tracking underlying subluxations thermal scan improves the patient's assessment, management of the vertebral subluxations and helps monitor patient's response to care.[20] Skin temperature differences that are between one and two standard deviations indicate mild asymmetry, differences between two to three standard deviations indicate moderate asymmetry, and differences exceeding three standard deviations indicate severe asymmetry.

On the patient's thermal scan mild asymmetries were found at: C7(L), T1(L), T4(L) and T10(L). Moderate asymmetries were present at: C6(L), and T5(L). Severe asymmetry was found at T6(L).

Radiology

Radiographs were taken and lateral cervical x-ray was analyzed using Chiropractic BioPhysics protocol. It has been shown that radiographic line drawing analysis is one of the most reliable methods in clinical practice.[21] Cervical curve measurement was performed with posterior tangent method - with a line that was tangent to the posterior vertebral body margins of C2-C7. This line, called the Absolute Rotational Angle (ARA), showed significant loss of cervical lordosis (See Chart 1a in the Appendix). Atlas Plane Angle (angle between the Atlas plane and the horizontal plane line) was 14.7 degrees, which should ideally be a 28.7 degree angle.[9]

The results of all examinations listed above along with patient's history and other clinical findings were used in determining recommendations for the type, frequency, and duration of chiropractic care. Follow-up examinations were performed to evaluate the patient's response to chiropractic care.

Chiropractic Care

The care plan consisted of Network Spinal Analysis care. Based on initial spinal assessment the practice member was to receive brief low force spinal adjustment contacts to enhance the self-regulation of passive, active and neural spinal

subsystem tension, increase somatic awareness, reduce vertebral subluxation and increase neural coherence. Recommended initial visit frequency was initially 3 times per week. After 4 months of care (42 adjustments), frequency was decreased to 2 times per week. Chiropractic management plan was dependent on the progress of the practice member and was to be adjusted according to his/her assessment. The practice member received a total of 61 adjustments over a period of 6 months.

Network Spinal Analysis

Network Spinal Analysis represents a tonal approach, which states that "tone is the normal degree of nerve tension" and views "the spine and nervous system as a functional unit".[11] The objectives of Network Spinal Analysis care are to promote practice member self-awareness, increase spinal self-organization, detect the presence of adverse mechanical cord tension and vertebral subluxation and using "hands on", low-force adjustments in order to increase spinal and neural integrity.[22] As a result of Network care the spine and nervous system become more adaptable to the environmental changes and work as one functional unit. Network Spinal Analysis, as a tonal approach, emphasizes the importance of Reorganizational functional outcomes in the assessment and management of the practice member.[11]

Assessment

During each visit the practice member was assessed according to Network Spinal Analysis care protocol. Recommended spinal assessment includes hard tissue palpation (restriction, fixation, misalignment, hypermobility, postural shifts, and bilateral weight scales), muscle palpation, and checking neural control indicators (short leg syndrome, heel tension, elevated leg, cervical syndrome, ankle eversion stress, leg adduction/abduction, z-flick, leg crossover, sacrotuberous ligament tension, sacral/thoracic correlation, and respiration changes) for presence of adverse mechanical cord tension phase indicators and vertebral subluxation.[22]

The assessment of the practice member in this study consisted of the following elements: heel tension, heel eversion stress, leg adduction/abduction, checking for the presence of (passive and active) tension in the spine and spinal musculature.

Entrainment

During each visit, assessment of the practice member would determine the adjustment (called "Spinal Entrainment") at the specific access point to the nervous system (called "Spinal Gateway").[5] It has been suggested that certain shift in the brain/body is associated with Network Spinal Analysis low-force contact. This shift occurs from stress physiology to that expressing "safety" which supports growth and reorganization.[5] The objective of the Spinal Entrainment is to synchronize internal processes throughout the body, "to result in a state that promotes healing and growth."[23]

Results

After 7 weeks of Network care the patient stated that, "subjective experience is improved". He noted that he had become more aware of his spine. This awareness was especially noticeable while the patient was sitting and was not a result of greater discomfort or pain. The patient became aware that sitting and lying down bring about this awareness.

The patient stated that overall pain decreased and there was more ease in the spinal movement. The patient noted that the way he carried his body changed: he was holding his head higher, slouching less and he found it easier to keep straight up. He also realized that he had become more aware of his breathing, which was easier and deeper. He claimed that his body had become more effective at releasing its tension. During that period, the patient experienced the following changes in his life: ended several years long incompatible relationship and his "bad boss" was gone.

Eight weeks later initial care reevaluation was performed. The patient stated that he had experienced breath move through his body and his body moved on the table in response to adjustments. He felt "more in touch with feelings/emotions" and could "experience them more intensely." He also noticed more balance and flexibility, ease in his back and better sleep. After 6 months of Network care, follow-up examinations were performed: heart rate variability, sEMG, thermal scan and radiology (see Charts 1 through 3 in the Appendix). Surface EMG demonstrated an improvement in all areas of tension exhibited at the initial exam - muscle tension was normal at T10(R), T12(R), C1(L) and C1(R) and there was no asymmetry at T2(L), L1(R), S1(R). Thermal Scan demonstrated increased symmetrical temperature patterns for areas of asymmetries exhibited at the initial exam - there were no asymmetries shown at C7(L), T1(L), T4(L), T10(L), C6(L), T5(L) and T6(L). Lateral cervical film showed a significant improvement in Atlas Plane Angle (which was now 30.0 degrees) and the restoration of the patient's lordotic cervical curve.

Improvement in the patient's objective outcomes indicates that while under Network care, the patient's body has undergone a reorganization.[24] Restoration of the lordotic cervical curve is a sign that the patient's spinal and neural integrity improved, which allowed for healing and correction.

Discussion

Different approaches have been described in chiropractic literature that attempt to correct cervical curve and posture-related imbalances.[3] Those include: Pierce Results System, CBP protocol, Pettibon Corrective and Rehabilitative Procedures, Activator Methods Chiropractic Technique, Diversified Technique, Gonstead Technique, Knee Chest Technique, and Network Spinal Analysis.[2-5,10,12,13,23,25-33] All those chiropractic techniques differ in approach to patient, assessment, management protocol and outcome measures. The studies available in the literature provide various results in terms of management period, frequency of visits, angle of correction, etc. It makes it therefore challenging to indicate which of the available chiropractic approaches may be suggested as more efficacious for patients with decreased cervical lordosis.

Harrison et al used spinal manipulation combined with extension-compression cervical traction to manage patients

with decreased cervical lordosis.[4] The management period was 14.6 weeks and the patients were seen 38 times. During that time average increase in Cobb angles was 13° to 14° and the angle of intersection of the posterior tangents on C2 and C7 improved on average by 17.9°. In another study, Harrison et al reported that an average of 60 visits over a 3-month period is needed to note significant improvements of cervical lordosis.[31] The results demonstrated that the average increase in cervical lordosis was 13.2° when a combined approach of cervical extension compression traction and spinal adjustment was used. The same study found no improvement when only CBP spinal adjustment was administered.[31] Plaugher et al also reported no improvement in patients with decreased cervical curve who underwent 6.5 adjustment sessions over 3 weeks under Gonstead chiropractic care.[30] There are studies, however, which demonstrate improvement in cervical lordosis following chiropractic management alone.[4,5,23,25,29,32] Only two of those studies utilize Network Spinal Analysis technique.[5,23]

Improvement in cervical lordosis or restoration of the cervical curve has been associated with various outcomes in the literature. It has been suggested that restoration of normal spinal curves leads to improved health outcomes, pain reduction, increased function, and improved quality of life.[12,13] Chiropractic literature provides limited evidence that the following conditions may resolve following increase in cervical curvature and reduction of vertebral subluxations: headaches, migraines, chronic otitis media, neck pain, sinus infection, muscle aches, fatigue, joint dysfunction, asthma, allergies and digestive problems.[2,4,12,26,27,33] In the study by Soriano and Apatiga, improvement in fibromyalgia symptomatology has been reported following reduction of vertebral subluxations and increase in cervical curvature.[29] Morningstar suggested that loss of the cervical curve may have negative musculoskeletal effects beyond the cervical spine. His study demonstrated that restoration of the cervical curve might help eliminate mechanical lower thoracic pain.[3]

The evidence available in the scientific literature suggests that in case of decreased cervical lordosis, cervical vertebrae may be in a position where they directly touch the spinal cord.[13] Loss of normal cervical curvature may therefore exert pressure, cause compression or traction on the spinal cord leading to loss of spinal and neural integrity. It has also been hypothesized that the abnormal posture may result in excessive loading to the spine and spinal structures, and negatively affect physiological function.[1,12]

Alterations in the biomechanics of the cervical spine - loss of cervical lordosis in particular - may alter normal afferent input into the cerebellum.[28] Tension in the medulla, brain stem and cranial nerves is generated by flexion and extension motions of the cervical spine. And so, when normal biomechanics of the cervical spine is compromised, the brain stem may touch the anterior wall of the foramen magnum during flexion of the cervical spine. When that occurs, the anterior subarachnoid space may narrow even to an extent where it vanishes completely.[34] Increased stretching and traction of the spinal cord may lead to increased intramedullary pressure, increased pressure of the cerebrospinal fluid, increased pressure within the nerve cells, and consequently cause neurologic deficit.[1,23] According to Harrison et al, exerting pressure on nerve tissues through mechanical traction caused by loss of normal cervical lordosis increases levels of sympathetic nerve activity.[1]

Chiropractic literature seems to emphasize the biomechanical components resulting from loss of normal cervical lordosis. However, there is evidence that low force contact approach, such as Network Spinal Analysis protocol, may lead to increase in cervical lordosis. The evidence is still limited, and the exact mechanism explaining how Network Spinal Analysis adjustments transmit through the body and result in the reorganization of the cervical curve, remains unknown.[5] Low-force adjustments used during Network care result in reduction of vertebral subluxation and consequently an increase spinal and neural integrity. Reorganization of the lordotic cervical curve is a sign that the patient's spinal and neural integrity improved, which allowed for healing and improved function of the nervous system.

Limitations

This case study has several limitations. As it is a case study, the sample size is small and the evidence provided - low. The patient presented with several conditions accompanied by loss of cervical lordosis. Hence the outcomes obtained in this study may not be generalized to all patients with decreased cervical lordosis. Another limitation could also be the patient's lifestyle - the patient's file indicates that at the beginning of Network care, he "ended several year-long incompatible relationship and his bad boss was gone". It remains unknown if any other changes had been made during the course of chiropractic management, and how they affected the patient's progress and response to Network care. While two questionnaires - Initial Care Reevaluation and Basic Care Somatic Observations Survey - were filled out by the patient during the period of care, additional subjective outcome measures would have provided further useful information in this study.

Conclusion

This case study reports on the increase of the cervical lordosis in a patient undergoing Network Spinal Analysis care. Improvement in the patient's objective outcomes indicates that while under Network care, the patient's body has undergone reorganization. This case study adds to subluxation-based chiropractic research focused on the restoration of the cervical curve. In particular, this study provides limited evidence that Network Spinal Analysis care may be safe and effective in addressing loss of normal cervical lordosis.

Further research is warranted to determine the relationship between Network Spinal Analysis adjustments and improvement in the cervical curvature, to elucidate the mechanism of improvement following Network care, and to clarify how Network care may facilitate the reorganization of the cervical curve. Current evidence available in the literature is limited, and requires further investigation. The majority of chiropractic research consists of case studies using various research methods, management protocols and outcome measures. Conducting larger population studies and using unified research methodology are therefore important recommendations for future research.

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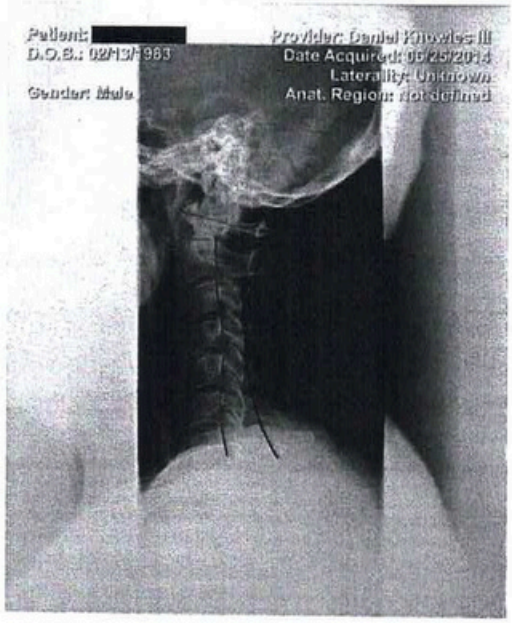
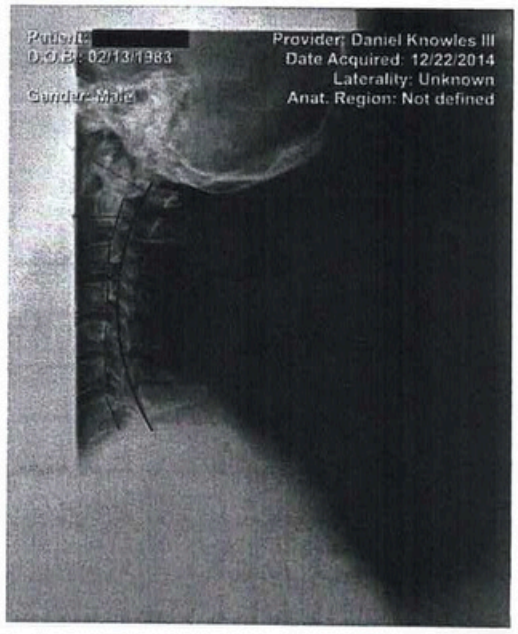
APPENDIX

Chart 1. Radiographs.



1a. Initial lateral cervical film demonstrating decreased cervical lordosis.



1b. Lateral cervical film taken after 6 months of care demonstrating the restoration of the lordotic cervical curve.

Chart 2. Heart Rate Variability

HRV Scan	*Initial Outcome*	*After 6 Months of Network Care*
Mean IBI	825.97	735.6
Mean BPM	73	82
STD of IBI	77.96	77.4
Sympathetic Response	in Normal Range	in Normal Range
Parasympathetic Response	in Normal Range	in Normal Range
Autonomic Activity	73.58	70.8
Autonomic Balance	72.22(S)	67.73(S)

Chart 3. sEMG and Thermography

Type of Examination	*Initial Outcome*	*Improvements After 6 Months of Network Care*
sEMG	reduced muscle tension at T10 (R), T12(R)	normal muscle tension at T10(R), T12(R)
	mild elevation of muscle tension at C1(L)	normal muscle tension at C1(L)
	moderate elevation of muscle tension at C1(R)	normal muscle tension at C1(R)
	asymmetry at T2(L), L1(R), S1 (R)	no asymmetry at T2(L), L1(R), S1(R)
Thermal Scan	mild asymmetries at C7(L), T1 (L), T4(L), T10(L)	no asymmetries at C7(L), T1(L), T4 (L), T10(L)
	moderate asymmetries at C6(L), T5(L)	no asymmetries at C6(L), T5(L)
	severe asymmetries at T6(L)	no asymmetries at T6(L)

Case Study

Reduction of a Lumbar Scoliosis & Improved Cervical Curve in a Geriatric Patient Following Network Spinal Analysis™ Care: A Case Study

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Abstract

Objective: This case describes the reduction of a lumbar scoliosis and improvement in the cervical curve in a 75 year old male patient under Network Spinal Analysis™ (NSA) care. Possible mechanisms for structural change through a low-force, tonal chiropractic adjustment technique are discussed.

Clinical Features: The patient was a 75 year old male who presented for wellness based chiropractic care. He also had a complaint of mild to moderate shoulder pain. A lumbar scoliosis with a Cobb Angle of 11 degrees was found on a standing radiograph, as well as a kyphotic cervical curve and reduced atlas plane line.

Intervention and Outcomes: The patient received NSA care under standard protocols for a two year period. The patient was also asked to do two rehabilitative stretches for home care. The Cobb Angle reduced to three degrees at one year, and less than one degree at two years. The atlas plane angle increased from 6 degrees to 22 degrees. The patient's subjective findings reflect these changes.

Conclusions: Network Spinal Analysis™ care, and other low force techniques, may be effective in reorganizational change by addressing structural deformities in the spine and in restoring normal spinal curves. More research is needed in this area.

Key Words: *scoliosis, vertebral subluxation, Network Spinal Analysis, entrainment, chiropractic, tone, exercise, geriatric, cervical curve, surface electromyography, thermography, reorganizational healing*

Introduction

According to Souza, idiopathic scoliosis is "truly an enigma."[1] The nature of this spinal deformity, its causes, and its consequences are contested in the literature. In the adolescent, scoliosis is more often considered a cause of clinical concern. This is due to the possibility for rapid progression during the pubertal growth spurt, with the possibility of permanent deformity and, rarely, visceral complications.[2]

But while the danger associated with rapid progression may be diminished in adulthood, the possibility for reduction or resolution is considered unlikely due to decreased flexibility of the spine in older age.[1] Furthermore, there is evidence that scoliosis may progress through adulthood, with an increased potential to do so in the elderly.[3] When the criteria of a 10 degree Cobb Angle is considered the minimum, an estimated 2.5-15 percent of adults have a scoliosis.[4] Bracing or surgery are only considered in the largest and most progressive curves, leaving the vast majority of the scoliotic population without a clear management protocol.

The research concerning the clinical significance of scoliosis and the efficacy of chiropractic management is mixed and contradictory. A recent review of the literature found Level IV "very weak" evidence to support chiropractic manipulation for the management of adult idiopathic scoliosis.[5] Even with a very weak evidence level the primary concern is maintenance and management of pain rather than spinal reorganization correction or improvement.

Conservative treatment and management, then, is most often aimed at pain and discomfort associated with scoliotic curves. At the same time, it has been reported that incidence of back

pain in adult idiopathic scoliosis is not appreciably different from that in the general population, but that it is more persistent, severe, and disabling than in the non-deformed adult population.[6] Given such ambivalent findings, it comes as a surprise when a recent review of non-surgical treatments for adult scoliosis begins by stating "adult deformity is a significant health issue within the aging population in both the United States and the world communities."[5]

It has also been argued that scoliosis is virtually a normal finding in the elderly due to its prevalence.[3] Cosmetic deformity, pain and stiffness are the most common complaints associated with scoliosis.[1] From a symptom-based perspective, there is only an imperative for conservative management when pain and symptoms are involved.

Ambivalence in the scoliosis literature notwithstanding, much research in the past decade has pointed to the need for normal spinal curves to promote healthy biomechanical and neurological functioning in the absence of pain and symptomatology.[7-9] In their review of the literature, Troyanvich, Harrison, and Harrison outline the effects of abnormal posture on physiological function.[8]

Increased stretching and tension of the spinal cord through holding abnormal positions such as lateral translations and flexion in a scoliosis or cervical kyphosis will cause increases in intermedullary pressure, increased CSF pressure, and increased pressure within the nerve cell, and eventual altered neurological function.[8] These authors present research that mechanical traction and pressure on nerve tissues results in a decreased threshold for firing and increased sympathetic tone.

Such processes are more likely to have culminated in the elderly, for whom regenerative mechanisms and spinal flexibility are likely to be reduced after years of aberrant spinal biomechanics. A recent study of 1353 community dwelling elderly men and women found hyperkyphosis in the thoracic spine to be linked with greater mortality, and in particular from atherosclerosis.[10]

In fact, the greater the hyperkyphosis, the higher the mortality rates. These authors pointed out that this was the case irrespective of osteoporosis (in the past thought to be the underlying cause both of hyperkyphosis as well as scoliosis), as well as when a variety of other factors and conditions were controlled for. Though this study does not concern scoliosis it suggests we pay greater attention to the chiropractic axiom that "posture is the window to the nervous system," particularly in the elderly.

These findings emphasizing the importance of healthy posture beg the question of how chiropractic can address vertebral subluxations associated with abnormal posture. Techniques such as Pettibon and Chiropractic Biophysics conceptualize subluxation as a global phenomenon, and focus on alteration of postural curves as the desired outcome of care.

A focus on posture as both a means and an end would also seem to necessitate forceful spinal adjustments and extensive rehabilitation to make up for years of compensations, inflammatory, and degenerative processes. Similar to such postural techniques, Network Spinal Analysis™ care also conceptualizes the subluxation as a global phenomenon involving the entire spine. However, NSA care does not focus on posture as the primary desired outcome. There has been a lack of research on how low-force and tonal techniques may affect posture instead through a focus on normalized physiological and neurological function.

Case Report

The following is a case-study of a geriatric patient under Network Spinal Analysis™ care. The patient, a 75 year old married white male, presented to a private practice of chiropractic in response to an advertisement in a local newspaper. When asked on an intake form to rate his top three health concerns, he listed high blood pressure, high cholesterol, and shoulder pain (as ranking 1, 2, and 3rd).

The patient cited a 20 year history of medical management for high blood pressure and high cholesterol, both conditions for which he was taking medication. He stated that he had been experiencing occasional "aching" and "tingling" in his right shoulder and arm for the past "couple of years." He said that physical activity helped relieve the pain, and he rated the severity of his shoulder pain as 2 out of 5 (on a 1-5 pain scale with 5 being the most severe).

On the review of systems, he also reported a recent history of constipation, acid reflux, and heartburn. He stated that he had never been hospitalized, and his only two surgeries were for hemorrhoids—both outpatient procedures. He reported a low level of daily stress. The patient said that he had never been under the care of a chiropractor, had his spine checked for subluxations, or had x-ray films taken of his spine. No history of trauma, motor vehicle accident, or other disease was reported.

The initial exam found forward head posture, a high left shoulder and a high right hip. On bilateral weight scales (used to detect postural imbalance) the patient was found to put 102.5 pounds on the left side, and 91.5 pounds on the right. The patient also had pain in right cervical rotation (records do not specify nature of location of this pain).

Radiographs were taken of the cervical, thoracic, and lumbar spine. In addition, surface electromyographic (sEMG) and thermal scans were performed. A care plan was initiated consisting of three visits per week with a re-assessment scheduled for 45 days. Re-assessments included exam, sEMG and thermography, and outcomes assessment tools (OATS) concerning his perception of progress under care. Cervical and lumbar films were again taken at one and two years after care was initiated to assess improvements in bony alignment.

Radiology

Lumbar films revealed a 10 degree left lumbar scoliosis with an apex at L3. The scoliotic angle was analyzed using the Cobb-Lippman method (Cobb Angle).[11] First, the segments involved in the scoliosis were determined. On the AP film a line was drawn along the superior border of the superior end vertebra, and a similar line is drawn along the inferior surface

of the inferior end vertebra. The horizontal angle between these two lines was measured. Some research has argued persuasively that the Cobb Angle lacks validity by not taking account of the 3 dimensional nature of scoliosis.[12] However, the measurement remains the standard for measuring and classifying scoliosis, and has been shown to have excellent inter and intra examiner reliability.[13] Cervical films revealed degenerative changes and a kyphotic cervical curve.

Using the Atlas Plane Line from CBP protocol, an angle of 6 degrees was found on the lateral cervical film. This line is found by connecting the midpoint of the drawing a line between the midpoint of the atlas the anterior tubercle and posterior arch. The angle between that line and a line horizontal to the top of the film should ideally create a 28.7 degree angle according to Harrison and Janik.[14]

sEMG and Thermography

Paraspinal surface electromyography (sEMG) and thermographic readings were taken using the Insight Millenium Subluxation Station (Chiropractic Leadership Alliance, Mahway, NJ). sEMG is used to measure asymmetrical paraspinal muscle activity, a common indicator for vertebral subluxation.[15] The Insight Millenium uses surface electrodes at specific vertebral levels (15 total) to measure the extent and severity of asymmetrical muscle activity that may be associated with subluxations, somato-visceral reflexes, and pain.

The Insight measures skin temperature with a rolling thermo-couple infrared scanner. Thermographs that display asymmetries and fixed "patterns" of cutaneous temperature asymmetry are thought to be associated with autonomic dysfunction— long considered a physiological indicator of neurological disturbance[16] and vertebral subluxation.

Scans were performed with the patient wearing a gown, seated, and with the spine and paraspinal region exposed. Based on normal office procedures, the patient had approximately five minutes to acclimate to the temperature inside the office, and approximately one minute from the time of gowning to temperature scan. Scans were performed from the sacrum to the second cervical vertebra, followed by bilateral scans of the mastoid fossas. Thermal scan and sEMG always preceded chiropractic adjustment/spinal entrainment.

At the initial exam, the patient demonstrated sEMG asymmetries at 8 out of 15 levels. Paraspinal muscular asymmetries were measured as "severe" at C3 on the right, and T12 and L1 on the left. Muscular asymmetry was recorded as "moderate" at T6 and T10 on the left. Paraspinal thermal asymmetries were severe at C1, T11, and T12, and moderate at T9, T10, L1, and L3. Thermal asymmetries were noted at a total of 15 of 24 vertebral levels.

Network Spinal Analysis™ Care

The details of Network Spinal Analysis™ theory and technique have been fully described elsewhere in the literature.[17] To summarize, the NSA care approach to the spine involves the advancement of spinal and neural integrity through associated "levels of care." Each level of care having unique outcomes derived from an advancing, more adaptable and dynamic spine and nervous system. Epstein draws upon the work of Breig and Panjabi to hypothesize that tension in neural tissues (termed "adverse mechanical cord tension") is shared between active (muscles and tendons), passive (ligaments, discs, and bones), and neural control (nerves and supportive tissues) "subsystems."[18] Marked facilitation in one or more subsystem indicates a loss of spinal and neural integrity, accompanied by a hyper-reactive, and physiologically unresponsive state of "defense physiology."[17]

During the Network adjustment, low-force contacts are made to the cervical spine and sacrum at regions called "spinal gateways" which are thought to initiate a shift toward a more responsive, self-reflective and adaptive state.[19] These are also areas with close association to the areas of dural connection in the spinal meninges. It is believed that contacts made at these regions initiate global changes throughout the body. The term "spinal entrainment" is often used in place of "adjustment" as a more descriptive term that signifies a harmonization or a synchronization of internal processes throughout the body, to result in a state that promotes healing and growth.

Spinal Entrainment

In Level One NSA care, the practitioner addresses stress physiology and loss of spinal and neural integrity through the entrainment process by checking and re-checking parameters associated with adverse mechanical cord tension (AMCT), and palpation of the active and passive subsystems. Decreases in tension are considered indicative of a release of tension patterns stored in the spinal cord and meninges.[17] Reduction and reorganization of these patters are also recognized through the development of two "waves" through the spine.

The Respiratory Wave, a visible, wave-like movement of breath up the spine, is associated with advancement through Level One care and reduction of tension in the three subsystems. The second wave, the Somatopsychic Wave is a movement wave, and is characterized by reorganization of stored tensions and the beginning of Level Two Intermediate Care.

The patient began a year-long care plan consisting of three visits per week for the duration of Level One care. This consisted of 33 visits in the first three months of care, at which time the care plan was changed to two times per week. The patient was seen a total of 100 visits in the first year of care, and 56 visits in the second year of care. The care plan was amended to 2-8 recommended visits per month after the first year.

Visits consisted of a practitioner assessment of spinal cord tension pattern and contacts at appropriate Spinal Gateway regions to promote tension reduction and establishment of the Respiratory Wave. Visits were five to ten minutes long. A re-examination was scheduled for 45 days.

Postural Exercises

In addition to spinal entrainments to address AMCT and

advance the progression of the Respiratory Wave and Somatopsychic Wave, the patient was also instructed on two corrective exercises aimed at restoring spinal curves.

These exercises are not part of NSA protocol but were part of the patient's care plan. The first exercise, the "lateral bend" or "spinal shift," involves the following. The patient is instructed to shift his or her shoulders as far to the left as possible, while maintaining a neutral position of the head and neck. The patient is instructed to hold this position for five seconds and repeat on the other side. The sequence is to be repeated ten times, 1-2 times per day.

This particular exercise is supported by a study in which adults with idiopathic scoliosis were instructed to do the exercise toward the concavity.[20] The second exercise, named here as the "neck curve exercise," is a form of cervical traction. The patient is instructed to lay on his or her bed, with or without a towel rolled underneath the cervical curve, and to allow the neck to extend and the head to hang off the edge of the mattress. The position is to be held for 1-2 minute increments to start, with gradual increases to as much as 15 minutes per day.

Outcomes Assessment Tools

Subjective assessments of practice member well-being are a very important measure of progress through NSA care. It is believed that self-reported wellbeing is the most important determinant of health.[21] At the initial exam and subsequent re-exams, questionnaires are used to evaluate the level of patient well-being and attainment of goals relevant to NSA care.

Answers are used to evaluate changes in the level of concern the practice member has with his or her original chief complaint or symptoms, and changes with respect to body awareness, breath, etc. The nature of the questions asked changes as the practice member advances through Network Spinal Analysis levels of care. In the initial questionnaire, the patient studied here rated his posture as a 5/10 (on a 1-10 scale with 10 being "excellent"). When asked how his life would change if he had optimal health, he responded that he would "be more active, less tired."

Results

At the first re-assessment (77 days and 34 visits into care), sEMG and thermal patterns changed. Two levels of musculature, C1 on the left and S1 on the left were measured as "severe" hypertonicities. C3 on the left and T12 on the left registered as moderate muscular asymmetries. Six out of 15 levels demonstrated muscular asymmetries, compared to eight initially.

Paraspinal thermography demonstrated severe imbalances at C1, and moderate imbalances at C2, L3, and L5. A total of 15 out of 24 levels demonstrated cutaneous temperature imbalances, which is the same as the initial scan. On the re-evaluation practice member questionnaire, the patient wrote that he was "still experiencing neck and shoulder pain" and "stiffness."

However, he also wrote that he "feels better" in an over-all sense. Interestingly, he also noted changes under care that in addition to still experiencing pain, "my balance is better." On the same form he wrote that as a result of care he is aware of a feeling of "balance as I walk."

Two years into care, instrumentation findings were severe on the right at T10, moderate at C7, and mild at T1, T8, and S1. One year after care began, sEMG asymmetries were moderate at L5 and S1 and moderate at L3. Imbalances remained on the thermal scans at the one and two year mark, but the patterns were different on each (see figures).

Radiographs improved dramatically. The scoliotic curve reduced to 3 degrees after one year of care, and was less than one degree after two years. The cervical curve showed marked improvement, with an atlas plane line improvement from 6 degrees to 21 degrees at one year, which maintained its measure at the second year.

Patient perception of health and quality of life changes were notable as well. A year and a half into care, the patient reported that his neck and shoulder were "much improved" and "more mobile." And despite reporting a slip and fall on the ice, the patient reported no resultant complications.

Discussion

"Conservative Care" and Scoliosis

There have been several recent articles investigating the possible usefulness of "conservative care" in the management of adult scoliosis. Some of this research is centered on postural approaches such as Chiropractic Biophysics or Pettibon.[22] Other case study research centers on forceful manipulations to mobilize fixated segments and increase spinal flexibility.[6,23]

Despite the lack of prospectively planned analyses, the results of case studies and retrospective analyses do make a case for chiropractic as conservative care in scoliosis management. A 1990 retrospective analysis of 16 chiropractic patients randomly chosen from the files of scoliotic patients in two private chiropractic practices found a statistically significant 4 degree improvement in Cobb angle in patients who were treated with heel lifts, Logan Basic technique, and diversified adjustments.[13]

Much of the research on scoliosis in adults and the elderly take the perspective that unless it is accompanied by pain or extreme cosmetic deformity, it's not worth treating. A 1982 study on scoliosis and the elderly found that not only was there no direct relationship between scoliosis and back pain, but that because scoliosis in the elderly "seldom becomes a problem of clinical significance, there would appear to be no valid reason for a more extensive study of the condition at this time."[3]

The study is noteworthy in that it included follow-up radiographs, something that is lacking in most of the studies. That study began in the late 1960s with 3600 randomly chosen adults in Israel ages 45-84 who were part of an osteoporosis study at had AP and lateral films taken of the thoracic and

lumbar spine. In the original study curves of with a 10 degree Cobb measurement were found in 30 percent of the sample.

At a follow up (7-13 years later) on 15 percent of those subjects, those with larger curves to begin with and in the older group had an average progression of 4 degrees. 65 percent of the group from 65-84 had an increase in their scoliosis.

A 2010 study published in *Spine* concluded that the monetary costs of non-surgical conservative management of the non-operative scoliosis greatly outweighed the benefits.[4] The researchers prospectively studied a group of scoliotic patients who used chiropractic care, physical therapy, exercises, bracing, and bed rest. The authors concluded that "among the 68 adult scoliosis patients who used nonoperative resources, there was no significant change in any of the HRQOL outcome parameters." These outcome parameters consisted of the SRS-22, SF- 12, and ODI.

Part of the inclusion criteria for the 2010 *Spine* study is a scoliosis of 30 degrees or greater. It is noteworthy that even with a scoliosis much more severe than the patient in this study, patients were not shown to benefit from care they received. It is not known what type of chiropractic care these patients received.

That they did not benefit may also be a relic of the outcomes assessment tools used as well—which were centered on pain, disability, and impairment rather than on wellbeing. Pre and post x-rays were not done in this study. That the patient in this case was seen to benefit, in response to questions on OATS, x-rays, and thermography and sEMG indicates the importance of a focus that includes patient subjective assessments as well as objective measures of neurological function.

As it is implied by the term "conservative," chiropractic care for scoliosis tends to be focused on either pain management or on prevention of the curve from progressing. The 2010 Spine study did not use follow up radiographs in their determination that conservative treatments are not beneficial for adult scoliosis. The unstated assumption in these studies' failure to address possible improvements in adult scoliosis is that the condition is necessarily debilitating and permanent.

Furthermore, a 1986 review and case series states "There is no scientific documentation that chiropractic treatment or any other conservative treatment can permanently reduce these curvatures. In fact, most idiopathic curves are structural with bony deformity which cannot be altered."[6] These authors go on to argue that chiropractors can address scoliosis through the management of associated back pain.

As discussed earlier, we do not know to what extent this patient's scoliosis would be considered a structural or a functional curve based on exam findings. The initial radiograph does not demonstrate an obvious rotatory component. Minimal spinal degeneration in the lumbar spine, as well as the smallness of the curve would seem to argue in favor of a functional nature of his curve.

Indeed, improvements in surface EMG that correspond directly to improvements in the scoliosis as well as the patient's cervical curve. For example, after one year of care a severe muscular asymmetry emerges on the right side of the lower thoracic spine (the concavity), whereas the hypertonic muscular activity had been on the left one year prior.

But there is significant reason to suspect that functional scoliosis is a step in the progression toward more severe structural deformity. According to Wolff's law, bone adapts and remodels according to the stresses placed upon it by muscular attachments.

Therefore, especially in the case of a geriatric patient whose regenerative mechanisms may be limited, the "conservative care" model should be reconsidered. Simply conserving a scoliotic curve, when accompanied by significant muscular facilitation, may be an oxymoron. That the patient's scoliosis was not accompanied by acute pain as might be expected in the case of reflex muscular spasm[1] or physical deformity and yet improvements were attained would seem to argue against the rationale for chiropractic care as a form of "conservative care." A paradigm shift in adult scoliosis management is needed toward a focus on optimum neurological function that minimizes aberrant activity in the muscular system.

Posture and Tone

Kent's 1996 article on subluxation models outlines three main approaches to addressing the vertebral subluxation—segmental, postural, and tonal.[24] In the postural model, the vertebral subluxation complex is considered a global, system wide phenomenon. Interference with proprioceptive mechanisms, and altered biomechanics throughout the body are said to create and maintain this distortion. Similarly, tonal approaches consider subluxation and methods of addressing subluxation according to the overall state of the nervous system.

Even upper cervical techniques, though focused primarily on subluxation at C1, do so as a matter of addressing system-wide autonomic imbalance evidenced through pattern analysis. Similarly, Network Spinal Analysis™ focuses its intervention on specific Spinal Gateway regions to achieve outcomes concerning the nervous system as a whole. There is one recently published case study authored by Rohrbach and the authors of the present study that documents an improvement in cervical curve under NSA care.[25]

Postural approaches to the subluxation have supplied a great deal of the theoretical orientation and the data in support of improvement of spinal curves as a desired neurological outcome. Harrison and Troyanovich in particular have drawn upon the cadaveric studies of Alf Breig and concepts of biomechanical engineering to outline how postural distortions alter nerve tissue and reduce neurological function.

Flexion distortions, seen in cervical kyphosis and also a component of scoliotic curves, are argued to create the greatest strain on the spinal cord and potential for aberrant neurology.[9] While straight transverse "shear" forces are hypothesized to create stress on neural tissues, when the 3 dimensional global phenomenon of scoliosis is considered, that stress is likely to be much more damaging.

Through the understanding offered by Panjabi, tension may have increased in the active, muscular system as a result of a loss of control at the neural-control subsystem. It is possible that by addressing neurological function through the spinal entrainment process, spinal and neural integrity increased and the scoliosis diminished.

Exercise

As mentioned above, research concerning rehabilitative or therapeutic exercise and scoliosis most often focuses on intensive corrective regimens. The difficulty home-care exercise is that compliance is often not known, so it is difficult to determine the impact. Mamyama reported on 69 adults instructed to use the "side-shift" exercise toward the concavity of their scoliosis.[20] It was found at a four year follow-up that their curves either stayed the same or slightly improved.

The authors stated that a limitation of their study is that compliance was not known. Because exercises were not the primary focus of care in this study, it would be premature to credit the exercises with the improvements in this case. Similarly, two other case studies use exercises to address scoliosis; one study focused on the reduction of pain through Sacro Occipital Technique in conjunction with Pilates exercises, and the other prescribed a specific exercise based on Applied Spinal Biomechanical Engineering.[26,27]

Both suffer from the shortcoming of the difficulties of monitoring and recording patient participation and compliance. Because of these issues, more care needs to be taken in researching the effects of rehabilitative exercises, especially in conjunction with chiropractic care, in order to draw any conclusions.

Geriatric Population

The finding that low force adjusting may initiate a structural change in the spine is particularly interesting with reference to the geriatric population. As discussed earlier, geriatric spines are generally thought to be less flexible, subject to degenerative processes, and likely to worsen, as evidenced by the hesitancy even to recommend "conservative" care in the literature.

The results this patient experienced in NSA care provide a counter-point to this orientation toward helping the elderly. Improvement of spinal curves on x-ray, improvement in thermal scan and sEMG, and patient perception of gaining balance and the ability to walk in a more erect fashion all have direct implications for problems typically facing the elderly. Deteriorating organ systems, spinal stenosis, inactivity, slips and falls and resultant disability—these might all be theoretically be addressed through chiropractic care that focuses on increased neurological function.

Those in the profession who advocate imposition of an extremely limited number of chiropractic office visits to ameliorate most diagnoses are sure to question the efficacy of the care plans and number of visits presented in this case report. However, considered in the context of sky-rocketing health care costs and Medicare dollars spent managing chronic conditions in the final years of life, there is no doubt that more research into the benefits of chiropractic care for the elderly is warranted.

The patient in this study was 75 years old, experienced both decreased pain and an increased sense of overall wellbeing. He reported only being on two prescriptions. He even reported experiencing one fall during care with no resultant injury or residual disability. Without further research, we do not know if these results are due to the possibility that this patient is part of a self-selecting group of NSA patients that are more health conscious than the average health-care consumer.[21] Nevertheless, an elderly population made up of mobile, healthy people with high neurological function is likely to be a benefit to the wider society.

Limitations

There are several limitations to this study. First and foremost are those limitations inherent in any case study. A research finding from one non-randomly selected patient provides only anecdotal evidence for the existence of any phenomenon. However, existence of a case that demonstrates a phenomenon should provide interest in how to reproduce that outcome, creating impetus for further research.

In this case we have seen that a patient undergoing low-force chiropractic care to address imbalances in the nervous system experienced major changes in the structure of his spine that could not be accounted for by structural adjustments with rehabilitative exercises of the kind thought to do the most to affect postural outcomes.

Another limitation is imposed by the information recorded in the patient file. For example, we know that the patient was asked to do two home exercises for the improvement of spinal curves. Since there was no one with him at home, it is unknown if the patient actually did these exercises and how often, however on the questionnaire one and a half years into care the patient responded that he was doing the exercises daily. There is no other documentation to support that, and he was not asked to do them during office visits. Such factors could be monitored more closely in a prospectively planned study.

While a scoliotic curve was revealed on the radiograph, further assessments were not done to determine the nature of the scoliosis. Adam's test, a standard in the assessment of a "structural" versus a "functional" scoliosis was not performed. Such a test would have served as an indicator for the severity of the lateral deformity and the likelihood of response to care through changes in muscle activation.

There were only two patient questionnaires that fell within the time period of study. More questionnaires, with more repeated questions would have allowed us increased insight into changes in the patient's perceptions and quality of life. Because changes in diet, exercise, and the adoption of "healthy practices" has been documented as an effect of NSA care,[21] more investigation into these would have been useful..

Conclusion

This case provides limited evidence that Network Spinal

Analysis care may be effective in addressing scoliosis and structural abnormalities in the spine. This case provides a complement to an extensive body of literature that documents the interrelated effects of abnormal posture, stresses on neurological tissues, decreased neurological function, and worsening biomechanics.

A possible mechanism is that the NSA entrainment initiates a shift from stress physiology and "defense posture." Stress physiology is associated adverse mechanical cord tension and loss of coordination between the spinal stability subsystems. In this model, it may be supposed that adult idiopathic scoliosis represents a potentially reversible adaptation to stresses.

This model should be compared to the two sides of the conservative care coin, where adult idiopathic scoliosis is either an inevitable march toward increasing deformity and pain through old age, or a clinical irrelevancy where there is no pain. These findings support the necessity of chiropractic care that moves beyond the symptom-oriented "conservative care" approach. The possible benefits of such an approach on a rapidly aging population are likely to be well worth the effort.

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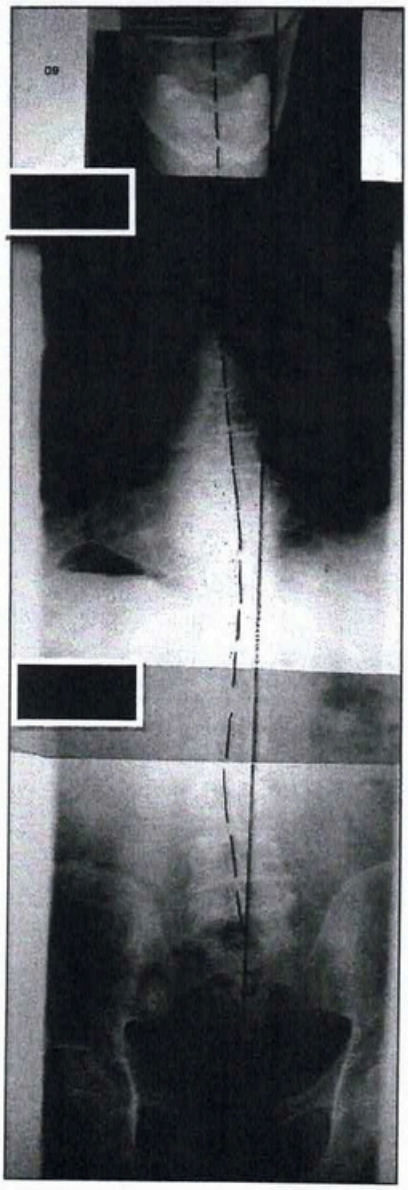
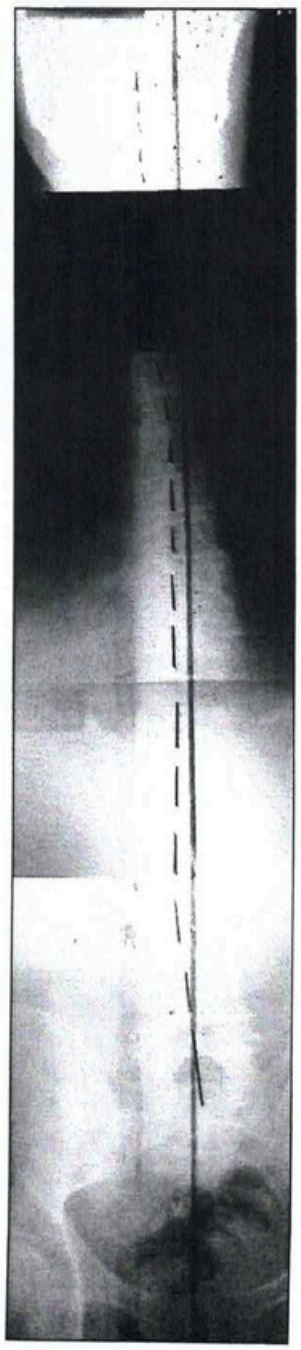
Figures

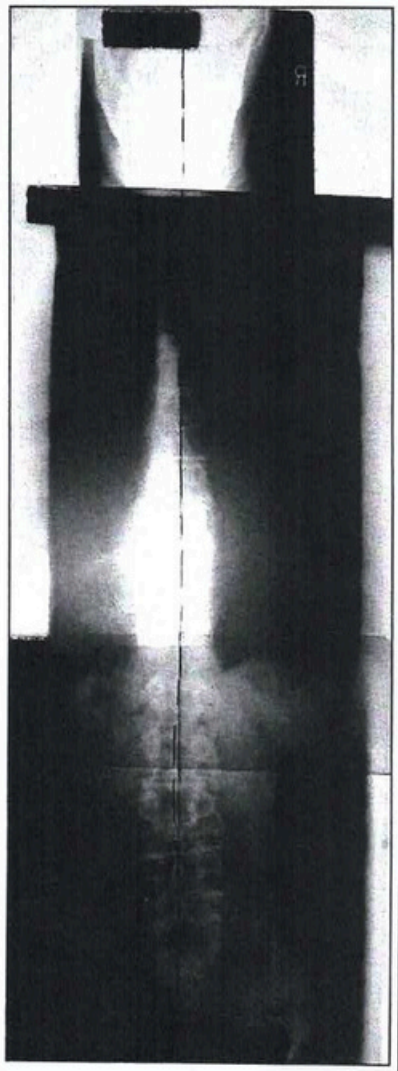
Full Spine Radiograph at Start of Care

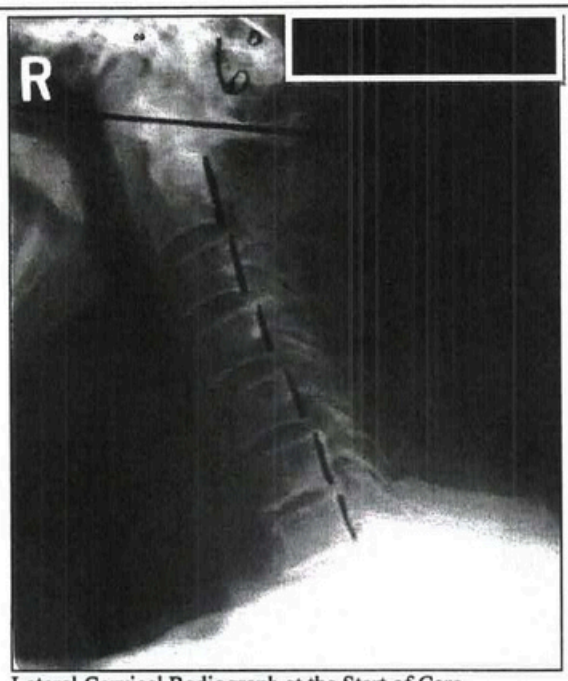


Full Spine Radiograph after 1-Year

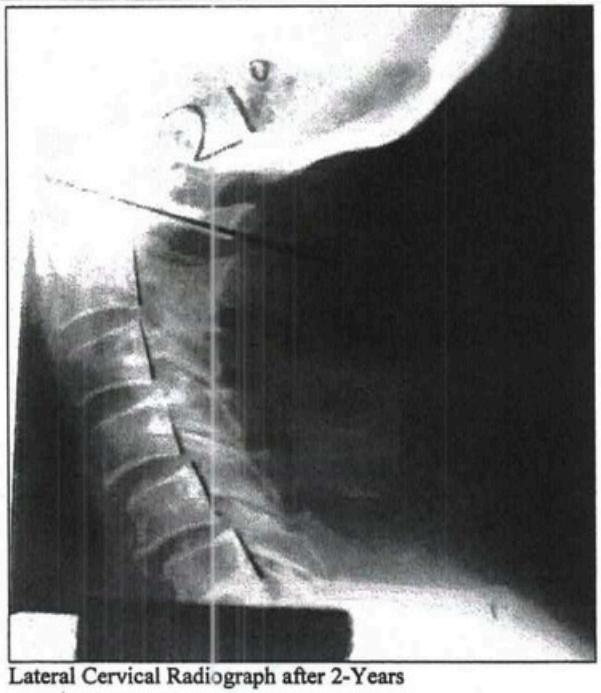


Full Spine Radiograph after 2-Years

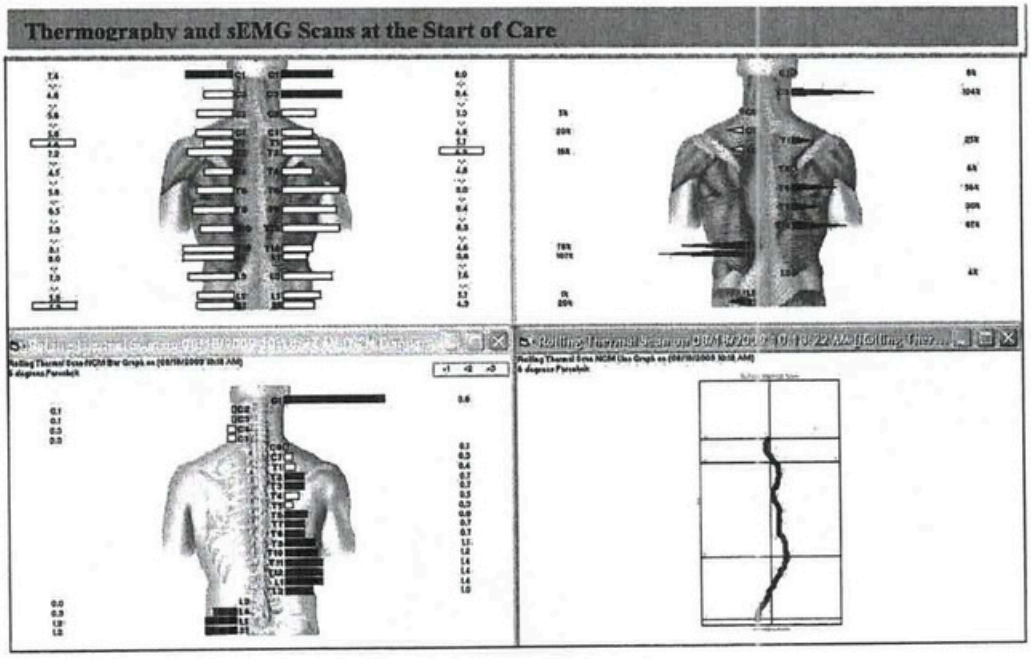




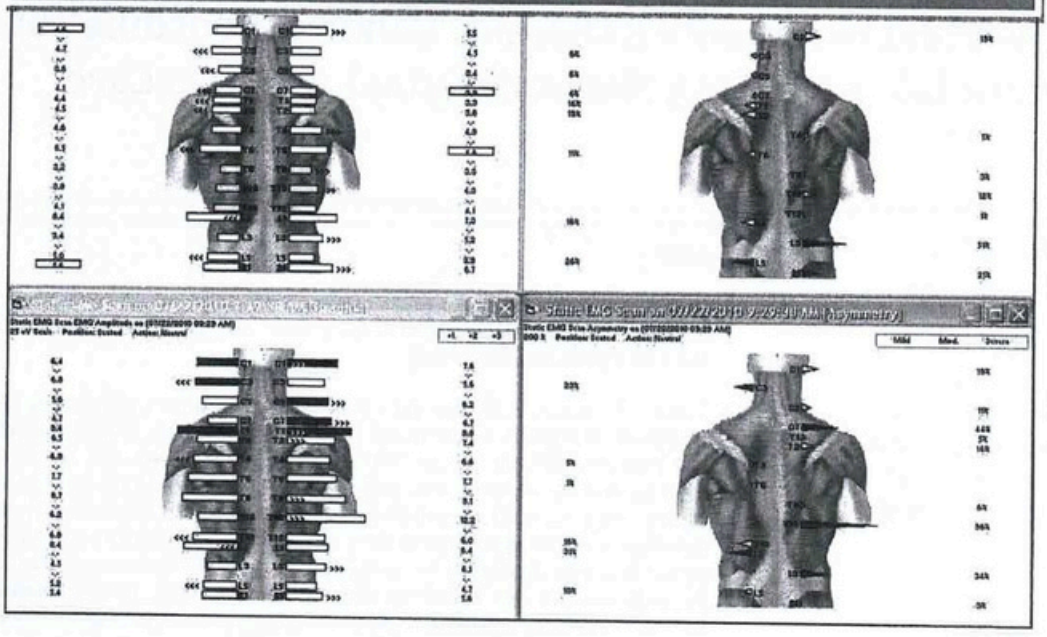
Lateral Cervical Radiograph at the Start of Care



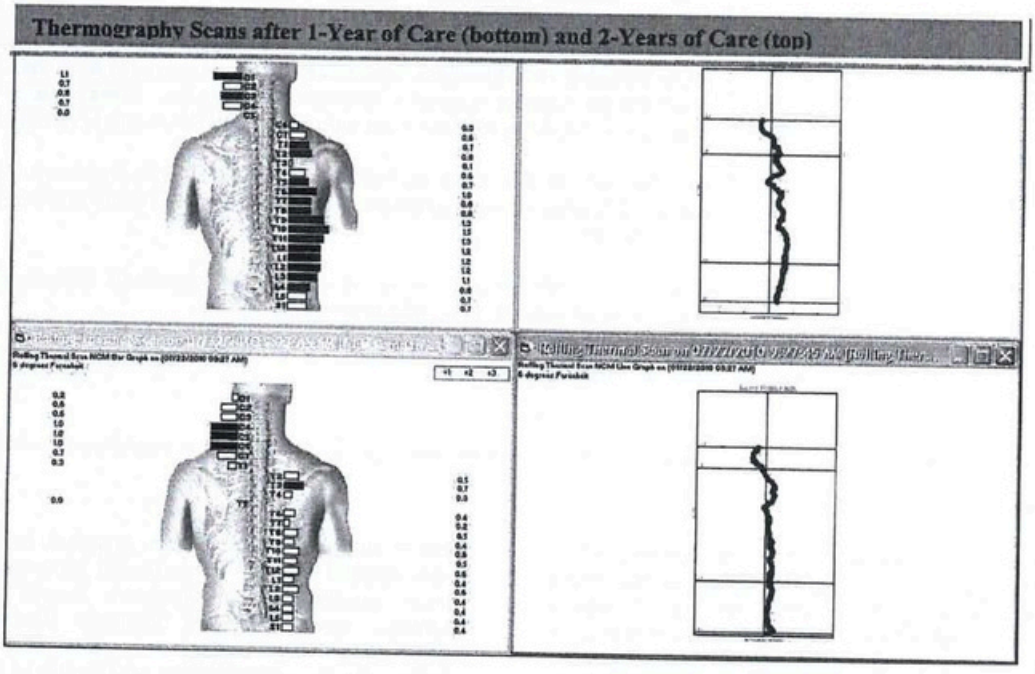
Lateral Cervical Radiograph after 2-Years



sEMG Scans after 1-Year of Care (bottom) and 2- Years of Care (top)



Thermography Scans after 1-Year of Care (bottom) and 2-Years of Care (top)



Case Study

Improvement in Meniere's Disease, Balance, Coordination & Quality of Life Following Network Spinal Analysis Care

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Abstract

Objective: To report on multisystem health changes of a patient diagnosed with Meniere's disease while under a long term chiropractic care program utilizing Network Spinal Analysis (NSA).

Clinical Features: A 56 year old white male presented to a chiropractic clinic with a complaint of bilateral carpal tunnel symptoms, numbness in both feet after sitting, and pain and fullness in the left ear. The left ear pain and fullness was also accompanied by dizziness and progressive hearing loss experienced over the past twenty years. Physical examination revealed significant structural and neurological imbalances. Spinal subluxations were identified at multiple levels of the spine. The patient had been managing his symptoms with ten different medications prescribed for various complaints including: blood pressure, anxiety, muscle spasms and fluid retention. Auditory evaluations had shown progressive degeneration of hearing in his left ear, along the whole range of frequencies tested.

Intervention and Outcomes: The patient received NSA care, basic workshop style education about stress, simple range of motion exercises, and beginning Somato-Respiratory Integration exercises. The first re-evaluation showed positive changes in symptomatology and lifestyle. His auditory exam four months from the start of care showed improvements especially with lower frequencies. These changes in hearing continued to improve, and then were maintained over the course of treatment.

Conclusions: In this case, an individual diagnosed with Meniere's disease had improved hearing as well as reduction of other symptoms while enrolled in an NSA care program.

Key Words: *chiropractic, vertebral subluxation, Meniere's disease (syndrome), hearing improvements, Network Spinal Analysis (NSA)*

Introduction

Meniere's disease affects the inner ear and is characterized by intermittent episodes of vertigo, low frequency sensorineural hearing loss, tinnitus, and aural pressure. Normally endolymph, (responsible for maintaining a sense of balance) is produced and then absorbed through active transport into the endolymphatic duct and sac within the inner ear. However, development of an increased volume of endolymph and expansion of the sac within the membranous inner ear, a phenomenon called endolymphatic hydrops, can result in bouts of vertigo.[1, 2]

Several mechanisms have been proposed to explain how endolymphatic hydrops produces the intermittent spells of vertigo associated with Meniere's disease. The most prominent theory describes increased distention of the endolymphatic duct leading to rupture of its membrane allowing for the potassium-rich endolymph to flow into the perilymphatic space and irritate the hair cells and cranial nerve eight, which are responsible for sensing movement and balance. This irritation, in turn, causes direction-changing nystagmus (perceived as episodic vertigo) and hearing loss.[3]

Another explanation proposes that an obstruction within the endolymphatic duct leads to hormonal production of additional endolymph as well as glycoproteins in an attempt to overcome the obstruction. When the obstruction is overcome, the sudden outflow across the sac causes deflection of structures in the otoliths and semicircular canals thus depolarizing the hair cells and could result in vertigo.[1,3] Another proposed mechanism states a narrow bony endolymphatic duct limits the flow of the endolymph causing a buildup in the endolymphatic sinus. Eventually the buildup of fluid forces open the valve of Bast and the fluid overflows into the utricle causing distortion of the hair cells thus causing vertigo. With repeated incidence cellular damage decreases the functionality of the sac, increasing amounts of endolymph remain in the cochlear duct, and hearing deteriorates.[2]

Sajjadi and Paparella reported significant anterior and medial displacement of the sigmoid sinus in those with Meniere's disease as compared to healthy controls. This forward location can cause compression of the endolymphatic sac creating abnormal vascular flow that leads to the development of obstruction and hydrops. They report that prevalence studies suggest the disease more commonly affects adults in the fourth and fifth decades, has a familial tendency, affects more Caucasians of northern European decent, and has a slight female predominance.[1]

Although no definitive cure and no one effective treatment is available for patients with Meniere's disease, most find relief with a combination of medical therapy, psychological counseling and reassurance, along with lifestyle and dietary changes. Patients with Meniere's are advised to restrict intake of salt, caffeine, alcohol, and tobacco products. Diuretics such as Dyazide and Triamterene are commonly prescribed to reduce salt and retain potassium levels. If more invasive intervention such as a Meniett device (a pressure pulse treatment), and endolymphatic sac enhancement surgery are unsuccessful, Gentamicin injections into the middle ear hair cells to destroy the cells, vestibular neurectomy, or even labyrinthectomy are other possible surgical options.[1,4]

Endolymphatic sac enhancement (ESE) surgery has been reported to be effective with varying results, with studies showing a conservative 59%[4] and greater than 76%[1] effectiveness in alleviating intractable vertigo. However, pathological findings have been associated with ESE surgery including perisaccular fibrosis and production of granulation tissue that fills the mastoid air cells and the perisaccular space creating saccular compression and obstruction.[1]

Several chiropractic studies report improvement in patients with symptoms of vertigo as it relates to Meniere's disease as well as cervicogenic vertigo.[4-10] The purpose of this paper is to report on a case of a male diagnosed with Meniere's disease as he progressed through chiropractic care utilizing Network Spinal Analysis (NSA).

Case Report

History & Examination

A 56 year old male presented to a private chiropractic clinic with reported complaints of bilateral carpal tunnel symptoms, bilateral paresthesia of the feet, and pain and fullness in the left ear. The left ear pain and fullness followed a twenty-year history of vertigo and progressive hearing loss. This symptomatology had led to a previous diagnosis of Meniere's disease by a medical doctor.

When asked to reflect on areas of his current lifestyle and rate them as "poor", "good", or "excellent", he rated his diet and exercise as "poor" and his sleep and general health as "good". He also evaluated his stress levels using a visual analog scale where "1" represents no stress and "10" represents extreme stress, rating his stress level as a "2" for both occupational and personal life stress. In response to the initial consultation paperwork, the patient reported ten different pharmaceutical medications he was taking as prescribed for various diagnoses.

A postural examination revealed: right head tilt and rotation, a right high shoulder and a right high ilium. Bilateral weight scales showed that he carried an extra 33 pounds on the left side as compared to the right. Thermography and surface electromyography (sEMG) were performed on the initial visit and on average every 15 visits to illustrate changes in vascular sympathetic tone and somatic signals to the muscles in response to chiropractic care (Appendix A). It has been shown that sEMG is a reliable, valid and objective method of evaluating paraspinal muscle activity.[11] Additionally, thermography is a reliable method of observing the sympathetic nervous system response to vertebral subluxations and chiropractic adjustments.[12]

Initial visit thermal scan exhibited multiple areas of temperature difference measured in degrees Fahrenheit with "severe" differences up to 1.4 degrees at C4 and T1, "moderate" differences up to 1.3 degrees at C2, C3, C7, T4, and L4, and "mild" differences up to 1.0 at T2, T3, T6, T7, T8, L5, and S1. The initial sEMG scan illustrated multiple areas of muscular asymmetry with "extreme" asymmetry at T1, T4, T6 and S1, "severe" asymmetry at C7, T2, and L5, "moderate" asymmetry at T12, and "mild" asymmetry at C1, C3, T8, and L1. Normative values have been established, and the Insight software translates the results into these labeled categories.

The Network "Phasing System", which is further explained in the discussion, was used to identify areas of spinal cord tension at specific segments. The patient was evaluated with this method on each visit.

Interventions

The patient was examined and cared for with NSA protocol. After an assessment via the "Phasing System", low force contacts were applied at "Spinal Gateways" to increase the patient's awareness of spinal tension patterns, posture, and to initiate spinal waves and promote reorganizational strategies. A total of 118 NSA adjustments, also called entrainments, were administered over a period of 34 months. The care was administered through progressive levels of care with unique physiological markers, assessments, and outcomes (Table 1).

He began to show resolution of the dominant spinal patterns six weeks into his care program, and level two NSA

entrainments were introduced. Only the first two levels of NSA entrainments were used for the duration of his care. This concept will be further explained within the components of NSA protocol. NSA protocol is a non-linear approach in which the contacts made could be at different segments within each of the five phases, depending on the rapport detected by the practitioner. Contacts were made along varying aspects of the sacral tubercles, the occiput, and at any of the cervical vertebra depending on the phase (Table 2). Throughout the duration of care, the patient was found to exhibit all of these phases at some point. His care plan consisted of an average of three visits per week for the first three months. He was seen an average of three times per month over the period of a year and an average of 2.5 times per month for the following year, through the end of reported care.

In addition to the NSA adjustments, the patient also participated in basic workshops about stress and how it can affect the nervous system, spine, and health, and performed simple range of motion exercises such as knee to chest and piriformis stretches. As a complement to NSA care he also attended an introductory somato respiratory integration workshop, and self-awareness exercises were performed at home. These exercises are designed to enhance somatic awareness through the use of self-directed focus of movement, breathing and verbalization of statements about one's internal state.[13]

Re-evaluations

An audiologist examined the patient each year during the treatment period and had documentation supporting left sided hearing loss. The audiogram prior to beginning care indicated hearing deficiency throughout all frequencies in the left ear. After approximately four months of care, the patient's audiogram showed global improvements with greater improvements noted in the lower frequencies and the greatest overall improvement at 1000 Hz frequency. The audiogram performed during the second year of care showed similar global improvements with greater improvements noted in the higher frequencies, especially at 8000 Hz. During the third year of care the patient had minor regressions in hearing loss at the 250, 500, 2000 and 4000 Hz ranges; however, he still showed net improvement when compared to the audiogram performed prior to beginning care. (Figure 1)

Re-exams were done approximately every 15 visits using the Insight Millennium Subluxation Station to obtain and analyze sEMG and thermographic qualities of the patient's spine as he progressed through NSA care. These scans were completed on visits 13, 25, 52, 64, 81, 89, 100, and 115 to show the progression of the patient's autonomic regulation and changes in muscular symmetry. Overall, rolling thermal scans showed improvement in regulation of autonomic function through smaller and less frequent differences in paraspinal temperature. Surface EMG scans also showed relative improvements over the reported span of treatment with fewer areas of muscular asymmetry as well as a decrease in overall severity. (Appendix A)

A re-evaluation questionnaire was completed on the 89th adjustive visit which was approximately a year and nine months into care. The patient was asked to rate his overall health and well-being as the function of his nervous system improved by writing a "1" if improvement was noticed in the functional area and a "2" if significant improvement was noticed in the functional area. He reported that he felt more relaxed, more rested, more alert, had more energy, and could think more clearly. He also noticed improvements in his moods, sleep, vision, and overall comfort. A decrease in frequency and severity of headaches and colds or flu was reported as well as a noticeably improved ability to bend, walk, sit, and stand compared with the time prior to beginning care. His improvements in hearing, balance, and coordination were noted to be of significant improvement, with particular acknowledgement that his hearing improvement was also noticed by his family. Other noted lifestyle changes included increased water consumption and exercise.

A second re-evaluation questionnaire was completed a year after the first. Functional improvements included an increase in his ability to cope with or handle stress, a greater sense of well-being, and a heightened perception of his health as well as others' perception of his health. He indicated noticeable positive changes in the following: overall comfort (including joint, back, and neck comfort), and increased flexibility. He also reported greater ease with sitting, standing, lifting, bending, and driving. Decreases were reported in both frequency and severity of headaches and sinus congestion, as well as carpal tunnel symptoms.

He also indicated noticeable positive improvements with the following: memory, cognition (his ability to think more clearly), mood, sleep, coordination, allergies, and immunity. He again noted significantly fewer incidences of sickness with a cold or the flu and significant improvements in his breathing. Other positive indicators were noted with respect to: strength, relaxed demeanor, alertness, energy levels, and balance. An additional special notation was made that he had observed an improvement in his hearing since beginning care. Additionally, the patient reported a reduction in the amount of prescribed medications taken daily, from ten to two.

Discussion

Network Spinal Analysis (NSA) care is an evidence-based approach to wellness and body awareness developed by Dr. Donald M. Epstein and used exclusively by doctors of chiropractic. According to Dr. Epstein, NSA care encompasses certain aspects of multiple longstanding chiropractic methods, principles of quantum mechanics, neuroanatomy, neurophysiology, and psychoneuroimmunology as well as changing perspectives in health care to explain its approach.[14]

Based on Alf Breig's research on Adverse Mechanical Cord Tension (AMCT), NSA care developed and utilizes a "Phasing System" to correlate spinal cord tension with specific osseous segments. This "Phasing System" is administered through advancing levels (Tables 1 and 2) that have unique physiological markers, assessments, and outcomes which, according to Irastorza, are tracked via spinal and neural integrity subsystems as well as assessments by both practitioner and patient as they progress through the levels of care.[14, 15]

NSA seeks to perfect the technique through evidence based practice measures. It has evolved over the years and, more specifically, in 2004 was updated from a system of health care delivery seeking to reduce two specific types of vertebral subluxation: structural and facilitated, to a multi-component system of patient-centered health care delivery.[16] Originally viewed as a system of classifying, prioritizing, and adjusting vertebral subluxations, NSA has evolved into a system designed to enhance one's cognitive and precognitive awareness of spinal structure, body tension patterns, and specific spinal waves comprised of a "Respiratory Wave" and a "Somatopsychic Wave" to reorganize the nervous system.[17,18]

The Respiratory and Somatopsychic waves are unique to NSA care and are waves of muscular activity professed to encourage reorganization of the body's neural circuitry, spinal oscillation, and changes in the function of the autonomic nervous system contributing to a more relaxed state.[15, 18]

The four components of the updated NSA system include 1) gentle precise contact, 2) the process of spinal waves assisting in creation of adaptive strategies, 3) a psychosocial component that suggests an ability to facilitate positive self-modification of behavior by affecting the person's perception of their state of wellness and thereby influence the adoption of a health promoting lifestyle, and 4) a wellness education paradigm that creates an awareness of multiple concepts including the differences in allopathic and non-allopathic practices as well as differences in approaches, goals, and objectives of each. Patients are also educated on the differences in actions consistent with illness and wellness as well as the physiological effects of making healthy lifestyle choices and the importance of self-reports of health and quality of life when working towards wellness.[16]

Prior to making a contact, the clinician makes clinical notations about the passive (bones and ligaments), active (muscles and tendons), and neural (phase indicators) tensions in the body. When gentle and precise contacts are made in areas of specific spinal-dural attachments, called "Spinal Gateways", the brain is cued to create new wellness promoting and reorganizational strategies for living and healing. This is accomplished through the development of spinal waves.[15] The Spinal Gateway is described as "an interface between the dimensions of energy, consciousness, and physical tissue. [It is] a nexus or hub for interactions between the spinal stability subsystems".[19]

The Spinal Gateways are found in the vicinity of the tissues that overlie the spinal-dural attachments which are reported to be at occiput, C2, C5, S2, S3, S4, and coccyx.[19, 20] After the contact is made, clinical notations are made about changes in the tension parameters and regions of the spine that stretch or spontaneously move with the adjustment of other segments.

This may appear as muscular or bony movement as the spinal cord tension is released after receipt of the self-directed corrective force (the contact) at the subluxated segments. The "Respiratory Wave" is described as smooth, rhythmic muscular movements that are often synchronized with deep respirations and when fully developed produce movement from the sacrum to the cranium, segment by segment, and exhibit muscular expansion in both the axial and anterior/posterior planes simultaneously.[14]

In his article which outlined the transition of NSA care, Dr. Epstein described that it was the clinical findings related to the "Somatopsychic Wave Phenomenon" that provoked the shift in the system's approach. He reported that Bohacek and Jockheere's research evaluating unfiltered surface electromyography signals revealed a wave with "dynamical non-linear character distinct from voluntary muscle contraction" suggesting that the "Somatopsychic Wave" cannot be consciously generated but can be consciously halted. Patients who were aware of deeper respiration patterns and/or the "Somatopsychic Wave Phenomenon" reported greater wellness and quality of life as compared to those who were also under NSA care but not perceptive of the phenomena.[16] Also, research study of the nature of the "Somatopsychic Wave Phenomenon" reveals increasing levels of complexity as the patient progresses through a series of levels of care.[15]

Irastorza explained that NSA care operates from a model of "Reorganizational Healing" and "involves the dynamic relationship and outcomes of structural, behavioral and perceptual shifts in enhanced energetic (thermodynamic) efficiency, as well as the promotion of enhanced spinal-neural coherence," and as such "is an integrally informed structural approach to the developing field of integral health and medicine in which internal subjective and external objective developmental stages and states can be monitored and evolve."[15]

Although NSA does not claim to be a cure for medical conditions, it is estimated that more than 12,000 patients currently receive NSA care and there are many reports of improvements in symptoms of medical conditions.[18, 21, 22] To our knowledge there have been no reports of NSA care and Meniere's disease; however, there have been reports of NSA care and positive effects with multiple non-musculoskeletal issues including: reduction of psoriasis[21], improvement in vision[15], improvement in attention[18], and overall wellness and quality of life[23].

Surface Electromyography

Electromyography, also known as EMG, is a technique used to gather information about muscular activity. There are two approaches to gathering the information, needle electromyography and surface electromyography (sEMG). In his article comparing needle electromyography and surface electromyography, Kent described how sEMG study is more appropriate for evaluation of the global function of groups of muscles.

He described how sEMG can help to determine the severity of a condition as well as: areas of asymmetrical muscle contraction, areas of muscle splinting, abnormal recruitment patterns within muscles, dysponesis, and responses to dysafferentation as they are associated with vertebral subluxation. He also showed a physiological response to the chiropractic adjustment.[11] Additionally, Kelly reported that sEMG test-retest studies show very good to excellent reliability with correlation coefficients of 0.73 to 0.97 and

reports test-re-test reliability for the two approaches is in favor of sEMG with coefficients of 0.88 for sEMG and 0.62 for needle EMG.[24] Surface electromyography utilizes hand-held electrodes to measure and record electrical muscular activity as generated through the action potential. Data, including the amplitude, or muscle signal measured in microvolts, paraspinal muscular symmetry, and frequency shift is collected from fifteen paired sites along the spine, analyzed by a computer, and compared to a normative data base.[11]

Thermography

Infrared technology allows for the indirect evaluation of the sympathetic nervous system through the use of thermal scans which have been reported as a valid and reliable method for evaluation of sympathetic nervous system response as it relates to vertebral subluxation.[12] An infrared thermal scanning device measures peripheral skin heat emission created by paraspinal tissue vasoconstriction and vasodilation which is controlled by the sympathetic nervous system, a subcategory of the autonomic nervous system.[25] Thus paraspinal thermal differences indicate abnormal autonomic regulation. McCoy et al. report very high intra-examiner and inter-examiner reliability of paraspinal thermal scans with the Insight Millennium Infrared Thermal Scanner. [12]

Audiology tests

The primary hearing evaluation in this case was audiometry. Audiometric evaluation assesses bone conduction versus air conduction in a coherent patient. While wearing headphones, the patient is instructed to indicate when he or she can hear the sound. The audible sounds are produced at different decibels to determine any hearing deficiencies and the frequencies affected. With normal hearing defined as the ability to hear sounds at 15 db, a reduction in as little as 10db represents a deficiency.[26]

Di Duro reports that cases with vertigo also have sensorineural hearing loss. A possible explanation of this could be damage to the hair cells and vestibular portion of cranial nerve eight interferes with vestibulo-cochlear system function, causing a possible decrease in activation of the auditory cortex and primary association areas, leading to hearing loss. This deprivation of the normal peripheral input to the higher cortical regions has been shown to cause reorganization of brain activity.[27]

He explains that excitotoxic damage to the hair cells in the cochlea is shown to be reversible through neural plasticity and hearing could be restored. Di Duro also reports following reversible cochlear damage, plastic changes in the peripheral auditory system take longer.[27] It seems possible to extrapolate that the repeated exposure of potassium (toxic to the hair cells in the perilymphatic space) occurring with endolymphatic hydrops causes repetitive damage to the hair cells and thus plastic changes would not occur as expected.

However, Di Duro concludes that because of cortical integration of somatic, vestibular and visual information, it is possible that the afferent somatic information following chiropractic adjustment can create changes in the vestibulo-cochlear system and thereby influence changes in hearing. Perhaps this is the mechanism at work in this case study. The cortical integration could result in regulation of hormonal balance and reduce the fluid volume that occurs with endolymphatic hydrops allowing for restoration in hearing in this case.

Possible limitations of the study include limited patient history and limited documentation of examination findings including daily visit analysis of active, passive, and neural tensions as they relate to Network Analysis. Although the re-examination assessment questionnaires contained similar information as the questionnaires developed through NSA, they were developed by the private office and therefore were not peer-reviewed or analyzed for validity or reliability.

Conclusion

Over the course of the recorded care period, the patient reported improvements in multiple areas of his life, most notably with his symptoms of Meniere's disease. As a result of these improvements, his medicinal dependence decreased and his hearing significantly improved verified with objective testing through audiometry. He also experienced improved ability to communicate with his family. This case study adds evidence to support the research data-base of improvements made with patients under NSA care, with results expanding beyond the normal palliative care measures associated with many chiropractic techniques.

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Table 1

Level of Care	Description
1	Objectives: • To reduce facilitated subluxations, which are described as having a primary component of nerve root pressure related to adverse mechanical cord tension and a secondary component of osseous misalignment. • Entrainment of respiratory motion with spinal motion (respiratory wave) • Release of tension from spinal stability subsystems • Reduction of parameters of spinal cord tension
2	Objectives: • To reduce facilitated and structural subluxations. Structural subluxations have a primary component of vertebral misalignment and a secondary component of nerve interference and are thought to be initiated by mechanical or physical stress. These are not addressed until Level Two under the concept that in the absence of underlying chronic facilitation, the body is more accepting of structural adjustments. • Resolution of dominant spinal defense patterns • Development and refinement of the Somatopsychic wave (entrainment of two vertebral oscillators
3	Objectives: • Promote enhancement of overall health in individuals who have developed consistently flexible spines free of facilitated and structural subluxations and have coordinated the Somatopsychic Wave from sacral to cranial ends of the spine. • Absence of defense posture • Development of the third (thoracic) oscillator

Adapted from Epstein D. Network Spinal Analysis: a system of health care delivery within the subluxation-based chiropractic model. J Vert Sublux Res. 1996 Aug; 1(1):1-9.

Table 2

Phase	Correlating osseous segments	Possible direct "Spinal Gateways"
1	Sacrum or Occiput	medial to lateral aspects of the sacrum
2	C1 or C5	C1/CO or C1/C2
3	Ilium at Posterior Superior Iliac Spine or Sacral apex	Posterior Superior Iliac Spine or Sacrotuberous Ligament
4	C2 and or C3	C2/C1, C2/C3, C3/C2, or C3/C4
5	C2 and Sacral apex or C5 and coccyx	C2/C1, C2/C3, C3/C2, or C3/C4 C4/C3, C4/C5, C5/C4, C5/C6, C6/C5, or C6/C7

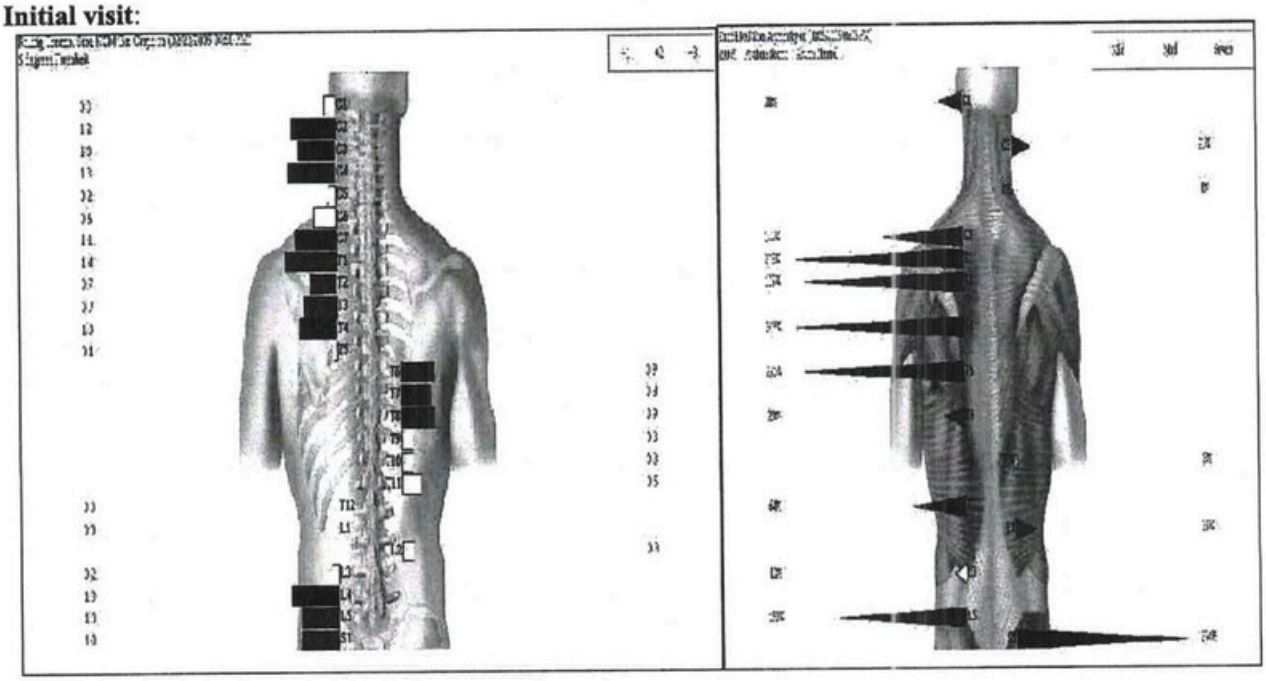
Adapted from Pauli Y. Improvement in attention in patients undergoing Network Spinal Analysis: a case series using objective measures of attention. J Vert Sublux Res. 2007 August: 1-9.

Figure 1

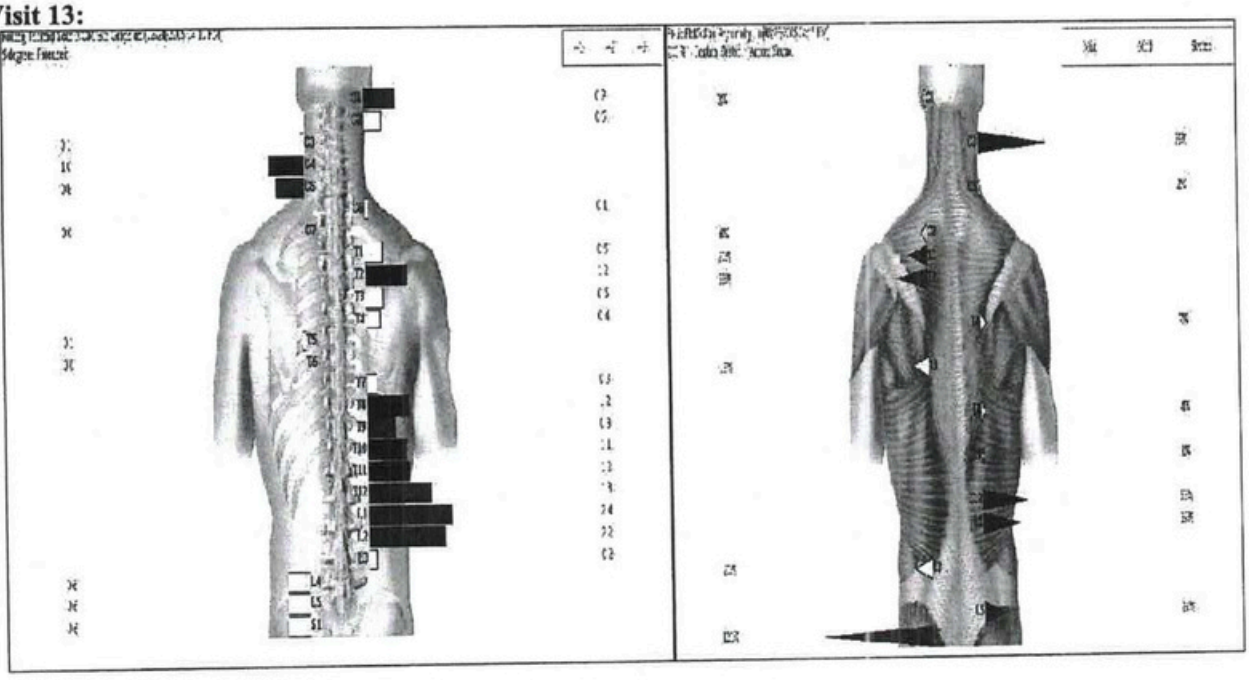
Test number	Frequency in Hertz	250	500	1000	1500	2000	3000	4000	6000	8000
1	right ear	10	8	10		7		10		15
	left ear	42	40	43		30		40		50
2	right ear	10	10	10		7		10		15
	left ear	25	20	20		15		35		55
Left ear difference of dB from test 1 to test 2		17	20	23		15		5		5
3	right ear	10	10	10		7		10		10
	left ear	30	18	10		8		25		35
Left ear difference of dB from test 2 to test 3		-5	2	10		7		10		20
Left ear difference of dB from test 1 to test 3		12	22	33		22		15		15
4	right ear	10	10	7		10		10		15
	left ear	35	20	10		12		30		30
Left ear difference of dB from test 3 to test 4		-5	-2	0		-5		-5		5
Left ear difference of dB from test 1 to test 4		7	20	33		18		10		20

Appendix A

Initial visit:



Visit 13:



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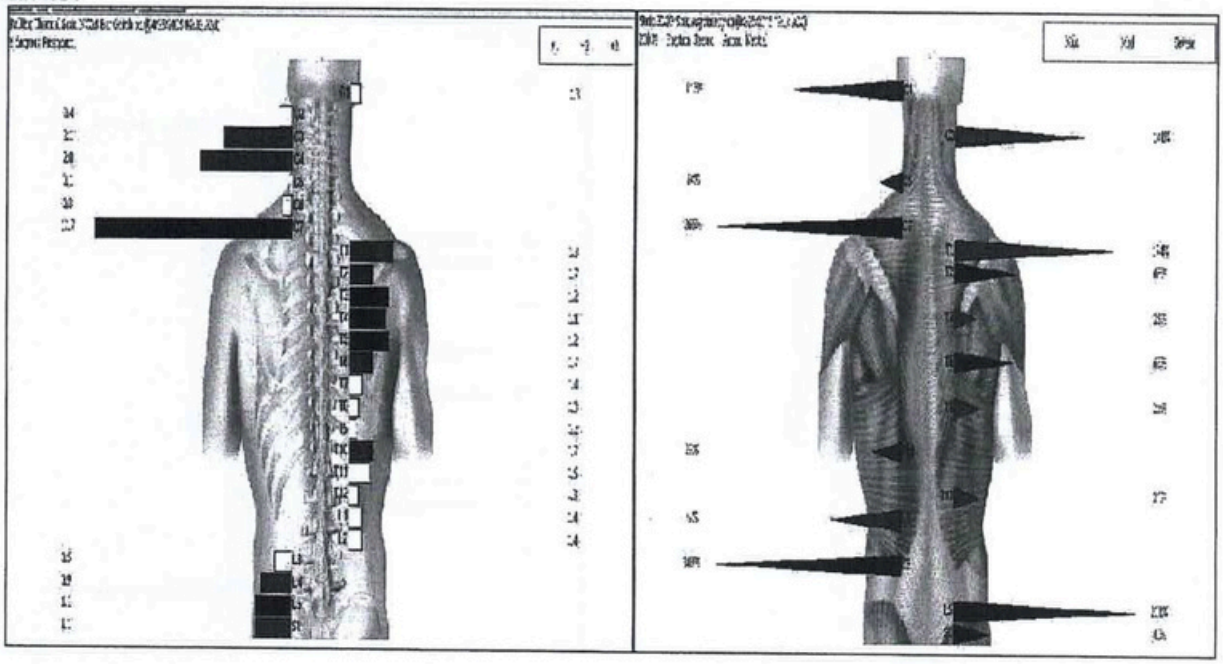

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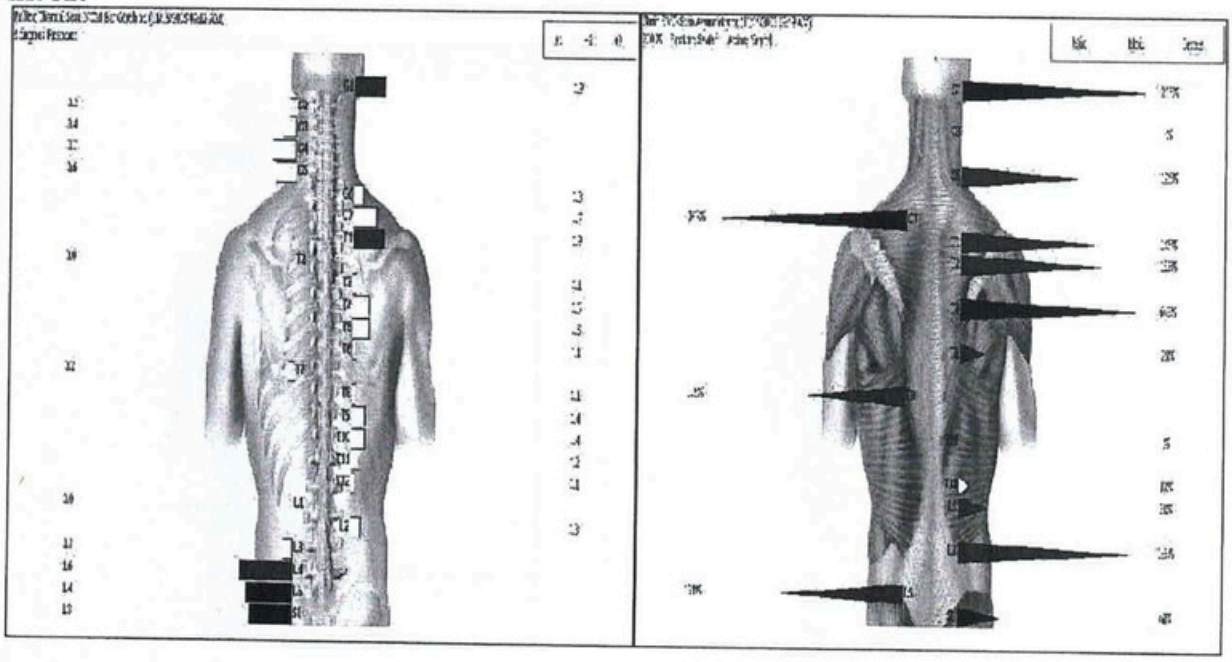

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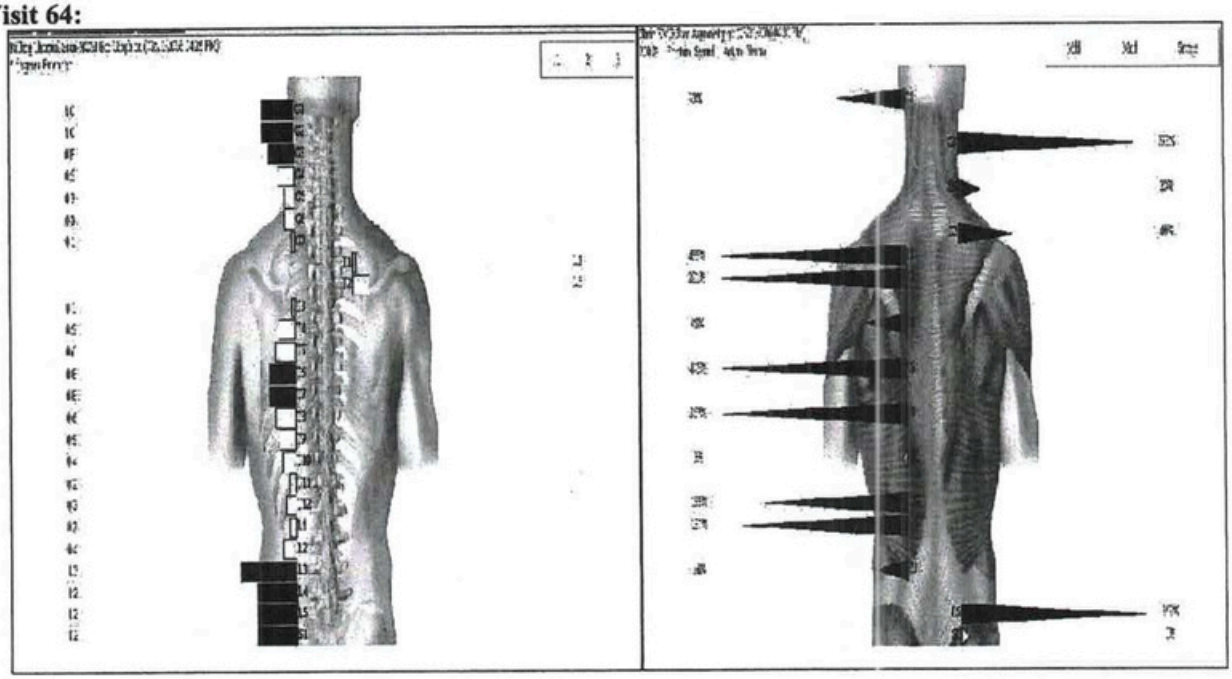

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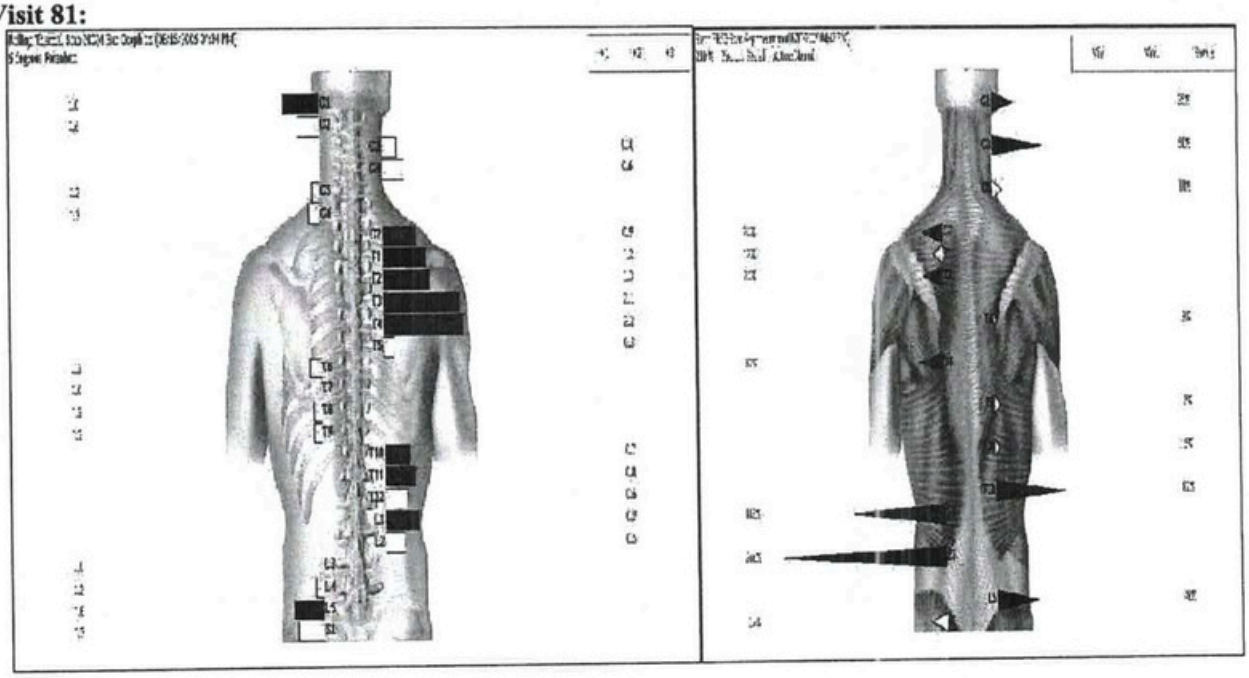

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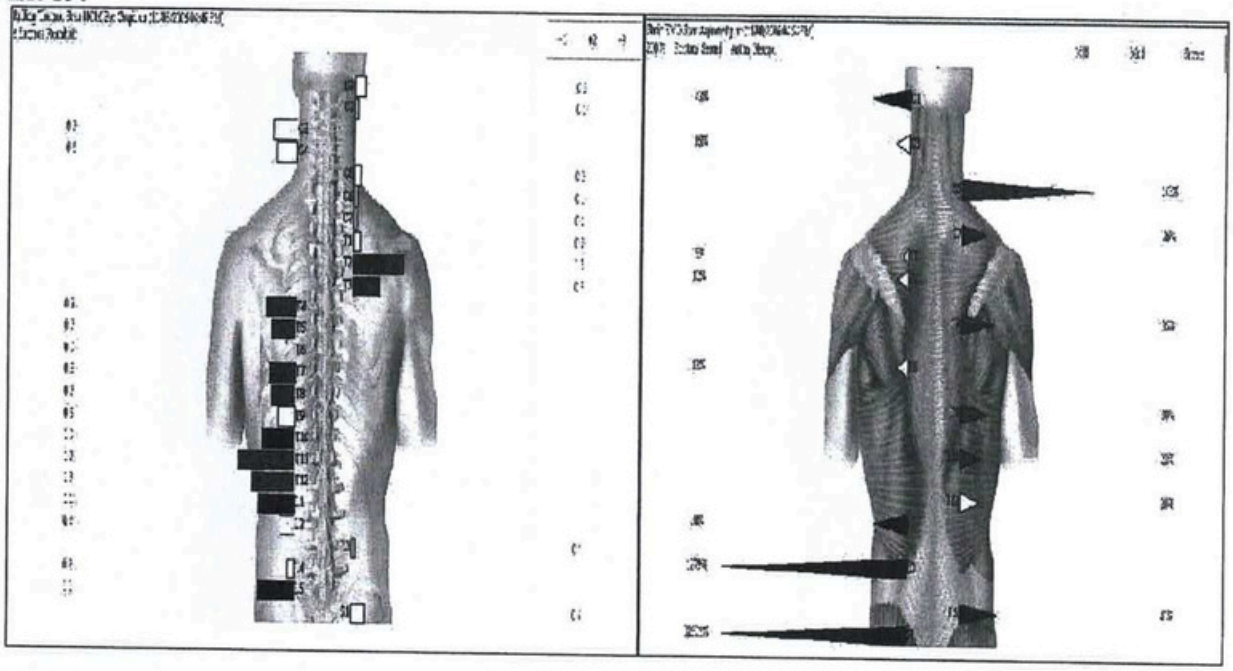

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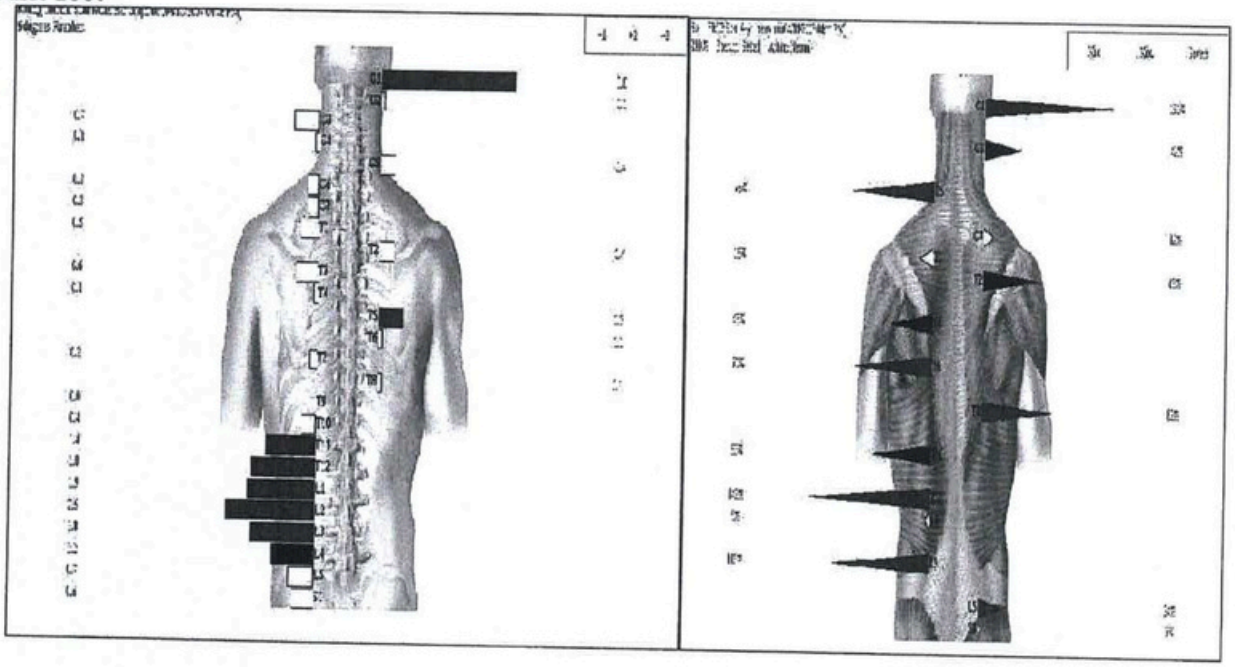

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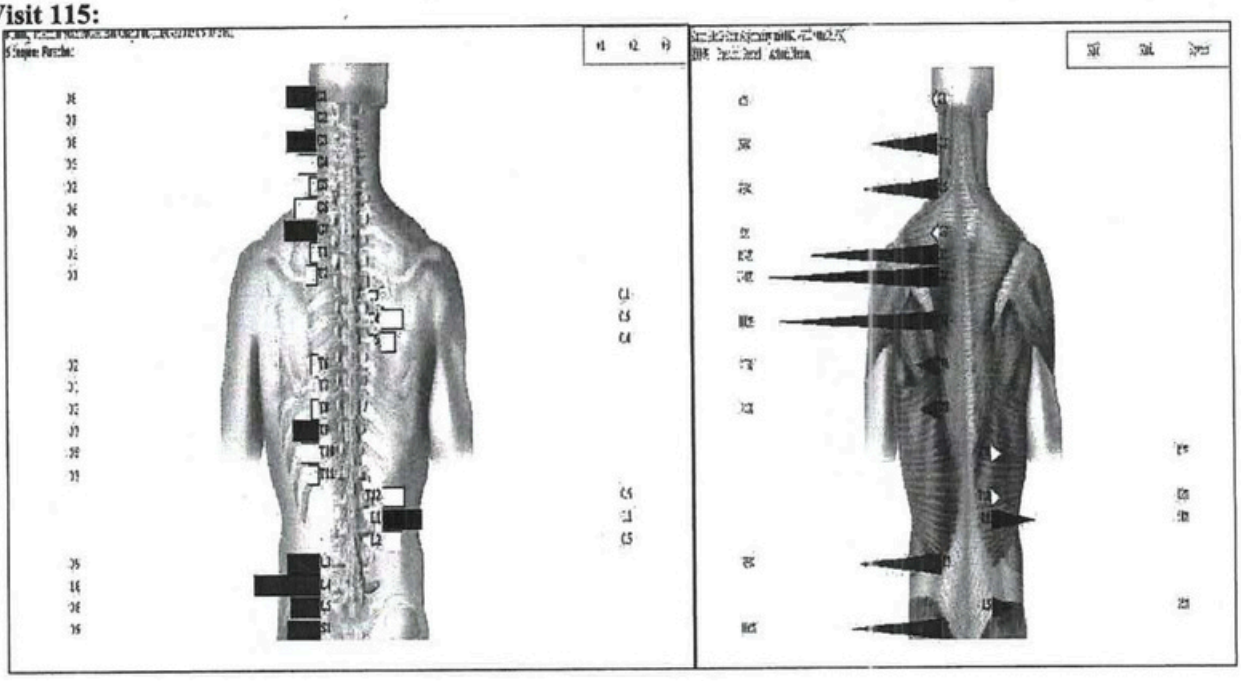

Correction of Subluxation Using CBP Technique and Improvement of Adolescent Idiopathic Scoliosis: A Case Report

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Introduction

Scoliosis appears in 2-4% of the general population. There is a lack of consensus on the usefulness of protocols other than monitoring, bracing, and surgery in scoliosis patients. This report explores the outcome of a case study on subluxation based chiropractic care using CBP Technique in an adolescent female scoliosis patient, as well as a review of the relevant literature.

Methods:

A 10-year old female, previously diagnosed with scoliosis, was monitored with rolling par-spinal thermography, static para-spinal electromyography and Cobb Angles for five and a half months while under first time chiropractic care. Initial postural analysis and AP lumbar x-ray revealed a 16.2 degree right thoracolumbar convex scoliosis from T12-L6. The intervention was subluxation based care using CPB protocols of mirror image adjustments, exercises and traction. Post x-rays, taken at 3 months, showed a decrease of 4.6 degrees in the Cobb Angle measurement (a 28.4% improvement). Rolling para-spinal thermography, and static para-spinal EMG were taken one month after the start of care, and again after five and a half months. Both types of post scans demonstrated improvement in the cervical and lumbar spine, while the thoracic spine remained similar.

Discussion

The literature is paradoxical for chiropractic and scoliosis angle reduction. There is relatively little chiropractic literature corresponding to rolling par-spinal thermography and static para-spinal electromyography. Thus, further investigation into this topic is needed. The lack of a control group is a limitation to this study, and with the literature on scoliosis in general.

Conclusions

The literature is paradoxical for chiropractic and scoliosis angle reduction, and there has been little investigation into potential benefits of subluxation correction in scoliosis patients. This current case study adds to the body of literature to support the need of further larger studies, including control groups, on chiropractic care, subluxation correction and scoliosis.

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Case Study

Restoration of the Cervical Curve and Improvement in Neurological Function in a Patient Following Network Spinal Analysis

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Abstract

Objective: To describe the restoration of a cervical curve following Network Spinal Analysis™ (NSA) chiropractic care in a patient with neck pain.

Clinical Features: The patient presented with a chief complaint of neck pain. Radiographs were taken and demonstrated an Atlas Plane Angle measurement of 12° and a cervical Absolute Rotation Angle (ARA) of 10°, representing a cervical kyphosis.

Intervention and Outcomes: The patient received NSA care that consisted of Network adjustments entailing light contact to specific regions of the patient's spine. Follow up radiographs were taken after one year of care. The radiographs demonstrated significant sagittal curve improvement with an Atlas plane line measurement of 32° and an Absolute Rotational Angle (ARA) of -27°.

Conclusion: Successful chiropractic care was described in this case by improved measurements in the cervical curve. The Atlas plane line improved by 18° and the Absolute Rotation Angle improved by 37°. More research is warranted in this area.

Key words: *cervical curve, kyphosis, lordosis, Network Spinal Analysis, chiropractic, entrainment, tensegrity, subluxation, surface electromyography, thermography*

Introduction

In the last few decades, research has illustrated the importance of the natural contours of the spinal column with regards to one's symptoms, pain, and overall health.[2] The cervical curve develops as an anterior curve (lordosis) in infancy when the infant learns to hold his head upright.[3] When the normal lordotic curve of the cervical spine is compromised, the proper biomechanical function of the spine becomes disrupted, altering the body's ability to transmit forces through the body to decrease the chance of injury to a localized area.[2]

Symptoms associated with an abnormal cervical curve may include cervical-brachial neuralgia, numbness, vertigo, nausea, paresthesia, occipital neuralgia, suboccipital pain, vascular headaches, migraine headaches, and muscle spasm with limited cervical range of motion.[4]

With this in mind, some chiropractic techniques have been developed in an effort to address the biomechanical integrity of the cervical spine by focusing on the characteristics of the cervical curve. Most commonly, CBP, Pettibon and Pierce have focused on the restoration and correction of the cervical curve via spinal adjustments, mirror-image adjusting, cervical extension-traction, 3-point bending, cervical compression traction with a posterior –anterior transverse load at mid-neck, and a headweight device.[2,5]

At the heart of the chiropractic philosophy is the premise that the body has the innate ability to heal and self correct. However, the efficacious correction of the cervical curve has always been thought to require manual or mechanical

manipulation, stretching, neuromuscular re-education and high velocity thrusts.[2] There has been very limited research on the correction of the cervical curve in the absence of force, and the purpose of this paper is to report on the body's ability to self-correct and restore the proper spinal curvatures through Network Spinal Analysis care™.

Case Report

This paper is a retrospective study on a Network Spinal Analysis patient. The patient is a 23 year old female massage therapist who presented for Network care with complaints of neck pain rated as an 8-9/10 on the pain scale, as well as shoulder and sacroiliac pain. Her past history reveals a roll-over car accident two years prior, E coli infection, and fractures unrelated to the motor vehicle accident of her left shoulder, right wrist and ankle, all of which no complications were noted. On her initial health questionnaire, she claimed that her health was preventing her from breathing deeply and that if she had optimum health, she wouldn't be "debilitated by neck issues." In addition to the health questionnaire, thermal scanning, surface electromyography and x-rays were taken of the cervical, thoracic and lumbar spine.

SEMG Scan

The initial static electromyography (SEMG) scan was performed along the patient's paraspinal muscles to measure differences in muscle tension.[6] The scan demonstrated areas of significant asymmetry at 10 levels, and severe elevation of muscle tension at 5 levels. Thermal scans used to assess aberrations in the function of the autonomic nervous system demonstrated severe asymmetry at C2 and C3 on the right. Ideally, a healthy individual's scan will demonstrate symmetry. Thus, asymmetrical temperature differences throughout the spine are indicative of autonomic nerve dysfunction.[7] In this case, the patient's scans demonstrated both sympathetic nerve dysfunction as well as marked differences in paraspinal muscle activity, indicating a lack of coordination in the nervous system.

Radiology

Radiographic line analysis was performed on the lateral cervical x-ray. This included a cervical curve measurement using Chiropractic Biophysics protocol by drawing a line tangentially from the posterior vertebral bodies of the 2nd and 7th cervical vertebra. This line, the Absolute Rotational Angle, measured 10 degrees indicating a cervical kyphosis. According to CBP protocol and Kapandji, this angle ideally should measure 42.2 degrees and exhibit a lordotic curve.[2] The second line analyzed, the Atlas Plane Angle, is found by drawing a line bisecting the anterior tubercle and posterior arch of the Atlas and measuring the angle at the anterior tubercle as it intersects with a horizontal line drawn parallel to the top of the film. Harrison and Janik's studies indicated that the Atlas plane angle should ideally create a 28.7 degree angle to the horizontal plane line.[8]

Chiropractic Care

The patient began a 12 month care plan consisting of Network Spinal Analysis. This plan broke down to 3 visits per week for the first 90 days, and 2 visits per week for the following 9 months for a total of 109 adjustments over a 1 year period. At each visit, the patient was analyzed using Network Spinal Analysis protocol. This entailed assessing heel tension, heel eversion stress, adduction and abduction stress, in addition to noting the presence of passive and active tension in the spine and surrounding musculature. In order to understand the fundamental mechanics of NSA, it is important to understand that in addition to vertebra and discs comprising the spine, the spinal cord is also suspended and supported by an intricate system of tissues called the meninges.

The meninges and spinal cord, along with the connective tissue that attaches this system to the top and bottom of the spine are subject to the physical and emotional stresses on the nervous system, resulting in tension and distortion.[9] In Network Spinal Analysis, the presence of stress in the nervous system is translated into heel tension and eversion stress and is termed 'adverse mechanical cord tension'. Heel tension indicates flexion/extension cord tension, while heel eversion stress indicates lateral bending cord tension. Relating to this concept, Network created five "phases" with which to categorize the spinal cord tension patterns.

Entrainment

Depending on the criteria found in the assessment at each visit, the patient was adjusted with an NSA low force contact referred to as a Network Adjustment or 'Spinal Entrainment' at the appropriate 'Spinal Gateway' area. The 'Spinal Gateway' is an access point to the nervous system, connected either directly or indirectly an area of the spine associated with and connected to the dura matter.[10] It has been proposed that an NSA contact appears to be associated with the brain/body shifting from stress physiology and its associated defense posture to that of an experience of "safety" that is more conducive to reassessment, growth and re-organization.[10]

Results

During the course of care the patient stated that her pain drastically diminished and as a result she was consistently more aware of her spine. She also claimed that she was more aware of her breathing, which became easier, deeper, and was felt in new areas of her spine. As movement became easier, she also noticed that she felt taller, more able to carry herself strongly, and recovered from injuries with more ease. In addition, she increasingly experienced the body's rhythms and was able to recognize when her body was restoring and releasing spinal tension.

SEMG demonstrated a shift in muscle tension asymmetry from 10 levels at the initial exam to 4 levels. The severity of muscle tension which was present at 5 levels initially resolved entirely at re-examination. In conjunction, thermal scans demonstrated increased symmetrical temperature patterns indicating a reduction of autonomic nerve dysfunction. Line analysis demonstrated significant sagittal curve improvement with an Atlas plane line measurement of 32° and an Absolute Rotational Angle (ARA) of -27°. The ARA angle not only improved by 41%, but the cervical curve moved from an unfavorable kyphosis to a restored lordosis.

Improvement occurred in the patient's SEMG and thermal scans and for the purpose of this case, this data serves to support the presence of coordination and reorganization occurring in the patient's body while under NSA care.[11] Coupled with an alteration of the cervical curve, these changes exemplify the enhanced spinal and neural integrity of the body system as it regains awareness allowing for its self-assessment and correction.

Network Spinal Analysis™ Care is a unique system for advancing integrity of the spine and nervous system by allowing for the development of new strategies of self-organization through enhancement in the patient's passive, active, neural and emotional sub-systems.[12,13] In contrast to traditional chiropractic techniques that address an area of fixation and attempt to control a present problem, NSA seeks to promote new properties within the nervous system and spinal tissues and to assist in advancing self organization, allowing the expression of a greater degree of wellness.[13] During Network care, two healing waves develop that are unique to Network. The first wave is a breathing wave that releases tension throughout the spine and musculature of the body and helps to relax the patient. The second wave, the somatopsychic wave, is characterized by an undulating movement through the spine and is associated with an advancing positive reorganization of the spine.[14-16]

Discussion

Research indicates that chiropractic adjustments alone have been shown to be largely unsuccessful at correcting spinal curves.[17] Therefore, justification and utilization of muscle strengthening and stretching exercises, mirror image adjusting and traction have been employed for curve correction. In a prior study performed using cervical extension-compression traction combined with diversified and drop table adjusting, the average change in the absolute rotation angle was found to be 13.2 degrees.[17]

In comparison, this patient receiving NSA care accomplished a 17 degree change, a 22% improvement over spinal adjustments combined with traction. The comparison of these numerical values does not imply that Network care is better or superior to CBP or Pettibon in the correction of the cervical curve; however, it sets the stage to explore the benefits Network care may have apart from the subjective quality of life improvements that have been researched in the past.[18]

Tone

The improvement of the cervical curve through the application of Network Spinal Analysis can be assessed through the concept of tone. Representative of the normal degree of tension, activity, strength, excitability and integrity of nerves and muscles, tone is observed in a state of health, whereas any compromise to 'health' can be attributed to any variation or breakdown in the compressional (vertebral) or tensional (soft tissue) structures.[12,19]

As DD Palmer stated a century ago, "life is the expression of tone," a statement today that can be incorporated into the model of tensegrity.[20] In their review of posture related research, Oakley et al stated, "with mal-alignment in neutral posture, static and especially dynamic function from this mal-alignment dictates altered stress/strain relationships of associated spinal structures, including bones, intervertebral discs, facet joints, musculo-tendinous tissues, ligamentous tissues, and neural elements".[21]

Tensegrity

It is the altered stress/strain relationships within the human spine that is created by the poor alignment, yet it also facilitates the aberrant structure and creates tonal changes. Ingber articulated this idea very clearly when he wrote, "transmission of tension through a tensegrity array means to distribute forces to all interconnected elements and at the same time to couple or 'tune' the whole system mechanically as one".[19] This tuning of the body may possibly be aided by the charge created by the piezoelectric charge which is postulated to be read by nearby cells which respond by augmenting, reducing or changing the intercellular elements in the area to best accommodate the stress.[22] On this note, the interwoven effect of tensegrity structures explains a possible mechanism, why a gentle and specific contact to the spine during NSA care is experienced far removed from the site of application.

The redistribution of tension throughout the spine can be seen manifested as the oscillatory patterns of organization created during an NSA entrainment. Two unique healing waves develop that are associated with spontaneous release of spinal and life tensions, and the use of existing tension as fuel for spinal re-organization and enhanced wellness. The validity of the organic nature of these waves has been documented in Bohacek and Jonckheere's study on surface electromyography signals.[23] This study demonstrated that the Somatopsychic wave experienced during Network care exhibited a "non-linear characteristic distinct from voluntary muscle contraction," further emphasizing its possible correlation with the dissipation of tension in the body or other neurophysiological processes.[1,23]

As the tone in the body changes and tension decreases, the body moves away from the defense physiology and becomes more receptive to change. As Panjabi stated so simply, "as our brain is better able to inventory the body, it can better orchestrate healing".[12]

Studies performed at the University of Southern California for the past 10 years have postulated that sEMG signals recorded on the paraspinal muscles during the Network entrainment provide a "window" through which to view the central nervous system by demonstrating that as a patient progresses through the levels of Network care, the sEMG signals become less random and more predictable to reveal a better "organization" of the neural circuitry.[15] This finding highlights the higher cognitive functioning of the brain as it becomes aware of the spine; the main conduit of consciousness, the coordinator of body function, and a proposed location of the subconscious mind.[14]

Conclusion

Although the exact mechanism in which Network Spinal

Analysis care facilitates an improvement in the cervical curve is unknown, the evidence of the change exists in this case. The reorganization of the cervical curve may be possible without the use of forceful adjustments, manual muscular retraining or head devices. Following the principle of tensegrity, a gentle contact to the spine with the intent to allow the spine to correct vertebral subluxations and the nervous system to balance to the optimal tone for function and healing becomes possible. However, further research is necessary to determine how the somatopsychic and respiratory waves created during a Network Entrainment causes the dissipation of tension thereby allowing the healing process to commence. What holds true, regardless or our ability to quantify or visualize the process, is the body's ability to reconnect, recognize itself, and self-correct.

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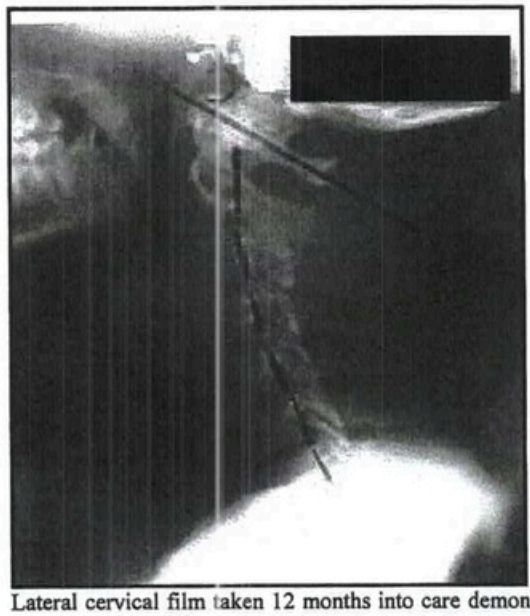
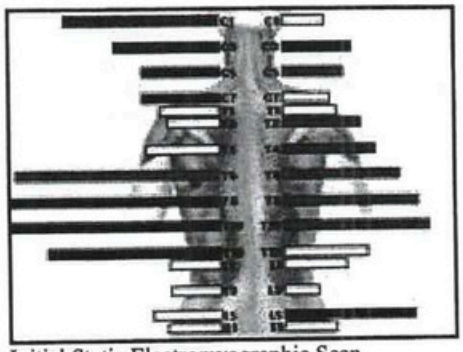
Radiographs & Instrumentation

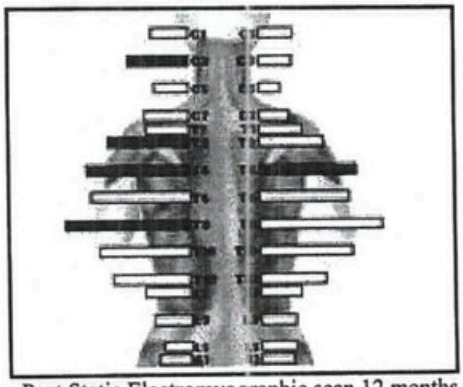
Initial lateral cervical film demonstrating a reversed (kyphotic) cervical curve.



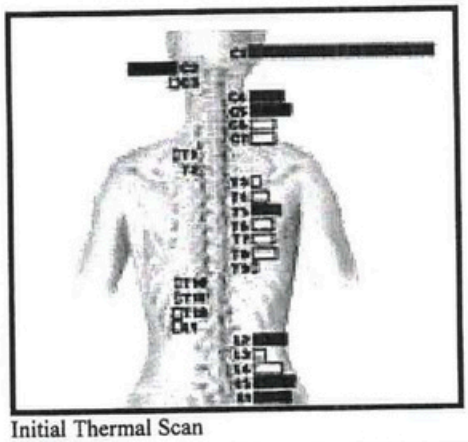
Lateral cervical film taken 12 months into care demonstrating the restoration of the patient's lordotic cervical curve.



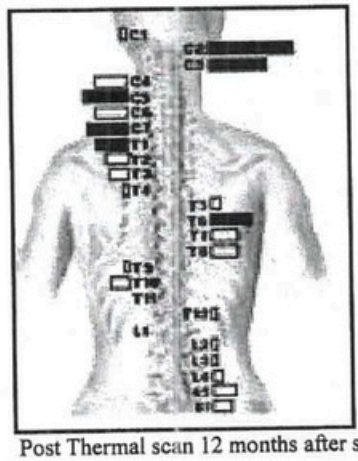
Initial Static Electromyographic Scan



Post Static Electromyographic scan 12 months after starting care



Initial Thermal Scan



Post Thermal scan 12 months after starting care

Case Study

Improvement of a Functional Movement Disorder in a Patient Receiving Network Spinal Analysis and Somato Respiratory Integration Care: A Case Report

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Abstract

Introduction: A 36 year-old female presented to a wellness based chiropractic clinic suffering from uncontrollable hyperkinesia, featuring myoclonic jerks and tics. A neurologist made the diagnosis of a functional (nonorganic) movement disorder and referred the patient to a psychiatrist for treatment of a suspected psychogenic movement disorder. She chose not to see a psychiatrist and instead began chiropractic care.

Methods: Network Spinal Analysis (NSA) and Somato Respiratory Integration (SRI) care was delivered over a period of twenty weeks. The patient was evaluated for indicators of Adverse Mechanical Cord Tension (AMCT), including vertebral subluxation and spinal defense patterns, according to the NSA protocol. Spinal and neural integrity (SNI) was assessed through static and motion palpation, postural and neurological assessments, and surface electromyography.

Results: Significant improvements in SNI were achieved, as were other wellness based outcomes of NSA and SRI care as reported by the patient. These improvements coincided with the steady improvement of all signs and symptoms of a FMD, with a complete resolution of all hyperkinetic movement, myoclonic jerks, and tics by 20 weeks of care.

Conclusion: NSA and SRI care was found to be of promise for restoring neurological function in a patient with a FMD. The findings in this case could support further research into the relationships between SNI, vertebral subluxation, and FMD's.

Key words: *Chiropractic, Network Spinal Analysis, Somato-Respiratory Integration, Functional Movement Disorder, Spinal and Neural Integrity, Vertebral Subluxation*

Introduction

Functional movement disorders (FMD's) account for over 16% of patients referred to neurology clinics.[1,2] A FMD is described as abnormal movement or positioning of the body due to the nervous system not working properly, but not due to any underlying neurological disease. FMD's often cause major challenges in terms of diagnosis and treatment due to the absence of pathophysiological understanding.[2] 'Psychogenic' suggests that there is an entirely psychological explanation for these symptoms, with a historical emphasis on causation by emotional trauma.[3]

FMD patients may experience a range of distressing and disabling symptoms, including: tremors, tics, myoclonus, dystonia, Parkinsonism, and gait disorders.[1,3,4] Common treatments include psychotherapy, behavioral therapy, physical and occupational therapy, and pharmacological treatment. Usually a combination of therapies is used and a team approach is recommended.[2,4,5]

Some FMD's have been shown to respond to pharmacological treatment of underlying depression and anxiety.[6] Tics have been shown to improve with counseling and behavioral therapies; while hyperkinetic movement disorders are becoming increasingly managed with pharmacological treatment focused on the basal ganglia, including dopamine receptor-blocking drugs and monoamine-depleting drugs.[7]

A longitudinal study of 228 PMD patients between 1990 and 2003 found that 56.6% patients showed an improvement in symptoms within 2 to 14 years, 21.3% remained unchanged, and 22.1% became worse.[4] Predictors for a favorable outcome have been attributed to the elimination of stressors, stress management, good physical health, psychological support, and positive social life perceptions. A favorable prognosis has also been associated with compliance with the prescribed treatment plan and the patient's perception of effective treatment.[4]

Subluxation centered chiropractic care may offer an important contribution to the management of patients with FMD's by improving neurological function.

Case Report

Presentation

A 36 year old Caucasian female presented with a chief complaint of uncontrollable body shakes (hyperkinesia) with tics and myoclonic jerks that began, according to the patient, following an Alexander Technique session approximately 5 months prior. She reported high work stress during the time of the initial onset. There had been no improvement in her symptoms during this time, and at the commencement of care the patient was unable to work. Secondary complaints were anxiety and chronic neck pain, which increased with the onset of the involuntary body movements.

Aggravating factors were anything that required physical effort or mental focus, including: work, exercise, Tai Chi, stretching, and meditation. Alleviating factors were things that did not require any mental or physical focus, such as resting and gentle walking.

She consulted her medical doctor who immediately referred her to a neurologist. No physical or neurological cause was found upon neurological exam, and there was no neural imaging conducted. The neurologist made a diagnosis of a functional (nonorganic) movement disorder and referred the patient to a psychiatrist for a suspected psychogenic movement disorder (PMD). The patient chose not to see a psychiatrist and began chiropractic care instead. She did not follow up with the neurologist at any stage.

Network Spinal Analysis (NSA)

NSA care is an evidence based chiropractic and wellness modality. It is applied through specific low force contacts made at specific points along the spine. Through these contacts, called a Network adjustment or a spinal entrainment, a dynamic spinal wave phenomenon is initiated that is believed to lead to a higher brain awareness of the body (somatic awareness) and its external and internal environment, particularly the spine.[8,9] Research, through mathematic modeling of this reorganizational spinal wave phenomenon, has demonstrated an increase in the organization of the central nervous system.[10-14] NSA is exclusively practiced by chiropractors in relationship to the identification and self-regulation of spinal tension and vertebral subluxation patterns.[9]

NSA care is applied through three increasing Levels of Care that are associated with new emerging properties within the spine and nervous system.[9] Level 1 and early Level 2 of care were used exclusively in this case presentation. Low force NSA contacts were applied on specific spinal segments with an upward traction of the connective tissue in either a flexion/extension or a lateral bending direction. All spinal entrainment contacts were made with the patient prone and with a brief duration of one second or less for Level 1, and with sustained duration contacts of up to two minutes for early Level 2.

Somato Respiratory Integration (SRI)

SRI is a system of exercises which link enhanced somatic awareness with respiration and movement.[15,16] SRI promotes a person's ability to focus attention on gross and subtle body movements, self-directed breathing, and awareness of tension in the body. SRI exercises help a person dissipate energy stored as tension, enhance structural flexibility, and increase the experience of safety within the body.[16]

There are twelve SRI exercises associated with 12 Stages of Healing.[16] The first two SRI exercises (stage 1 and stage 2) were used exclusively in this case presentation. Stage 1 SRI exercise involves three different body areas with attention focused on one body area at a time. The hands are placed palm over palm, facing down with both hands overlying each SRI position. SRI position #1 is over the breastbone on the upper chest, SRI position #2 is at the bottom of the ribs over the xiphoid process, and SRI position #3 is over the umbilicus. The stage 2 SRI exercise involves focusing one's attention on two body areas, with one hand overlying one area and the other hand overlying another area while alternating breathing between the two areas.[16]

Spinal and Neural Integrity

The Epstein Model of Spinal and Neural Integrity (SNI) is one of the models upon which NSA care is based.[17] SNI, which is based on the theory of Panjabi,[18] suggests that there are three spinal stability subsystems which regulate a dynamic state called spinal and neural integrity. These subsystems are the passive, active, and neural control subsystems.

The passive subsystem is composed of the vertebrae, ligaments and spinal discs. Tension in this subsystem suggests that the small inter-segmental muscles of the spine are acting in defense, as the individual is locked in a protective physiology. The active subsystem is composed of the spinal muscles and tendons, especially the long muscles of the spine. Tension in the spinal muscles is thought to relate to adaptation to stress, including emotional tension. The neural control subsystem is composed of the spinal cord, nerve roots and peripheral nerves, as well as the attachment of the meninges to the vertebral segments.

An additional subsystem, the emotional subsystem, is proposed by Epstein to be associated with the range of motion and tension within any tissue of the body, including the elements of the passive, active, and neural control subsystems.[17] The emotional motor system is reported to influence the threshold of excitability at every spinal level.[19] The ability or inability to perceive, process and verbalize a body sense or emotion is believed to be linked to this system.[17] Although chiropractors utilizing NSA care do not assess the emotional subsystem directly, they consider its implication in spinal and neural integrity.

The concept of Adverse Mechanical Cord Tension (AMCT), introduced by the neurosurgeon Alf Breig, is associated with lengthening in flexion/extension or lateral bending of the spinal cord and the neural control subsystem.[20] NSA care evaluates this neurologic parameter through heel tension resistance to flexion/extension of the Achilles tendons and/or eversion resistance to lateral bending of the Achilles tendons. AMCT is proposed to be associated with stress physiology and expressed by an individual as a defense posture.[21]

Treatment protocols

The patient was placed on an initial program of NSA and SRI care beginning at 3 visits per week for 8 weeks. Stage 1 SRI exercises were used on each visit before NSA care was applied. The patient was evaluated for indicators of AMCT according to the NSA protocol (Figure 1). Spinal levels addressed with NSA care throughout the initial eight weeks, but not on every visit were: Occiput, C1, C2, C3, C5, C6, C7, bilateral sacrum, left ilium and coccyx.

The patient's care was then reduced to two visits per week for a further twelve weeks. SRI exercises for stages 1 and 2 were used at the beginning of each visit, before NSA care was applied. Spinal levels addressed with NSA care during this period, but not on every visit, were Occiput, C1 – C7, T1, T2, bilateral sacrum, left ilium, and coccyx.

Assessment and periodic re-assessment of spinal and neural integrity was measured according to spinal stability subsystem findings, and was recorded at the initial exam, at 8 weeks, and at 20 weeks of care (Tables 1, 2, and 3).

Assessment protocols and initial findings

The passive subsystem was assessed through static and motion palpation in the sitting and prone positions, and graded on a scale of 1 – 5 (Table 1). Passive system tension was noted on initial exam from C7 to T4 and from T7 to L1 with restricted spinal motion, segmental fixation, and lack of compliance in these areas. No visible respiration was seen through these spinal levels when resting in the prone position. Static palpation and visual observation in the sitting and prone positions revealed a significant increase in the thoracic kyphosis and a large left lateral curvature from T7 to L1 and then a smaller right lateral curvature from T2 to T6.

The active subsystem was assessed using computerized surface electromyography (sEMG) exam (Table 2). sEMG exams were done using a Myovision 3G static system with a 25-500 Hz Bandpass filter and handheld scanning probes set to display data between 1 and 200 microvolts. Scanning probes were placed in an electroconductive solution before each measurement and readings were taken with the patient in the standing position at two spinal levels simultaneously, inferiorly from C2 to S1, with a grounding probe placed at every third spinal level. Surface electromyography with attached electrodes has been shown to exhibit very good to excellent test-retest reliability.[22,23] All sEMG exams were repeated by the same trained clinician with over 1000 sEMG exams to date. Initial sEMG assessment revealed abnormally low readings at T7, T10, T12, L4, and S1, suggesting muscle fatigue and a lack of spinal stability in these areas[24,25] High sEMG readings were found at C2, C4, C7, T1, T3, T6, and T9, indicating high active subsystem tension at these spinal levels (Figure 2).

The neural control subsystem was assessed through evaluation of the Achilles' tendons in both flexion/extension and eversion motion with the patient lying in the prone position, and graded on a scale of 1 – 5 (Table 3). Initial assessment found high neural control subsystem tension bilaterally in both directions.

At the start of care there was a temporary significant increase in the patients' hyperkinesia during SRI with a violent jerking reaction when she focused her attention on SRI position #3. The patient reported that she felt no connection to her body in this position, and became agitated and distressed when focusing on this area. There was a significant decrease in her hyperkinesia and an immediate improvement of all FMD symptoms when she focused her attention on SRI position #1. SRI position #2 appeared to be neutral, causing neither an increase nor decrease in her FMD symptoms.

The overall clinical impression of this patient was extreme stress physiology expressed as defense posture with little functional evidence of spinal and neural integrity.

Results

After 8 weeks of care there was a significant reduction in passive system tension from C7 – T4 and from T7 – L1 with greater compliance and range of motion in flexion/extension and lateral bending directions. There was also visible respiration observed through both of these spinal regions while the patient was lying prone. sEMG exam showed a significant increase in the muscle activity from T10 to S1 (Figure 2). While this increase in muscle activity could be viewed as an increase in active system tension, it was in the area that was surrounding the large left lateral spinal curvature, which was previously underactive due to muscle fatigue. Therefore, this was tracked as a potential reorganizational spinal response indicating an increase in spinal stability. Active system tension was reduced from C2 to T5. Neural Control system tension was reduced through the Achilles tendons bilaterally in flexion/extension and lateral bending directions.

The patient reported feeling more connected to her body in SRI position #3 and was able to focus her attention on this area for a few seconds at a time without any tics or myoclonic jerks occurring. The patient reported feeling more relaxed in her body and spine, more ease and depth in her breathing, less anxiousness, increased positive feelings about herself, and

generally feeling more at peace. There was a significant improvement in the patients FMD symptoms with fewer and less intense myoclonic jerks and tics.

At 20 weeks of care there was a further reduction in the passive subsystem tension with greater segmental compliance from C7 to T4 and T7 to L1 in static palpation, and a greater range of motion in both flexion/extension and lateral bending with motion palpation. Respiration was visibly moving through the patient's entire spine from sacrum to occiput while lying in the prone position. There was a visible reduction in the thoracic kyphosis in the standing, sitting and prone positions, but little to no change was evident in the lateral curvatures of the spine from visual analysis. sEMG exam showed an improved balance and symmetry throughout the entire spine in a pattern that was more consistent with and supportive of the lateral curvatures of the spine, suggesting a reorganizational spinal response (Figure 2). Neural control subsystem tension was significantly reduced through flexion/extension and lateral bending of the Achilles tendons bilaterally, indicating a reduction in stress physiology and defense posture.

The patient was able to focus her attention on SRI position #3 for an indefinite time period with no signs or symptoms of a FMD occurring. She returned to work and reported significant improvements in the associated symptoms of anxiety and chronic neck pain. By 20 weeks of care a high degree of spinal and neural integrity was evident. This correlated with the complete resolution of all signs and symptoms of a FMD. This improvement was still evident more than twelve months later.

Discussion

The emotional impact of prolonged stress has been shown to increase the sympathetic response associated with anxiety and vigilance.[26] AMCT, which is proposed to be associated with stress physiology and expressed by an individual as a defense posture, is associated with a loss of critical self-perception and self-regulatory processes due to dissociation of higher brain centers. This is believed to be the same mechanism through which vertebral subluxations and spinal defense patterns are maintained in the body.[18]

The patient reported feeling more connected to her body and spine within 8 weeks of care, indicating a heightened somatic awareness. This is an essential component of healing and wellness which may, in part, account for the self-reported improvement of NSA clients.[27] NSA care has been demonstrated to have a strong correlative effect (twice that of lifestyle modification) as a predictor of increased quality of life and wellness lifestyle choices.[28] The increase in positive wellness based perceptions as reported by the patient, including feeling more at peace in her body, less anxious, and more positive feelings towards herself, may have also been contributing factors to the improvement in her condition.

SRI can provide a person with a means of dispelling fear and encouraging trust in their body-mind, while promoting greater internal peace or ease.[29] In SRI, it is recognized that some areas of the body may have greater somatic awareness or connection than others and may be referred to as a place of 'peace'.[16] During the course of care, this place of peace (found at SRI position #1) was used repeatedly to support a change in the patient's physiology, strengthen the body-mind connection, and promote an internal shift from defense towards safety.

Overall, the combined changes in the patient's physiology, heightened somatic awareness, reduction of AMCT and improved spinal and neural integrity, may account for the improvement of the FMD in this case. The authors recognize that the patient was in good overall physical health, eliminated the stressors in her life by stopping work in order to focus on her well-being, and received care in an environment where she felt safe, trusted the clinicians, and had positive expectations in the wellness based outcomes. These factors also need to be considered as likely contributing factors to the positive outcome in this case.

It is important to note that NSA and SRI care was not applied as a treatment for a FMD, the signs and symptoms of a FMD, or the associated symptoms of anxiety and neck pain in this case. NSA and SRI care was applied in this case for the purpose of improving spinal and neural integrity and to promote a shift in the patients' physiology toward greater internal peace and safety.

Conclusion

During a 20 week course of chiropractic care, utilizing NSA and SRI, a patient showed a complete resolution of all signs and symptoms of a FMD. The patient also reported improvements in her secondary complaints of anxiety and chronic neck pain. These improvements coincided with greater spinal and neural integrity and other wellness based outcomes of NSA and SRI care. Chiropractic care was found, in this case, to be of promise for restoring neurological function in one patient with a FMD. The findings in this case could support further research into the relationships between SNI, vertebral subluxation, and FMD's.

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Conflict of interest

The authors declare that they have no conflicts.

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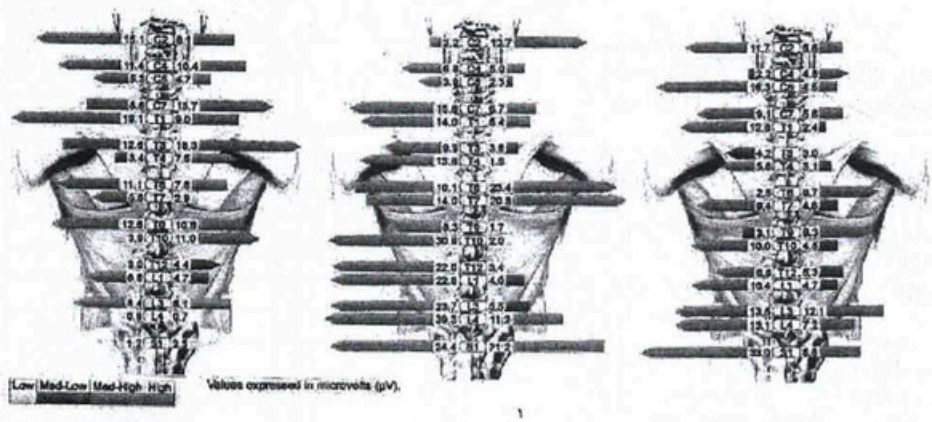
Figures & Tables

Figure 1: NSA indicators of Adverse Mechanical Cord Tension
Certain musculoskeletal changes are considered to be indicators of the effects of AMCT. This is a list of these indicators and the spinal phenomena with which they are associated. These include both observational and palpation findings. For the significance and priority of the adjustment protocol, refer to The Theoretical Basis and Clinical Application of NSA Care (Epstein 2004).

Indicator	Segmental Level Assessed
Short Leg	Unilateral cord tension
Cervical Syndrome Test	Tension in cervical spinal cord
Leg Crossover	sacral or pelvic distortion
Ankle Eversion Stress	Lateral flexion spinal tension
Flexion/Extension Heel Tension	Flexion/extension spinal tension
Z-flick	C2, C3 lateral bending spinal tension
Leg Adduction Stress	C2, C3 spinal cord tension
Leg Abduction Stress	C5, coccyx flex/ext. spinal tension
Palpation (motion, static, muscular)	all vertebral segments
Sacrotuberous ligament tension	lateral bending sacrum
Postural analysis	all vertebral segments
Flexibility (Range of Motion)	all vertebral segments

**Positive indicators contributing to the location and/or characterization of vertebral segments for entrainment are assessed pre and post entrainment to determine efficacy of the force applied

Figure 2. Surface EMG assessment at the start of treatment, 8 weeks and 20 weeks



Initial assessment 8 week re-assessment 20 week re-assessment

Table 1 – Passive Subsystem Assessment

Spinal levels	Initial	8 weeks	20 weeks
Upper Cervical C1 – C2	2	2	1
Mid Cervical C3 – C4	3	2	1
Lower Cervical C5 – C7	4	3	2
Upper Thoracic T1 – T4	5	3	2
Mid Thoracic T5 – T8	5	3	2
Lower Thoracic T9 – T12	5	4	3
Upper Lumbar L1 – L3	4	3	2
Lower Lumbar L4 – S1	3	2	2

Tension Scale: 1 – Low; 2 – Med-Low; 3 – Medium; 4 – Med-High; 5 - High

Table 2 – Active Subsystem Assessment

sEMG DATA	Initial		8 week		20week	
Spinal level	Left	Right	Left	Right	Left	Right
C2	15.1	8.1	3.2	13.7	11.7	5.6
C4	11.4	10.4	6.8	5.0	2.2	4.8
C5	5.3	4.7	3.9	2.3	16.3	4.5
C7	8.6	13.7	15.8	6.7	9.1	5.8
T1	19.1	9.0	14.0	5.4	12.6	2.4
T3	12.6	18.3	9.9	3.6	4.2	3.0
T4	3.4	7.6	13.6	1.6	5.8	3.1
T6	11.1	7.8	16.1	23.4	2.5	9.7
T7	5.6	2.9	14.0	20.8	9.4	4.6
T9	12.6	10.6	8.3	1.7	3.1	8.3
T10	3.9	11.0	30.9	2.0	10.0	4.5
T12	3.0	4.4	22.0	3.4	6.8	5.3
L1	6.8	4.7	22.6	4.0	10.4	4.7
L3	8.4	8.1	23.7	5.5	13.5	12.1
L4	0.8	0.7	39.1	11.2	13.1	7.2
S1	1.2	2.5	24.4	21.2	33.0	8.6
Total	128.9	124.5	268.3	131.5	163.7	94.2
Total	253.4		399.8		257.9	

Values expressed in microvolts (μv)

Improvement of a Functional Movement Disorder in a Patient Receiving Network Spinal Analysis and Somato Respiratory Integration Care: A Case Report

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Introduction: A 36 year-old female presented to a wellness based chiropractic clinic suffering from uncontrollable hyperkinesia, featuring continuous myoclonic jerks and tics. A neurologist made the diagnosis of a functional (non-organic) movement disorder (FMD) and referred the patient to a psychiatrist for treatment of a suspected psychogenic movement disorder (PMD). She chose not to see a psychiatrist and instead began chiropractic care.

A FMD is described as abnormal movement or positioning of the body due to the nervous system not working properly, but not due to any underlying neurological disease. Patients may experience a range of distressing and disabling symptoms, including: tremors, tics, myoclonus, dystonia, Parkinsonism, and gait disorders. Intervention is aimed at improving symptoms and function, and common treatments include psychotherapy, behavioral therapy, physical and occupational therapy, and pharmacological treatment. Usually a combination of therapies is used and a team approach is recommended. A longitudinal study of 228 FMD patients between 1990 and 2003 found that 56.6% of patients showed an improvement in symptoms within 2 to 14 years, 21.3% remained unchanged, and 22.1% became worse. Subluxation centered chiropractic care may offer an important contribution to the management of patients with FMD's by improving neurological function.

Methods: Network Spinal Analysis (NSA) and Somato Respiratory Integration (SRI) care was delivered over a period of twenty weeks. The patient was evaluated for indicators of Adverse Mechanical Cord Tension (AMCT), including vertebral subluxation and spinal defense patterns, according to the NSA protocol. Spinal and neural integrity (SNI) was assessed through static and motion palpation, postural and neurological assessments, and surface electromyography.

Results: Significant improvements in SNI were achieved, as were other wellness based outcomes of NSA and SRI care as reported by the patient. These improvements coincided with the steady improvement of all signs and symptoms of a FMD, with a complete resolution of all hyperkinetic movement, myoclonic jerks, and tics by 20 weeks of care.

Discussion: NSA care was applied for the purpose of improving SNI, with the elimination of vertebral subluxations being an outcome of this. SRI exercises were used to further increase somatic awareness and promote a shift in the patients' physiology toward greater internal peace and safety. The improvement of SNI combined with other wellness based outcomes of NSA and SRI care may have accounted for the rapid improvement of a FMD in this case.

Conclusion: NSA and SRI care was found to be of promise for restoring neurological function in a patient with a FMD. The findings in this case could support further research into the relationships between SNI, vertebral subluxation, and FMD's.

Key words: Chiropractic, Network Spinal Analysis, Somato-Respiratory Integration, Functional Movement Disorder, Spinal and Neural Integrity, Vertebral Subluxation