Case Series

Improvement in Signs and Symptoms of ADHD and Functional Outcomes in Four Children Receiving Torque Release Chiropractic: A Case Series

Nick Hodgson, B.App.Sc. (Chiropractic)
Holder Research Institute Australia, Victoria, Australia

Charles Vaden, D.C.
Private Practice of Chiropractic Clarksville, TN

Abstract

Objective: The cases of four children receiving Torque Release chiropractic adjustments for spinal subluxation with concurrent reduction in the signs and symptoms of ADHD and functional outcome measures are discussed.

Clinical Features: Four children ages 8 to 12 years of age presented to the clinic seeking help with their symptoms of ADHD. Each had been previously diagnosed with ADHD by a medical doctor and displayed impairment in either inattention or impulsivity, or both components. Three of the children were currently on prescription medication to manage their symptoms and one had a recent history of prescription medication use.

Intervention and Outcomes: Improvement in ADHD symptoms is based on the use of an ADHD symptom questionnaire completed by the primary caregiver and functional outcome measures include digital postural assessment, surface paraspinal electromyography, infrared paraspinal thermography, heart rate variability and spinal range of motion analysis. Chiropractic care utilizing Torque Release Technique was administered for 10, 10, 5, and 6 months respectively.

Conclusions: While such a small population does not offer statistical significance, in this group ADHD symptoms improved on average by 17%, functional status improved on average by 23% and general wellbeing improved on average by 21%.

Key Words: *ADD, ADHD, Chiropractic, Heart Rate Variability, Paraspinal Thermography, Posture, Reward Deficiency Syndrome, Surface Electromyography, Subluxation, Torque Release Technique.*

Introduction

Attention Deficit/Hyperactivity Disorder (ADHD) is defined as a common psychiatric condition that affects approximately 6 to 9% of children and 3 to 5% of adults in the United States, with similar figures worldwide.[1] According to the National Institutes of Health ADHD is the most commonly diagnosed childhood behavioural disorder.[2] This disorder is defined by a combination of signs/symptoms of inattention and hyperactivity or impulsivity: Diagnosis is based on impairment in these two domains.[3]

The "Inattention" component of ADHD is manifested as daydreaming, distractibility, and difficulty focusing on a single task for a prolonged period. These symptoms tend to persist into adulthood. The expression of the "hyperactivity" component includes fidgeting, excessive talking, and restlessness. These symptoms tend to taper off early in life.[3] Presence of the disorder is linked with several problems in personal, social, academic and occupational life.

ADHD is usually early in onset, and growing evidence indicates that ADHD is more persistent than previously thought. Predictors of persistence of ADHD include family

history of the disorder, psychiatric comorbidity, and psychosocial adversity.[3]

Longitudinal studies of childhood ADHD demonstrate lower academic and occupational achievement and higher rates of incarceration, mental health problems, and divorce. It is often associated with comorbidity, including oppositional defiant, conduct, depressive, bipolar, and anxiety disorders, cigarette smoking and substance abuse. Children with ADHD have significantly reduced health-related quality of life (HRQL), and those with oppositional defiant disorder or conduct disorder (ODD/CD) as a comorbidity (approximately 34%) are particularly more susceptible to poorer HRQL.[4] Early drug treatment with stimulants has been shown to have a protective effect against the development of CD and anti-social personality disorder.[1]

The recommended medical treatment for children with ADHD is stimulant medication with concurrent psychotherapy.[5] Early recognition and stimulant treatment during childhood has been correlated with favourable long-term outcome in ADHD adults.[6]

Children with ADHD are at greater risk than children without ADHD for substance abuse and delinquency, whether or not they receive drug therapy. Those with active ADHD symptoms, however, are at a greater risk of substance abuse than those whose symptoms are well managed. This may be why stimulant use has been shown to decrease the risk of substance abuse in comparison with untreated or inadequately treated individuals.[1] Note that those with the hyperactivity / impulsivity have been shown to be more susceptible to the onset of substance abuse than those with an inattention component only.[7]

There are drawbacks, however, to the use of stimulant medication for the treatment of ADHD. About 25% of college students who were prescribed medication for their ADHD reported using their drugs to "get high" and 29% reported having ever given or sold their medication to someone else.[1] Furthermore, stimulants are known to increase noradrenergic and dopaminergic transmission leading to increased blood pressure and heart rate, which may cause a greater increase in cardiovascular complaints in about 5%-15% of children.[8]

Methylphenidate, amphetamines, and atomoxetine (a non-stimulant) are the FDA-approved medications for ADHD which can influence cardiovascular function[9], and methylphenidate is the most widely prescribed ADHD medication.[10] Common adverse effects of stimulants include nausea, upset stomach, decreased appetite, insomnia, and headache. More rare adverse effects include motor tics, irritability, mood lability, hallucinations, growth defects[1] (decreased height), epilepsy, seizures, psychotic symptoms, sudden death, liver failure, suicide-related events, and permanent changes in the brain. The use of "drug holidays" is purported by many to be a method to reduce the side effects associated with stimulants, yet the evidence for this is very limited.[11]

The common alternatives to stimulants for the treatment of ADHD are atomoxetine, atypical antipsychotics, bupropion, clonidine and guanfacine. Side effects of clonidine and guanfacine may include sedation, headaches, and fatigue. Atomoxetine is associated with suicidal behaviours in approximately 0.44% to 2% of users.[12]

It is common for practitioners to prescribe a medication for the treatment of ADHD while concomitantly treating a co-occurring disorder with another medication such as a psychotropic drug. There is little to no research regarding the use of polypharmacy in the treatment of children with ADHD and co-occurring disorders such as ODD, Depression, Anxiety, tic disorders, etc.[8]

Prescription rates of ADHD drugs nearly doubled between the years of 1995 (2.52%) to 2004 (4.63%) with the largest increase in the 15-19 year age group. Only 50% of adolescents adhere to dosage prescriptions at one year, and that statistic drops to 25% at the 3-year mark.[1] Drug-free alternatives are needed for the treatment and management of ADHD.

Family studies consistently support the assertion that ADHD runs in families. Heritability data from twin studies of ADHD attribute about 80% of the etiology of ADHD to genetic factors. Molecular genetic data are bolstered by considerations suggesting that DRD4 and DAT genes may be relevant for ADHD.[3] Pregnancy and delivery complications, prenatal exposure to nicotine and psychosocial adversity have also been identified as risk factors for ADHD.

Considerable evidence suggests that the disorder has a strong biological underpinning; the pathophysiology includes dysfunction in both noradrenergic and dopaminergic systems.[13, 14] There seems to be a consensus in the literature that a fronto-subcortical dysfunction is responsible, at least in part, for the ADHD spectrum.

Research by Holder and Blum has demonstrated that a "brain reward cascade" of neurotransmitters exists which results in feelings of well-being when operating properly. Interference in this cascade is termed, Reward Deficiency Syndrome (RDS), and results in feelings of well-being being replaced by anxiety, anger, or by craving substances which alleviate the negative emotions. RDS is characterized by loss of proper activation of reward centers in the brain that create a sense of wellbeing. These reward centers include the nucleus accumbens, CAI cluster cells, and Ca_x cluster cells, and are part of a midbrain-forebrain-extrapyramidal circuit, which includes the hypothalamus, ventral tegmental region, substantia nigra, hippocampus, and the locus ceruleus.[15]

RDS has been implicated for all addictions and compulsive disorders including ADHD.[15] Research is beginning to demonstrate Chiropractic's role in re-establishing proper brain reward mechanisms in those suffering from RDS.[16, 17] Previous research and a number of case studies have documented positive outcomes in cases with ADHD and this study intends to add to this evidence.[18-23]

Methods

This paper retrospectively reports the cases of four male children, receiving Torque Release Technique Chiropractic Adjustments for Spinal Subluxation, who completed an initial course of chiropractic care, and were assessed "pre-care" and

"post-care" utilising ADHD and general health symptom severity and regularity questionnaires completed by the primary carer, and functional outcome measures including digital postural assessment, surface paraspinal electromyography, infrared paraspinal thermography, heart rate variability and/or spinal range of motion analysis.

Torque Release Technique

Torque Release Technique (TRT) is a Chiropractic technique designed by Dr Jay Holder beginning in 1996 for the purposes of conducting a randomized clinically controlled trial. TRT is based upon all of the original chiropractic principles as described in Stephenson's Chiropractic Textbook and the Art of Chiropractic as well as D.D. Palmer's The Chiropractor. TRT embraces a quantum physics paradigm, which acknowledges the inseparable unity between the living body and the mind, and embraces the neurophysiological mechanisms responsible for wellbeing, namely, the Brain Reward Cascade.[24-26]

This technique was developed by integrating the evidence based physical examination protocols and indicators from seven established Chiropractic techniques in an effort to create a representative Chiropractic technique for Chiropractic's second century of existence. These techniques include Directional Non-Force Technique, Palmer Upper Cervical, Network Spinal Analysis, Sacro-Occipital Technique, Logan Basic, Thompson Terminal Point, and Toftness.

The protocol is based upon differentially diagnosing the "primary" subluxation, which is a non-linear, time-dependent entity. This means that the "primary" cannot be pre-determined, but must be assessed based upon real-time interaction with the nervous system. At any given moment in time there is only one most appropriate subluxation to adjust. It is believed that by adjusting the "primary subluxation", all other associated secondary and tertiary subluxations are reduced and the electrical discharges of the nervous system are improved, allowing for optimal expression of life and wellbeing.

TRT utilizes fifteen indicators of dis-ease and spinal subluxation to locate, quantify, qualify, and assess the presence of subluxation. These include palpation (scanning, tissue, intersegmental, and motion palpation), functional leg length reflex (FLLR), abductor tendency, foot flare, foot pronation / supination, achilles tension, abnormal breathing patterns, inappropriate sustained patterns of paraspinal contractions, congestive tissue tone, postural faults (standing, sitting, prone), Cervical Syndrome Test, Bilateral Cervical Syndrome Test, Derefield Test, "Wrong-un" Test, and abnormal heat or energy radiation from the body.

The examiner also utilizes a "Pressure Test" paired with an FLLR test as the most specific and sensitive test for locating the "primary". A Pressure Test is a light touch to the skin overlying the spine in a specific location with a particular vector in order to test whether or not this vector is the line of correction for the vertebral subluxation. After the pressure test is administered, a rapid dorsiflexion of the feet is applied by the practitioners contacting hands in order to stretch the Achilles tendon and initiate a bilateral Achilles reflex. Upon initiation of this reflex, tonal changes of the pelvic musculature adapt the leg length reflex as a response to this stimulus. Perfectly even functional leg length occurs when the stimulus (Pressure test) was delivered in the proper vector to correct the Primary subluxation. If an improper vector was utilized, the functional leg length may change but will not become perfectly even. When the Primary is located the examiner may then deliver an adjustive force in the correct vector (line of correction) to allow the patient's nervous system to adapt this force and adjust the subluxation.

Frequency of care is determined by the quantity and quality of subluxation indicators. As subluxation findings diminish, then care frequency may also be diminished. A maximum of three primary subluxations may be adjusted in a single visit.[25]

Many TRT practitioners choose to employ the use of the Integrator adjusting instrument to deliver their adjustments. We elected to do so for this study. The Integrator is a hand-held instrument designed to deliver a "toggle-recoil" style adjustment with complete reproducibility. The Integrator currently holds a patent for the "removal of vertebral subluxation" and an FDA 510K and CE approval, and is available for sale and use only to licensed Chiropractors or Chiropractic students trained in its indications and use by Holder Research Institute accredited trainers.[27]

Several case studies have been conducted with the use of this technique as well as a randomized placebo-controlled clinical trial.[16, 17, 28-31] For more information regarding TRT we defer to a thorough review compiled by Shriner.[24]

Outcome Measures

ADHD Symptom Severity and Regularity Questionnaire (cases 1-4):

A questionnaire was designed based on the DSMIV ADHD symptom list of inattention and impulsivity/hyperactivity[32], which included a rating scale for severity and regularity of symptoms. The questionnaire was completed by the primary caregiver prior to commencement of care and after the initial course of adjustments. The rating system allowed pre and post comparison of each individual symptom, each of the two groups of symptoms and all symptoms combined.

Children's Health Severity and Regularity Questionnaire (cases 1,2 & 4):

A questionnaire was designed covering an array of child health issues which included a rating scale for severity and regularity of symptoms. The questionnaire was completed by the primary caregiver prior to commencement of care and after the initial course of adjustments. The rating system allowed pre and post comparison of each individual symptom, the severity and regularity of all symptoms, and all the scores combined.

Digital Postural Assessment (cases 1-4):

Postural analysis was performed prior to commencement of care and after the initial course of adjustments. This was quantitatively assessed utilising Posture Pro Digital

Assessment Software designed by Ventura Designs. Postural assessment was utilized as a means of measuring functional Chiropractic outcomes and as a general measure of health status. One retrospective review of 752 patients demonstrated that positive sagittal balance is highly correlated with adverse health status outcomes.[33] A prospective cohort study consisting of 1,353 participants demonstrated that elderly men and women with hyperkyphotic posture have a significantly increased rate of death.[34]

One study demonstrated that "angular relationships between adjacent spinal regions in the sagittal plane can be objectively quantified using image-based analysis" when light-weight markers attached directly to the skin are used.[35] This method eliminates the error incurred when heavier markers droop under their own weight and is consistent with the methods utilized in this case series.

Red marker stickers were placed on standard anatomical landmarks (AP: Level of ears, centre of shoulder joints, ASISs, centre of patellae, centre of ankle joints, episternal notch and umbilicus. Lateral: EAM, centre of shoulder joint, greater trochanter, centre of knee joint, and just anterior to Lateral Malleolus.) AP and Lateral static posture photos were taken using a digital camera. The images were imported into Posture Pro and then the postural analysis was performed by clicking on the appropriate anatomical markers according to the software's protocol.[36] The software then calculated degrees of forward head posture, pelvic tilt; head, shoulder, pelvic, knee and ankle unlevelling; and head and pelvic list. For this study a calculated number called "Total Deviation", being the total of all the above data, was utilised for pre and post comparison.

Paraspinal Surface Electromyography (EMG) (cases 1-3):

Aberrant paraspinal muscle activity has been identified as one component of the vertebral subluxation complex[37] and can be measured by the use of paraspinal surface electromyography (sEMG). SEMG is routinely utilized by Chiropractors as an objective, quantitative means to assess for functional changes in the central nervous system in regard to outcomes of care.[38] A study involving 30 patients demonstrated that Chiropractic care is associated with long-term changes in sEMG activity.[39] Studies on sEMG have demonstrated very good to excellent test-retest reliability[40, 41] as well as inter and intra-examiner reliability.[42] For more information regarding the clinical use of sEMG in Chiropractic practice we defer to a thorough review compiled by Kent.[38]

Cases 1-3: Paraspinal Surface EMG was assessed using an Insight Millennium Subluxation Station developed by Chiropractic Leadership Alliance. This device measures muscle tone at bilateral paraspinal anatomical locations in the seated position according to a standardised protocol. The readings are compared to a normative database[43] and rated as being within range, one, two or three deviations hypertonic above norm or hypotonic. Asymmetry of the readings is also rated in severity.

For the purposes of this study the pre and post assessments were compared in two ways using 1) a scoring system which added the abnormal severity scores (1 = 1 standard deviation above norm, 2 = 2 standard deviations above norm, 3 = 3 standard deviations above norm, 2 = Hypotonic), and 2) a scoring system which added the asymmetry severity scores.

Paraspinal Infrared thermography (cases 1-3):

Cases 1-3: Paraspinal infrared thermography was assessed using an Insight Millennium Subluxation Station developed by Chiropractic Leadership Alliance. This device measures paraspinal temperature at bilateral paraspinal anatomical locations in the seated position according to a standardised protocol. The readings are compared one side to the other and rated in asymmetry severity as one, two or three deviations. For the purposes of this study the pre and post assessments were compared using a scoring system which added the abnormal asymmetry severity scores.

Paraspinal thermography is utilized by chiropractors to assess for left-right asymmetries and fixed thermal patterns which may exist as a result of segmental or global distortions of neuro-spinal integrity. It is largely held that paraspinal skin temperature patterns will remain symmetrical in a normal, healthy state, but may become aberrant or asymmetrical when autonomic dysfunction occurs.[44] There is evidence in the literature suggesting that paraspinal thermograpy may improve immediately following chiropractic adjustments utilizing Torque Release Technique; the chiropractic technique utilized for the care of the patients in this study.[45]

Autonomic dysfunction, therefore, can be clinically quantified by the use of paraspinal thermography and serves as a clinically meaningful and reliable outcome measure of Chiropractic care as evidenced by the literature.[46, 47] Paraspinal thermographs may be analysed for pattern or for symmetry; however, we have chosen to report only on symmetry for the purposes of these cases. Note that no acclimatization was performed on these cases, but patients were gowned and scanned immediately.

Spinal Range of Motion Assessment (case 4):

Case 4: Spinal ranges of motion for neck and trunk were measured using VROM software developed by Ventura Designs. Photographs were taken of the subject at ends of range of motion for neck flexion, extension, left and right lateral flexion and left and right rotation, trunk flexion, extension, left and right lateral flexion and left and right rotation. These photos were imported into the VROM software and using a goniometer type angle measuring device within the software ranges of motion were measured and compared to AMA norms.[48]

Central components of the vertebral subluxation complex include "altered biomechanics" and "connective tissue involvement including disc, other ligaments, fascia, and muscles"[37] which leads to aberrant range of motion findings. Spinal range of motion is presently used as a functional measure of outcome.

EMWave Heart Rate Variability (case 4):

Heart Rate Variability Coherence Ratio Analysis was performed utilising Heart Math EMWave hardware and

software. This system monitors heart rate variability and calculates a coherence ratio which divides the percentage of time spent in high, medium and low coherence states. For the purpose of this study the subject was attached to the EMWave in a relaxed seated position, for 5 minutes and the pre and post comparison was based on change in these ratios.

Heart rate variability (HRV) is a quantitative measure of the resting rates and rhythms of the heart, which is determined by complex mathematical calculations. Because increased sympathetic tone decreases HRV and increased parasympathetic tone increases HRV, HRV analysis provides an accurate accounting of the balance between the parasympathetic and sympathetic nervous systems. Increased variability denotes the ability of the nervous system to adapt the heartbeat and rate to changing stimuli in the environment and is a powerful marker of cardiovascular and neural health, and longevity.[49-51]

Children with ADHD have been shown to have a greater sympathetic-dominant component (0.04 to .15 Hz) and a diminished parasympathetic-dominant component (0.15 to 0.4 Hz also known as the "Respiratory Sinus Arrhythmia") of the heart rate variability measure.[52-55] The literature asserts that because chiropractic care has profound effects upon sympathetic and parasympathetic tone through the removal of vertebral subluxation, HRV is useful as an outcome assessment in clinical chiropractic practice.[56]

Changes in HRV as a result of chiropractic care have been documented in the literature.[57, 58] One recent study performed by Hart suggests that low-tech options for autonomic assessment may be available for Chiropractors to utilize on a visit-to-visit basis as opposed to every 6 or 12 visits due to time constraints inherent to the more high-tech procedures.[59]

Torque Release Technique Tonal Indicators of Subluxation (case 4):

A scoring system was developed to rate the severity of the prone indicators of Subluxation as compiled by Torque Release Technique: Breathing Movement (Rated 0-5), Heel Tension (Rated 0-5 left and right), Abductor Tendency (Rated 0-5 left and right), Foot Flare (Rated 0-5 left and right), Foot Pronation/Supination (Rated 0-5 left and right), Functional Leg Length Inequality (Rated in mms), Cervical Syndrome Test (Rated as 0 for negative and 2 for positive), Bilateral Cervical Syndrome Test (Rated as 0 for negative and 2 for positive) and Derefield Test (Rated as 0 for negative and 2 for positive).

Results

Case 1

A 12 year old male presented with his mother with the hope of helping his ADHD. He had been diagnosed by a Paediatrician. He was taking 40mg Ritalin/day and Clonidine to assist sleeping which was impaired by the Ritalin. General history revealed a caesarean birth, asthma when younger, episodes of tonsillitis, and previous tonsillectomy. Initial General Health Questionnaire revealed significant impairment in the following topics: Angry; frustrated and/or tantrums; Argues with siblings and/or friends; Behavioural problems; Concentration problems; Learning problems; and Taking prescription medication/s. Progress General Health Questionnaire 10 months later revealed no significant impairment. Initial health rating was scored as 41 for regularity and 33 for severity totaling 74. Progress health rating was scored as 32 for regularity and 10 for severity totaling 42.

Initial ADHD questionnaire revealed significant impairment in 2 of the 6 defining symptoms of inattention: Ignores details; and Has difficulty organizing tasks and activities. The questionnaire also revealed significant impairment in 3 of the 6 symptoms of impulsivity/hyperactivity: "On the go", as if driven by a motor; Talks excessively; and interrupts or intrudes on others.

Progress exam ADHD questionnaire conducted after 18 adjustments performed over a 10 month period revealed significant impairment in 1 of the 6 defining symptoms of inattention: Makes careless mistakes. The questionnaire also revealed significant impairment in 1 of the 6 symptoms of impulsivity/hyperactivity: Talks excessively.

The Inattention scores dropped from 52 to 43 in the 10 month period of care; the impulsivity/hyperactivity score dropped from 50 to 34. The combined ADHD score therefore dropped from 102 to 77.

Initial Paraspinal Surface EMG revealed mild to severe hypertonicity in the cervical region and hypotonicity in the lower thoracic to thoracolumbar region with a total of 35 points of standard deviation from norms. Progress exam Paraspinal Surface EMG conducted 10 months later revealed mild to severe hypertonicity in the cervical region and hypotonicity in the thoracolumbar region with a total of 33 points of standard deviation from norms.

Initial Paraspinal Surface EMG Symmetry Analysis revealed mild to severe asymmetry in the upper thoracic region and moderate to severe asymmetry in the lumbar region with a total of 18 points of standard deviation from norms. Progress exam Paraspinal Surface EMG Symmetry Analysis conducted 10 months later revealed severe asymmetry in the lower thoracic region with a total of 12 points of standard deviation from norms.

Initial Paraspinal Infrared Thermography revealed mild to severe asymmetry in the upper cervical region and moderate to severe asymmetry in the thoracolumbar region with a total of 18 points of standard deviation from norms. Progress exam Paraspinal Infrared Thermography conducted 10 months later revealed severe asymmetry in the thoracolumbar region with a total of 8 points of standard deviation from norms.

Combining these functional scores revealed a drop from a score of 71 to 53 in the 10 month period. This practitioner's goal is to achieve a score in the region of 30.

Case 2

A 10 year old male presented with his mother with the hope of

helping his ADHD. He had been diagnosed by a Paediatrician. He was taking 20mg of slow acting Ritalin/day and Clonidine to assist sleeping which was impaired by the Ritalin. General history revealed an elective caesarean birth, no significant illnesses and no surgery, and the mother's observation that he was always bruised from his level and intensity of activity.

Initial General Health Questionnaire revealed significant impairment in the following topics: Concentration problems and Learning problems. Progress General Health Questionnaire 10 months later revealed significant impairment in the following topics: Learning problems. Initial health rating was scored as 31 for regularity and 25 for severity totaling 56. Progress health rating was scored as 34 for regularity and 16 for severity totaling 50.

Initial ADHD questionnaire revealed significant impairment in 1 of the 6 defining symptoms of inattention: Avoids activities that require a sustained mental effort. The questionnaire also revealed significant impairment in 1 of the 6 symptoms of impulsivity/hyperactivity: Fidgets or squirms.

Progress exam ADHD questionnaire conducted after 19 adjustments performed over a 10 month period revealed significant impairment in 1 of the 6 defining symptoms of inattention: Makes careless mistakes. The questionnaire also revealed significant impairment in 1 of the 6 symptoms of impulsivity/hyperactivity: Talks excessively.

The Inattention scores dropped from 44 to 43 in the 10 month period of care; the impulsivity/hyperactivity score dropped from 43 to 25. The combined ADHD score therefore dropped from 87 to 68.

Initial Paraspinal Surface EMG revealed mild to extremely severe hypertonicity in the cervical to mid thoracic regions and hypotonicity in the thoracolumbar region with a total of 56 points of standard deviation from norms. Progress exam Paraspinal Surface EMG conducted 10 months later revealed severe hypertonicity in the cervical to upper thoracic regions and hypotonicity in the lower thoracic to thoracolumbar region with a total of 39 points of standard deviation from norms.

Initial Paraspinal Surface EMG Symmetry Analysis revealed severe asymmetry in the upper cervical region, moderate asymmetry in the mid thoracic region, severe asymmetry in the lower thoracic to thoracolumbar regions, and moderate asymmetry in the lumbosacral region with a total of 23 points of standard deviation from norms. Progress exam Paraspinal Surface EMG Symmetry Analysis conducted 10 months later revealed severe asymmetry in the cervicothoracic region, severe asymmetry in the thoracolumbar region and severe asymmetry in the lumbosacral region with a total of 23 points of standard deviation from norms.

Initial Paraspinal Infrared Thermography showed symmetry with a total of 0 points of standard deviation from norms. Progress exam Paraspinal Infrared Thermography conducted 10 months later revealed mild to moderate asymmetry in the upper cervical region with a total of 3 points of standard deviation from norms.

Combining these functional scores revealed a drop from a score of 79 to 65 in the 10 month period. This practitioner's goal is to achieve a score in the region of 30.

Case 3

An 8 year old male presented with his mother seeking help with his behaviour and general wellbeing. Their biggest health priority was for him to be as healthy as he could be. His favourite activities were Australian Rules Football, skateboarding and bike riding. His worst physical event in life had been a dislodged growth plate in his left wrist. His worst emotional event was the loss of his father in a workplace accident. He had not previously received chiropractic care. His general systems history review was unremarkable. He had been diagnosed with ADD and had previously been medicated with Ritalin but had not been taking it during the preceding months. His mother tried to keep him on a low sugar diet.

Initial ADHD questionnaire revealed significant impairment in 5 of the 6 defining symptoms of inattention: Does not seem to listen when directly addressed; does not follow through on instructions, fails to finish; loses things he needs; gets distracted by extraneous noise; and is forgetful in daily activities. The questionnaire also revealed significant impairment in 4 of the 6 symptoms of impulsivity/hyperactivity: Talks excessively; blurts out answers before questions have been completed; has difficulty waiting his turn; and interrupts or intrudes on others.

Second progress exam ADHD questionnaire conducted after 18 adjustments performed over 5 month period revealed significant impairment in 1 of the 6 defining symptoms of inattention: Does not seem to listen when directly addressed. The questionnaire also revealed significant impairment in 1 of the 6 symptoms of impulsivity/hyperactivity: Interrupts or intrudes on others.

The Inattention scores dropped from 49 to 47 in the 5 month period of care, the impulsivity/hyperactivity score dropped from 38 to 31. The combined ADHD score therefore dropped from 87 to 78.

Initial Paraspinal Surface EMG revealed moderate to severe hypertonicity in the cervical region and hypotonicity in the thoracolumbar region with a total of 24 points of standard deviation from norms. Second progress exam Paraspinal Surface EMG conducted 5 months later revealed mild to severe hypertonicity in the cervical region and mild hypertonicity in the mid to lower thoracic region with a total of 20 points of standard deviation from norms.

Initial Paraspinal Surface EMG Symmetry Analysis revealed moderate to severe asymmetry in the cervical region and moderate to severe asymmetry in the lumbar region a with total of 18 points of standard deviation from norms. Second progress exam Paraspinal Surface EMG Symmetry Analysis conducted 5 months later revealed severe asymmetry in the cervicothoracic region and moderate asymmetry in the lumbar region with a total of 25 points of standard deviation from norms.

Initial Paraspinal Infrared Thermography revealed moderate to severe asymmetry in the entire cervical region, moderate to

severe asymmetry in the upper thoracic region and mild to severe asymmetry in the mid lumbar region with a total of 34 points of standard deviation from norms. Second progress exam Paraspinal Infrared Thermography conducted 5 months later revealed severe asymmetry in the entire cervical region, and moderate asymmetry in the lower thoracic region with a total of 21 points of standard deviation from norms.

Combining these functional scores revealed a drop from a score of 76 to 66 in the 5 month period. This practitioner's goal is to achieve a score in the region of 30.

As a clinical observation of this case, the degree of improvement in both signs of ADHD and functional assessments is less than the other three cases presented in this paper. It is this practitioner's opinion that the significant life trauma suffered by this young boy was a significant complicating factor in this case. Of interest is that it is our observation that when small changes in functional assessments are observed, small changes in behaviour and health status are also observed. This point is made to suggest that the use of objective functional assessment is a useful clinical tool to measure efficacy of care and expectation of clinical benefit.

Case 4

An 8 year old male presented with primary complaint of Attention Deficit Disorder (without hyperactivity). He also suffered with bowel problems (constipation, pain and associated compaction) and weight loss and loss of appetite seemingly secondary to medication (Ritalin – 10mg once a day for 6 years). His diet was described as "good when eating". The patient had the digestive problems for 12 months. The child was also taking fish oil capsules and multi-vitamins a few times a week. The mother was hoping to be able to cease the medication. The main reason for consultation was to achieve a better level of health.

Past Illnesses included Glandular fever at age 2 which took 2 years to recover and is still not fully recovered. Previous operations included tonsils and adenoids being removed. No side effects from childhood vaccinations had been noticed. No allergies were reported.

The boy's general level of health at time of presentation was rated by the mother as 5/10, with a preferred goal of 8/10. Emotional state was rated 5/10 and ability to cope with stress rated 5/10. Initial and progress examinations revealed the following noticeable changes:

Total postural deviation improved from 34 degrees pre-care to 8 degrees post-care: Of note were improvements in shoulder protraction, unleveling and list of head/neck, and unleveling of hips, knees and ankles.

All pre- and post-care cervical ranges of motion were greater than AMA norms. Pre-care torso ranges of motion were as follows: Rotation and right lateral flexion were greater than AMA norms while left lateral flexion, flexion and extension were reduced. After 13 adjustments over a 6 month period, post-care torso ranges of motion were as follows: Left rotation was greater than AMA norms while right rotation, lateral flexion, flexion and extension were reduced.

Torque Release Technique Tonal Indicators of Subluxation were recorded. The total of all indicator scores pre-care was 21 and at progress exam was 19.

Heart rate variability analysis initially showed 63% low coherence, 14% medium coherence and 23% high coherence pre-care and was 59% low coherence, 26% medium coherence and 15% high coherence post-care.

Completion of general health questionnaire pre- and post-care showed improving severity and regularity in the areas of: Concentration problems, disliking after-school activities, taking prescription medications, and vomiting, constipation or diarrhea. It also showed deteriorating severity and regularity in the areas of: Nausea and sick feelings in stomach. The rating system from the questionnaire calculated 48 points of regularity pre-care and 44 points post-care and 36 points of severity pre-care to 33 points post-care, totaling to a health dysfunction score of 84 pre-care to 77 points post-care.

ADHD questionnaire pre- and post-care showed improving severity and regularity in the areas of: Ignoring details, trouble sustaining attention in work and play, avoiding activities that require sustained mental effort, losing things he/she needs, forgetful in daily activities and having to get up from seat. The rating system from the questionnaire calculated 30 points of inattention regularity pre-care and 24 points post-care, and 22 points of severity pre-care to 18 points post-care; 12 points of impulsivity/hyperactivity regularity pre-care and 9 points post-care, and 10 points of severity pre-care to 9 points post-care totaling to an ADHD dysfunction score of 75 pre-care to 59 points post-care.

Combined Results

When the measurable changes were combined for the four cases the following trends were observed:

<u>ADHD Symptoms:</u>
Inattention decreased in regularity by 8.7%
Inattention decreased in severity by 15.8%
Impulsivity/Hyperactivity decreased in regularity by 23.8%
Impulsivity/Hyperactivity decreased in severity by 24.1%
Combined Symptoms decreased in regularity by 15.1%
Combined Symptoms decreased in severity by 20.1%
Total Dysfunction rating decreased by 17.3%

<u>Functional Assessments:</u> (Cases 1-3)
SEMG points of deviation decreased by 19.8%
SEMG Symmetry points of deviation increased by 1.5%
SEMG Symmetry points of deviation decreased by 38.2%
Total Spinal Dysfunction Score decreased by 23.3% (Cases 1-4)

<u>Child Health Questionnaire:</u> (Cases 1,2 & 4)
Regularity of symptoms decreased by 10.0%
Severity of symptoms decreased by 35.1%
Combined regularity and severity of symptoms decreased by 21.0%

Discussion

The results of this case series seem to indicate that Chiropractic care improves patient outcomes and prognosis in the management of ADHD in both medicated and un-medicated children. Another retrospective case series of five male children receiving Chiropractic care and nutritional supplementation demonstrated similar ADHD outcomes.[60]

Related Chiropractic Literature

Authors have proposed various mechanisms for the positive results obtained through chiropractic care in the literature. Bastecki et al[21] demonstrated complete resolution of ADHD symptoms in a five-year-old child following eight weeks of Chiropractic care utilizing the Chiropractic Biophysics technique. The authors noted a change from a 12° cervical kyphosis to a 32° cervical lordosis, and suggested that mechanical tensile forces generated from abnormal cervical posture lead to vascular compromise, cell death, and eventual nerve dysfunction related to the symptoms of ADHD. They posit that correction of abnormal posture and concurrent abnormal tensile forces affecting the spine may lead to the improvement of neurological function, which may result in resolution of non-musculoskeletal conditions such as ADHD.

One case study[20] showed reduction of headaches and neck pain, and positive changes in behaviour in an eight-year-old child over the course of two months of care. It was proposed that improvements in cerebrospinal fluid mechanics reduced the child's pain and discomfort and improved his ability to concentrate, learn, and "sit still."

A case study by Elster[22] demonstrated resolution of ADHD symptoms in a nine-year-old child utilizing an upper cervical Chiropractic technique. This author proposed that there is a causative link between traumatic birth, upper cervical subluxation, and neurological conditions. It is proposed that upper cervical spine injury leads to increased afferent signals to the spinal cord via the articular mechanoreceptors. Excessive afferentation creates central nervous system facilitation, leading to cognitive dysfunction and/or other neurological conditions. It is also suggested that hyperafferentation to the sympathetic vasomotor center in the brainstem and/or the superior cervical ganglia leads to cerebral penumbra and decreased brain cell function. It is of interest to note that two of the children in this study are reported to have been born via elective caesarean section.

One study[19] described the positive outcomes of nine adults under Network Spinal Analysis (NSA) care. Patients were assessed using the Test of Variable Attention (TOVA) over the course of two months of care. This study was the first to link Chiropractic care to objectively measured attentional capabilities in adults. All nine patients experienced significant improvement in attention. The author suggests that NSA care triggers a "relaxation response" in the patient's nervous system, allowing them to reduce the negative effects of stress.

Another possible mechanism of action is via the activation of spinocerebellar pathways through the joint mechanoreceptor and muscle spindle activation resulting from an NSA session. Dysafferentation to the vermal region of the cerebellum may contribute to cerebellar diaschisis resulting in prefrontal dysfunction and altered attentional capabilities. A final explanation is that the Respiratory wave that patients develop under NSA care may help to synchronize thalamocortical oscillations and temporal binding which are associated with attentiveness and arousal.

A case study performed by Bedell[18] revealed improvements in behaviour in a seven-year-old female who presented with problems related to attention, focus, hyperactive behaviour, sleep disturbances, and negative aggressive behaviour toward her sister. Positive changes were noted on a behaviour and personality assessment completed by her mother weekly over the course of 90 days while utilizing Torque Release Technique and Craniosacral therapy to address the child's subluxations.

The author quotes Holder's work in regard to the effect of chiropractic care upon the brain reward cascade. It is suggested that "vertebral subluxation complex is the hallmark of insult to the vertebrate's ability to express a state of wellbeing to its fullest potential."[18] The causes of subluxation include chemical, emotional, and physical stresses that exceed the person's ability to cope with at the time of their incursion.

We outline the nature of subluxation and its effects upon the brain reward cascade below.

Subluxation and the Brain Reward Cascade

A neurophysiological mechanism of subluxation related to the brain reward cascade was first proposed in a publication of the Journal of Psychoactive Drugs entitled "Reward Deficiency Syndrome: A Biogenic Model for the Diagnosis and Treatment of Impulsive, Addictive and Compulsive Behaviours."[15] Reward Deficiency Syndrome (RDS) involves imbalances in brain neurotransmitters responsible for reward states and genetic defects of the D2 dopamine receptor gene, with resultant cognitive and psycho-neuro-immunological dysfunction.

The cascade begins at the hypothalamus with the release of serotonin, which interacts with opiate receptors to cause the release of enkephalins. The enkephalins act as inhibitors to the firing of gamma-amino-butyric-acid (GABA) from the substantia nigra. The supply of neuropeptidases also controls the amount of enkephalins available to affect GABA. GABA's normal role through GABA B receptors is to inhibit and control the release of dopamine from the ventral tegmental region (VTR). If uninhibited, dopamine released from the VTR reaches the D2 receptors in the nucleus accumbens creating a sense of reward or pleasure. Thus both the release of dopamine and the action of GABA act as modulators of reward through interconnected pathways.

Reward sites also exist in the CA_1 cluster cells of the hippocampus. Dopamine may be released into the amygdala to reach the hippocampus. An alternative reward pathway exists involving fibers projecting from the locus ceruleus to a reward area in the hippocampus positioned near cluster cells known as CAx cells. Norepinephrine at the CAx site is released upon stimulation of GABA A receptors in the hippocampus, causing reward[15].

These brain regions are primary constituents of the system responsible for memories, emotion, and pleasure, namely, the limbic system. The designation of "limbic tissue" is given to tissue that contains opiate receptor sites, and this is determined through a receptor detection technology known as autoradiography. Opiate receptors are densest in the amygdala and hypothalamus, but in 1998 Pert and Dienstrey[62] discovered that they are also found densely packed in the dorsal horn and dorsal roots of the spinal cord. By sheer volume, more limbic tissue exists in the spinal cord than the brain, thus the current distinction between "limbic" and "mesolimbic" tissue. There is therefore a direct nociceptive reflex at every level of the spinal cord to the limbic system.

There is evidence in mice of direct projection of spinal cord neurons to the amygdala and orbital cortex, which are involved in modulating somatosensory information to effect autonomic, endocrine, and behavioural functions[63]. Spinal nociceptive pathways to the limbic system, including the hypothalamus bilaterally, were discovered by Giesler et al[64] in 1994, and in 1993 Kyles et al[65] found that nociceptive information processing is mediated by the spinal cord.

Vertebral segments which have direct dural attachment into its periosteum are thought to have a more significant influence on dural tension and therefore incur a greater level of neurological insult to the spinal cord when displaced. It has been observed that primary subluxations occur more often at these vertebral levels and therefore are the most common segments to be adjusted by a Torque Release practitioner. The general sequela of vertebral subluxation may include spinal kinesiopathology, neuropathology, myopathology, connective tissue pathology, histopathology, biochemical changes, and increased inflammatory response[37].

Vertebral subluxation creates nociceptive bombardment to the dorsal horn of the cord. Facilitation and concurrent inflammation as a result of subluxation can create as much as a 100 fold increase in resting nociceptive discharge[66]. Facilitative carry-over into the anterior horn may create muscle splinting, further exacerbating the condition and holding the fixated segment in malposition.

We maintain that subluxation directly interferes with dopaminergic and opioidergic processing which is central to the vertebrate's ability to establish a state of well-being. A subluxation-free spine is necessary to maintain proper function of the brain reward cascade and reduce the propensity towards RDS. Because RDS has been implicated in all addictions and most compulsive disorders (including ADHD)[15], we suggest that the removal of vertebral subluxation led to the re-establishment of proper brain reward function and the resultant reduction of symptoms related to ADHD in these four children.

Call for Research

In 2010 a systematic review[61] of the literature regarding Chiropractic care and ADHD was performed. It was concluded that there is "no high quality evidence to evaluate the efficacy of chiropractic care for paediatric and adolescent AD/HD." There is essentially a "research gap" regarding ADHD and Chiropractic, and the need for further research utilizing randomised controlled trials is indicated.

Conclusions

This case study illustrates the positive response of four boys to Torque Release Technique in the domains of ADHD severity and regularity, spinal functional assessments and general wellbeing. While such a small population does not offer statistical significance, in this group ADHD symptoms improved on average by 17.3%, functional status improved on average by 23.3% and general wellbeing improved on average by 21.0%. A prospective randomised and controlled study would help to further quantify these positive changes.

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Outcomes:

1) ADHD QUESTIONNAIRES

CASE 1 ADHD QUESTIONNAIRE				
	17/11/2006		17/09/2007	
	REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4	SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4	REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4	SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4
Ignores details	3	3	3	2
Makes careless mistakes.	3	2	4	2
Has trouble sustaining attention in work or play	3	2	3	2
Does not seem to listen when directly addressed	3	2	2	0
Does not follow through on instructions; fails to finish	3	2	2	2
Has difficulty organizing tasks and activities	4	3	3	2
Avoids activities that require a sustained mental effort	3	2	2	2
Loses things he/she needs	2	2	3	2
Gets distracted by extraneous noise	3	2	2	1
Is forgetful in daily activities	3	2	3	2
Fidgets or squirms	3	2	3	2
Has to get up from seat.	2	1	3	2
Runs or climbs when he/she shouldn't	3	2	2	1
Has difficulty with quiet leisure activities	3	2	1	1
"On the go", as if driven by a motor	4	3	2	2
Talks excessively	4	4	4	3
Blurts out answers before questions have been completed	3	2	3	2
Has difficulty waiting his/her turn	3	2	2	1
Interrupts or intrudes on others	4	3	3	2
INATTENTION TOTAL	30	22	27	17
IMPULSIVITY/HYPERACTIVITY TOTAL	29	21	23	16
SUBTOTAL	59	43	50	33
TOTAL	102		83	

CASE 2 ADHD QUESTIONNAIRE

	17/11/2006		17/09/2007	
	REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4	SEVERITY None = 0 MIld = 1 Moderate = 2 Severe = 3 Unbearable = 4	REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4	SEVERITY None = 0 MIld = 1 Moderate = 2 Severe = 3 Unbearable = 4
Ignores details	3	2	3	1
Makes careless mistakes.	3	2	3	2
Has trouble sustaining attention in work or play	2	1	3	2
Does not seem to listen when directly addressed	2	1	2	1
Does not follow through on instructions; fails to finish	3	2	3	2
Has difficulty organizing tasks and activities	3	2	3	2
Avoids activities that require a sustained mental effort	4	3	3	2
Loses things he/she needs	2	1	2	1
Gets distracted by extraneous noise	3	2	2	1
Is forgetful in daily activities	2	1	3	2
Fidgets or squirms	4	2	2	1
Has to get up from seat.	3	1	2	1
Runs or climbs when he/she shouldn't	3	2	2	1
Has difficulty with quiet leisure activities	3	2	2	1
"On the go", as if driven by a motor	3	2	2	1
Talks excessively	3	2	1	1
Blurts out answers before questions have been completed	2	1	1	1
Has difficulty waiting his/her turn	3	2	2	1
Interrupts or intrudes on others	3	2	2	1
INATTENTION TOTAL	27	17	27	16
IMPULSIVITY/HYPERACTIVITY TOTAL	27	16	16	9
SUBTOTAL	54	33	43	25
TOTAL	87		68	

CASE 3 ADHD QUESTIONNAIRE

	20/10/2006		22/12/2006		19/03/2007	
	REGULARITY	SEVERITY	REGULARITY	SEVERITY	REGULARITY	SEVERITY
	Never = 0	None = 0	Never = 0	None = 0	Never = 0	None = 0
	Rarely = 1	Mild = 1	Rarely = 1	Mild = 1	Rarely = 1	Mild = 1
	Sometimes = 2	Moderate = 2	Sometimes = 2	Moderate = 2	Sometimes = 2	Moderate = 2
	Often = 3	Severe = 3	Often = 3	Severe = 3	Often = 3	Severe = 3
	Always = 4	Unbearable = 4	Always = 4	Unbearable = 4	Always = 4	Unbearable = 4
Ignores details	2	2	3	3	3	2
Makes careless mistakes.	3	2	2	3	3	2
Has trouble sustaining attention in work or play	2	2	2	3	3	2
Does not seem to listen when directly addressed	4	3	3	3	3	3
Does not follow through on instructions; fails to finish	3	3	2	2	2	2
Has difficulty organizing tasks and activities	2	2	2	2	3	2
Avoids activities that require a sustained mental effort	2	2	3	3	3	1
Loses things he/she needs	3	3	3	2	3	2
Gets distracted by extraneous noise	4	2	3	2	3	2
Is forgetful in daily activities	3	2	2	2	3	2
Fidgets or squirms	2	1	2	1	2	2
Has to get up from seat.	2	1	2	1	2	1
Runs or climbs when he/she shouldn't	1	1	1	1	1	1
Has difficulty with quiet leisure activities	2	1	2	1	2	1
"On the go", as if driven by a motor	1	0	1	1	1	1
Talks excessively	3	3	3	2	2	1
Blurts out answers before questions have been completed	3	3	3	2	3	2
Has difficulty waiting his/her turn	3	3	3	2	3	2
Interrupts or intrudes on others	4	4	3	3	3	3
INATTENTION TOTAL	28	23	25	25	29	20
IMPULSIVITY/HYPERACTIVITY TOTAL	21	17	20	14	19	14
SUBTOTAL	49	40	45	39	48	34
TOTAL	89		84		82	

CASE 4 ADHD QUESTIONNAIRE

	8/12/2009		15/06/2010	
	REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4	**SEVERITY** None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4	**REGULARITY** Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4	**SEVERITY** None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4
Ignores details	2	2	1	1
Makes careless mistakes.	2	2	2	2
Has trouble sustaining attention in work or play	3	3	2	2
Does not seem to listen when directly addressed	3	2	2	2
Does not follow through on instructions; fails to finish	3	2	2	2
Has difficulty organizing tasks and activities	3	2	2	2
Avoids activities that require a sustained mental effort	4	3	3	2
Loses things he/she needs	3	2	2	1
Gets distracted by extraneous noise	3	3	3	2
Is forgetful in daily activities	4	3	3	2
Fidgets or squirms	3	2	3	2
Has to get up from seat.	3	2	1	1
Runs or climbs when he/she shouldn't	1	1	0	0
Has difficulty with quiet leisure activities	1	1	1	1
"On the go", as if driven by a motor	2	1	1	1
Talks excessively	1	1	1	1
Blurts out answers before questions have been completed	1	1	1	1
Has difficulty waiting his/her turn	0	0	1	1
Interrupts or intrudes on others	0	0	1	1
INATTENTION TOTAL	30	24	22	18
IMPULSIVITY/HYPERACTIVITY TOTAL	12	9	10	9
SUBTOTAL	42	33	32	27
TOTAL	75		59	

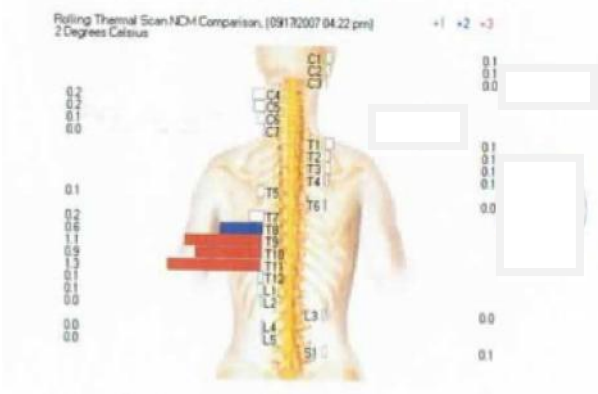
ADHD QUESTIONNAIRE - GROUP RESULTS

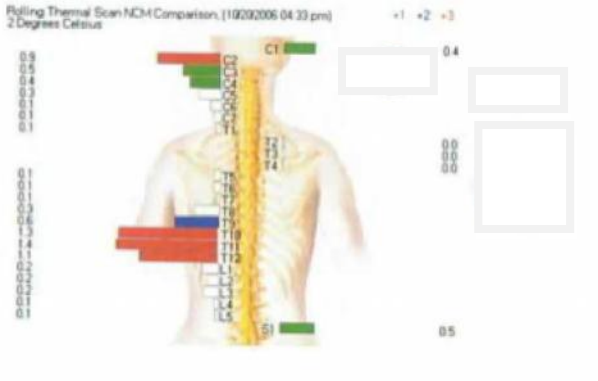
	AVERAGE SCORE				Case #1				Case #2				Case #3				Case #4			
	REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4		REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4		REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4		REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4		REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4	
	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-
Ignores details	2.5	2.5	2.3	1.5	3	3	3	2	3	3	2	1	2	3	2	2	2	1	2	1
Makes careless mistakes.	2.8	3.0	2.0	2.0	3	4	2	2	3	3	2	2	3	3	2	2	2	2	2	2
Has trouble sustaining attention in work or play	2.5	2.8	2.0	2.0	3	3	2	2	2	3	1	2	2	3	2	2	3	2	3	2
Does not seem to listen when directly addressed	3.0	2.3	2.0	1.5	3	2	2	0	2	2	1	1	4	3	3	3	3	2	2	2
Does not follow through on instructions; fails to finish	3.0	2.3	2.3	2.0	3	2	2	2	3	3	2	2	3	2	3	2	3	2	2	2
Has difficulty organizing tasks and activities	3.0	2.8	2.3	2.0	4	3	3	2	3	3	2	2	2	3	2	2	3	2	2	2
Avoids activities that require a sustained mental effort	3.3	2.8	2.5	1.8	3	2	2	2	4	3	3	2	2	3	2	1	4	3	3	2
Loses things he/she needs	2.5	2.5	2.0	1.5	2	3	2	2	2	2	1	1	3	3	3	2	3	2	2	1
Gets distracted by extraneous noise	3.3	2.5	2.3	1.5	3	2	2	1	3	2	2	1	4	3	2	2	3	3	3	2
Is forgetful in daily activities	3.0	3.0	2.0	2.0	3	3	2	2	2	3	1	2	3	3	2	2	4	3	3	2
Fidgets or squirms	3.0	2.5	1.8	1.8	3	3	2	2	4	2	2	1	2	2	1	2	3	3	2	2
Has to get up from seat.	2.5	2.0	1.3	1.3	2	3	1	2	3	2	1	1	2	2	1	1	3	1	2	1
Runs or climbs when he/she shouldn't	2.0	1.3	1.5	0.8	3	2	2	1	3	2	2	1	1	1	1	1	1	0	1	0
Has difficulty with quiet leisure activities	2.3	1.5	1.5	1.0	3	1	2	1	3	2	2	1	2	2	1	1	1	1	1	1
"On the go", as if driven by a motor	2.5	1.5	1.5	1.3	4	2	3	2	3	2	2	1	1	1	0	1	2	1	1	1
Talks excessively	2.8	2.0	2.5	1.5	4	4	4	3	3	1	2	1	3	2	3	1	1	1	1	1
Blurts out answers before questions have been completed	2.3	2.0	1.8	1.5	3	3	2	2	2	1	1	1	3	3	3	2	1	1	1	1
Has difficulty waiting his/her turn	2.3	2.0	1.8	1.3	3	2	2	1	3	2	2	1	3	3	3	2	0	1	0	1
Interrupts or intrudes on others	2.8	2.3	2.3	1.8	4	3	3	2	3	2	2	1	4	3	4	3	0	1	0	1
INATTENTION TOTAL	28.8	26.3	21.5	17.8	30	27	22	17	27	27	17	16	28	29	23	20	30	22	24	18
IMPULSIVITY/HYPERACTIVITY TOTAL	22.3	17.0	15.8	12.0	29	23	21	16	27	16	16	9	21	19	17	14	12	10	9	9
SUBTOTAL	51.0	43.3	37.3	29.8	59	50	43	33	54	43	33	25	49	48	40	34	42	32	33	27
TOTAL			88.3	73.0			102	83			87	68			89	82			75	59

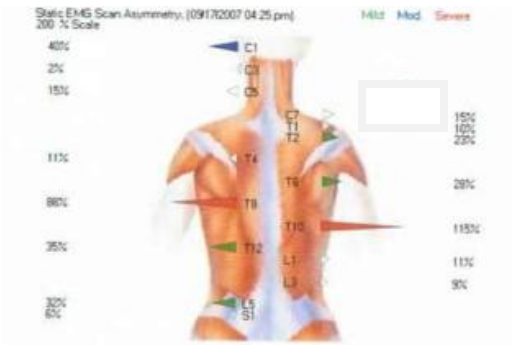
2) Functional Assessments

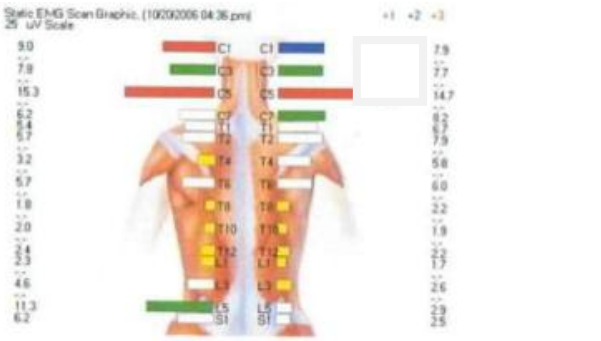
CASES 1-3 SUBLUXATION STATION FINDINGS								
	AVERAGE		CASE 1		CASE 2		CASE 3	
	PRE	POST	DATE 1	DATE 2	DATE 1	DATE 2	DATE 1	DATE 3
			20/10/2006	17/09/2007	20/10/2006	17/09/2007	9/10/2006	26/03/2007
Static SEMG Readings Score	38.3	30.7	35	33	56	39	24	20
Static SEMG Asymmetry Score	19.7	20.0	18	12	23	23	18	25
Rolling Thermal Scan Asymmetry Score	17.3	10.7	18	8	0	3	34	21
SPINAL DYSFUNCTION SCORE	**75.3**	**61.3**	**71**	**53**	**79**	**65**	**76**	**66**

Case 1 Subluxation Station Findings – Pre and Post (Right to Left)



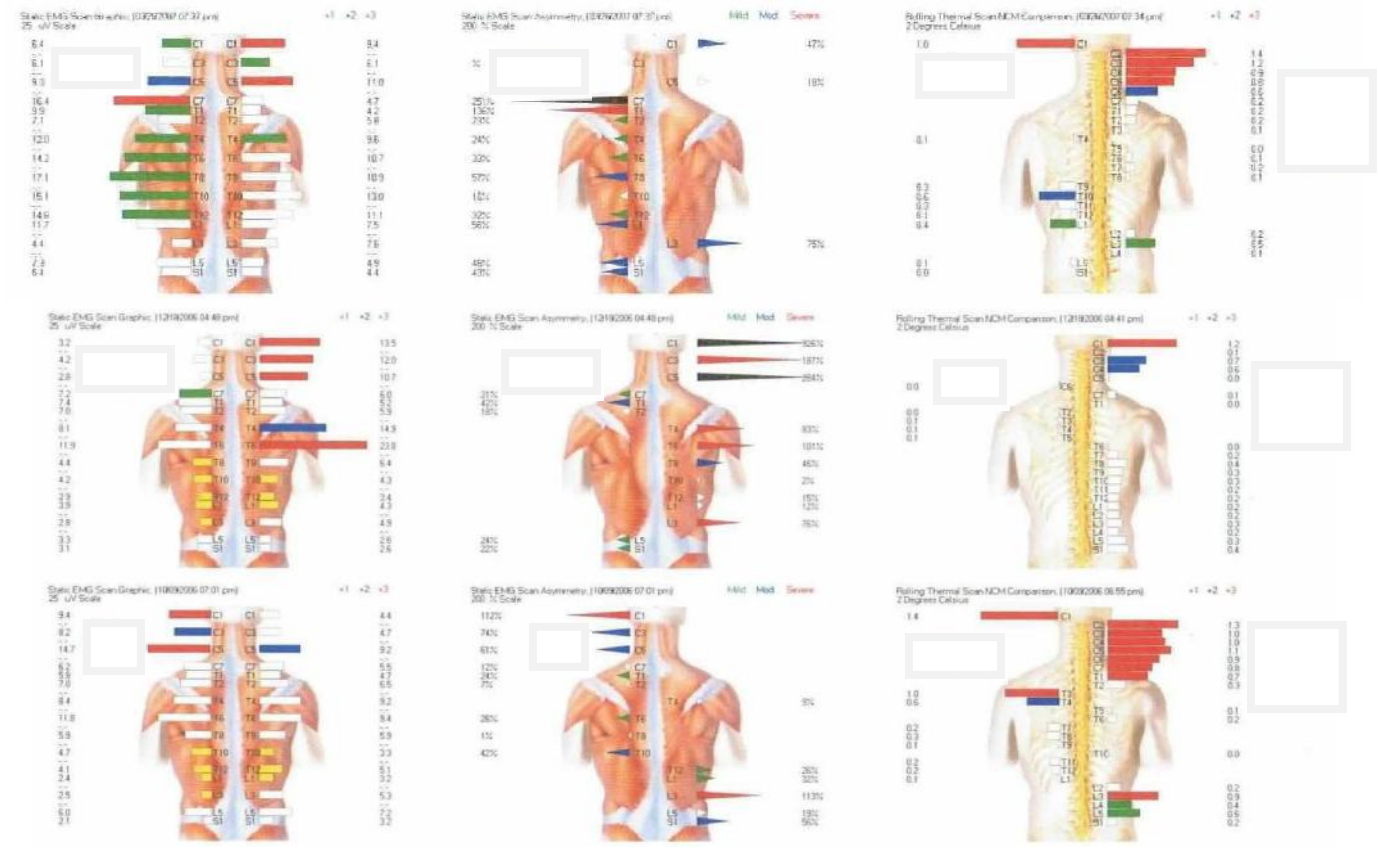






Case 2 Subluxation Station Findings – Pre and Post (Right to Left)

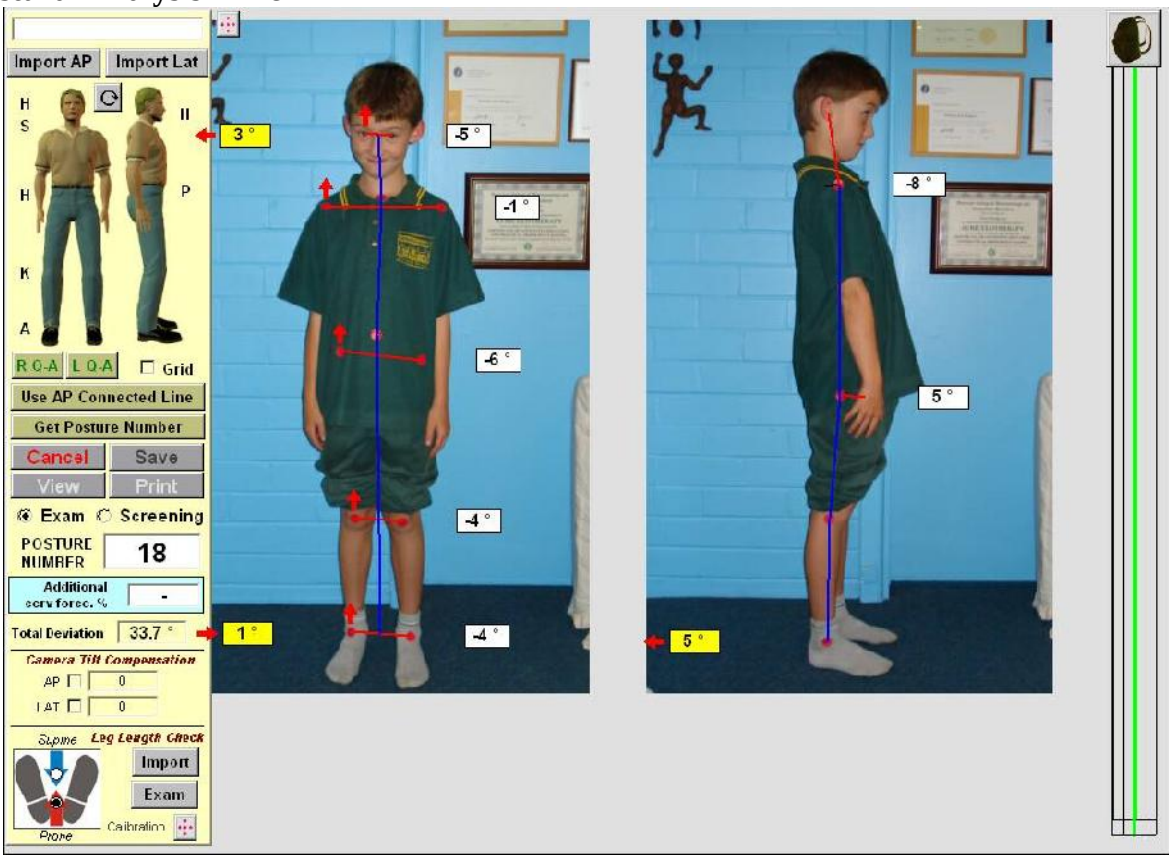
Case 3 Subluxation Station Findings – Pre and Post (Right to Left)



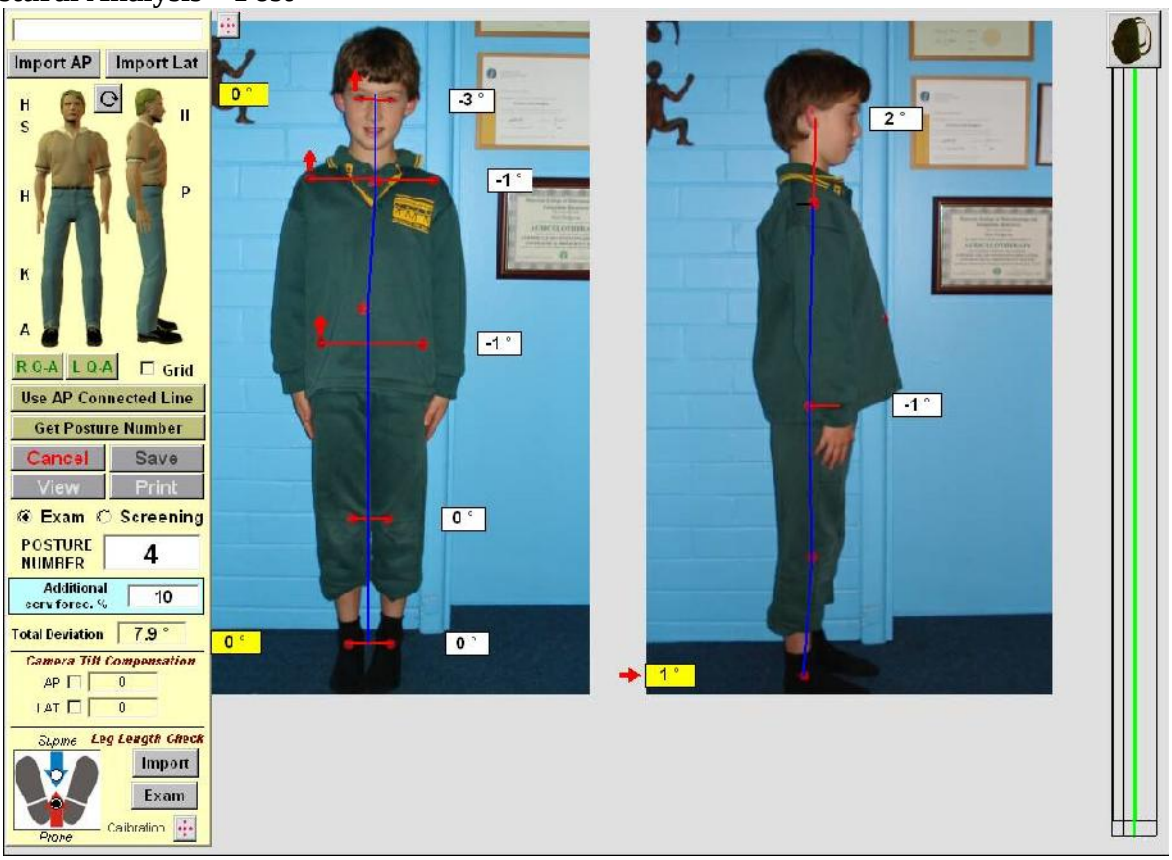
CASE 4 EXAMINATION FINDINGS

	DATE 1	DATE 2
	8/12/2009	15/06/2010
Cervical Flexion Impairment	-11.0	-14.0
Cervical Extension Impairment	-50.0	-28.0
Right Cervical Lateral Flexion Impairment	-13.0	-10.0
Left Cervical Lateral Flexion Impairment	-9.0	-17.0
Right Cervical Rotation Impairment	-8.0	-1.0
Left Cervical Rotation Impairment	-1.0	-8.0
AVERAGE C ROM IMPAIRMENT	**-15.3**	**-13.0**
Right Torso Rotation Impairment	-10.0	3.0
Left Torso Rotation Impairment	-13.0	-3.0
Right Torso Lateral Flexion Impairment	-1.0	11.0
Left Torso Lateral Flexion Impairment	9.0	14.0
Torso Flexion Impairment	26.0	12.0
Torso Extension Impairment	1.0	1.0
AVERAGE T & L ROM IMPAIRMENT	**2.0**	**6.3**
Total Postural Deviation	**34.0**	**8.0**
Breath	3.0	3.0
Left Heel Tension	2.0	1.0
Right Heel Tension	1.0	2.0
Left Abductor Tendency	0.0	1.0
Right Abductor Tendency	0.0	1.0
Left Foot Flare	2.0	1.0
Right Foot Flare	0.0	0.0
Left Foot Pronation/Supination	1.0	1.0
Right Foot Pronation/Supination	1.0	2.0
Functional Leg Length Inequality	9.0	5.0
Cervical Syndrome	0.0	0.0
Bilateral Cervical Syndrome	0.0	0.0
Derefield	2.0	2.0
TONAL TENSION SCORE	**21.0**	**19.0**
BIOLOGICAL / FUNCTIONAL AGE	**41.7**	**20.3**
HRV Coherence: % Time Low	63.0	59.0
HRV Coherence: % Time Medium	14.0	26.0
HRV Coherence: % Time High	23.0	15.0

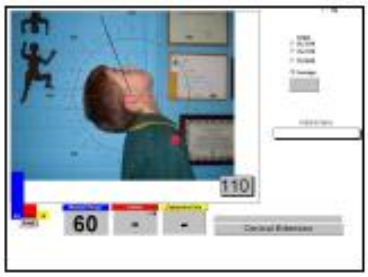
Case 4 Postural Analysis – Pre

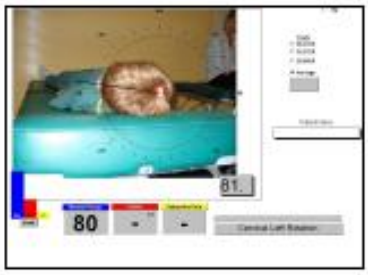


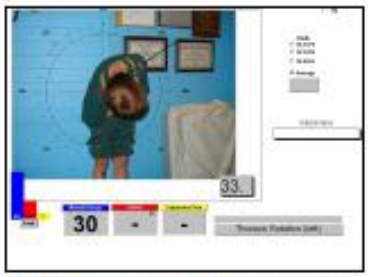
Case 4 Postural Analysis – Post



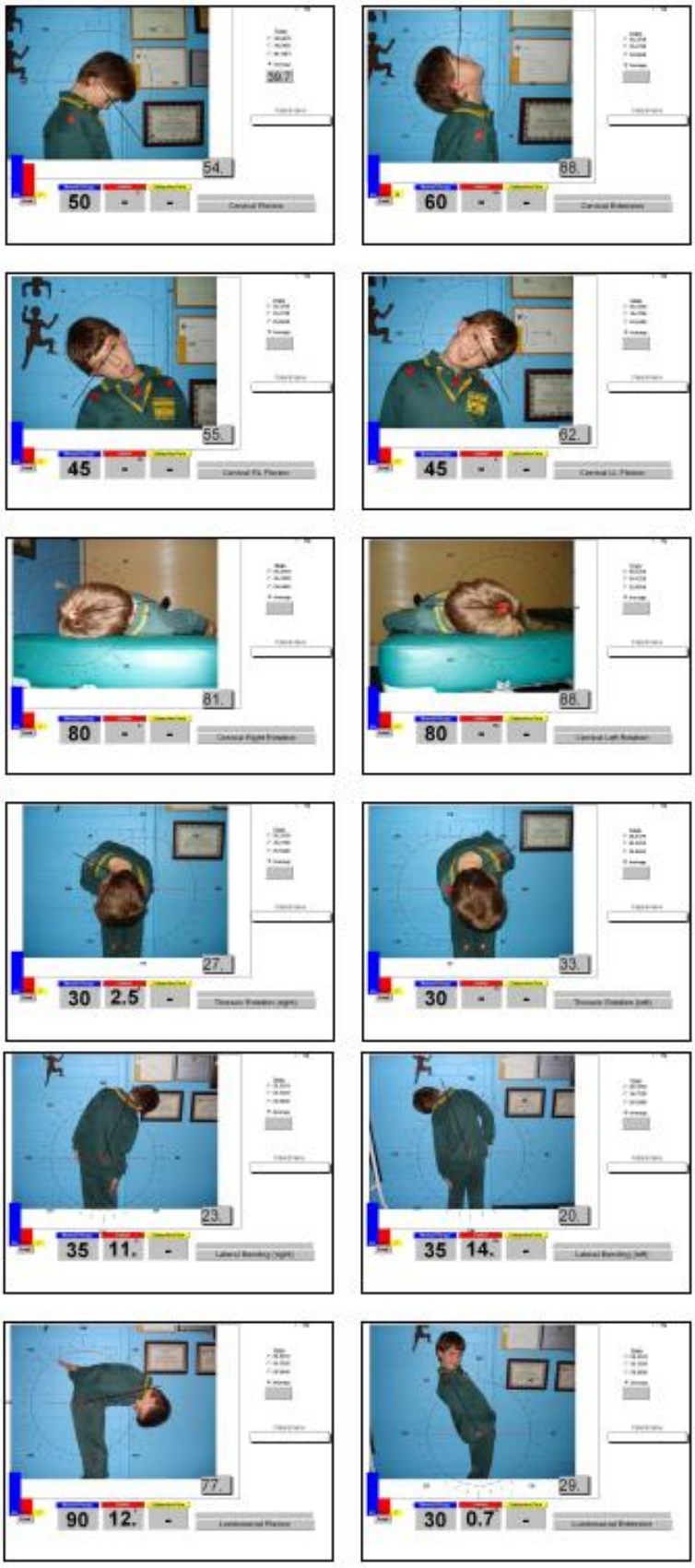
Case 4 Range of Motion Analysis – Pre



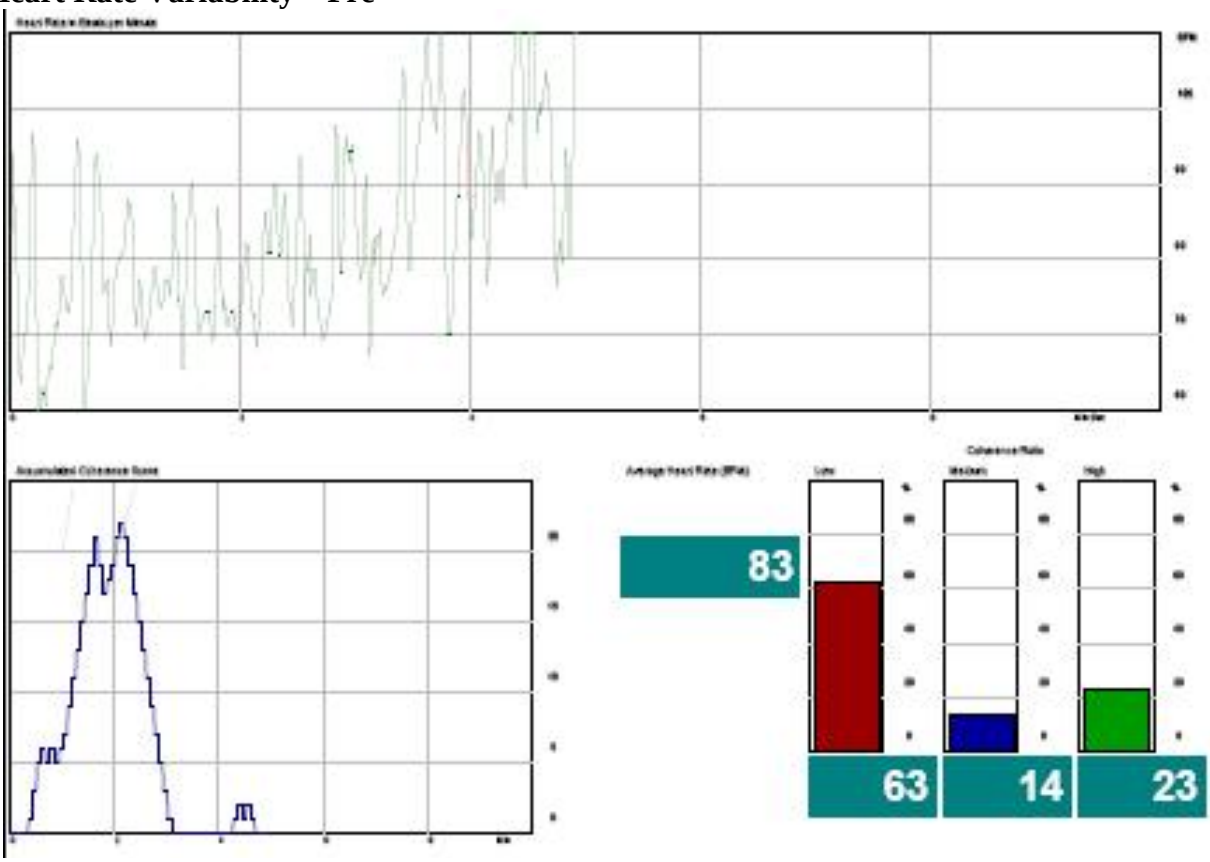




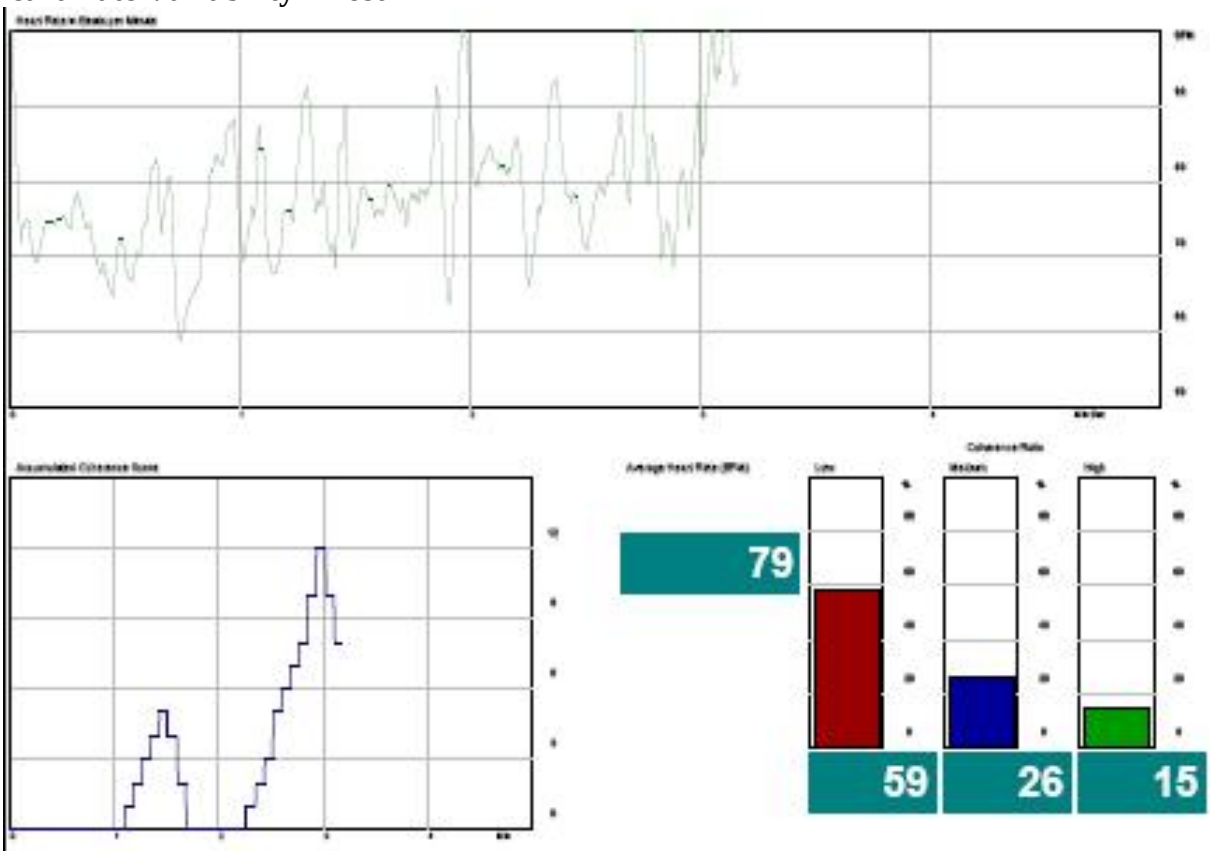
Case 4 Range of Motion Analysis – Post



Case 4 Heart Rate Variability – Pre



Case 4 Heart Rate Variability – Post



3) Child Health Questionnaire

CHILDREN'S HEALTH QUESTIONNAIRE - CASES 1, 2, 4

	AVERAGE SCORE				Case #1				Case #2				Case #4			
	REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4		REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4		REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4		REGULARITY Never = 0 Rarely = 1 Sometimes = 2 Often = 3 Always = 4		SEVERITY None = 0 Mild = 1 Moderate = 2 Severe = 3 Unbearable = 4	
	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-	PRE-	POST-
Angry, frustrated and/or tantrums	3.0	1.7	2.0	1.3	4	2	3	1	3	2	2	2	2	1	1	1
Argues with siblings and/or friends	2.7	2.3	2.3	1.7	4	3	4	2	2	2	2	1	2	2	1	2
Asthma, cough or breathing problems	1.3	0.7	1.0	0.7	2	1	1	1	1	0	1	0	1	1	1	1
Behavioural problems	2.0	1.3	1.7	1.0	3	2	2	2	2	1	2	0	1	1	1	1
Complains about attending school	1.7	1.7	1.3	1.0	1	1	1	0	1	2	1	1	3	2	2	2
Complains of aches and pains	2.0	1.7	1.7	1.0	1	1	1	0	1	2	1	1	4	2	3	2
Concentration problems	3.3	2.3	2.7	1.0	4	3	3	1	4	3	3	2	2	1	2	0
Dislikes after-school activities	1.0	0.7	1.0	0.3	1	0	1	0	0	0	0	0	2	2	2	1
Headaches	1.0	1.3	1.3	1.0	2	1	3	2	0	1	0	0	1	2	1	1
Health affects family activities	0.7	0.7	0.7	0.3	1	0	1	0	0	1	0	0	1	1	1	1
Infections	1.7	1.7	1.3	1.0	1	0	1	0	0	1	0	0	4	4	3	3
Learning problems	3.3	2.7	2.3	1.7	4	2	2	1	4	4	3	3	2	2	2	1
Low energy	0.3	1.0	0.3	0.3	0	1	0	0	0	1	0	0	1	1	1	1
Misses school when ill	1.0	1.0	1.0	0.7	1	1	1	0	1	1	1	1	1	1	1	1
Misses sport/recreation when ill	0.7	1.7	0.7	1.0	1	1	1	0	0	1	0	1	1	3	1	2
Nausea, sick feelings in tummy	1.3	1.7	1.0	1.0	1	2	1	1	1	1	1	0	2	2	1	2
Pains in feet and/or legs	1.3	1.0	0.7	0.3	0	1	0	0	2	1	1	0	2	1	1	1
Pains in hands and/or arms	0.7	0.7	0.7	0.3	0	0	0	0	1	1	1	0	1	1	1	1
Require bed rest during day when ill	1.0	1.3	1.0	0.3	1	1	1	0	1	1	1	0	1	2	1	1
Sad, depressed, unhappy or upset	1.3	1.3	1.0	0.7	1	1	1	0	1	2	1	1	2	1	1	1
Sick/Unwell	0.7	1.3	0.7	0.7	1	1	1	0	1	1	1	0	0	2	0	2
Taking over the counter medication/s	2.0	1.7	1.0	0.0	2	0	1	0	0	1	0	0	4	4	2	
Taking prescription medication/s	3.7	3.3	2.0	1.7	4	4	2	1	4	4	2	2	3	2	2	2
Tummy/abdominal pains	1.3	0.7	1.0	0.3	1	0	1	0	1	1	1	0	2	1	1	1
Vomiting, constipation or diarrhoea	1.0	0.7	1.0	1.0	0	0	0	0	0	0	0	1	3	2	3	2
SUBTOTAL	40.0	36.0	31.3	20.3	41	29	33	12	31	35	25	16	48	44	36	33
PRE-TOTAL			71.3				74				56				84	
POST-TOTAL				56.3				41				51				77