Case Study

Improved Intraocular Pressure in a 40-Year-Old Female Following Chiropractic Care to Reduce Subluxation

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Abstract

Objective: The purpose of this case study is to provide a detailed report of a patient diagnosed with borderline glaucoma undergoing chiropractic care.

Clinical Features: A 40-year-old female, diagnosed with borderline glaucoma, also presented with a numerous neuromusculoskeletal complaints. Previous to receiving chiropractic care, ophthalmic examination revealed a steady intraocular pressure increase.

Interventions and Outcomes: Over a period of 2 months and 11 days, the patient was seen 25 times received chiropractic adjustments using the Torque Release Technique®. Re-examination revealed improvements in sEMG and changes in paraspinal thermographic readings, positive changes in symptomatology, avoidance of carpal tunnel surgical intervention and reduced intra-ocular pressure.

Conclusions: While adding to the growing body of evidence that chiropractic care may result in improvements in intraocular pressure, this study concludes that further research with a larger population design is warranted.

Key Words: *Glaucoma, intraocular pressure, Torque Release Technique, chiropractic, vertebral subluxation, adjustment, spinal manipulation*

Introduction

The most common progressive optic neuropathy is glaucoma, and elevated intraocular pressure is the most important risk factor for the development of glaucomatous optic neuropathy.[1,2] Glaucoma, a common group of ophthalmic diseases, results in the atrophy of the optic disc and nerve fibers. In general, glaucoma is characterized by an increase in intraocular pressure.[3-5] More recently, glaucoma has been considered a process of elevated intraocular pressure with a vascular insufficiency of blood supply to the optic disc and nerve fibers.[3,6] This condition can present in one eye or both, in varying degrees, and occurs when there is reduced drainage of the aqueous humor of the eye resulting in an increase of intraocular pressure.[6] Intraocular pressure embodies the equilibrium of fluid production in the eye and the outflow of fluid from the eye.[5,7,8] Normal intraocular pressure is measured between 10-20 mmHg.[9]

Glaucoma is a slowly progressive eye disease, insidious in nature, and develops asymptomatically for years until visual deficits and irreversible impairment to the retina transpire. The prevalence rate ranges from 1% to 3.4% depending on race and region. Glaucoma is the second leading cause of blindness worldwide and it is estimated there will be 60.5 million people with open angle and angle closure glaucoma in 2010, which will rise to 79.6 million people by the year 2020. Of the 79.6 million people, 74% will have open angle glaucoma.[10] Early detection and treatment by lowering the intraocular pressure can slow, or even terminate the progression of the disease, reducing the impact of visual field loss.[4] The primary management of glaucoma is through the prevention and control of elevated intraocular pressure.[5,11] Modern medicine and pharmoacotherapy of glaucoma focuses on intraocular pressure, outflow facility, and the retina ganglion cell, to achieve the therapeutic goal of preserving visual function in patients. Medications either reduce or control levels of intraocular pressure. Gupta et al. state, “Despite new advances and techniques, it is observed that there is medically uncontrolled intraocular pressure. The ideal medication for this is not yet available.”[11] Some consider glaucoma a systemic disease, but this has not led to any management

strategies.[12] New drugs or interventions that improve ocular hemodynamics may be preferable.[13]

Changes in intraocular pressure have been associated with changes in systemic blood pressure.[14] Dielemans et al. studied the association between systemic blood pressure and intraocular pressure with additional exploration on the role of antihypertensive medications and its effect on intraocular pressure and hypertension. They concluded that there was no association between hypertension and intraocular pressure from the inclusion of the antihypertensive medication. The investigators stated that there is a physiologic factor common to both, the effect of generalized sympathetic tone.[9]

Intraocular pressure is considered to be dependent on ocular perfusion pressure, with autonomic nervous system function and the opioid system exerting their influence.[7,15] Spinal lesions, equivalent to vertebral subluxation, are associated with exaggerated sympathetic tone, as well as paraspinal muscle tone. Korr also states that "high sympathetic tone may alter organ and tissue responses to hormones, infectious agents, and blood components."[16,17] The chiropractor's role, according to Crawford et al., "is to recognize the important interaction of both the sympathetic system and the vascular components and to correct potentially deleterious imbalances in tonic activity, thus affecting the return to a normal state of homeostatic function."[18] In the presence of a vertebral subluxation, there are marked physiological changes.[19] In addressing the vertebral subluxation, the result is improved physiological function.[20] In the interest of evidence-based practice, this case study addresses the halt and reversal of elevated intraocular pressure in a patient diagnosed with borderline glaucoma following subluxation based chiropractic care using Torque Release Technique® (TRT).

Case Report

Patient History

A 40-year-old female, married with two children, employed full time, presented with a chief complaint of constant numbness in her arms and hands, specifically noted in the right digits one through three. The patient rated her chief complaint as a 5/10 on a severity scale with 1 representing mild and 10 unbearable. This particular complaint began two weeks prior to her initial consultation. Other complaints reported were neck pain, shoulder pain, dizziness, headaches, migraines, vertigo, anxiety, low back pain, right hip pain and clicking, numbness in the bottom of her feet, chronic fatigue, and cervical and lumbar intervertebral disc "problems."

Cervical disc issues were attributed to a sledding incident 12 years prior, with constant neck "tightness" since, with a rating of 3/10 in severity. The complaint of two lumbar disc issues with intermittent low back pain were noted beginning 14 years prior to the consultation, rated a 4/10 in severity, and were attributed to the birthing process of her son. The patient reported her complaint of headaches had been occurring for the past 28 years and frequent three times per week. In addition, her migraines, 8/10 in severity, occur quarterly and accompany photophobia and nausea. The patient reported a surgical history of varicose vein removal three years prior in both legs, and a caesarian section for the birth of her first child, 20 years earlier. Also noted, a prescription use of Aleve as needed for her carpal tunnel syndrome complaint. The patient denied any incidence of automobile accidents. Chiropractic care was sought 10 years proceeding to this consultation where she was diagnosed with her disc issues at that time. There was no report on the previous outcome of chiropractic care. The patient made her health goals to reduce the feeling in her fingers and improve flexibility and mobility to both the neck and low back regions.

Previous to receiving chiropractic care, over a timeframe of 3 years and 6 months, ophthalmic examination, using tonometry, revealed a steady intraocular pressure progression from OD and OS measurements of 14.5 mmHg to 18 mmHg. This resulted in a diagnosis of borderline glaucoma by her ophthalmologist.

Chiropractic Examination

The Insight™ Millennium was used to perform a paraspinal thermal and static surface electromyography (sEMG) scan. It was utilized to measure bilateral temperature differentials in skin temperature along the spine and to measure bilateral differences in muscle tone.

McCoy et al. found excellent inter and intra-examiner reproducibility for paraspinal thermal scanning and excellent inter and intra-examiner reliability of static paraspinal sEMG. Healthcare is becoming more evidence based, and these technologies provide objective evidence of the components of vertebral subluxation, monitor adaptability, and document the results of chiropractic care.[21,22]

The Insight™ Millennium is registered with the Food and Drug Administration (FDA) as a Class II Medical Device. The FDA 510(k) registration number is K990778. Indications for use include measuring bilateral differences in surface EMG along the spine, measuring surface EMG along the spine during functional tasks, measuring bilateral differences in skin temperature along the spine, measuring range of motion of the three spinal regions, and to chart patient progress during the course of treatment.[23]

Temperature differences one standard deviation above normal were observed at C1 and L5, and three standard deviations above normal were noted at C3 (Figure 1).

Uematsu et al., using 90 healthy volunteers, determined normative values for paraspinal skin temperature differentials and stated: "These values can be used as a standard in assessment of sympathetic nerve function, and the degree of asymmetry is a quantifiable indicator of dysfunction." Also, "Deviations from the normal values will allow suspicion of neurological pathology to be quantitated and therefore can improve assessment and lead to proper clinical management."[24]

Asymmetric differences in sEMG one or two standard deviations above normal were observed at C5, T1, T2, T8, L1, and L5, three standard deviations above normal at C1, C7, and T10, and over three standard deviations above normal at C3 (Figure 2).

Gentempo and Kent demonstrated that symmetry of paraspinal tone is the normal, and therefore asymmetrical tone indicates abnormality.[25] Paraspinal muscle tonal dysfunction is generally accepted as a neurophysiological component of the vertebral subluxation. These asymmetries and overall paraspinal pattern alterations of sEMG are associated with vertebral subluxations.[25-27] In addition, Whatmore and Kohli described a neurophysiological factor, which may be associated with vertebral subluxation, termed dysponesis. Dysponesis refers to a reversible physiopathologic state consisting of errors in energy expenditure, which are capable of producing functional disturbances within an organism.

These errors in energy expenditure act as an interference phenomenon in nervous system functioning. With an effect on nervous system function, regulation of the nervous system and organ function of almost any system in the body can be altered. Dysponesis consists mainly of covert errors in action potential output and the consequences of that output. The subsequent aberrant muscle activity may be evaluated using surface electrode techniques.[26,28] Kent states, "Surface EMG provides objective, quantitative data concerning the changes in paraspinal muscle function that accompany vertebral subluxation."[26]

Given the results of the full physical examination, enough data was warranted to proceed with lumbopelvic and cervical postural radiographs. These series were taken in order to determine the presence of pathology or any contraindication to chiropractic care. Radiographic impressions included hypolordosis of the cervical spine, posticus ponticus, and phlebolith formation noted on the anteroposterior lumbopelvic projection. All other osseous and soft tissue findings were unremarkable (Figure 3).

Intervention

Upon completion of the initial chiropractic examination, a patient corrective care plan was established. For each visit subsequent, the Torque Release Technique® model of analysis was used for the detection of vertebral subluxation, and chiropractic adjustments were performed if deemed necessary. All chiropractic adjustments were made with the Integrator™, a hand held instrument specifically designed "for the correction of the vertebral subluxation."[29-31] The patient was seen 25 times in the span of 2 months and 11 days.

55 primary subluxations were adjusted over the course of the 25 office visits. Segmental levels of primary subluxation included occiput, C1, C2, C5, C7, S2, coccyx and sphenoid. The most common level of primary subluxation was at the occiput. On the 25th visit, the patient was re-examined. Other than chiropractic adjustments, no other interventions were made during the course of care.

Torque Release Technique® (TRT)

TRT is a non-linear, non-mechanistic, neurological, vitalistic, tonal model of chiropractic analysis focused on locating the cause of abnormal tone within the cranio-spinal meningeal functional unit (C-SMFU), called the primary subluxation.[32-35] Founded by Jay Holder, DC, TRT was created out of a randomized, blinded, placebo controlled clinical trial conducted along with the University of Miami School of Medicine, to determine the outcomes that subluxation-based chiropractic had in affecting the state of well-being in the addicted population.[36] For this study, out of necessity to meet Institutional Review Board standards, and to surpass statistical confounding, a reliable and reproducible chiropractic adjusting instrument needed to be developed. Since the purpose of the study was to determine the outcome of traditional chiropractic, an instrument needed to be designed that was able to replicate what the human hands were intended to do.[32-37] This led to the creation of the Integrator™.

The Integrator™ was granted an FDA 510(k) clearance in 1996 making it chiropractic's first adjusting instrument specifically designed "for the correction of the vertebral subluxation."[29-31] It is considered the only true intra-patient/professional reproducible adjusting device due to a pre-cocking, pressure sensitive trigger, and automatic release mechanism that allows it to fire independent of the chiropractor at a pre-determined amount of contact pressure with the appropriate line of drive. The Integrator™ fires at a frequency of 64 Hz and the thrust of the adjusting shaft maintains a speed of 1/10,000th of a second, appropriate for subluxation reduction.

Other main features include torque means to selectively cause either a clockwise, counter clockwise, or straight non-twisting axial movement of the piston head, and a precise quarter of an inch recoil, components that were present in the original chiropractic technique of Toggle Recoil. This makes the Integrator™ the only device capable of adjusting 3 and 4 letter listings by providing a dynamic 3-dimentional thrust within the X, Y, and Z axes.[31-35,37]

In addition, the Integrator™ comes with three different and specific pisiform tips, black, white, and grey, that can be applied to the distal end zone of the anvil member. The white and grey tips are interchangeable and designed to replicate the size and shape of the human pisiform. The differences between the pisiform tips are their densities. The white tip measures at 60 durometers and is used for adjusting adults. The grey tip, the softest of the three, measures in at 30 durometers and is primarily used for children and the elderly. The black tip, the hardest of the three, measures 90 durometers, is not removable from the device, and is smaller in diameter. This tip is used for upper cervical specific techniques such as Blair Chiropractic, Atlas Orthogonal, and Toggle Recoil.[31-33]

Jay Holder, DC, developed TRT from seven already established chiropractic techniques including Thompson Terminal Point, Van Rumpt's Direction Non-Force Technique, DeJarnette's Sacro-Occipital Technique, Logan Basic, Toftness, Palmer Upper Cervical, and Network Spinal Analysis.[32,33,35] To detect the presence, vertebral level, and three-dimensional listing of the primary subluxation, the TRT model of analysis utilizes non-linear testing priorities (Figure 4), and through the previously mentioned techniques, a compiled list of 15 indicators of dis-ease and spinal subluxation are observed and/or tested for.

The 15 indicators are as follows:

1. The 4 types of palpation, "STIM":
    a. Scanning palpation
    b. Tissue palpation
    c. Inter-segmental palpation
    d. Motion palpation
2. Functional Leg Length Reflex (FLLR)
3. Abductor Tendency/Adductor Resistance
4. Foot flare (inversion/eversion)
5. Foot supination/pronation
6. Heel Tension (Achilles)
7. Abnormal breathing patterns
8. Inappropriate sustained patterns of paraspinal contractions
    a. Determined by scanning palpation or sEMG
9. Congestive tissue tone
10. Postural faults (sitting, standing, prone)
11. Cervical syndrome test
12. Wrong-un test
13. Bilateral cervical syndrome test
14. Derifield test
15. Abnormal heat/energy radiation from the body
    a. Determined by scanning (thermography), by hand and/or in conjunction with such devices as the Neurocalometer, Dermathermagraph, Thermo-Scribe II, Insight™ Subluxation Station, etc.[32-35]

TRT recognizes three varieties of subluxation, primary, secondary, and tertiary, with the primary subluxation being the source of all additional subluxations. The secondary and tertiaries present as symptoms of the primary, compensatory to the source. By successfully addressing the primary subluxation, the secondary and tertiary subluxations will abate. In TRT, adjustments are only delivered to the primary subluxation, with the understanding that adjusting secondary and tertiaries are detrimental to the patient by placing them into a neurological pattern.[32-34]

Additionally, TRT recognizes that the three types of subluxations are either cord pressure or cord tension in nature, giving emphasis to the latter.[32-34] Originally described by R.W. Stephenson, cord pressure subluxations are characterized by the impingement of neural contents located in the spinal canal, and cord tension subluxations by distortion of the meninges.[38] Meningeal distortion is thought to create abnormal tone and abnormal tensional patterns to the neural tissue itself. The tone of the nervous system is thought to be responsible for the normal adaptive response of the overall functional unit, therefore abnormal tone will create a maladaptive state.[35,39] Chiropractic was founded on tone and as described by D.D. Palmer, "Life is the expression of tone…Tone is the normal degree of nerve tension…Consequently, the cause of disease is any variation of tone."[40]

Cord tension and variation of tone within the nervous system from meningeal distortion are derived from points of dural attachment to bone. There are direct attachments from the spinal cord to levels of the spine via dura mater. These neural bridges occur directly at the foramen magnum of the occiput, C2, C5, S2, S3, S4, the ends of the C-SMFU, sphenoid and coccyx by means of the filum terminale, and indirectly at C1 via the rectus capitis posterior minor muscle.[32-35,39,41,42] Given the all-encompassing nature of the meningeal networks to the spinal cord, the tonal model recognizes that the body functions as one unit, and that one stress on the body can and does affect other parts of the body. With altered tone, neurological impulses from the brain to the body and vice versa do not get transmitted properly.[17,34,41] Using the TRT model of analysis and the non-linear testing priorities, the level of primary subluxation almost always shows up at the levels of dural attachment, although any vertebral level can be subject for analysis in priority 8.[32-35]

The previously listed 15 indicators of dis-ease and subluxation assist in identifying multiple combinations of subluxations and listings, but none can differentiate which are primary, secondary, or tertiary.[32-35] In order to determine the difference, one must perform a differential diagnosis for the primary. This is done by the use of the pressure test, originally developed by Van Rumpt, DC. The pressure test is a very light directional touch applied from the distal tip of the phalanx with a specific line of drive to the potential level of primary subluxation, a neurological projection in three-dimensional space. The neurological input from the pressure test will elicit an immediate neurological response. The patient's nervous system will either perceive the touch as the direction of correction, the direction of subluxation, or the direction of correction with torque. This neurological response is analyzed during the FLLR to obtain the exact line of correction in the X, Y, and Z axis, and to determine if the adjustment was properly received.[32-34]

For the typical TRT experience and analysis, the patient will first climb onto the adjusting table and orientate themselves in the prone position, face straight down in the face hole, with the bow of their shoe resting on the end seam of the table. The table should be equipped with a two-inch foam wedge at the foot end to place the knees into slight flexion and allow for proper dorsiflexion of the feet while performing the FLLR. The doctor will then approach the foot end of the table and center the patient by picking up their legs and shaking them side to side using the sternum as a fulcrum. This will center the patient.

The doctor must position themself in a way that will position their dominant eye over the center of the foot end of the table to ensure a proper reading of the FLLR. At this time, the doctor will "erase the neurological display" of the patient by flexing their knees past 45 degrees at least two times, also known as "pumping the legs." The clearing of the neurological display is implemented before any analysis is done and also after any adjustment is executed. This proprioceptive long lever maneuver is thought to trick the patient's body into thinking it is going from a non-weight bearing position to one of weight bearing, and allows the body to process the adjustment and present the next set of primary, secondary, and tertiary subluxations. This is known as retracing. The FLLR is then performed by abruptly dorsiflexing the feet bilaterally for less than half of a second, and releasing immediately to evoke the achilles deep tendon reflex. On the third second after the first engagement, the feet are engaged once again for less than half of a second. The reflex is observed on the second engagement and a side of functional short leg is determined. In TRT, the side of functional short leg is the side of primary

subluxation, with C2 and any subluxation with a listing of posterior inferior (PI) being the exception.

After establishing the side of functional short leg, the non-linear testing priorities, 15 indicators of dis-ease and subluxation, and the pressure test are utilized to discover the exact level of primary subluxation and its neurological manifestation in terms of a listing. A screening test, such as the cervical syndrome test or the wrong-un test are considered positive if and when the functional leg length becomes perfectly even during the three second window of the Achilles deep tendon reflex. A differential diagnosis via the pressure test is then indicated to determine the level and listing of primary subluxation. The FLLR is re-performed with each and every screening test or pressure test in order to observe the neurological response associated with each specific neurological input. The FLLR reading will become perfectly even when and only when the primary subluxation is pressure tested in the correct line of correction with the correct torque.

Once a definitive diagnosis of the primary subluxation is determined, the adjustment is made by placing the pisiform tip of the pre-cocked Integrator™ at the precise level and precise line of drive with enough pressure to trip the automatic release mechanism of the instrument, allowing it to fire independently of the chiropractor. During the adjustment, the doctor with their free hand, incorporates a Thompson Terminal Point Drop by moving the patient's primary subluxation in the direction of correction and having the Integrator™ fire concomitantly in that same direction. This is done by rocking the segment into motion, to reinforce the line of drive, making the subluxation less resistant to the adjustment. As previously mentioned, after the adjustment is made, the doctor will then clear the neurological display allowing the patient to process the adjustment and retrace to the next primary subluxation. According to TRT protocol, a maximum of three primary subluxations are adjusted per visit. If the third and final adjustment is a PI coccyx, a 4th adjustment is indicated by the adjustment of the sphenoid. If the primary subluxation is a PI occiput, or a PI coccyx, following their correction, no further adjustments are to be made at that time.[32-35]

Outcome

Upon re-examination, 2 months and 11 days since initiating care, the patient reported changes in her symptomatology. The patient was asked to rate her health progress by circling the words that best fit the progress that she had made since starting her care. Descriptive words included: same, mild improvement, moderate improvement, much improvement, and totally better. These terms are defined as 0%, 25%, 50%, 75% and 100% improvement respectively. The patient reported moderate improvement in low back pain and headaches, much improvement in neck pain, shoulder pain, hip pain and clicking, and dizziness, and totally better with numbness in both her hands and feet. In addition, on a visit-to-visit basis, the patient was asked, "Since you started care what percentage has your condition improved?" On the fourth visit, the patient reported a 30% improvement in her overall condition, on the sixth visit, she reported a 40% improvement, on the thirteenth visit, she reported a 70% improvement, and on the 15th visit, she reported a 90% improvement in her overall condition. The patient also stated that the effects of chiropractic care resulted in the avoidance of potential carpal tunnel syndrome surgical intervention.

A follow-up scan measuring thermography and sEMG were performed. Changes in thermographic readings were noted. Temperature differences three standard deviates above normal were observed at C1, C2, C3, and L4 (Figure 5). In regards to the sEMG, a reduction in paraspinal muscle asymmetry occurred in the cervical and thoracic spine. Asymmetric differences in sEMG one or two standard deviations above normal were observed at C1, T4, T10, T12, L1, and S1, and three standard deviations above normal at L5 (Figure 6).

A radiographic follow-up was not performed at this time.

The patient also had a re-examination with her ophthalmologist nine days before her chiropractic re-examination, 2 months and 2 days since initiating chiropractic care. The patient's progression of elevation in intraocular pressure not only ceased, but reversed. At this re-examination, using tonometry, the patient's OD and OS intraocular pressure measured at 16 mmHg and resulted in the ophthalmologist to no longer consider the need for medical intervention.

Discussion

With an increased interest in complementary and alternative medicine (CAM), patients may seek chiropractic care in addition to traditional glaucoma management.[43] As additional research is being conducted, chiropractic is now becoming more accepted. Numerous ocular effects have been reported including changes in visual acuity, oculomotor function, intraocular pressure, and pupillary size, as the result of chiropractic care.[44] Leboeuf-Yde et al. summarized that approximately 25% of patients report at least one improved non-musculoskeletal symptom after chiropractic adjustments. Of these responses, 14% were classified under eye and visual improvement. This included improvements in eye pressure, pain, double vision, tunnel vision, visual disturbances, and eye movements, among others.[45] For example, Bennett and Tedder described a case in which a 64 year old female presented with a chief complaint of fibromyalgia, and an additional complaint of glaucoma. Following Knee Chest Upper Cervical Specific technique, she reported improvement in eyesight after one adjustment to the atlas.[46]

Conway proposes a direct correlation between the cervical spine and its relation to the central nervous system, with the normalization of intraocular pressure. Her case study described reduction in elevated intraocular pressure of a pediatric patient. This particular patient's OD and OS intraocular pressure measured at 21 mmHg and 28 mmHg respectively, prior to receiving chiropractic care. One month after the initiation of chiropractic care, her OD reduced to 17 mmHg, and OS 15mmHg, and also resulted in the cancellation of adenoid surgery. After 4 months of care, her OD measured at 14 mmHg and OS 11mmHg. As described, most of the chiropractic adjustments were directed toward the cervical spine, particularly the atlas.[47] Irastorza et al. suggested an association between increased spinal and neural integrity with the decrease of spinal subluxation patterns, resulting in a positive effect of the sympathetic nervous system. The case described a 46-year-old male, presenting with progressive

vision loss due to diabetic retinopathy, and a chief complaint of numbness in both arms and fingers of the left hand. The patient's retinal specialist reported of poor circulation to the optic nerve. Over the course of three years under Network Spinal Analysis chiropractic care, the patient's intraocular pressure decreased from 50mmHg to 18mmHg, and the patient's retinal specialist stated; "the retina was re-attaching to the eye contributing to his vision coming back." The patient also reported that he was no longer experiencing numbness in both arms and fingers of the left hand. The investigators concluded that the effect of generalized sympathetic tone was responsible for elevated intraocular pressure and that sympathetic tone is addressed in chiropractic through the reduction and self-regulation of the vertebral subluxation.[48]

Gorman and Wingfield found that cervical sympathetic stimulation has been shown to reduce blood supply to the retina and concluded a cause-effect relationship amongst vision improvement in their patient and chiropractic care. They hypothesized that the presence of vertebral subluxation in the cervical spine was responsible for irritating the cervical sympathetic nerves.[49]

Cipolla et al. determined an effect on intraocular pressure after spinal manipulative therapy, specifically to the cervical and upper thoracic regions of the spine. The results indicated a significant decrease in intraocular pressure that was not seen in the control group. "It is thought that this decrease occurred by means of an influence of the autonomic nervous system on the input-output mechanism of the eye."[8]

The eye has an intimate neuroanatomic relationship with the autonomic nervous system. Fibers from the edinger-westphal nucleus pass through to the ciliary ganglion via the third cervical nerve, synapse, and travel through the ciliary nerves of the eye, providing the parasympathetic innervation. Sympathetic innervation, originating from the intermediolateral horn cells of T1-T3, ultimately send nerve fibers to the carotid plexus, which in turn passes along the small arteries of the eye. A decrease in intraocular pressure is related to decreased production of aqueous fluid, a consequence of decreased blood flow in the ciliary body, provided by these small arteries.[8] Aqueous humor is produced by the ciliary bodies in the posterior chamber of the eye, influenced by this neuroanatomic relationship. Sympathetic irritation may also hinder the aqueous outflow from the eye. Irritation of the cervical sympathetics may arise from vertebral subluxation in the cervical or upper thoracic spine.[5,8,44] Cervical and upper thoracic adjustments have been shown to effectively lower intraocular pressure by means of an effect on the autonomic nervous system.[5,8,44,47,48]

Beckenstein refers to a study that took place at Lincoln Chiropractic College, in which chiropractic adjustments, specifically to the cervical and upper thoracic spine, lowered intraocular pressure. He proposed by removing irritation to the sympathetic nervous system, via the chiropractic adjustment, that this resulted in facilitation to the aqueous drainage process of the eye by allowing the pupil to constrict. He also proposed that relaxation of hypertonic cervical musculature, consequential to the effectiveness of the chiropractic adjustment, may reduce venous congestion as well.[5,44]

Pharmacotherapeutically speaking, antiglaucomatous agents are used to act on aqueous humor dynamics with the goal to reduce intraocular pressure. Miotic agents are used to cause contraction of the sphincter pupillae, reversing the obliteration of the iridocorneal angle. They are also used to improve trabecular patency by contraction of the ciliary muscles. Beta-blockers and carbonic anhydrase inhibitors are used to reduce the secretion of aqueous humor produced by the ciliary body. Prostaglandins are also utilized to alter permeability and pressure gradients to increase uveoscleral outflow. Direct cholinergic agonists act on the parasympathetic receptors in the eye and indirect cholinergic agonists inhibit the acetylcholinesterase enzyme, both used to control intraocular pressure. If and when these agents are not sufficient to lower the intraocular pressure, combination therapy is indicated and for patients who do not respond, laser trabeculoplasty and incisional surgery are recommended.[11] Prescription eye drops, such as bimatoprost, timolol, dorzolamide, and their combinations, have shown effectiveness in reducing intraocular pressure, with the bimatoprost/timolol combination showing greater effectiveness and cost-effectiveness.[50]

Numerous botanical and nutrient usage have been noted for the treatment of glaucoma, but most studies are preliminary without controlled variables, and require a larger subject size.[11] Megavitamin supplementation has not been shown to have lasting beneficial effects on glaucoma, and also have toxicities of their own. Marijuana can have an influence on the lowering of intraocular pressure, but given its low response rate, short half-life, and toxic effects, it is not an appropriate therapeutic agent.[43] Other experimental interventions used to reduce intraocular pressure include the utilization of saffron extract, loganic acic, xylopia aethiopica(African guinea pepper), and solanum melongena(garden egg). All were shown to have a hypotensive effect, but with short-term results. Proposed mechanisms include reduced oxidative stress, nitric oxide inhibition, lacrimation and gustatory rhinorrhea, and a miotic effect on the pupil, respectively.[51-54]

Meta-analysis results revealed that aerobic exercise can have an effect on post-exercise intraocular pressure. Roddy et al. suggest, through combined evidence, that those who are physically fit maintain a baseline intraocular pressure lower than those who do not exercise. It was also shown that the effect of exercise on intraocular pressure was greater for the sedentary population than for normally active populations. Also, long term effects of exercise induce adaptations of the sympathetic nervous system which contribute to an overall reduction in baseline intraocular pressure.[55]

There have also been reports of progressive intraocular pressure decrease by means of acupuncture, and auricular acupoint/pressure treatment. Proposed mechanisms of involvement were changes in hemodynamics and aqueous humor flow to the eye.[13,15,56,57] The exact mechanisms by which acupuncture alter retrobulbar vessel circulation are uncertain, but it is reported that blood flow in the eye is controlled by sympathetic and parasympathetic nerves.[13,15] Although the effects of acupuncture on intraocular pressure weakened following each treatment as intraocular pressure returned closer to baseline readings, there was a continuing downward trend from the prior treatment.[56] In one study, the follow up four weeks after the last treatment, intraocular

pressure readings returned to their initial levels, suggesting temporary effects.[57]

Conclusion

A review of the literature reveals reports of ocular changes after spinal manipulative therapy (SMT) and chiropractic adjustments shows that ocular changes are mentioned by patients more commonly than the literature suggests. It is proposed that chiropractic may have a role in the treatment of ocular complaints in conjunction with optometrists and ophthalmologists. Ocular effects are typically overlooked as only few chiropractors have knowledge of optometry, and few optometrists and ophthalmologists are aware of the philosophy, science, and art of chiropractic. The review suggests that the effect of SMT and adjustments have on ocular are well worth investigating as they could be indicated as part of the overall therapy for glaucoma.[44] Given the intimate neuroanatomic relation between the eye and the autonomic nervous system, it comes as no surprise that ocular changes are seen as a result of chiropractic care.[5,8,44-49] With a variety of proposed mechanisms and treatment strategies, the majority share a common understanding that the physiological element responsible for an increase in intraocular pressure is dysautonomia.[5,7,8,9,11,13,15,43,44,47-49,54,55] Chiropractic recognizes a cause of dysautonomia, the vertebral subluxation, and in its reduction a result of autonomic regulation and improved physiological function transpire.[16-20] Chiropractic may therefore be indicated as part of the overall management for glaucoma.[5]

This case study describes the subluxation-based chiropractic care, using Torque Release Technique®, of a 40-year-old female diagnosed with borderline glaucoma and the concomitant objective improvements in intraocular pressure and clinical indicators of vertebral subluxation. In addition, this study reports significant improvements in patient symptomatology with the avoidance of medical interventions for both carpal tunnel syndrome and elevated intraocular pressure. While adding to the growing body of evidence that subluxation-based chiropractic care can cause improvements in intraocular pressure, further research with a larger population design is warranted. The nature of the case study design is a limitation due to its inability to be generalized to a larger population.

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Figures

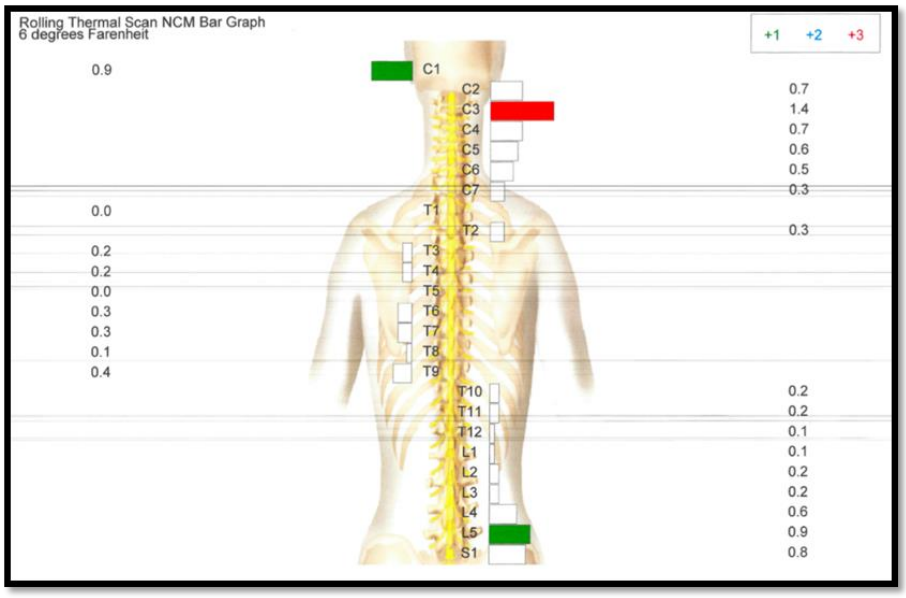

Figure 1. Initial paraspinal thermal scan

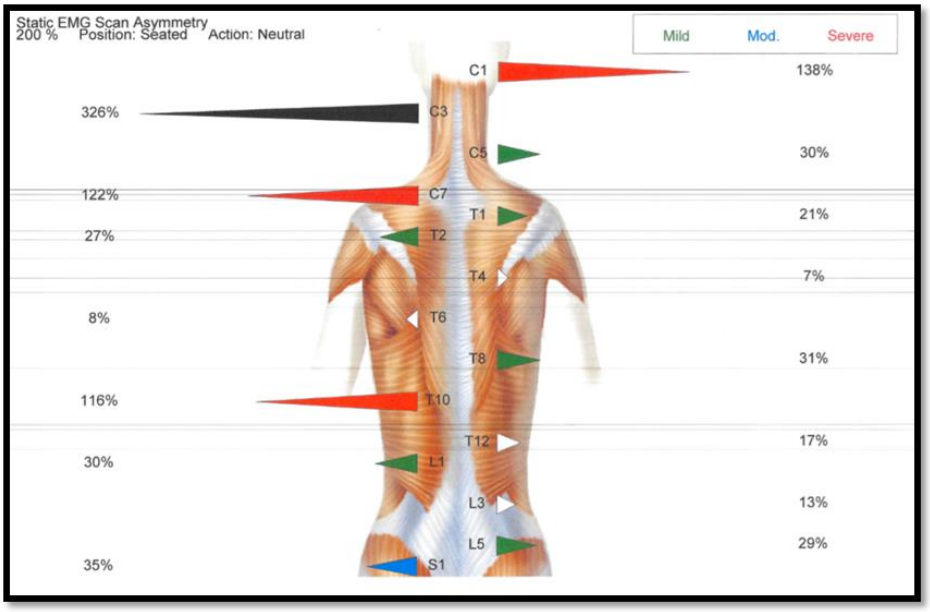

Figure 2. Initial sEMG scan

Lateral cervical

AP open mouth and AP lower cervical

AP Lumbopelvic

Lateral lumbar

Figure 3. Initial radiographs

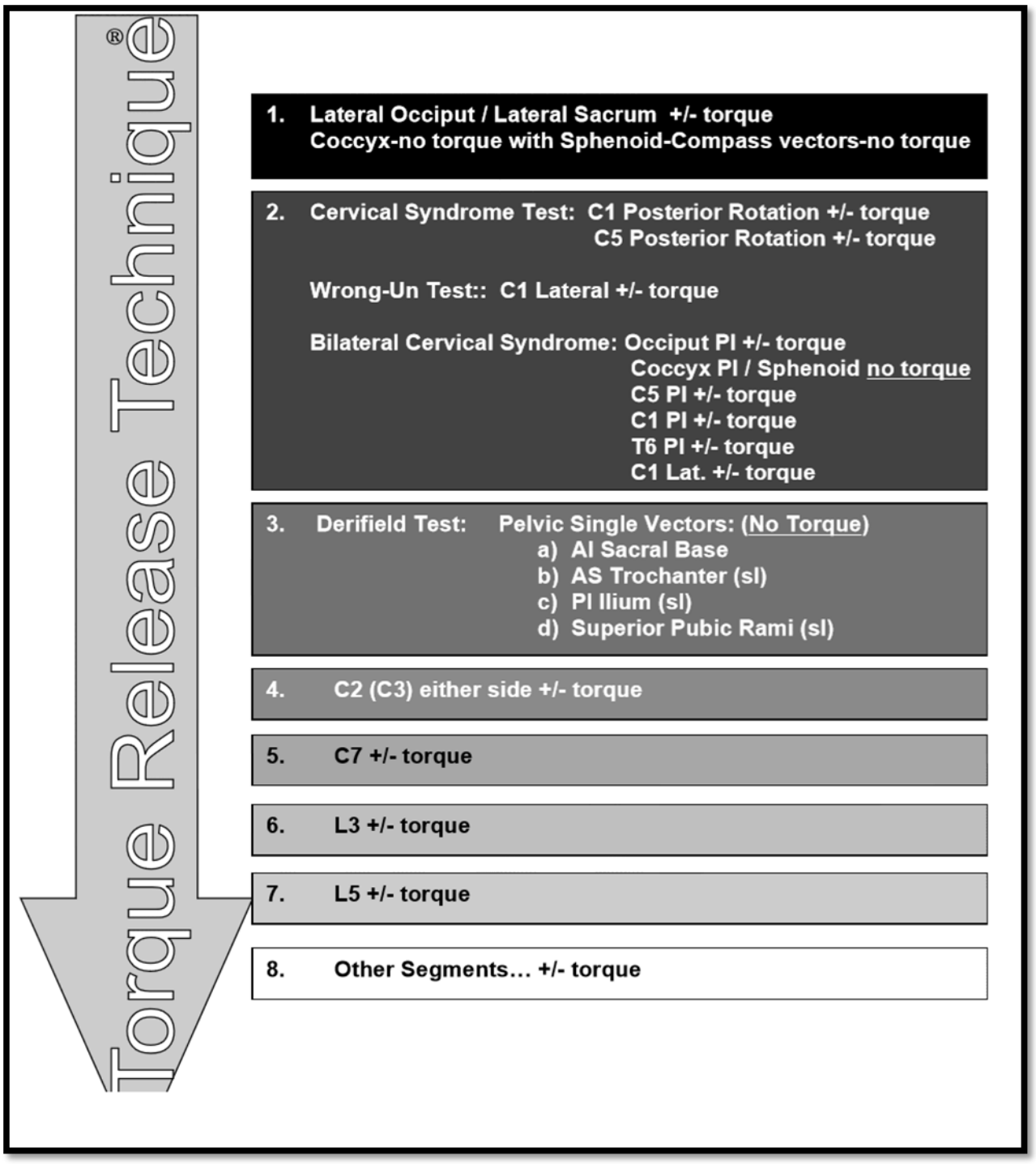

Figure 4. Torque Release Technique® non-linear testing priorities[32,33]

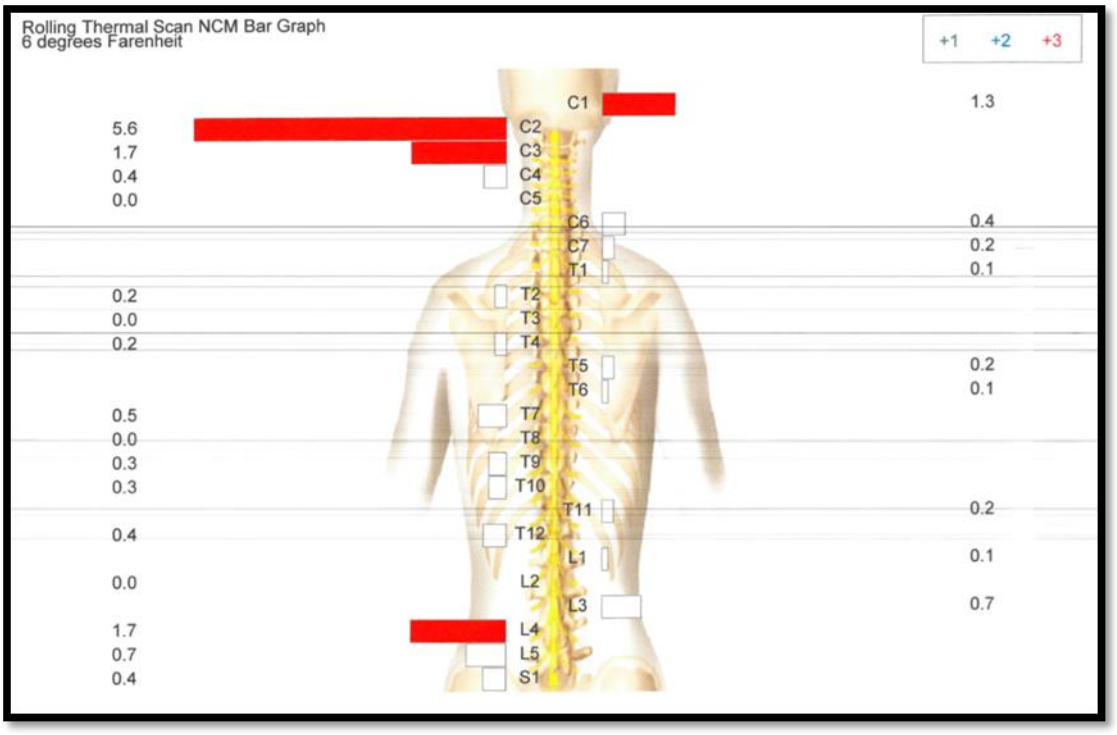

Figure 5. Paraspinal thermal scan re-examination on the 25th patient visit, 2 months and 11 days from the initiation of chiropractic care

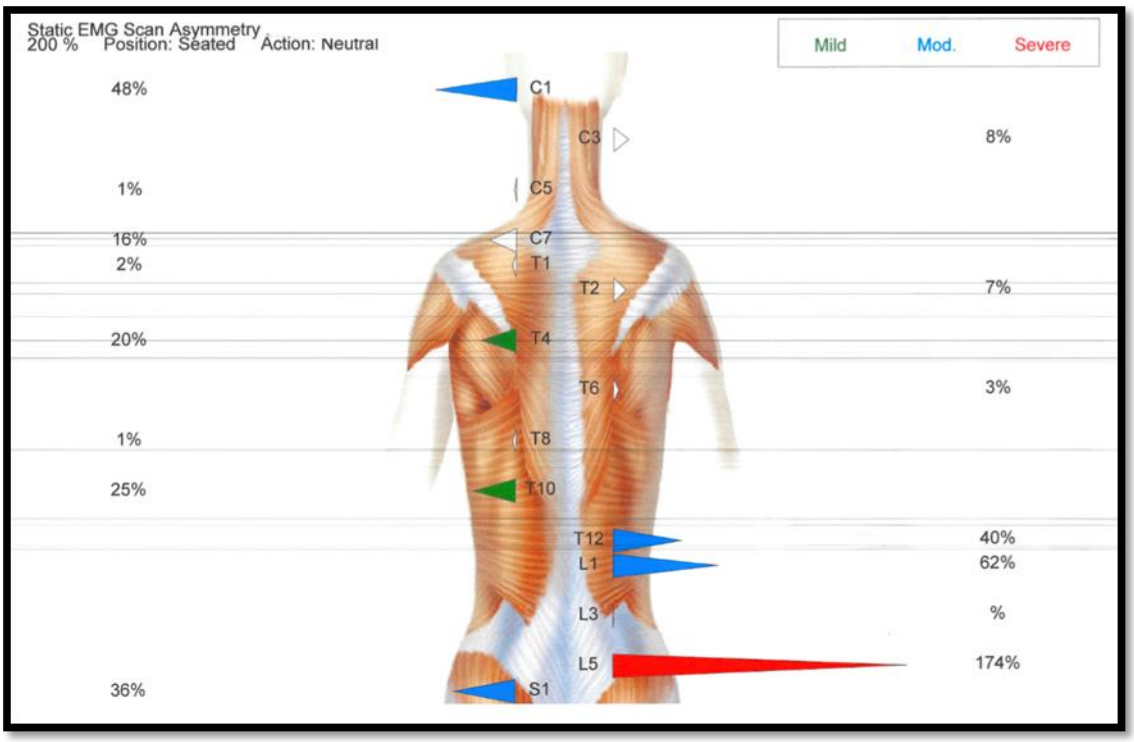

Figure 6. sEMG scan re-examination on the 25th patient visit, 2 months and 11 days from the initiation of chiropractic care