Orthospinology Upper Cervical

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In order to do justice to Dr. Eriksen's work I provide herein the unedited paper as provided to me by him. In this paper he summarises the orthogonal approach to upper cervical analysis, correction, puts forward some theories as to the casual mechanisms of ill health and provides a rich list of references for further reading. The evidence that 'specific' upper cervical chiropractic is effective in promoting wellness is compelling and widespread. You need only look for it.

POSITION PAPER FOR ORTHOGONALLY-BASED UPPER CERVICAL CHIROPRACTIC CARE

By Kirk Eriksen, D.C.

Definition

First, I would like to provide a definition for orthogonally-based upper cervical chiropractic care as follows: A method for analyzing and correcting the occipito-atlanto-axial subluxation complex. It is actually a series of steps in the total care of the patient and is therefore a chiropractic procedure and not simply a spinal adjusting technique. The procedure employs a method of X-ray analysis that quantifies the lateral and rotational misalignments between atlas and axis as well as atlas and occiput. The analytical procedure examines the spatial orientation of the atlas, the geometry of the articulating surfaces, and the misalignment configuration to arrive at an effective correction vector. In addition to the X-ray analysis, the system contains steps for ensuring the precision of the X-ray analysis, adjusting procedures, and post-adjustment re-evaluation procedures. These procedures allow the doctor to assess the effectiveness of the adjustment and, equally important, to fine-tune the adjustment to the individual patient. The adjustment can be administered manually or by using an adjusting instrument. The hand delivered adjustment involves a light contact and a shallow thrust. The contact point, the pisiform, usually travels less than 3/16" during the thrust. Many doctors utilize a hand-held solenoid-powered instrument to deliver a very quick and shallow thrust, or various forms of table-mounted instruments.

Anatomy/Biomechanics

A thorough understanding of the anatomy, biomechanics and neurophysiology of the upper cervical spine is a prerequisite to be able to appreciate the clinical manifestations of the occipito-atlanto-axial subluxation complex. White and Panjabi describe the upper cervical articulations as *"…the most complex joints of the axial skeleton, both anatomically and kinematically."*[1] The two upper cervical vertebrae differ in shape and function from the remainder of the spine. The configuration of the atlanto(C1) and axial(C2) joints, enables these structures to carry the head and determine its movement. These articulations also provide protection for the intimate neurologic and vascular structures. The atlas and axis are two of the nine atypical vertebrae. The atlas articulation is diarthrodial and is the most freely movable segment in the spine, in relation to C1-C2 rotation and C0-C1 flexion/extension. The occipito(C0)-C1 articulation consists of reciprocally curved superior facets of the lateral masses of the atlas and the ellipsoid synovial joints of the occipital condyles. This articulation allows for primarily flexion-extension motion, with very little rotation or lateral flexion. The atlas vertebra has a condyloid articulation with the axis that allows for 45-50% of rotation in the cervical spine, but the consensus of the studies show that little motion occurs between the atlas and occiput. The small amount of movement

that does occur is found at the end point of the range of motion. This is a critical point when discussion is made about the misalignment component of the subluxation.

Neurology

The neurological dysfunction related to the upper cervical subluxation can be explained by a few different mechanisms. However, it is likely that these mechanisms manifest concurrently in many patients. The two most plausible hypotheses have to do with spinal cord tension and mechanoreceptive dysafferentation. The upper cervical spinal cord is directly attached to the circumference of the foramen magnum, to the second and third cervical vertebrae and by fibrous slips to the posterior longitudinal ligament.[2] Hinson[3], Grostic[4] and others discuss dissection evidence showing a dural attachment at the atlas level. The uppermost denticulate ligaments are arranged almost horizontally, as compared to the inferiorly angled ligaments found around the rest of spinal cord. The most cephalad ligaments are also thicker and stronger to help anchor the spinal cord around the foramen magnum. These ligaments are so strong that they have been found to sever the upper cervical spinal cord in some cases of hydrocephalus.[5] Recent studies have also revealed a connective tissue bridge between the rectus capitis posterior minor muscle and the dura mater of the upper cervical spinal cord.[6] A similar attachment has also been found to the spinal cord via the ligamentum nuchae.[7] The spinal dura mater has been found to be innervated and a possible source of pain and neurological dysfunction.[8,9] These anatomical facts, as well as the biomechanical descriptions covered previously, reveal that the upper cervical spine is quite susceptible to injury and/or the entity called *subluxation*. The upper cervical spine has sacrificed stability for mobility as evidenced by ~50% of cervical rotation occurring between the atlanto-axial articulation. Grostic's paper, *The Dentate Ligament—Cord Distortion Hypothesis*[4], provides a compelling hypothesis for how these anatomical connections can lead to spinal cord distortion, in the presence of upper cervical misalignment. It is posited that the neurological dysfunction can occur via two mechanisms: 1) direct mechanical irritation of the nerves of the spinal cord, and/or 2) collapse of the small veins of the cord, producing venular congestion with a loss of nutrients necessary to carry on the high energy reactions necessary for nerve conduction. Spinal cord tension can affect the spinocerebellar tracts which can result in a functional short leg.

Afferent/efferent joint mechanoreceptive neurology also has interesting implications in this area of the spine. Mechanoreceptive innervation has been found in the cervical facet joints, ligaments, intervertebral discs.[10-13] The muscle spindle may be the most important proprioceptive receptor in the upper cervical spine. The spindles are intrafusal fibers that are imbedded within all muscles of the body; however, they are extremely dense in the suboccipital muscles.[14-20] The human experience is governed by receptors of all types. Cerebral cortical firing initiates efferent activity. However, the thalamus regulates the cerebral cortex through summation and integration. Another key point is that all sensory information goes through the thalamus (except aspects of olfaction).[21] It is apparent how these two functions are vitally important for neurological integrity and appropriate cortical representation. Mechanoreception is the primary input into the cerebellum due to life in a gravity environment. The primary load to the thalamus is via the cerebellum due to the vast amount of afferent input required to maintain upright posture. It is plausible to theorize that stimulating or regulating mechanoreceptors can have a significant impact on the neurological activity of the brain and many bodily functions.

It appears that the cervical spine has more mechanoreceptors per surface area than any other region of the spinal column.[22] It is thought that the upper cervical articulations have the greatest amount or receptors in the cervical spine. This may give the region the greatest potential for spinal mechanoreceptive afferentation into the neuraxis. There is also evidence suggesting that the upper cervical afferents feed directly into the vestibular and other high order nuclei.[23-32] This enables a less modified input of information from the upper cervical articulations into the brain stem nuclei, as opposed to the lower segments of the spine. Inappropriate afferentation (i.e. subluxation) and appropriate input (subluxation correction) into the vestibular nuclei is yet another plausible explanation for the functional short leg/pelvic distortion that is observed

clinically with patients under upper cervical chiropractic care. This can occur by way of upper cervical mechanoreceptive functional integrity through the anterior and posterior spinal cerebellar tracts, cerebellum, vestibular nuclei, descending medial longitudinal fasciculus (medial and lateral vestibular spinal tracts), regulatory anterior horn cell pathway which affects postural motor tone.

X-ray Assessment

The X-ray analysis is the real core of upper cervical procedures. Because the radiological assessment is so important, early developers, such as Dr. John Francis Grostic, felt that chiropractors should always lead the way in X-ray quality and patient safety. He was the first in the profession to advocate and teach doctors the use of aligned X-ray equipment. He collaborated with Travis Utterback to help develop self-centering head clamps, the X-ray turn-table chair and "L-Frame" apparatus. Many X-ray equipment setups (such as my own) are installed with the utilization of laser alignment to ensure precision. The issue of X-ray safety is addressed with the utilization of lead filters, high film/screen speed combinations, shielding and high kVp technique by many doctors who utilize upper cervical procedures. The use of lead filters has been shown to reduce radiation to the patient by as much as 80-90%.[33-34] Increasing film screen speed from 250 to 800 can also reduce the milliamperage per second (mas) setting by almost 70%, while not sacrificing image quality to any clinical significance.[35]

The radiological assessment provides a quantitative analysis as opposed to only qualitative information. This makes it possible to determine if the care is actually reducing the subluxation, or if it is just moving the structures around with no net correction. Thus, quantification of the misalignment provides a means of evaluating the effectiveness of the adjustment. Orthogonally-based procedures utilize several measurements from the X-rays to calculate the correction vector used in the adjustment. The films are analyzed with manual template analysis and/or computer-aided digitization. By using this information, the goal is to compute a correction vector which will reduce all of the misalignment factors proportionately. In essence, the Procedure enables the doctor to provide a "tailor-made" adjustment.

It should be noted that the upper cervical X-ray analysis involves angular measurements of the atlas in the frontal (Z), sagittal (X) and transverse (Y) planes. Angular measurements in degrees are utilized, as this analysis is less prone to magnification errors in comparison to linear measurements. Inter- and intra-examiner reliability in the marking and reading of the films has been demonstrated and reveals error of only $<.6^{o}$ and $<.5^{o}$, respectively.[36-39] Rochester and Owens have studied the issue of patient placement and the potential distortion errors that can take place in the measurement of upper cervical X-rays.[40] Patient-to-film error can occur if head rotation is present when the film is taken. According to their study, the distortion is insignificant in most all cases seen in clinical practice. The study involved the development of a computerized algorithm, with the utilization of a three-dimensional computerized model of the cervical spine and head, as well as the measurement of X-rays from a clinical practice. Other potential errors include human measurement that can occur when the doctor draws lines on the X-rays and measures the deviations. He/she could either measure or record it incorrectly. This potential error has been greatly decreased with the development of computerized digitization programs. The previous reliability study by Rochester tested the DOC! program and revealed that it was as good as, if not superior to, manual analysis.

<u>Post X-ray Assessment</u>

Two large studies (n=458[41] and n=200[42]) found that in these orthogonally-based practices, the more the subluxation was reduced, the better the patient outcome. The study by Eriksen and Owens determined this by measuring patient rating of symptoms as well as number of visits and adjustments necessary. This study concluded that post X-ray assessment was recommended to ascertain that at least 50% correction was achieved after the initial adjustment. Post X-ray assessment is also important to determine if an errant adjustment occurs; and provides

information for the doctor to make the appropriate correction(s) for future adjustments. A series of case studies have been published which found that significant errors in upper cervical adjusting caused temporary iatrogenic symptomatic reactions in unsuspecting patients.[43] This is an important finding since many believe that the upper cervical adjustment is innocuous since very little force, if any, is actually felt by the patient. This type of adjustment is too gentle to "injure" the patient, but osseous structure is realigned and the central nervous system is affected in the process. The "seasoned" doctor understands that the true tragedy is not correcting the subluxation so the patient can experience neurological integrity, as opposed to temporarily increasing the misalignment. A single reported case revealed a patient's upper cervical subluxation being reduced significantly after a NUCCA upper cervical adjustment.[44] The patient was then sent to a practitioner who utilized diversified/ Maitland manipulation. The patient was once again X-rayed, which revealed that the misalignments had increased more than the original subluxation. Fortunately, the patient was re-adjusted by the NUCCA doctor and the subluxation was reduced once again.

Studies have revealed that the radiographic measurement of misalignment between the occiput and atlas is not affected when the head is placed, up to a certain degree, in off-centered positions.[45-47] However, this does not indicate that X-ray placement is not important, as it can cause errors in other measurement parameters. A study by Jackson et al.[48] involved 38 subjects who had two sets of anterior to posterior nasium and lateral cervical radiographs. The second set of X-rays was taken from one-half to four hours after the initial set. No chiropractic adjustment was administered between radiographs, although a simulated adjustment was conducted. The analyzed data revealed a reliability measurement of one-half degree for the upper angle and two-thirds of a degree for the lower angle. This study helps to further establish that the upper cervical misalignments that are measured on precision X-rays are static and that post adjustment radiography is a valid outcome assessment. One study has shown that barring trauma, an upper cervical misalignment pattern in a patient with signs of subluxation tends to be static (although the magnitude of the misalignment tends to decrease over time when the patient becomes subluxated).[49] In other words, the upper cervical spine does not move around freely finding a new position each time the patient is radiographed. It appears that the reduction of the misalignment post adjustment is due to something other than patient placement. These reasons, taken together, explain why upper cervical protocol calls for X-ray assessment of misalignment factors in an occipito-atlanto-axial subluxation.

Postural Distortion

Upper cervical subluxations manifest clinically in various forms of postural distortion (i.e. functional leg length inequality, pelvic distortion, head and shoulder tilt, head translation, unequal weight distribution, etc.). The functional leg check is an outcome assessment utilized by most all upper cervical doctors on a visit-by-visit basis. It is my opinion that *functional pelvic distortion* (FPD) is a more accurate term; for what the doctor is actually measuring is muscle tone and resultant pelvic imbalance, instead of only leg length. Functional pelvic distortion contrasts with anisomelia, which is an anatomical short leg. Leg length inequality (LLI) often has a different significance to various physicians. For some, this condition is thought to have no importance until the inequality is ½" or greater.[50] To the other extreme, many authors feel that a difference of just a few millimeters is significant for various musculoskeletal complaints.[51-59] LLI has been related to lower back pain[60-68], disc/joint degeneration[54,60,65,69-75], an increased susceptibility to sports injuries and potential improved performance[71,76-84], an association with scoliosis[58,69,74,75,85-93], and its effect on bilateral weight deviation.[94-99] Preliminary data have been published showing very high intra- and inter-reliability for the supine leg check assessment.[100] Moderate reliability has been assessed for the prone leg check.[101-103] Pilot studies on pre- and post-assessment of FPD after an upper cervical adjustment have been conducted[104-106,] with larger validity studies planned for the future.

A blinded single case study did show a statistically significant correlation between an objective measure and the FPD test for when an adjustment was indicated.[107] Another case study involved atlanto-occipital intra-articular injection that moderated postural distortion.[108] Another study also revealed postural changes occurring in subjects after undergoing upper cervical care.[109] Two studies have shown statistically significant changes in right and left weight bearing pre- and post- upper cervical adjustment.[95,96] In addition, there are reports of relief of low back and leg pain[110-127], knee pain[128] and idiopathic scoliosis[129,1130] with the utilization of upper cervical specific care. This implies, but does not prove, a causal link between global postural distortion and upper cervical chiropractic care.

Outcome Assessments

Other outcome assessments that have been studied in clinical and research settings with specific upper cervical chiropractic care include the following: thermocouple scanning[131-134], surface electromyography[105,106,135], somatosensory evoked potentials[136-141], static palpation[142-144] and range of motion.[145] Palpatory and other methods of determining upper cervical misalignments and asymmetry have not been shown to be reliable.[143,144,146,147] There is also research that reveals how non-radiographic methods of determining upper cervical subluxation listings have poor concordance when compared to X-ray analysis.[146,148] The motion of the upper cervical spine is quite complicated, capable of excursion into the *x*, *y* and *z* planes. The X-ray procedure provides the information for the appropriate direction or vector to adjust the patient.

Studies on Patient Efficacy

Orthogonally-based upper cervical care is not a treatment for conditions or diseases, however, this subluxation-centered care has been shown to have an associative effect on various conditions. The following is a review of the peer-reviewed literature that shows a documented correlation between orthogonally-based care (Grostic/ Orthospinology, NUCCA and Atlas Orthogonality) and the improvement of various patient complaints. Studies have been published showing positive outcome for patients with cervical curve distortion[153,154], neck pain[155-1156], cervicobrachialgia[157,158], motor vehicle trauma[159], headaches[160-161], low back pain[110-116], scoliosis[129], postural distortion[95,96,108], knee pain[128], general health enhancement[158-160], cerebral palsy[161], autism[162], Tourette's syndrome[163], seizure disorders[164], mental dysfunction[165], multiple sclerosis[166], Arnold-Chiari malformation[167], HIV[168], cystic hygroma[169], asthma[170], bowel dysfunction[171-172] and hypertension.[173-174] The previous papers involve various levels of scientific evidence which range from case studies to randomized controlled clinical trials.

Conclusion

This paper has provided a compelling and cogent argument for the clinical and scientific efficacy of orthogonally-based upper cervical chiropractic care. There is a logical chain of arguments that support specific upper cervical work. This chain is supported by some evidence at each link, with the evidence for some aspects being stronger than others. Given the anatomical, biomechanical and neurological complexity of the upper cervical spine, specific upper cervical work is an appropriate approach to adjust the upper cervical subluxation.

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