A Brief History of the Modus Operandi of Measuring and Correcting The Atlas Subluxation Complex Syndrome and The Role of Posture in The National Upper Cervical Chiropractic Association (NUCCA) Standard of Care

By

Jim Palmer, Professor of Physics @University of Toledo and Kevin Creswell, NUCCA Doctor of Chiropractic @ Edmonton, Canada

Abstract: The case is presented for the historical importance of the C-1 joint in the development of early chiropractic and the difficulties that have been overcome by Grostic-Gregory and more recently by Gregory (NUCCA) in developing a rigorous, repeatable, consistent analysis system used both before and after intervention with the result being the elimination of the observable and measurable signs of the Atlas Subluxation Complex. Measurement of the success of intervention is evidenced by postural changes, by changes between pre and post X-ray measurements, and by an improvement in medically diagnosed health problems and associated signs and symptoms.

Key words: posture, upper cervical, Atlas Subluxation Complex Syndrome, Atlas Subluxation Complex (ASC), contractured leg or LLI; C-1 joint, Anatometer, basic types, biomechanics, atlas laterality, atlas rotation, and normal cervical biomechanical relationship.

POSTURE AND ITS MEASUREMENT: A BRIEF HISTORY

Posture is the position or carriage of the body and limbs as a whole and is a manifestation of the degree of biomechanical balance and positional symmetry in an individual and is an interrelationship between muscle and skeletal tissue of the body. R. Hruska describes posture thusly:

Posture is a reflection of the 'position' of many systems that are regulated, determined and created through limited functional patterns. These patterns reflect our ability and inability to breathe, rotate, and rest, symmetrically with the left and right hemispheres of our axial structure. Function (movement) is … limited because soft tissue and osseous restrictions prevent one from using muscles and joints beyond their normal (design) range. Adaptation and compensation for these limitations require neuromotor encoding and hyperactivity of muscle…(with) compensatory activity and hyperactivity usually (becoming) dysnchronous in the accessory muscles of respiration and at the appendicular flexors and axial extensors, thus limiting functional rotation at the trunk and through the lumbo-pelvic-femoral and cranial-mandibular-cervical complex.[1]

Investigations of upright or load-bearing posture have ranged from the highly subjective visual grading to the more objective methods utilizing photographs, bilateral and four-quadrant weight scales, Anatometer I, II, and II plus, X-rays, electromyography, and moiré topography. Defining "good" posture and determining how "good" posture should be measured has seen little agreement among authorities. This point was made clear in a review by W.W. Massey in which he stated:

In the literature related to standards of "good" posture, there were many definitions describing the correct upright position. Authorities emphasized segmental alignment, pelvic inclination, carriage of the head and neck, the distribution of the weight of the feet, the curves of the spine, abdominal protuberance, the position of the chest, and the center of gravity in the trunk. When considered collectively, there seemed to be general agreement in the choice of criteria used to describe the conditions for "good" posture. **[2]**

Early (1909) research by Reynolds and Lovett determined the line of gravity of the erect body and related this line to the A-P spinal profile as determined by a spinal "conformateur."[3] In 1935 MacEwan correlated subjective ratings with various body measurements taken from photographs and by 1939 Hellebrandt and Braun had measured shifts of the center of foot pressure in both the sagittal (A-P) and frontal (lateral) planes. [4, 5] In 1959 Thomas and Whitney utilized a force analysis platform and accelerometer to relate center of foot pressure shifts with center of gravity deviations during normal standing.[6] Electromyographic measurements of postural muscles illustrating both static and dynamic aspects of erect posture were done by Joseph and Nightingale, Floyd and Silver, Nachemson , and Klausen and Rasmussen. [7-10] In 1971 R. R. Gregory, founder of NUCCA (1966), in conjunction with D. Seemann and P. Benesh, developed a prototype Anatometer to " provide objective leg-disparity data that could be correlated with postural, pelvic-distortion data while a

patient was standing vertically in a load-bearing position". [11] Also in 1971 Stevens and Tomlinson used displacement transducers to measure postural sway. [12] In 2004 M. Dickholtz, Sr., a NUCCA certified doctor, presented at the spring NUCCA seminar results of his efforts to simultaneously make both frontal plane tilt and transverse plane rotations of both shoulders and pelvis visible to patients by use of an optical-lever, laser- light system. Digital pre and post-adjustment photographs are taken and stored in patient files. Research is being done at the Medical University of Ohio located in Toledo, Ohio, under the direction of Dr. Vijay Goel, chairman of the University of Toledo's Department of Bioengineering, to determine relationships between Anatometer II plus measurements and state of the art postural measurement equipment recently designed at the University of Toledo.

<u>POSTURE AND WELLNESS</u>

Kinesiologists have long been aware that postural problems are compounded by and correlated with less efficient locomotion. Sports fans have always marveled at the "fluid" and seemingly effortless motions of the very best athletes. But what is the relationship between posture and wellness? In a 1945 paper on body mechanics and posture, K. G. Hansson stated:

The medical profession was slow in accepting poor posture and poor health as one of cause and effect .In 1740 Nicholas Audry taught that many illnesses in children had their origin in imperfect body mechanics. …All surveys of posture in our primary schools show less illness, as proved by absences among children taught good body mechanics. **[13]**

Dickson credits Goldthwait, in speaking of posture and activity as saying:

To stand erect and walk and move easily, to have all parts of the body so adjusted that easy balance and graceful use may result, is to be desired for more important reasons than the esthetic. Such elements are necessary for perfect health and that we may use the body with least friction, the least expenditure of energy and with the greatest efficiency. **[14]**

It is worth noting that Goldthwait's statement is essentially equivalent to S. Gracovetsky's "objective function" model hypothesis that "expresses the idea that tasks are executed in such a way as to minimize and equalize the stress at each joint.'' If Gracovetsky's hypothesis is valid, then "the analysis of any task will reveal whether or not the subject is executing that task with minimum and equal stress." [15] Standing erect is such a task. Poor posture resulting from misalignment of C-1 requires compensatory movements by other parts of the body to maintain balance; thus energy is expended to counteract the effects of gravity.

M. Forrester-Brown (1935) states that " good posture is fundamental to health and to efficiency in every walk of life…(and) that the chief single factor in maintaining good posture is the tone of the abdominable muscles (which) balance the back muscles of the spine." [16] Although correlation between posture and wellness has long been noticed both in the chiropractic and in the medical profession, the advent of CAT and

MRI scans, and the almost two dozen other types of scans has resulted in much less emphasis on posture in the medical profession, the major exception being scoliosis. Goldthwait (1915) hypothesized that in an anatomic and mechanistic conception of disease nearly all of the chronic conditions have an orthopedic facet to their solution. [17] Cochrane, who was associated with Goldthwait's clinic for nearly two years, explains Goldthwait's study as follows:

The hypothesis of the study was that many of the manifestations of chronic disease and ill health are due to the lack of the right elements of metabolism, or to absorption of the wrong elements of deranged metabolism, resulting directly or indirectly, from faulty function of the viscera due to improper use of the body in respect of posture. Such incorrect posture acts fundamentally by invalidating the normal support of the viscera. Many of the chronic conditions requiring treatment represent a derangement of the mechanism which regulates and maintains the proper and correct posture of the body. **[18]**

In 1917 Brown carried out a combined medical and postural examination of 746 Harvard students. Brown found that students having poor posture had seven times as many backaches as those having good posture. [19] In a 1921 paper on the effect of posture on the health of the child, Dickson gave the following conditions that he associated with poor posture: foot, knee, and leg ache, nervousness and irritability, fatigue and failure to gain weight, restlessness at night, and even constipation and gastrointestinal disturbances. [14] Cochrane stated that arthritis and gastrointestinal disturbances yielded to postural correction and concluded: "Problems relating to man's posture have a direct bearing on medical and surgical practice". [18] In a 1922 paper that appeared in <u>Lancet</u>, Thompson listed a number of conditions that may be "cured" through correction of poor posture. [20] In a 1932 paper, J.R. Garner suggested that good posture minimizes fatigue while building resistance to infections. [21] Affecting posture, however, in both a meaningful and predictive way has been elusive for health care professionals in all fields of practice. There is a long history of trying to relate x-ray measurements with postural measurements and postural and x-ray measurements with medically diagnosable "health" problems or a relief of disease signs and symptoms. Seaman and Troyanovich discussed this issue in a January 2000 article. [22] Having delineated a myriad of problems associated with poor posture, they ask; "What is our standard chiropractic approach for addressing poor posture? Unfortunately there isn't one that is universally taught in our chiropractic institutions." Continuing they state: "Unfortunately, there is little evidence to suggest that adjustments of any kind will substantially influence a patient's postural alignment. This leaves chiropractic between the proverbial rock and a hard place. We know posture is an important factor in health, but we have no real effective tools in our standard chiropractic arsenal to address the problem". [22]

<u>POSTURE AND NUCCA</u>

It is the experience of upper cervical chiropractors (2-3% of all chiropractors) in general and NUCCA practitioners in particular that there is no anatomical region of the human body that is so commonly a first cause of postural problems as the upper cervical spine. Specifically this first cause is itself often the effect of injury from trauma, surgery, applied mechanical forces, or even age itself. This site of injury can be at any location; either above, at, or below C-1. The C-1 joint, composed of C0-C1-C2, is the focus of upper cervical work. It is well known that at no other location in the spine are the joint mechanoreceptors as dense, motion so allowed, and structures below and probably above so dependent. [23-26] NUCCA's forte, even among the other upper cervical specific groups, has been to deal directly with postural imbalance. Indications when to and when not to intervene are dependent upon postural measurements. The direction of vectored manipulation, the how to intervene, is dependant on X-ray analysis and an understanding of biomechanics and patient abnormalities.

The National Upper Cervical Chiropractic Research Association (NUCCRA), NUCCA's research branch, has dealt with measurement and analysis of postural imbalance due to a disarrangement of the upper cervical spine since 1971. [27] Measurement on X-rays of the disarrangement of C-1 is correlated to postural imbalance which is determined by measuring the existence of a physiological or apparent leg length differential on a patient while the patient is in a supine position. In all cases, patients that have X-rays presenting at least three-quarter of a degree or more of atlas laterality have a measurable leg length differential or contractured leg. [28] In a landmark article in The Upper Cervical Monograph, A. Berti , using a chart-reading thermocouple instrument called the Analgraph, found a direct relationship between incremental deviations on the graph and apparent leg length differential. For each one-increment deviation on the graph there was $1/8^{th}$ of an inch leg length differential.[29] There is agreement in the literature that a $3/8^{th}$ of an inch or more of a contractured leg is positively correlated with a C-1 subluxation . [30]

The hypothesis for the existence of a contractured leg is that it is the result of the imbalance between the facilitatory and inhibitory neurological mechanisms in the brain stem resulting in spastic contracture of the extensor muscles. H.W. Magoun states that the central reticular formation of the brain stem exerts ascending and descending influences upon the cerebral cortex and upon the motor outflows from the spinal cord. The more cephalic of these connections facilitates spinal motor discharge while the more caudal region exerts an inhibitory action, and the imbalance in these extra-pyramidal motor connections is thought to be responsible for spasticity in which condition inhibitory influences are no longer active while the facilitatory connections, being unopposed, exert an augmented effect. [31] In a speech given at the Palmer College of Chiropractic in 1977, R.R. Gregory states

If this (Magoun) is true, and NUCCRA research has verified it, then the appearance of spastic contracture in the skeletal musculature should be accompanied by imbalance between the inhibitory and facilitatory mechanisms of the brain stem. What would cause

such imbalance from a subluxation standpoint? The only answer to this question is: tractionization of the brain stem by a C-1 subluxation. We found that both lateral and longitudinal tractionization could be demonstrated to exist. That is, the contents of the cervical canal could be stretched by a C-1 subluxation and the displacements or misalignments of the subjacent cervical vertebrae as they deviated into the frontal and transverse planes of motion from the vertical axis of the body. Such tractionization could exist upward into the brain stem, producing imbalance between the two neurological mechanisms or motor connections. As inhibitory control was reduced to the skeletal muscles, spastic contracture resulted from a C-1 subluxation which in turn distorted the spinal column. If a C-1 subluxation is capable of causing tractionization that would produce imbalance within the CNS, a correlation should exist between C-1 subluxations and the distortions in the body produced by the spastic contracture resulting from C-1 tractionization effects on the neurological mechanisms. We have found that without exception such correlations do in fact exist. When, for example, a transverse rotation of the pelvis exists in a patient a corresponding misalignment factor in the patient's atlas subluxation exists controlling that body distortion. It may be found that atlas laterality causes pelvic rotation in some cases; in others it may be established that abnormal excursion of the pelvis into the frontal plane is the result of atlas rotation. This fact should point up to you the great importance of accurately analyzing films, the great importance of the misalignment factors, and the great importance of precise adjusting.[32]

Steindler in his 1955 **Kinesiology of the Human Body Under Normal and Pathological Conditions** *defines spastic contracture as 'the cessation of the functions of inhibitions which normally regulate muscle tone.'[33] Thus one sees spastic contracture when an imbalance exists between the neurological mechanisms in the brain stem because the inhibitory and regulatory control to the skeletal musculature is reduced by the atlas subluxation. Steindler's definition is collateral with Magoun's explanation in that imbalance between the facilitatory and inhibitory mechanisms causes cessation in full or in part of the inhibitory influences from the brain stem that regulate muscle tone. C-1 is located at the caudal end of the brain stem; therefore it is logically in that position that would permit, when misaligned, of interference with the normal function of inhibitory influence on the skeletal musculature, causing over-innervation of the motor units of the spinal cord and resulting in bodily distortions, malalignments of the spinal column from its true vertical axis. Steindler, in his Theory of Contractures, states that over-innervation of the motor units of the spinal cord, due to the existing imbalance between these two brain stem motor mechanisms, constitutes the pathology- the pathological element. Thus, the C-1 subluxation has an established pathological element which is over-innervation. As the only way that over-innervation can be removed from the motor units chiropractically is by maximal correction of the atlas subluxation, any so-called adjustment of any vertebral segment below atlas fails to be an adjustment because it cannot correct over-innervation, the pathological element of the subluxation. [32]*

The historical NUCCA/NUCCRA position is that the C-1 subluxation is totally responsible for spastic contracture of the musculature, distortion of the spinal column from its true vertical axis, pelvic misalignment into the transverse and frontal planes of motion and therefore displacement of the pelvic center of gravity, distortion of the

effect of the gravitational forces of the body, the contractured leg, and that the atlas subluxation is a physical stressor; a C-1 subluxation is the primary and controlling subluxation and thus the most damaging and far -reaching subluxation in the spine. The cause of over-innervation is not at the neurological level of the suspected vertebra but at the level of the foramen magnum. It should be noted that R.R.Gregory intentionally left a reasonable degree of latitude in the possible etiology of the C-1 subluxation, realizing that many years would probably pass before research in the scientific community would explain the neurophysiology. It should be noted that Gregory was well aware of research by A. Brieg.[34, 35]

Recent research by M. D'Attilio et.al., suggests that C-1 tilt can be induced superior to the atlas by dental occlusion; in this research 100 percent of the test group (N=15) that "wore an occlusal bite pad…on the maxillary right first molar" developed a scoliotic curve. According to the authors, "the scoliotic curvature observed in our sample was probably related to the consequential tilt of the first cervical vertebra(C-1)(probably atlas laterality) which affects the tilt of adjacent vertebra, destabilizing the vertical alignment of the spine."[36] A review article by Korbmacher et. al., states that "The literature is consistent in reporting a high prevalence of pathologic orthopedic findings with an orthodontic treatment need." and further states that "The high prevalence of orthodontic findings in patients with deformities of the cervical spine reported unanimously in the literature suggests interactions between the disciplines of orthodontics and orthopedics."[37] NUCCA 's position would be to substitute "upper cervical specific" groups which includes NUCCA, Orthospinology, and Atlas Orthogonal for orthopedics. NUCCA practitioners in general appear to have a more rigorous system with more pervasive and refined posture measurements, more meticulous X-ray procedures, and consistently better corrections as evidenced by its certification process and standards.

POSTURE AND ITS MEASUREMENT BY NUCCA

The key clinical research instrument relating standing body posture in 3-dimensions to X-ray findings has been the Anatometer. The Anatometer was designed and built to test the hypothesis that the contractured leg (usually referred to as LLI or high or short leg) is not caused by an isolated pelvic distortion alone but rather by disarrangement of the C-1 joint. [38] Use of the Anatometer II and II plus yields measurements of standing pelvic angular displacements in both transverse and frontal planes, angular displacement of the "fixed" point (located at either T-1 or C-7) from the vertical, pelvic width, ilium height, and percent weight differential on the load bearing foot plates. [11] Early Anatometer studies found the following: "1. The pelvis posturally distorts into both the frontal and transverse planes when the patient has an atlas subluxation as determined by X-ray analysis. 2. As the X-ray measured atlas subluxation parameters are reduced, the Anatometer listings of the patient are also reduced. 3. When the subluxation listings (laterality, rotation, etc.) are reduced to zero the pelvic distortion eventually returns to zero in both the frontal and transverse planes."[39] These results led R.R. Gregory to state in April 1976: " The NUCCRA

research work accomplished over the last five years with the use of the (prototype) Anatometer as a data retrieval instrument has established the basic NUCCA hypothesis that C-1 subluxations can be responsible for neuromusculature problems which causes spastic contracture of skeletal muscles and resultantly, bodily distortions." [40] Norman Thomas (ICCMO), building upon C.S. Sherrington [41], has theorized that an ascending muscle reflex phenomenon accompanies the bodily distortion into the skull causing shift of the weight distribution of the temporal mandibular joints leading to dental malocclusion. Uncorrected, the potential for development of cranial mandibular dysfuncton (cranial mandibular disorders) increases. Clinical attempts to correct malocclusion in the ascending cranial mandibular disorder patient without realignment of the occiput/atlas/axis joint complex has limited the response of the patient to conservative dental procedures, including dental orthotics (splint therapy) (Ascending/Descending Cranial Mandibular Disorders).[42] Shoe heel lifts on the contractured leg side, although providing support of weight distribution at the foot, do not correct pelvic angulations.

The prototype Anatometer was capable of one significant measurement that later versions of the Anatometer did not have. The prototype had vertically moveable footpads. A significant observation was made with use of the movable footpads: A new patient could be placed on the Anatometer and the difference in vertical distance between the two footpads could be altered until the patient would balance in the transverse (horizontal) plane as measured with the "hip calipers". [43] This was found to be the end position resulting from the complete elimination of the C-1 disarrangement and of the Atlas Subluxation Complex Syndrome. Whatever imbalances were left in the frontal plane were due to other factors such as an anatomically short leg, true scoliosis, micro-fiber build up in muscles, and yet to be determined unknown problems such as malocclusion. Using foot lifts to compensate for the amount of imbalance in posture associated with C-1 joint disarrangement is considered unnecessary and potentially deleterious to the patient. Potential causative factors of postural imbalance originating above C-1 have not yet been considered by NUCCA. Clinical postural measurements always consist of a supine leg check to determine the side of the contractured leg and, when available, the set of Anatometer measurements or other postural measurements. Neurocalometers, neurocalographs, infrared units, or surface electromyography are often used in NUCCA practices to help in analysis.

A BRIEF HISTORY OF NUCCA MODUS OPERANDI

No one less than Hippocrates himself discussed that complex three-dimensional structure called the human spine. He wrote about supportive connective tissue, muscles, vertebrae, and discs. In a normal state vertebrae, discs, ligaments, and muscles work together to protect the spinal cord, provide flexibility, and transmit loads. Due to injury these structures undergo changes leading to disarrangement of the spinal column. Hippocrates noted disarrangement by writing about rotation of the spinouses and alteration in spinal curves in both frontal and transverse planes. He noticed, for

example, that "cases when the (spinal) curvature is below the diaphragm are sometimes complicated with affectations of the kidneys and parts about the bladder…" [44] Attempts to correct these perceived asymmetries have existed for millennia. Egyptians have "replaced" disarranged vertebrae for at least 3000 years and the Chinese for at least as long. [44] Chiropractic from its beginnings in the United States over a hundred years ago realized that structural and relational asymmetries were associated with structural "interferences" or positional disarrangements. By the mid 1930's the upper cervical area had become well identified as the major area of interference. Inability to consistently define and most importantly reduce or correct these "subluxations", meaning less than a luxation or dislocation, resulted in a growth in empirical trial and error efforts and a movement away from upper cervical specific as the primary "technique".

In 1941 John F. Grostic and Ralph R. Gregory began research into addressing problems in the upper cervical spine. Gregory reviewed The Atlas Specific by A.A. Wernsing which mentioned that the atlas could be seen to move laterally on the occipital condyles "as on the rim of the circle" [45]. Grostic realized that measurement of disarrangement could be measured in degrees! M. Thomas in <u>NUCCA Protocols and Perspectives</u> provides a simple description of the discovery process, part of which is the following:

"In order to measure angles, the entire idea of measurement in the spine had to be reconceived. Instead of measuring how one bone moved in relation to another bone, Grostic reasoned that a line passing through the vertebrae could represent the positions of the bones of the spine. The relationship between individual bones is then more easily realized by measuring the angles formed by these lines. The idea of attempting to measure how far one bone had moved over the top of, or underneath another bone (a segmental analysis) was being replaced with an analysis of how the structures moved together. Dr. Grostic soon realized, when examining the film of an AP view (called nasal cavity or A.P. view in the 1940's; now called a nasium view) of the head and neck, that he could pick out like-points on both sides of the skull and bisect them, creating a line that could be represented as the center of the skull in the frontal plane. This line came to be known as the "central skull line". Grostic also realized that the shadow of the superior articulating surfaces of the axis on the nasium view could be represented as part of the rim of a circle. Each of the cervical vertebrae could be seen to misalign in a direction determined by the displacement of this "axial circle". The atlas was seen to "sit" between these two "circles" On the nasium film, the atlas position could be represented as a line (tangent) between the two circles of (usually) different sizes. A line could also represent the direction of the disarrangement of the lower neck (or cervical spine). This was a mathematical relationship that could be understood. Force applied to the transverse process of the atlas could be raised or lowered to move the structures represented by the circles in such a way that the head and neck could be anatomically returned to a normal position in the midline. This midline represented the center of the neural canal. The "subluxation" was now measurable. Equally important, the effects of the adjustment were becoming measurable on the post X-ray .It was soon seen that the nasium X-ray view revealed lateral "side-slip" (atlas laterality) of the atlas up one side of the occipital condyles ("moving as if on the rim

of a circle") creating an acute angle when compared with the central skull line (angular measurement)."[44]

Additional measurements were taken on the nasium view. When combined with additional measurements from a vertex view, including a rotational measurement of the atlas (atlas rotation), and a lateral view, a three-dimensional clinical model could be visualized. Through empirical studies of thousands of cases, and with an accounting for anatomical asymmetries and abnormalities, a calculus from which a unique adjustment vector could be made for each individual case was developed. By 1946 the first class of "Grostic" was given in Ann Arbor, Michigan.

Gregory was able to independently develop or improve upon both the accuracy and precision of all levels of analysis of the "Grostic" system by .1) development of a double-pivot-point system in X-ray analysis (1962), 2) development of a more effective tricepts pull adjustment(1965), 3) establishment of a vertical axis as normal(1965), 4) realization of the rotation of the subjacent cervical vertebra due to axis spinous rotation and cervical spinal deviation from the vertical axis (angular rotation)(1968), 5) design of better film analytical instruments, 6) development of the predominant factor theory(1970), 7) design and development of the Anatometer which reduces the need for X-rays (1978), 8) classification of C-1 subluxations into basic types(1980), 9) realization that the occipital-atlanto-axial relationship is a lever system and the identification of this lever system (1981), 10) identification of the components of the lever system and their relationship inherent in an occipital-atlanto-axial subluxation(1981), 11) establishment of specific patient placement to fit the biomechanics of each of the four basic types(1981), and 12) realization of out-of-pattern basic types and their most common etiology – manipulation by others(1983).[46] These improvements resulted in a precision sufficient enough to show that actual changes had been made in lessening the disarrangement of C-1 as determined from X-ray analysis.[47]

NUCCA GLOSSARY OF TERMINOLOGY *

Atlas Subluxation Complex(ASC) **This term is a neologism intended to denote the far-reaching and damaging effects of the subluxated occipital-atlanto-axial area of the cervical spine upon the spinal column and the human organism. It differs in meaning from the commonly used chiropractic term "atlas subluxation" or "atlas-axis subluxation" in that the term Atlas Subluxation Complex embraces the demonstrable mechanical and neurological phenomena which, through research, have been found to be associated with subluxation of the occipital-atlanto-axial spine. The term includes the atlas vertebra in all its planes of misalignment, its positional relationship to the occiput, subjacent vertebrae and pelvis, inclusive of the excursions of the structures into any or all of the bodily orientation planes; resulting in, or capable of resulting in, concomitant detriment to the susceptive neurological components.**

Atlas Subluxation Complex Syndrome: **The term is limited in meaning to include only the observable and measurable signs of an Atlas**

Subluxation Complex. The Atlas Subluxation Complex Syndrome is the group of signs which are always present and measurable in proportion to the intensity of the Atlas Subluxation Complex. This group includes misalignment factors as shown by X-ray, resulting traction of the neurological component, presence of spastic contracture of the lumbar and pelvic musculature, distortion of the pelvic girdle, displacement of the body's center of gravity, contractured leg, and deviation of the spinal segments from the vertical axis of the body.

Neurological Component: This term includes that nerve structure which is deformed by traction, enfoldment, and/or compression resulting from the effects of the misalignment factors of the vertebrae, occiput, and pelvic girdle regardless of the location of the nerve structure: skull, spinal column, or that nerve structure emitting through foramina of the skull and/or spinal column.

Vertical Axis: The Vertical Axis is formed by the intersection of the frontal and sagittal planes of motion. It is perpendicular to the ground. In the "normal" spinal column the Vertical Axis passes through the center of gravity located in the pelvis at the point where all three planes of motion intersect. The pelvic girdle, occiput or skull, and/or any spinal vertebrae can be considered as normally positioned when aligned with the vertical axis and the parts proportionately influenced by gravitational stresses. Standard anatomical position is assumed.

Normal: The NUCCA procedure incorporates a system of measurement on X-rays that makes possible the location of the relative position of the atlas. When the relative position of the atlas is such that there is a removal of the Atlas Subluxation Complex Syndrome for the greatest period of time, the Atlas is then said to be in its "normal" position. On X-rays a "corrected atlas" is seen to be centered on or nearly on the determined vertical axis.

Atlas Laterality: A rotational abnormal movement of C1 about the condyles of occiput and about the sagittal axis of motion. Rotation is angular motion about an axis of motion.

Atlas Rotation: The abnormal excursion of the cervical spine and skull as a unit about the vertical axis of the body and into either the right or left frontal plane of the body, thereby producing gravitational stresses resulting in rotations of the vertebrae and tractionization of the contents of the spinal canal and nerve root.

- **Additional descriptive terminology can be found at: http://www.nucca.org/articles/bio_nucca_glossary.htm**

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