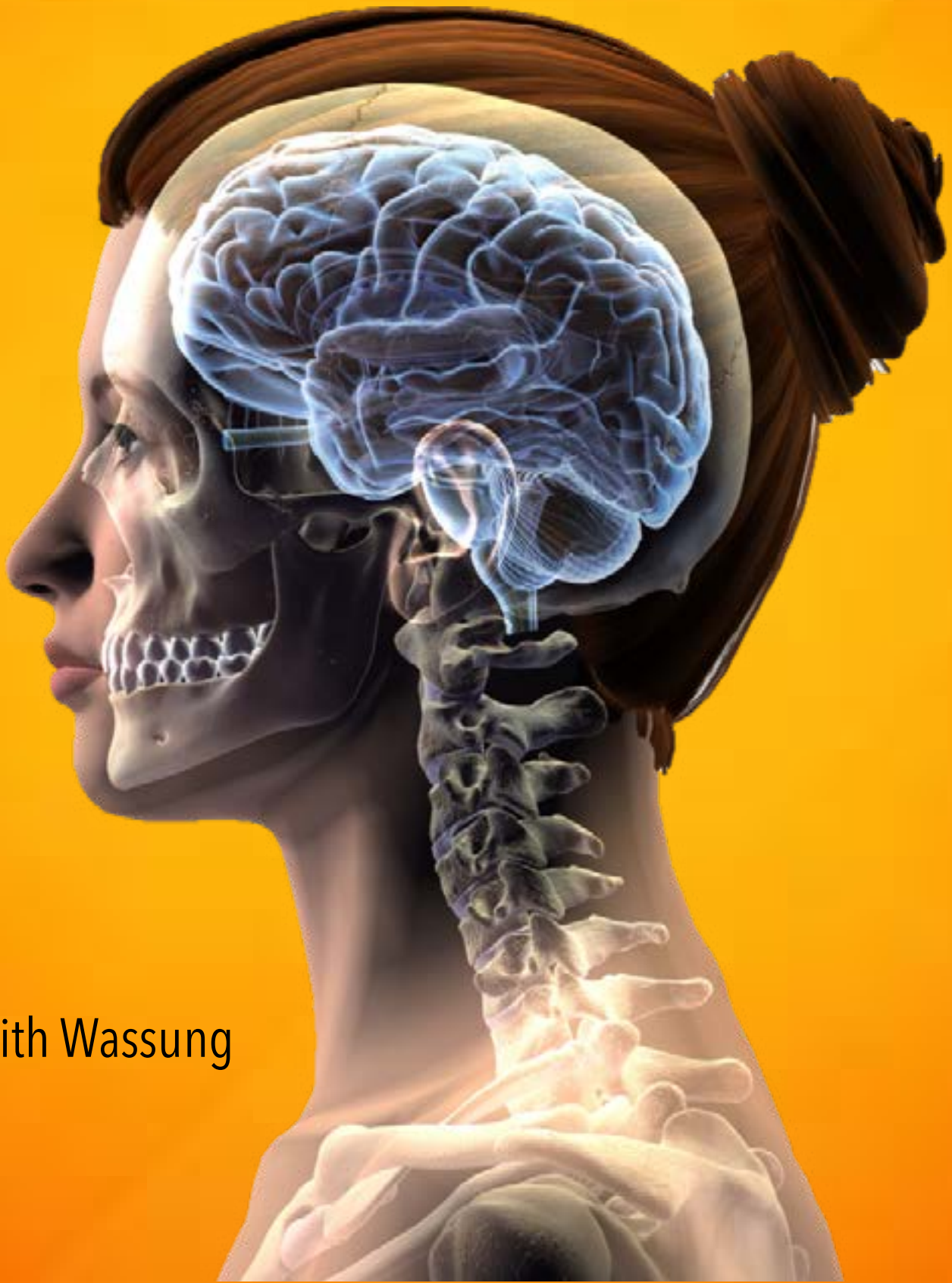
THE CERVICAL CURVE

STRUCTURE, FUNCTION AND OPTIMAL HEALTH



by Keith Wassung

INTRODUCTION

The neck of the human body is a bio-mechanical marvel. It possesses a wide range of mobility in nearly every direction. The neck serves as a conduit for the major blood vessels to the brain and is the primary pathway of the central nervous system. The cervical (neck) region is one of the most important areas of the body and a growing body of research clearly shows that its structural integrity and function are absolutely critical to overall health and healing.

The brain and the spinal cord make up the central nervous system. The spinal cord is often thought of as just a cable that transmits nerve messages, but it is actually a direct part of the brain. The spinal cord plays a crucial role in the health and homeostasis of the human body by sending and receiving billions of nerve messages every single second.

The Central Nervous System is so vital to overall health and functioning of the human body that it is protected by the hardest substance in the body, a series of vertebral bones that make up the spinal column.

The human vertebral column, or spinal column, is a highly versatile mechanism and displays all the rigidity, strength, and leverage required in the job of a crane. In contrast, it is extremely elastic and flexible. The vertebral column exhibits more varied functions than any other unit of the human body.

The small bones of the spine are called vertebrae and are designed to fit together in an S-shape. This column of curves is balanced so that the weight of the human body is evenly distributed throughout the spine. If these curves are out of balance, the vertebrae are pushed out of line, placing abnormal stress on the nerve pathways, muscles, and soft tissues of the spine.

When viewed from the side, the vertebral column shows four normal curves. The curves of the vertebral column are important because they increase its strength, help maintain balance in the upright position, absorb shock during walking and running, and help protect the spinal column from fracture.[1]

PRINCIPLES OF ANATOMY AND PHYSIOLOGY

The curves of the spine are important because they allow the spine to support more weight and to withstand more stress than if it were straight. This is because the curves increase resistance to axial compression — that is, head-to-toe squishing of the spine. That means ten times more weight can be supported by a curved spine than if it was straight.

Humans are born with a C-shaped spine and the spinal curves develop in resistance to different gravitational stresses that affect the body.

The first spinal curve to develop is the cervical curve and it develops as the baby learns to lift its head**.**

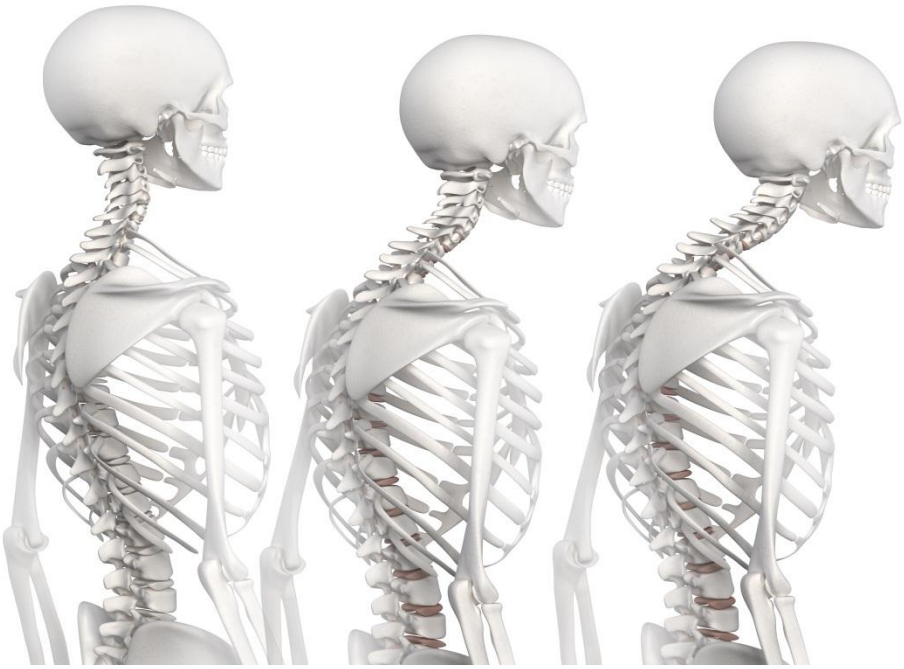
The cervical spine consist of 7 vertebrae -- the same in all mammals — from the tiny mouse to the long-necked giraffe. The cervical bones - the vertebrae - are smaller in size when compared to other spinal vertebrae.

The purpose of the cervical spine is to contain and protect the spinal cord, support the skull, and enable diverse head movement (e.g., rotate side to side, bend forward and backward).

Between each vertebra (with the exception of the space between C1 &C2) are springy discs of tough cartilage with a jellylike core that compress when under pressure to absorb shock. These discs are subjected to tremendous forces.

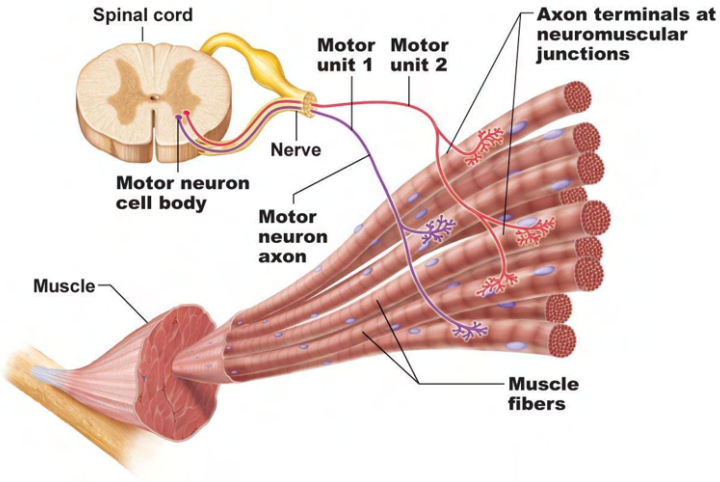
Strong ligaments and muscles surround the spine to stabilize the vertebrae and to control movement. The cervical spine has a unique structure that is related to its important biomechanical functions.

Head Support: The cervical spine supports the weight of the head, which weighs between 10-14 pounds — about the same as a bowling ball. With proper posture, the weight of the head is held directly above the center of gravity. In a forward head position, the head is held ahead of the center of gravity and results in a stress load on the cervical spine that is equivalent to the weight of the head multiplied by the number of inches the head is forward from the center.



Mobility: The spine is a dynamic structure; designed for movement in a wide variety of positions, including flexion, extension, lateral flexion, and rotation of the head. Specialized articulation between the occiput and the atlas (C1) allows for 50% of the flexion and extension of the neck. Specialized articulation between the atlas (C1) and axis (C2) allows for 50% of the rotation of the neck.

Protection and Transmission: The spinal cord and nerve roots are encased within the protective structure of the spinal column. Pairs of nerves exit in the intervertebral foramina (IVF). When the spine is in its optimal structure, the spinal cord and nerve roots are protected. Loss of this optimal spinal structure results in the interference of normal nerve transmission.



The human body contains millions of sensory receptors that supply input into the Central Nervous System (CNS) to allow it to control and coordinate all bodily functions.

Each receptor is sensitive to a form of physical energy — mechanical, thermal, chemical, and electromagnetic.

The receptors transform stimuli into electrochemical energy that the nerves use to supply sensory information into the CNS.

Encased within the joints of the body are different types of mechanoreceptors that enable our bodies to unconsciously monitor the exact position of our muscles, joints, and bones — a process called "proprioception."

Proprioception is our "body sense": If you have ever tried to walk after one of your legs "falls asleep," you will have some idea of the difficulty in coordinating muscular activity without proprioception.

Mechanoreceptor input into the CNS occurs at an optimum state when the biomechanical integrity of the spine is intact. Loss of spinal structure diminishes important sensory input into the CNS.

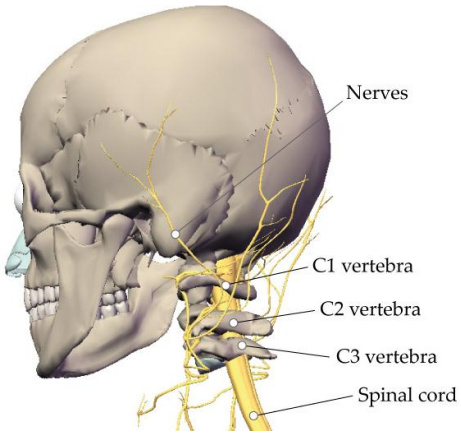
It is widely recognized that proprioceptive input from muscles, joints and other receptors is necessary for the accurate control of movement and posture. Loss of proprioception results in large systematic errors in multi-joint movements attributed, at least in part, to impaired motor programming. [2]

JOURNAL OF NEUROPHYSIOLOGY

OPTIMAL STRUCTURE OF THE CERVICAL SPINE

When discussing the human body, it is important to understand that the word “normal” applies to a condition that is optimum or ideal, rather than a condition which might be considered “average” for a large group of people.

The point is not to try and determine an exact ideal of what everyone’s body conforms to, but rather to use the laws and principles of physics, math, and neuroanatomy to determine a range of optimal normal values to which everyone can strive to achieve.



Health care is slowly changing from a symptom/disease-based system to a function/ performance-based system in which the structure of the human body is restored and maintained. Correction and maintenance of the structure of the spine, in particular the cervical spine, is of paramount importance in the pursuit of optimal health.

Gray’s Anatomy clearly shows how spinal muscles leave the greatest pivotal stress at C1 and C4-C5 to allow for the greatest strength and potential energy. This demonstrates that there must be lateral curves for peak performance.[3]

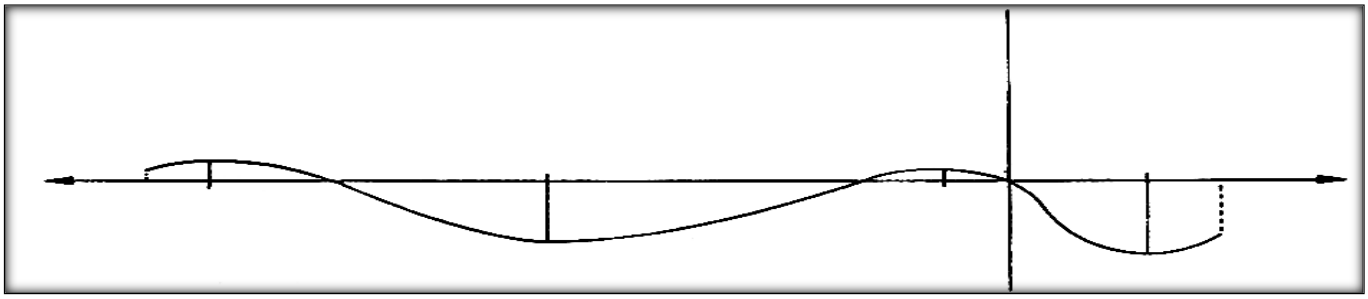
There is a mechanical basis for these normal anatomic curves; they give the spinal column increased flexibility and augmented, shock-absorbing capacity, while at the same time maintaining adequate stiffness and stability at the intervertebral joint level. [4]

CLINICAL BIOMECHANICS OF THE SPINE

"The normal curvatures of the spinal column lie in the plane of the sagittal suture. The curves absorb vertical forces in a spring-like fashion and this has shock-absorbing qualities. The ideal shape of the spine was elucidated by Killus(1976) with the help of computer analysis. Killus superimposed 150 measurements and with the help of further conversions, found the ideal spinal column." [5]

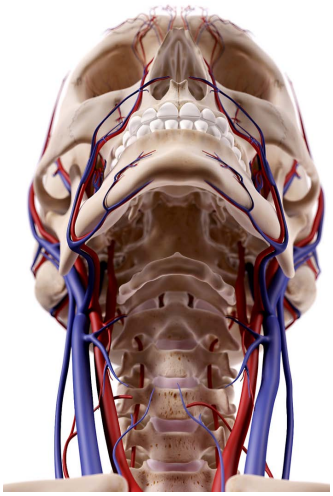
NORMAL BIOMECHANICAL STRESS ON SPINAL FUNCTION

SIDE VIEW OF THE KILLIAN IDEAL SPINE MODEL



"A study in the research journal Neurosurgery, of patients who required surgery for cervical spondylotic myleopathy, revealed that those patients who had a normal cervical lordosis prior to the surgery showed significant post-operative neurological improvement over those surgical patients who did not have a pre-operative cervical curve." [6]

NEUROSURGERY



Because of its mobility, relatively small structure, and weight-bearing role, the cervical spine is a frequent site of spinal nerve trauma, subluxations, and fixations.

When you have sensitive nerve pathways passing through such a mobile structure, the potential for breakdown is high.

The cervical spine has the greatest amount of potential for malfunctions and for creating health problems that affect the entire health and function of the body.

THE CERVICAL SPINE AND TRAUMA

The cervical spine is susceptible to various forces that cause the vertebrae to lose their proper structural position. These types of traumas include macro trauma, such as auto accident/whiplash, sports injuries, and falls; repetitive or micro-trauma, such as work tasks and poor postural habits; and early development trauma, which includes childhood falls and even the birth process.

Whiplash injury is caused by a sudden exaggerated thrust of the head backwards, forwards, and sometimes sideways.

Abnormal forces are applied to muscles, ligaments, bones, nerves, blood vessels, and intervertebral discs, as the weighty head moves beyond normal physiological limits.

There are often no visible bruises or abrasions from this type of injury, yet victims report classic symptoms following the accident — even years after its occurrence.

The symptoms are due to abnormal structural of the vertebral bones and soft tissue of the head and neck. Whiplash injury is most often associated with automobile accidents, but can also occur due to impact sports, domestic violence, playfully tossing a small child into the air and even amusement park rides.

WHIPLASH FACTS

- Over one million Americans each year suffer a whiplash injury
- 25% of whiplash victims suffer from chronic pain disabilities;
- 1/7th of whiplash victims report pain 3 years after initial injury.

U.S. Automobile Accident Statistics [7]

"In speaking of the forces generated in the head and neck as a result of whiplash, the convention is to use the term G. One G is equivalent to the acceleration resulting from the earth's gravity, 32.2 feet/sec. Ewing measured the maximum peak acceleration of the head of human volunteers exposed to nominal 10-G, 250-G/sec runs and found the surprising high force of 47.8 G. Thus, in some cases, the head may accelerate up to 5 times the input acceleration." [8]

CROFT & FOREMAN

The birth process, even under normal conditions, is frequently the first cause of spinal stress. After the head of the child appears, the physician grabs the baby's head and twists it around in a figure eight motion, lifting it up to receive the lower shoulder and then down to receive the upper shoulder. This creates significant stress on the spine of the baby.

"Spinal cord and brain stem injuries occur often during the process of birth but frequently escape diagnosis. Infants who survive often experience lasting neurological defects. Spinal trauma at birth is essentially attributed to excessive longitudinal traction, especially when this force is combined with flexion and torsion of the spinal axia during delivery." [9]

Dr. Abraham Towbin

The proper structure of a baby's spine must be maintained, as the primary ossification (rigid bone development) is not complete until approximately 3-6 years of age. Deviation from proper spinal structure resulting from the birth process can result in abnormal spinal development.

LOSS OF OPTIMAL CERVICAL STRUCTURE AND FUNCTION

Loss of the optimal cervical spinal structure and its resulting pathologies are known in medical literature by numerous names including *spondylosis, spinal stenosis, cervical compression myleopathy, spondylocondrosis, cervical disc herniation, subaxial disc space narrowing, cervical fixation, cervical radiculitis, vertebral subluxation,* and many more.

Vertebral subluxation is perhaps the most accurate description of loss of normal vertebral position.

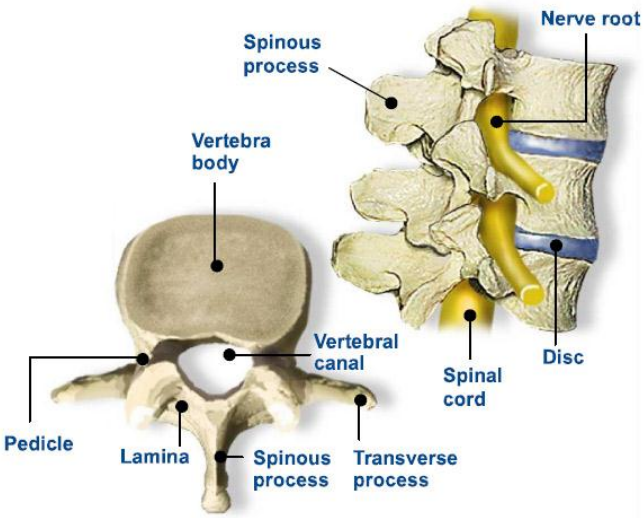
Vertebral subluxations alter the protective structure of the spine, which causes abnormal nerve transmission, resulting in a state of disharmony and lowered resistance in the body.

Vertebral subluxation also causes abnormal joint physiology, resulting in a degeneration of the bones and soft tissues of the spine.

Vertebral subluxation and loss of cervical curve is devastating to a person’s health and are well documented by leading health authorities.

“Neural dysfunction associated with acute or chronic subluxation syndromes basically manifest as abnormalities in sensory interpretation and/or motor activities. These disturbances may be through one of two primary mechanisms, either direct nerve or nerve root disorders of a reflex nature.” [10]

CERVICAL SPINE TRAUMA



“Encroachment or narrowing of the intervertebral canals may be the result of some involvement of the proximate soft tissue structures and/or the bony structures. Irritation of the cervical nerve roots may give rise to pain, sensory changes, muscle atrophy, muscle spasm, and alteration of the tendon reflexes anywhere along their segmental distribution. Any condition causing narrowing of the intervertebral canals may cause compression of the nerve roots. “ [11]

Ruth Jackson, M.D.
THE CERVICAL SYNDROME

“An injured joint is likely to cause persistent, disturbed, sensory feedback to the central nervous system and therefore existing motor programs have to be modified. Sensory receptors in the joint can influence muscle tone. This produces interdependence between biomechanical and neurological mechanisms.”

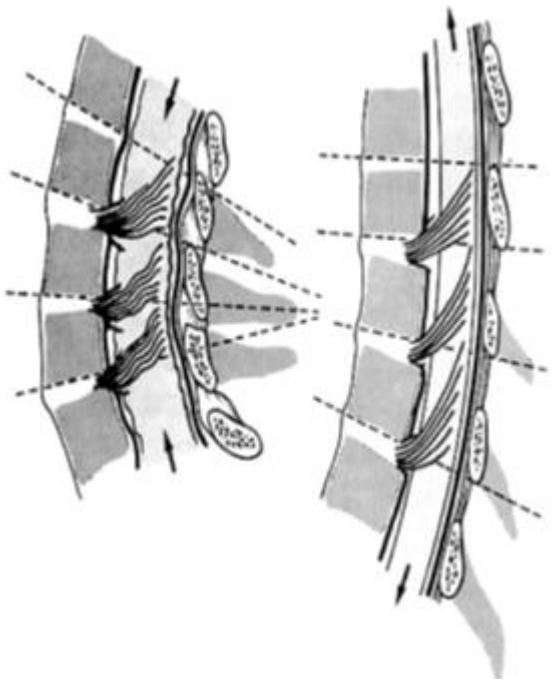
NEURO-ORTHOPEDICS

Alfred Brieg, leading neurosurgeon, has shown that the loss of the normal cervical curve stretches the spinal cord anywhere from 5 to 7 cm and results in abnormal tensions on the hind-brain, cranial nerves, cervical cord, and cervical nerve roots.

BIOMECHANICAL EFFECTS OF POSTURAL CHANGE

Abnormal rotations and translations on the soft tissue in the cervical canal are depicted in the figure at right. In A, the neck is in the normal lordotic position.

The cord is relaxed and folded in the posterior. The nerve roots are relaxed. Loss of curve B, the cord is stretched, the nerve roots are stretched, and the nerve roots are pressed upward against the pedicles of the vertebra.

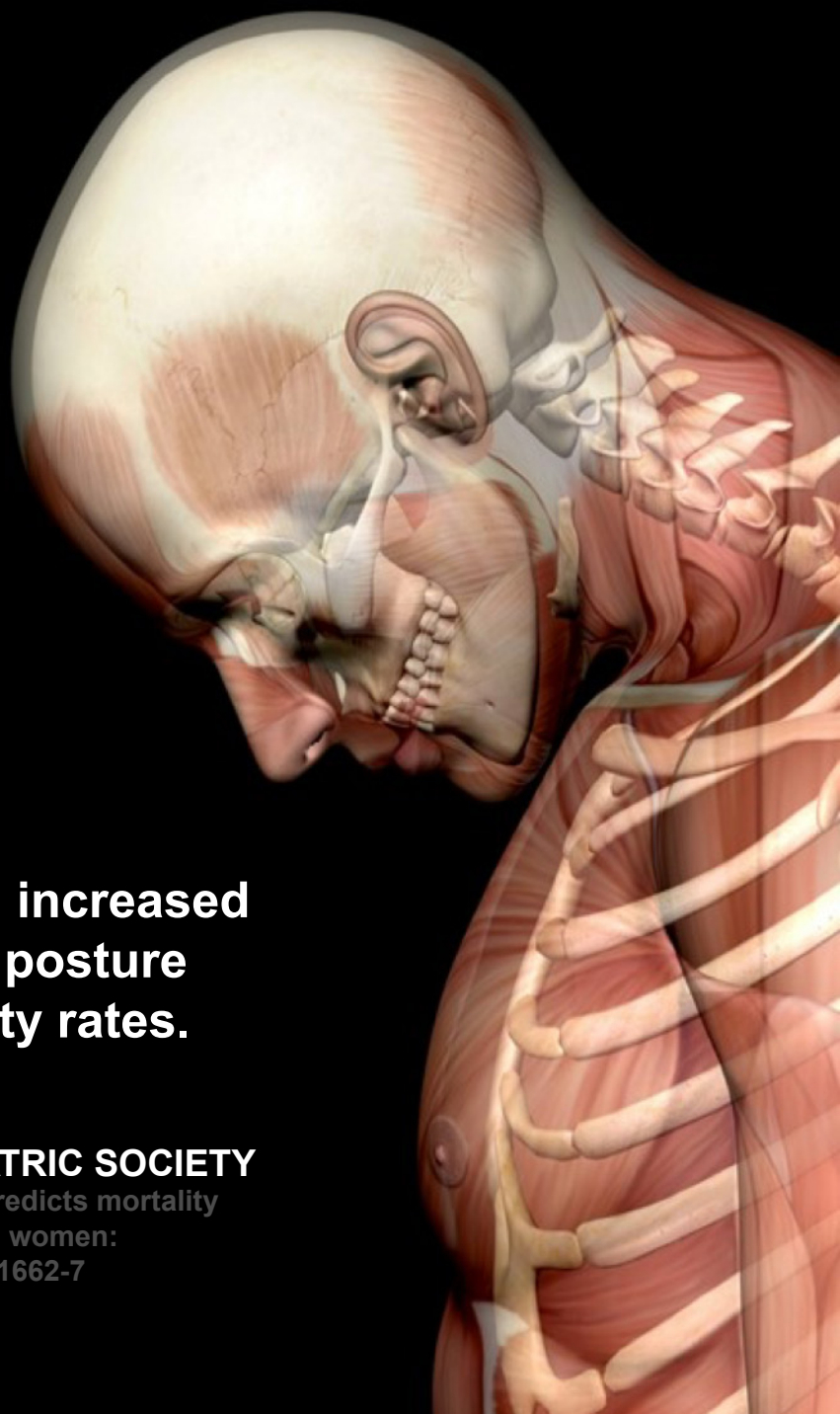


Hyperkyphotic Posture Predicts Mortality in Older Community-Dwelling Men and Women

Hyperkyphosis, commonly known as the dowager's hump, is frequently observed in older persons, yet little is known about its clinical significance. However, it is known that, in addition to being cosmetically undesirable, hyperkyphosis is associated with restrictive pulmonary disease and poor physical function, suggesting that hyperkyphosis might be also associated with other adverse health outcomes.

A total of 1353 participants, both male and female, who had measurements of abnormal posture made at an osteoporosis visit between 1988 and 1991, participated in the study.

The study concluded that older community-dwelling persons with hyperkyphotic posture had greater mortality rates, due to atherosclerosis and possibly pulmonary causes in particular.



The study also found that an increased severity of hyperkyphotic posture resulted in greater mortality rates.

JOURNAL OF THE AMERICAN GERIATRIC SOCIETY

Kado, D. Huang, M. Hyperkyphotic posture predicts mortality in older community-dwelling men and women: J Am Geriatr Soc. 2004 Oct;52(10):1662-7

SPINAL DEGENERATION

Spinal degeneration is the gradual and progressive breakdown of vertebral joints and related structures due to long-standing misalignments or vertebral subluxations, caused by deterioration of the intervertebral disc, bad posture, or a variety of traumatic injuries. When left uncorrected, these spinal misalignments cause abnormal biomechanics which erode joint surfaces. This degenerative process is similar to the abnormal wear on automobile tires when left unbalanced.

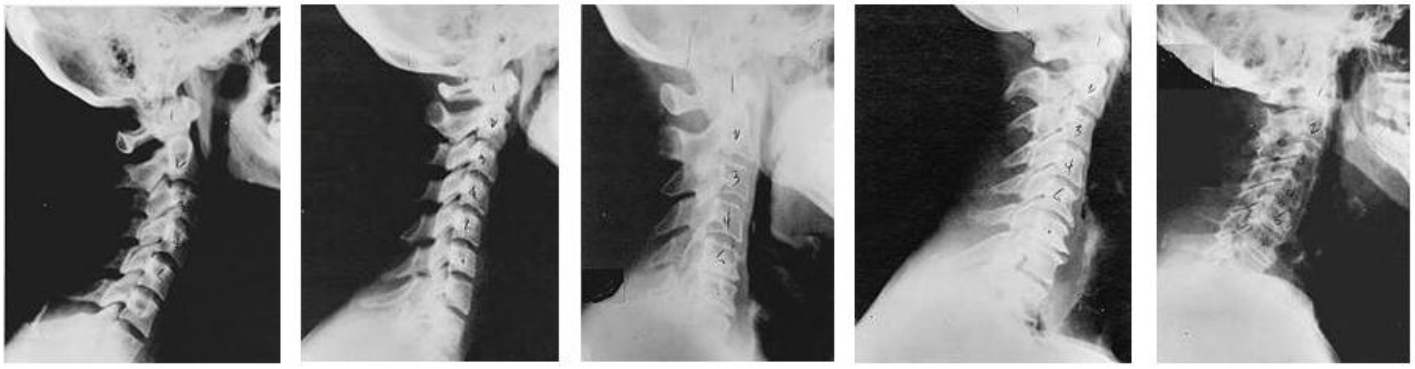
To stabilize the degenerating joints, the body deposits calcium at the edge of bone, resulting in irregular joint surfaces and arthritic spur ring. Although it has been suggested that aging is responsible for degenerative changes in the spine, recent research indicates otherwise. According to *Anatomico-Roentgenographic Studies of the Spine*, the incidence of degenerative changes varies from one segmental level to another. The C5/C6 level is most frequently involved, with C6/C7 being the level most frequently affected. The C2/C 3 level is the one least likely to exhibit degenerative changes. Clearly, the primary cause of spinal degeneration is abnormal stress loads on the biomechanics of the spine.[14]

"The aim of this study was to determine whether F-16 pilots are at an increased level of cervical spine degeneration versus pilots who do not fly F-16s and therefore are not exposed to the G-force stress on the cervical spine. In total, 316 pilots were evaluated, 188 F-16 pilots and 128 pilots in the control group. Two radiologists, who were blinded as to whether the x-ray films were of F-16 pilots or the control group, examined these x-rays separately. In both groups, the time between the pre- and post-x-rays was an average of six years. **Results**: Both radiologists found comparable statistically significant differences between the groups. In the F-16 group, an increased osteophytic spurring was found at levels of C4-C5 and C6-C7 and increased arthritis deforms were found in the cervical spine. These findings demonstrated that the increased biomechanical stress on the cervical spine was responsible for the degeneration." [15]

AVIATION SPACE ENVIRONMENTAL MEDICINE

Spinal degeneration often goes undetected because of the lack of pain and symptoms during the early phases. During the later phases, pain, loss of mobility, stiffness, and a host of neurological conditions become more common

PHASES OF SPINAL DEGENERATION



VERTEBRAL SUBLUXATIONS AND HEALTH CONDITIONS

Vertebral subluxations cause nerve interference which diminishes the inherent healing potential of the human body. Subluxations have been documented to cause a variety of health problems, including *headaches, migraines, carpal tunnel syndrome, neck pain, TMJ, sinus infections, ear infections, vertigo, allergies, asthma, thyroid conditions, sinusitis, arm pain, shoulder pain, hormonal imbalance, insomnia, fibromyalgia,* and many others

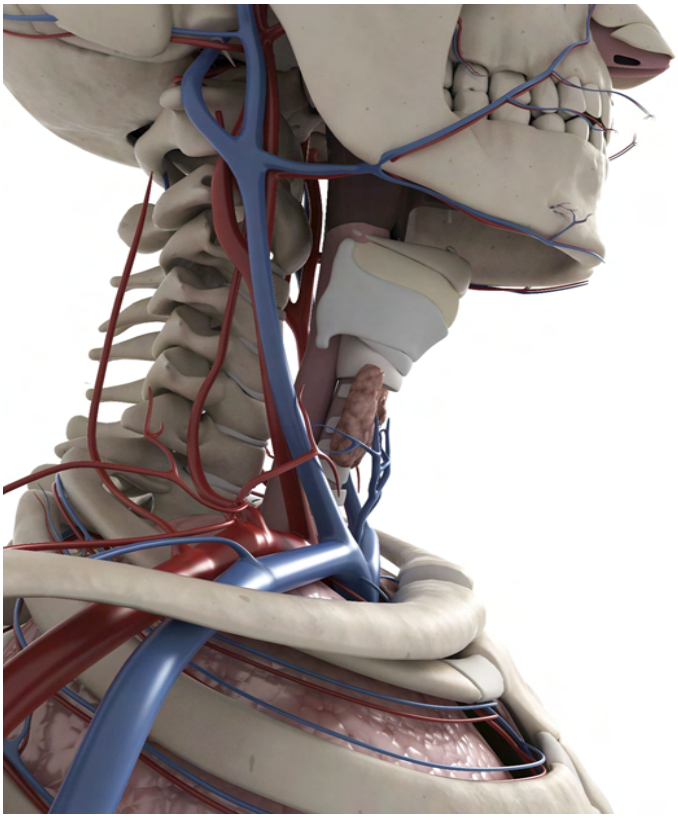
"I have seen pain and illness of the human body caused by subluxations."[16]

Dr. Louis Casamajor
Professor of Neurology

We have been conditioned to believe that health problems begin or are indicated by some type of a symptom, but nothing could be further from the truth.

In any health condition, the symptoms are always the last thing to show up and the first thing to go away.

Vertebral subluxations are often referred to as the "silent killer" because they destroy the health and healing potential of the human body long before the presence of any symptoms.



Cervical spine surgery is often necessary in cases involving major accidents, trauma or other obvious pathologies, but in many cases, the surgery could have been prevented by using a mechanical or corrective approach. Most cervical spine surgeries involve the removal of part of or all of the disc or bone, and then fusing the vertebrae together with a bone graft, either in front of or behind the spine. The bone graft may be one of two types: an autograft (bone taken from another part of the person's body) or an allograft (bone supplied by a bone bank donor). Often, metal plate screws or wires are also used to further stabilize the spine. Cervical spine surgeries always result in loss of function and mobility in the cervical spine.

CERVICAL SPINE SURGERY STATISTICS

From 1979 through 2009, spinal surgeries increased 137%, while the population on whom almost all of the surgeries are performed rose only 23%.

The rate of cervical spine surgery increased 53% from 1979 to 2009, and the rate of cervical fusion surgery increased more than 70%.

The rate of spinal surgery in the United States is 40% higher than any other country.

Complications of cervical spine surgery include nervous system complications (15 per 1,000) and death (6 per 1,000).[17]

National Center for Vital Statistics

CHIROPRACTIC HEALTH CARE

The science of Chiropractic is founded on the premise that a properly functioning nervous system is the foundation of health, and that the structural integrity of the spinal column must be maintained in order to facilitate optimal nervous system transmission and communication.

Virtually all spinal problems are caused by some type of mechanical or structural stress; therefore, it stands to reason that they require a mechanical correction. Drugs can do little more than suppress the symptoms that may be associated with spinal conditions and surgery, even when required, can eliminate some of the more obvious structural effects of subluxations, but neither can correct and restore the optimal structure of the spine.

Doctors of Chiropractic detect and correct vertebral subluxations by physically adjusting the spine to restore normal spinal function and balance which allows the nervous system to send and receive information. This allows the inherent healing potential of the body to best express itself.

Chiropractic adjustments restore the normal structure of the spine and maximize the posture of the human frame — a process that is unique to the Chiropractic profession

The Chiropractic correction of the spine is not something that happens overnight. The time frame for correction varies with individuals.

The corrective process requires time, and usually corrective exercises and changing of ergonomic and postural habits, but the results are worth it.

The pre-care x-ray (fig. 1) shows a lateral view of the cervical spine in which the normal cervical lordosis (curve) has been lost.

This has resulted in vertebral subluxation and abnormal stress on the spinal nerves, muscles, tendons, and ligaments. If left uncorrected, spinal degeneration will occur over time.

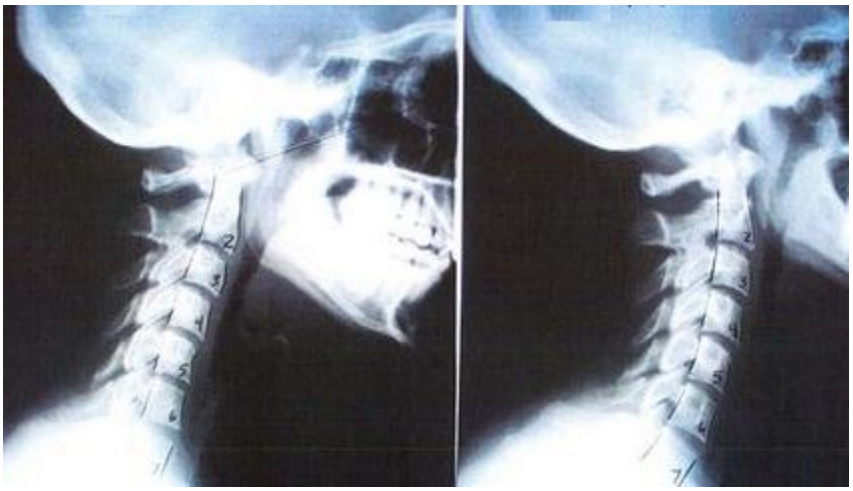


FIGURE 1

The post-care x-ray (fig. 2) shows a lateral view of the cervical spine that has undergone Chiropractic care.

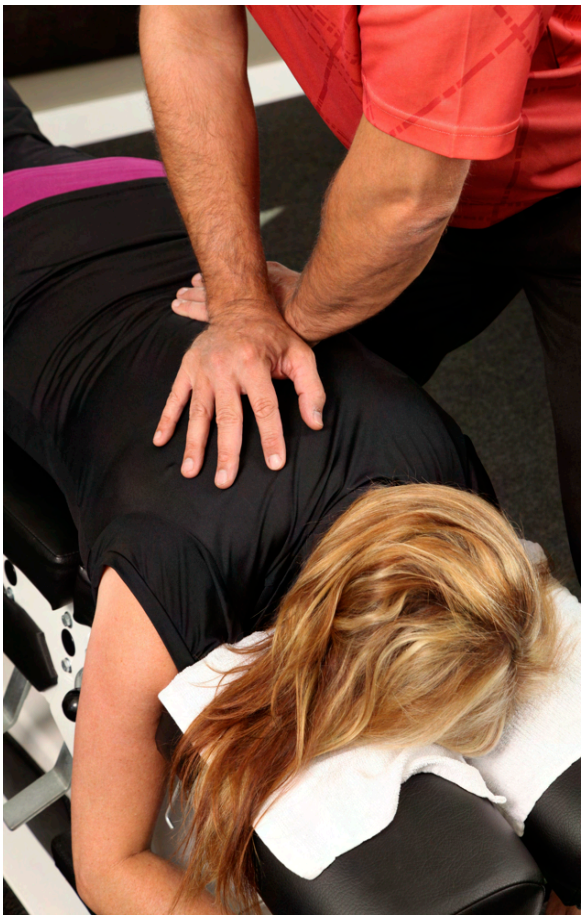
The cervical curve (lordosis) has been restored, resulting in the removal of nerve vertebral subluxations and restoration of normal balance, mobility, and stress loads on the spine.

FIGURE 2

Doctors of Chiropractic have been correcting vertebral subluxations in patients for over one hundred years, which has resulted in the recovery of virtually every known health problem and condition. It is important to remember that all healing is ultimately self-healing and that a Chiropractor simply removes the interference (subluxation) from the body's master control system.

The effectiveness of Chiropractic care (referred to in scientific literature as "adjustments" or "manipulation") has been demonstrated by thousands of scientific research and case studies.

"Even infants can be affected by life- and health-damaging effects of vertebral subluxation, according to a study by Dr. V. Fryman, M.D. The study, published in the *Journal of the American Orthopedic Association*, says that out of 1,250 infants chosen at random, 211 of them suffered from nervousness, vomiting, muscular abnormalities, tremors, and insomnia. Two hundred (95%) of those children had abnormal cervical (neck) muscle strain, indicating vertebral subluxation. When the subluxation was adjusted and the muscle strain removed, an immediate calming effect resulted: the children's crying stopped, the muscles relaxed, and the children fell asleep." [20]



"Interference to the nervous system results in damage within a short period of time and, therefore, Chiropractic care should begin at birth on a preventive basis. " [21]

Dr. Arpad DeNagy

Factual evidence strongly suggests that the atlas adjustment has an effect on the entire nervous system, primarily through its effect on joint mechanoreceptors. The most important proprioceptive information needed for maintenance of equilibrium is derived from the joint receptors of the upper cervical spine, appraising the orientation of the head with respect to the body. Upper cervical misalignments can adversely affect reticular formation activity by abnormal afferentation to the thalamus.

UPPER CERVICAL MONOGRAPH

"Subluxation alone is a rational reason for Chiropractic care throughout a lifetime from birth." [23]

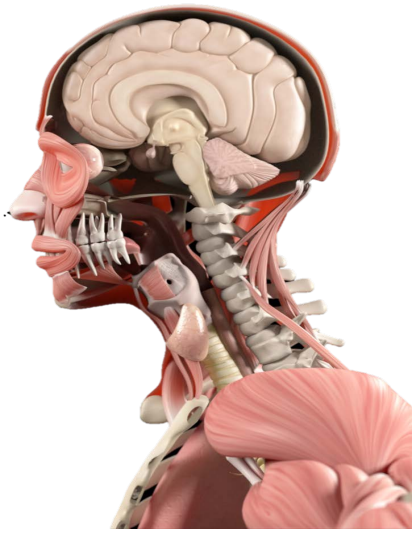
Dr. Lee Hadley,
Syracuse Memorial Hospital

“Chiropractors have suspected involvement of the somatoautonomic reflex, and current experimental findings suggest this is a valid assumption. It appears from clinical research that abnormal spinal reflexes can set into motion a wide variety of abnormal pathological and functional processes. The somatoautonomic reflex hypothesis may be the most logical justification for the use of chiropractic adjustments for conditions other than pain.” [24]

Robert A. Leach,
THE CHIROPRACTIC THEORIES

Spinal manipulation applied to a restricted atlanto-occipital joint results in an immediate disappearance of spontaneous activity in the oblique capitus superior muscle. With spinal manipulation, this is more rapid than either anesthetic applied to the joint capsule or to the muscle directly. [25]

MANUAL MEDICINE



“If people truly understood the value and importance of Chiropractic, they would hold their Chiropractor at gunpoint, if necessary, in order to ensure their family was adjusted.” [26]

Dick Gregory,
Comedian, Author, and Political Activist

“Capsular or ligament injury results in loss and deactivation of mechanoreceptors — the proprioceptive role of the affected segment is adversely affected. Spinal manipulation may help activate receptors and restoring proprioceptive control reduces the chance of re-injury. Hence, it is an important consideration in preventive care.” [27]

Basmajan & Ryberg,
RATIONAL MANUAL THERAPY

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THE EDUCATION AND TRAINING OF A DOCTOR OF CHIROPRACTIC

Educational requirements for doctors of chiropractic are among the most stringent of any of the health care professions. The typical applicant at a chiropractic college has already acquired nearly four years of pre-medical undergraduate college education, including courses in biology, inorganic and organic chemistry, physics, psychology and related lab work. Once accepted into an accredited chiropractic college, the requirements become even more demanding — four to five academic years of professional study are the standard. Because of the hands-on nature of chiropractic, and the intricate adjusting techniques, a significant portion of time is spent in clinical training.

Doctors of chiropractic — who are licensed to practice in all 50 states, the District of Columbia, and in many nations around the world — undergo a rigorous education in the healing sciences, similar to that of medical doctors. In some areas, such as anatomy, physiology, rehabilitation, nutrition and public health, they receive more intensive education than their MD counterparts.

Like other primary health care doctors, chiropractic students spend a significant portion of their curriculum studying clinical subjects related to evaluating and caring for patients. Typically, as part of their professional training, they must complete a minimum of a one-year clinical-based program dealing with actual patient care. In total, the curriculum includes a minimum of 4,200 hours of classroom, laboratory and clinical experience. The course of study is approved by an accrediting agency which is fully recognized by the U.S. Department of Education. This has been the case for more than three decades.

Records from insurance and court cases have constantly shown that chiropractic is the safest portal of entry health care available to the public today. Although no healthcare procedures are 100% safe, chiropractic stands on its record of safety and effectiveness unmatched in healthcare.

The chiropractic adjustment is a safe, efficient procedure which is performed nearly one million times every working day in the United States.

There is a singular lack of actuarial data that would justify concluding that chiropractic care is in any way harmful or dangerous. Chiropractic care is non-invasive, therefore, the body's response to chiropractic care is far more predictable than its reactions to drug treatments or surgical procedures. Of the nearly one million adjustments given every day in this country, complications are exceedingly rare.

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