Federation of Chiropractic Licensing Boards

Justification of Chiropractic Care Viewed Through a New Lens

Dan Murphy, DC
May 2, 2019
General Principles of Chronic Pain Management
Dan Murphy, DC

1) Gate Theory: Chiropractic management of asymmetries of posture/motion; improving mechanoreceptive afferentation while existing, living, and functioning in a gravity environment.

2) Balance the omega-6/omega-3 ratio (1.5-4/1); inflammation alters the threshold of the nociceptive afferent system. The billions Americans spend on pain drugs is primarily to counter the effects of too much omega-6 in the diet (or too low omega-3s).

3) Reduce pro-inflammatory cytokines:
   A) omega-6/omega-3 balance
   B) resveratrol (100 mg/day); curcumin (200 mg/day)

4) Laser therapy protocols (FDA approved July 2018)

5) Vitamin D: 50-70 ng/ml. Perhaps as many as 60% of those with chronic pain have low levels of vitamin D.

6) Treat the gut: leaky gut raises systemic inflammation bringing all nociceptors closer to excitation threshold:
   A) Avoid lectins and all things that damage the microbiome
   B) Take prebiotics and probiotics

7) Malic Acid: the sodium pump keeps the nociceptors further away from excitation threshold. The sodium pump runs on ATP energy. A proven disruption of lower ATP and chronic pain is low levels of malic acid in the Krebs Cycle. Supplementation with malic acid (2400 mg/day) and Mg++ (600 mg/day) has been shown to greatly help.

8) Reduce / avoid / eliminate dietary excitotoxins (glutamate, aspartate [half of aspartame]). Excitotoxins are known to create chronic pain sensitization, and their elimination can 100% “cure” chronic pain syndromes.

9) Manage insulin resistance:
   A) Insulin resistance lowers ATP (#10)
   B) Insulin upregulates the delta-5-desaturase enzyme (D5D), accelerating the conversion of linoleic acid (soy, corn, etc.) into the arachidonic acid cascade towards pro-inflammatory eicosanoids.

10) Any strategy that increases ATP is helpful: ATP runs the sodium pump:
    A) Chiropractic Adjusting
    B) Exercise
    C) Low Level Laser Therapy (is also a COX inhibitor)
    D) Breathing Exercises
    E) Anti-oxidant supplements
    F) Mitochondrial nutritional support (acetyl-l-carnitine, alpha-lipoic acid, CoQ10)
    G) Detoxification: undenatured whey protein, N-acetyl cysteine (NAC), sublingual glutathione, infrared sauna, oil pulling
    H) Stop Smoking. ETC.
"Opioids produce profound analgesia when taken systemically. They also produce mood changes, drowsiness, mental clouding, nausea, vomiting, and constipation."

Exogenous opioids include opium, morphine, codeine, and heroin. Endogenous opioids are called endorphins.

Both exogenous and endogenous opioids use the opioid receptors that are concentrated in the PAG and raphe nucleus.

Opioids exert multiple effects, including “suppressing the release of glutamate from presynaptic [nociceptive] terminals and inhibiting pain.”
A Brief History of the Opioid Epidemic and Strategies for Pain Medicine.

Jones MR¹, Viswanath O², Peck J³, Kaye AD⁴, Gill JS², Simopoulos TT².

Abstract

The opioid epidemic has resulted from myriad causes and will not be solved by any simple solution. Consequent to a staggering increase in opioid-related deaths in the USA, various governmental inputs and stakeholder strategies have been proposed and implemented with varying success. This article summarizes the history of opioid use and explores the causes for the present day epidemic. Recent trends in opioid-related data demonstrate an almost fourfold increase in overdose deaths from 1999 to 2008. Tragically, opioids claimed over 64,000 lives just last year. Some solutions have undergone legislation, including the limitation of numbers of opioids postsurgery, as well as growing national prevalence of enhanced recovery after surgery protocols which focus on reduced postoperative opioid consumption and shortened hospital stays. Stricter prescribing practices and prescription monitoring programs have been instituted in the recent past. Improvement in abuse deterrent strategies which is a major focus of the Food and Drug Administration (FDA) for all opioid preparations will likely play an important role by increasing the safety of these medications. Future potential strategies such as additional legislative policies, public awareness, and physician education are also detailed in this review.

KEYWORDS: Abuse deterrent formulations; Enhanced recovery after surgery; Non-opioid pain treatments; Opioid epidemic; Overdose

PMID: 29691801  PMCID: PMC5993682  DOI: 10.1007/s40122-018-0097-6
Adverse pathogens cause tissue destruction and subsequent inflammation.

The body evolved in a manner to wall-off the area of inflammation by over healing the region with a fibrous response.

The fibrous response became a physical barrier, reducing the ability of the pathogens to spread to other regions of the body, thereby improving the host’s chances for survival.

When inflammation is caused by non-infectious mechanisms, the same fibrotic tissue response occurs.

In such cases, without infectious pathogens, the fibrotic tissue response is excessive, resulting in mechanical harm to the host.

This harmful tissue fibrosis is worsened with early immobilization of the affected tissues.

This tissue fibrosis is minimized with early persistent controlled mobilization.

Established harmful tissue fibrosis is best managed with specific controlled motion for purpose of adhesion rupture and remodeling.

The motion to treat established harmful fibrotic tissue should be individualized to the needs of the patient.

Different fibrotic tissues respond optimally to different categories of controlled motion application:

1) Periarticular tissue fibrosis responds optimally to joint adjustments / specific line-of-drive manipulation.

2) Muscle fibrosis responds well to active resistive exercise.

3) Non-contractile tissue (tendon, fascia, ligament, etc.) fibrosis responds best to manually applied tissue friction.

Most patients have a combination of tissues that are adversely affected, depending on the mechanism of injury or stress.

Consequently, a combination of these applications of controlled motion, by someone who is expertly trained, is often required to achieve timely, efficient, and long-lasting clinical improvements.
In 1984, orthopedic surgeon Sir James Cyriax, MD, Textbook of Orthopaedic Medicine, Diagnosis of Soft Tissue Lesions, Volume 1.

“The excessive reaction of tissues to an injury is conditioned by the overriding needs of a process designed to limit bacterial invasion. If there is to be only one pattern of response, it must be suited to the graver of the two possible traumas. However, elaborate preparation for preventing the spread of bacteria is not only pointless after an aseptic injury, but is so excessive as to prove harmful in itself. The principle on which the treatment of post-traumatic inflammation is based is that the reaction of the body to an injury unaccompanied by infection is always too great.” (Cyriax, p. 14)

“When pain is due to bacterial inflammation, Hilton’s advocacy of rest remains unchallenged and is today one of the main principles of medical treatment. When, however somatic pain is caused by inflammation due to trauma, his ideas require modification. When non-bacterial inflammation attacks the soft tissues that move, treatment by rest has been found to result in chronic disability, later, although the symptoms may temporarily diminish. Hence, during the present century, treatment by rest has given way to therapeutic movement in many soft tissue lesions.

Movement may be applied in various ways: the three main categories are:

(a) active and resistive exercises:
(b) passive, especially forced movement: and
(c) deep massage.” (Cyriax, p. 14)

“Fibrous tissue is capable of maintaining an inflammatory response long after the initial cause has ceased to operate, the scar that forms remaining painful whenever tension is put upon it, perhaps for decades.” (Cyriax, p. 15)

"It seems that the inflammatory reaction at thr injured fibers continues, not merely during the period of healing, but for an indefinite period afterwards, maintained by the normal stresses to which such tissues are subject. This sustained phenomenon appears to be mediated by the prostaglandins, a set of hormones that provokes inflammation." (Cyriax, p. 15) [Key Point: prostaglandins]

“Tension within the granulation tissue lines the cells up along the direction of stress. Hence, during the healing of mobile tissues, excessive immobilization is harmful. It prevents the formation of a scar strong in the important direction by avoiding the strains leading to due orientation of fibrous tissue and also allows the scar to become unduly adherent, e.g. to bone.” (Cyriax, p. 15-16)

"Many lesions with which orthopaedic medicine deals are due to scarring that remains unwarrantedly painful." (Cyriax, p. 16)
On this topic, Cyriax’s comments include a review of the 1940 primary research by ML Stearns, stating:

“Her (Stearns) main conclusion on the mechanics of the formation of scar tissue was that external mechanical factors, were responsible for the development of the fibrillary network into orderly layers. Within four hours of applying a stimulus, an extensive network of fibrils was already visible around the fibroblasts; during the course of 48 hours this became dense enough to hide the cells almost completely: and in 12 days a heavy layer of fibrils had appeared. At first the fibrils developed at random, but later they acquired a definite arrangement, apparently as a direct result of the mechanical factors. Of these factors, movement is obviously the most important and equally obvious it is most effective and least likely to cause pain before the fibrils have developed an abnormal firm attachment to neighboring structures. When free mobility was encouraged from the onset, the fibers in the scar were arranged lengthwise as in a normal ligament. Gentle passive movements do not detach fibrils from their proper formation at the healing breach but prevent their continued adherence at normal sites. The fact that the fibrils rapidly spread in all directions provides sufficient reason for beginning movements at the earliest possible moment; otherwise they develop into strong fibrous scars (adhesions) that so often cause prolonged disability after a sprain.” (Cyriax, p. 15)


“The injured tissues next undergo remodeling, which can take up to one year to complete in the case of major tissue disruption. The remodeling stage blends with the later part of the regeneration stage, which means that motion of the injured tissues will influence their structure when they are healed. This is one reason why it is necessary to consider using controlled motion during the recovery stage. If a limb is completely immobilized during the recovery process, the tissues may emerge fully healed but poorly adapted functionally, with little chance for change, particularly if the immobilization has been prolonged. Another reason for encouraging controlled motion is that any adhesions that develop will be flexible and will thus allow the tissues to move easily on each other. Caution should be observed during the first two weeks, as mentioned previously, as the tensile strength of the tissues may be markedly reduced.” (p.127)
The End of Alzheimer's

The First Program to Prevent and Reverse Cognitive Decline

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Professor and Founding President, Buck Institute; Professor, UCLA
These authors review the case of a boy who continued to use his knee in the absence of normal external rotation of the tibia on the femur during knee extension. One and a half years later, at surgery, dimpling of the articular cartilage of the medial femoral condyle was observable with the naked eye, presumably owing to continued abnormal compression of this portion of the articular surface from loss of normal arthrokinematic movement. They state:

“The traditional approach to management of patients presenting with loss of pain-free movement at a joint usually involves various modes of pain relief, active and passive measures to improve osteokinematic movement, and encouragement of normal use of the part.”

“It should be clear that this approach is inadequate and perhaps dangerous. First, it ignores the basic problem, which is often loss of normal arthrokinematics. Second, it involves considerable forcing of osteokinematic movements in the absence of normal arthrokinematic movement, which may only occur at the expense of the articular cartilage. This is to say that the resiliency of the cartilage may allow a certain amount of osteokinematic movement to occur without the normal accompanying arthrokinematic movements.”

“A more logical approach to the management of these patients emphasizes the restoration of joint play to allow free movement between bones. This can be achieved only by (1) evaluating to determine the nature and extent of the lesion, (2) deciding if joint mobilization is indicated based on the evaluation, (3) choosing the appropriate techniques based on the direction and extent of restrictions, and (4) skillfully applying techniques of specific mobilization.”

“Efforts to relieve pain and reduce muscle guarding are, of course, important adjuncts to treatment but do not in themselves constitute a treatment program. Also, some movement should be encouraged in the cardinal planes, but only as normal kinematics are restored.”

“To a certain extent, functional use of the part should be restricted through careful instructions to the patient until normal joint mechanics are restored. This approach minimizes the possible danger of undue stresses to the articular cartilage during attempts to restore movement. It also minimizes the possibility of discharging a patient who has relatively pain-free functional use of the joint, but who may have some residual kinematic disturbance sufficient to cause cartilage fatigue over time and perhaps osteoarthrosis in later years.”
Modern Developments
in the Principles and Practice
of Chiropractic

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1980

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APPLETON-CENTURY-CROFTS/New York
or manipulative procedures help to restore the active and passive ranges of motion while specific spinal adjustments help to restore the active, passive, and paraphysiological motion of joints. The spinal adjustment often produces joint separation (the "pop"). In this way neutral joint mobility (best determined by joint challenge or springing) and end fell mobility (best determined by dynamic palpation methods) is often restored. Some characteristics of the "joint crack" or "joint pop" elicited during an adjustment have been determined. Sandoz (1969) noted that there was an increased range of motion in all directions in the motion segment following an adjustment and the appearance of a radiolucent cavity in the joint space, thought to be intraarticular gas formation. The "crack phenomenon," which accompanies joint separation, is followed by a short refractory period of about 20 minutes before the "joint crack" can be reproduced (Roston and Haines 1957).

**General Biomechanical Concepts**

The movements most often discussed in the application of spinal manipulative therapy are flexion and extension, lateral flexion, and rotation. Translatory or gliding motion also exists at certain joints. There are very few movements in the spinal column that take place in a single plane. White and Panjabi (1978) have discussed the coupled motions in the cervical, dorsal, and lumbar spine showing that during the individual motions of rotation and lateral flexion one motion cannot be produced without the other. Adjustments that are given for laterality correct rotation and rotation adjustments correct laterality. The overall shape of the motion...
MANAGING LOW BACK PAIN

Second Edition

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CHURCHILL LIVINGSTONE
HOW DOES MANIPULATION WORK?

The Effect of Manipulation on a Normal Joint

Two British anatomists, Roston and Wheeler Haines, published a paper in 1947 entitled "Cracking in the metacarpophalangeal joint." The three phalanges of the middle finger were wrapped in adhesive tape and the tape was attached to a spring dynamometer to indicate the degree of tension applied to the finger. A progressively increasing force was applied to distract the metacarpophalangeal joint. Radiographs were taken at intervals to record changes in the joint space. In this experiment, the force was applied by a machine and not manually and by progressive traction rather than by a thrust, but the conditions may be considered comparable with those in a spinal adjustment.

The results of the experiment are shown in Figure 17-2. The tension is recorded on the abscissa and the separation of the cartilage surfaces on the ordinate. The initial separation of 1.8 mm is due to the thickness of the cartilages. The separation increases gradually up to a tension of 8 kg. At this point the surfaces jump to a separation of 4.7 mm and a cracking noise is heard. Increasing tension to 18 kg produces a further joint separation up to 5.4 mm. On reduction of the tension the joint surface separation is again approximately 2 mm, a distance slightly more than the initial separation of 1.8 mm. The ways in which the results of this experiment may be correlated with apophyseal joint manipulation are shown in Figure 17-3.

Three phenomena occur at the same time as the elastic barrier is passed: The articular surfaces separate suddenly; a cracking noise is heard; a radiolucent space appears within the joint. These occurrences can be explained as follows. Normally a small negative pressure is present in a joint space; it maintains the cartilage...
SACROILIAC SYNDROME

In the sacroiliac syndrome local and reflex pain is present and movement is restricted. In our present state of knowledge it is difficult to envisage how synovium can be entrapped or how subluxation can occur in a joint that has very small range of movement. Adjustments directed specifically to this joint, however, often relieve the symptoms.

Possibly the effect is produced by stretching the posterior muscles, breaking intra-articular adhesions and relieving the joint fixation with the resultant stimulation of the surrounding mechanoreceptors.

QUADRATUS LUMBOUM SYNDROME

In the quadratus lumborum syndrome and other paraspinal myofascial syndromes, there is hypertonicity and a tender trigger point in the belly of the muscle. It is postulated that when the lesion is not treated quickly, fibrosis develops within the affected portion of the muscle. The thrust of the adjustment is directed to stretching the tight segment of muscle.

HERNIATION OF THE NUCLEUS PULPOSUS

Many theories have been propounded to explain the way in which manipulative adjustments may relieve the patient with this condition of back and leg pain. We are doubtful that manipulation can reduce a large disc herniation. Availability of the high resolution CT scanner and soft tissue imaging make it possible now to visualize accurately the site and size of a disc herniation and to assess the effects of different forms of treatment by repeat scanning after a period of time. Before long the physician should be in a position to say what form of treatment is most effective.

De Sèze\textsuperscript{11,12} believes that lumbago develops because a fragment of the nucleus pulposus becomes incarcerated within an annular tear with resultant bulging of the annulus and pressure on the sinuvertebral nerve.
NECK PAIN

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FIGURE 1


FIGURE 2

Cervical spinal manipulation where the joint is taken to the limits of passive range of motion before a thrust is delivered. If a thrust is not delivered, then this procedure would be considered a grade III or grade IV mobilization in lateral flexion.

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<td>I</td>
<td>Small amplitude movement performed at the beginning of the passive range of motion.</td>
</tr>
<tr>
<td>II</td>
<td>Large amplitude movement performed within the passive range of motion.</td>
</tr>
<tr>
<td>III</td>
<td>Large amplitude movement performed up to the point of limitation in the passive range of motion.</td>
</tr>
<tr>
<td>IV</td>
<td>Small amplitude movement performed at the limit of the passive range of motion.</td>
</tr>
<tr>
<td>V</td>
<td>Small amplitude, high-velocity thrust performed at the end of the passive range of motion (manipulation).</td>
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The spinal cord as organizer of disease processes: III. Hyperactivity of sympathetic innervation as a common factor in disease.

Korr IM.

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The Sympathetic Nerve—An Integrative Interface between Two Supersystems: The Brain and the Immune System

ILIA J. ELENKOV, RONALD L. WILDER, GEORGE P. CHROUSOS, AND E. SYLVESTER VIZI

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Autonomic Failure
A Textbook of Clinical Disorders of the Autonomic Nervous System

FIFTH EDITION

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Cerebral metabolic changes in men after chiropractic spinal manipulation for neck pain.


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Abstract

**BACKGROUND:** Chiropractic spinal manipulation (CSM) is an alternative treatment for back pain. The autonomic nervous system is often involved in spinal dysfunction. Although studies on the effects of CSM have been performed, no chiropractic study has examined regional cerebral metabolism using positron emission tomography (PET).

**OBJECTIVE:** The aim of the present study was to investigate the effects of CSM on brain responses in terms of cerebral glucose metabolic changes measured by [18F]fluorodeoxyglucose positron emission tomography (FDG-PET).

**METHODS:** Twelve male volunteers were recruited. Brain PET scanning was performed twice on each participant, at resting and after CSM. Questionnaires were used for subjective evaluations. A visual analogue scale (VAS) was rated by participants before and after chiropractic treatment, and muscle tone and salivary amylase were measured.

**RESULTS:** Increased glucose metabolism was observed in the inferior prefrontal cortex, anterior cingulated cortex, and middle temporal gyrus, and decreased glucose metabolism was found in the cerebellar vermis and visual association cortex, in the treatment condition (P < .001). Comparisons of questionnaires indicated a lower stress level and better quality of life in the treatment condition. A significantly lower VAS was noted after CSM. Cervical muscle tone and salivary amylase were decreased after CSM. Conclusion The results of this study suggest that CSM affects regional cerebral glucose metabolism related to sympathetic relaxation and pain reduction.

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Inami A¹, Ogura T², Watanuki S¹, Masud MM³, Shibuya K⁴, Miyake M¹, Matsuda R¹, Hiraoka K¹, Itoh M⁴, Fuhr AW⁵, Yanai K⁶, Tashiro M¹.

Abstract

Objective. The aim of this study was to investigate changes in brain and muscle glucose metabolism that are not yet known, using positron emission tomography with [¹⁸F]fluorodeoxyglucose ([¹⁸F]FDG PET). Methods. Twenty-one male volunteers were recruited for the present study. [¹⁸F]FDG PET scanning was performed twice on each subject: once after the spinal manipulation therapy (SMT) intervention (treatment condition) and once after resting (control condition). We performed the SMT intervention using an adjustment device. Glucose metabolism of the brain and skeletal muscles was measured and compared between the two conditions. In addition, we measured salivary amylase level as an index of autonomic nervous system (ANS) activity, as well as muscle tension and subjective pain intensity in each subject. Results. Changes in brain activity after SMT included activation of the dorsal anterior cingulate cortex, cerebellar vermis, and somatosensory association cortex and deactivation of the prefrontal cortex and temporal sites. Glucose uptake in skeletal muscles showed a trend toward decreased metabolism after SMT, although the difference was not significant. Other measurements indicated relaxation of cervical muscle tension, decrease in salivary amylase level (suppression of sympathetic nerve activity), and pain relief after SMT. Conclusion. Brain processing after SMT may lead to physiological relaxation via a decrease in sympathetic nerve activity.

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The Neurochemically Diverse Intermedius Nucleus of the Medulla as a Source of Excitatory and Inhibitory Synaptic Input to the Nucleus Tractus Solitarii

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Sensory afferent signals from neck muscles have been postulated to influence central cardiorespiratory control as components of postural reflexes, but neuronal pathways for this action have not been identified. The intermedius nucleus of the medulla (InM) is a target of neck muscle spindle afferents and is ideally located to influence such reflexes but is poorly investigated. To aid identification of the nucleus, we initially produced three-dimensional reconstructions of the InM in both mouse and rat. Neurochemical analysis including transgenic reporter mice expressing green fluorescent protein in GABA-synthesizing neurons, immunohistochemistry, and in situ hybridization revealed that the InM is neurochemically diverse, containing GABAergic and glutamatergic neurons with some degree of colocalization with parvalbumin, neuronal nitric oxide synthase, and calretinin. Projections from the InM to the nucleus tractus solitarius (NTS) were studied electrophysiologically in rat brainstem slices. Electrical stimulation of the NTS resulted in antidromically activated action potentials within InM neurons. In addition, electrical stimulation of the InM resulted in EPSPs that were mediated by excitatory amino acids and IPSPs mediated solely by GABAA receptors or by GABAA and glycine receptors. Chemical stimulation of the InM resulted in (1) a depolarization of NTS neurons that were blocked by NBQX (2,3-dioxo-6-nitro-1,2,3,4-tetrahydrobenzo[f]quinoxaline-7-sulfonamide) or kynurenic acid and (2) a hyperpolarization of NTS neurons that were blocked by bicuculline. Thus, the InM contains neurochemically diverse neurons and sends both excitatory and inhibitory projections to the NTS. These data provide a novel pathway that may underlie possible reflex changes in autonomic variables after neck muscle spindle afferent activation.

Key words: posture; neck; cardiovascular; respiration; medulla oblongata; autonomic

Introduction

Reflex changes in cardiorespiratory variables during body movements rely on interactions between the somatic and autonomic nervous systems. A prime example of such interaction is the somatosympathetic reflex, in which stimulation of thinly myelinated group III (Aδ) and unmyelinated group IV (C-fiber) limb muscle afferent fibers can reflexly increase cardiorespiratory output (Potts et al., 2000, 2003; Wilson, 2000). These reflexes are mediated via sensory afferent input to the spinal cord, which is then relayed to the nucleus tractus solitarius (NTS), a brainstem site for cardiorespiratory integration (Potts et al., 2003). Cardiorespiratory changes can also be evoked by stimulation of neck muscle afferents (Bolton et al., 1998; Bolton and Ray, 2000), proposed to contribute to alternations in cardiorespiratory outflow in preparation for a change in posture (Bolton and Ray, 2000). In contrast to limb afferents, the sensory signals from these muscles appear to be mediated by group Ia muscle spindle afferents (Bolton et al., 1998). However, the neural pathways that link these afferent signals to cardiorespiratory control are completely unknown.

One target for sensory information from neck muscles is the cervical spinal cord where terminations can be found in the dorsal horn (although sparse) and the central cervical nucleus (CCN) (Bakker et al., 1984; Pfäffler and Avidsson, 1988; Prihoda et al., 1991). The CCN projection is generally considered to underlie spinal somatic reflex circuits, such as those for the tonic neck reflex involved in postural control (Wilson et al., 1984; Brink et al., 1985; Hongo et al., 1988; Popova et al., 1995). There is also a strong direct neck muscle afferent projection to the medulla oblongata where fibers terminate in the external cuneate nucleus and a nucleus located at the lateral edges of the dorsal aspect of the hypoglossal motor nucleus (XII), referred to either as the...
The Neurochemically Diverse Intermedius Nucleus of the Medulla as a Source of Excitatory and Inhibitory Synaptic Input to the Nucleus Tractus Solitarii

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The intermedius nucleus of the medulla: A potential site for the integration of cervical information and the generation of autonomic responses

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ABSTRACT
The intermedius nucleus of the medulla (InM) is a small perihypoglossal brainstem nucleus, which receives afferent information from the neck musculature and also descending inputs from the vestibular nuclei, the gustatory portion of the nucleus of the solitary tract (NTS) and cortical areas involved in movements of the tongue. The InM sends monosynaptic projections to both the NTS and the hypoglossal nucleus. It is likely that the InM acts to integrate information from the head and neck and relays this information on to the NTS where suitable autonomic responses can be generated, and also to the hypoglossal nucleus to influence movements of the tongue and upper airways.

Central to the integratory role of the InM is its neurochemical diversity. Neurones within the InM utilise the amino acid transmitters glutamate, GABA and glycine. A proportion of these excitatory and inhibitory neurones also use nitric oxide as a neurotransmitter. Peptidergic transmitters have also been found within InM neurones, although as yet the extent of the pattern of co-localisation between peptidergic and amino acid transmitters in neurones has not been established.

The calcium binding proteins calretinin and parvalbumin are found within the InM in partially overlapping populations. Parvalbumin and calretinin appear to have complementary distributions within the InM, with parvalbumin being predominantly found within GABAergic neurones and calretinin being predominantly found within glutamatergic neurones.

Neurones in the InM receive inputs from glutamatergic sensory afferents. This glutamatergic transmission is conducted through both NMDA and AMPA ionotropic glutamate receptors.

In summary the InM contains a mixed pool of neurones including glutamatergic and GABAergic in addition to peptidergic neurones. Neurones within the InM receive inputs from the upper cervical region, descending inputs from brain regions involved in tongue movements and those involved in the co-ordination of the autonomic nervous system. Outputs from the InM to the NTS and hypoglossal nucleus suggest a possible role in the co-ordination of tongue movements and autonomic responses to changes in posture.

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Neck muscle afferents influence oromotor and cardiorespiratory brainstem neural circuits.

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Abstract

Sensory information arising from the upper neck is important in the reflex control of posture and eye position. It has also been linked to the autonomic control of the cardiovascular and respiratory systems. Whiplash associated disorders (WAD) and cervical dystonia, which involve disturbance to the neck region, can often present with abnormalities to the oromotor, respiratory and cardiovascular systems. We investigated the potential neural pathways underlying such symptoms. Simulating neck afferent activity by electrical stimulation of the second cervical nerve in a working heart brainstem preparation (WHBP) altered the pattern of central respiratory drive and increased perfusion pressure. Tracing central targets of these sensory afferents revealed projections to the intermedius nucleus of the medulla (InM). These anterogradely labelled afferents co-localised with parvalbumin and vesicular glutamate transporter 1 indicating that they are proprioceptive. Anterograde tracing from the InM identified projections to brain regions involved in respiratory, cardiovascular, postural and oro-facial behaviours-the neighbouring hypoglossal nucleus, facial and motor trigeminal nuclei, parabrachial nuclei, rostral and caudal ventrolateral medulla and nucleus ambiguus. In brain slices, electrical stimulation of afferent fibre tracts lateral to the cuneate nucleus monosynaptically excited InM neurones. Direct stimulation of the InM in the WHBP mimicked the response of second cervical nerve stimulation. These results provide evidence of pathways linking upper cervical sensory afferents with CNS areas involved in autonomic and oromotor control, via the InM. Disruption of these neuronal pathways could, therefore, explain the dysphagic and cardiorespiratory abnormalities which may accompany cervical dystonia and WAD.

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Figure 3 | **Functional anatomy of the inflammatory reflex.** Afferent (sensory) neural signals to the brain stem are relayed by the vagus nerve to the nucleus of the solitary tract (nucleus tractus solitarius; NTS). Polysynaptic relays then connect to the outflow centres of the autonomic nervous system, the rostral ventrolateral medullary (RVLM) sympathoexcitatory neurons and the vagal motor neurons in the nucleus ambiguus (NA) and the dorsal vagal motor nucleus. Outflow arrives at the coeliac ganglion from either the vagus nerve or the preganglionic efferent nerves, which originate in the sympathetic
The Vagus Nerve Can Predict and Possibly Modulate Non-Communicable Chronic Diseases: Introducing a Neuroimmunological Paradigm to Public Health

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Abstract: Global burden of diseases (GBD) includes non-communicable conditions such as cardiovascular diseases, cancer and chronic obstructive pulmonary disease. These share important behavioral risk factors (e.g., smoking, diet) and pathophysiological contributing factors (oxidative stress, inflammation and excessive sympathetic activity). This article wishes to introduce to medicine and public health a new paradigm to predict, understand, prevent and possibly treat such diseases based on the science of neuro-immunology and specifically by focusing on vagal neuro-modulation. Vagal nerve activity is related to frontal brain activity which regulates unhealthy lifestyle behaviors. Epidemiologically, high vagal activity, indexed by greater heart rate variability (HRV), independently predicts reduced risk of GBD and better prognosis in GBD. Biologically, the vagus nerve inhibits oxidative stress, inflammation and sympathetic activity (and associated hypoxia). Finally, current non-invasive methods exist to activate this nerve for neuro-modulation, and have promising clinical effects. Indeed, preliminary evidence exists for the beneficial effects of vagal nerve activation in diabetes, stroke, myocardial infarction and possibly cancer. Thus, we propose to routinely implement measurement of HRV to predict such GBD in populations, and to test in randomized controlled trials effects of non-invasive vagal nerve activation on prevention and treatment of GBD, reflecting possible neuro-modulation of health.

Keywords: global burden of diseases; neuroimmunology; neuromodulation; vagal nerve; prediction; prevention

1. The Problem

Major non-communicable causes of death and of years of life lost today include coronary heart disease (CHD), stroke, cancer and pulmonary diseases [1]. Many risk factors (pollution, smoking, diet-driven cholesterol, insufficient exercise, etc.) explain a large proportion of major global burden of diseases—GBD (e.g., [2]). Furthermore, many of these diseases have common underlying biological causes, as we shall see below.

While modernization has brought many positive developments (e.g., transportation, huge improvements in disease detection and treatment, immense improvements in access to information via
Outcomes from magnetic resonance imaging-confirmed symptomatic cervical disk herniation patients treated with high-velocity, low-amplitude spinal manipulative therapy: a prospective cohort study with 3-month follow-up.

Peterson CK, Schmid C, Leemann S, Anklin B, Humphreys BK.

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Abstract

OBJECTIVE: The purpose of this study was to investigate outcomes of patients with cervical radiculopathy from cervical disk herniation (CDH) who are treated with spinal manipulative therapy.

METHODS: Adult Swiss patients with neck pain and dermatomal arm pain; sensory, motor, or reflex changes corresponding to the involved nerve root; and at least 1 positive orthopaedic test for cervical radiculopathy were included. Magnetic resonance imaging-confirmed CDH linked with symptoms was required. Baseline data included 2 pain numeric rating scales (NRSs), for neck and arm, and the Neck Disability Index (NDI). At 2 weeks, 1 month, and 3 months after initial consultation, patients were contacted by telephone, and the NDI, NRSs, and patient's global impression of change data were collected. High-velocity, low-amplitude spinal manipulations were administered by experienced doctors of chiropractic. The proportion of patients responding "better" or "much better" on the patient's global impression of change scale was calculated. Pretreatment and posttreatment NRSs and NDIs were compared using the Wilcoxon test. Acute vs subacute/chronic patients' NRSs and NDIs were compared using the Mann-Whitney U test.

RESULTS: Fifty patients were included. At 2 weeks, 55.3% were "improved," 68.9% at 1 month and 85.7% at 3 months. Statistically significant decreases in neck pain, arm pain, and NDI scores were noted at 1 and 3 months compared with baseline scores (P < .0001). Of the subacute/chronic patients, 76.2% were improved at 3 months.
CONCLUSIONS: Most patients in this study, including subacute/chronic patients, with symptomatic magnetic resonance imaging-confirmed CDH treated with spinal manipulative therapy, reported significant improvement with no adverse events.

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KEYWORDS: Chiropractic; Intervertebral Disk Displacement; Manipulation; Neck Pain; Spine

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Outcomes of acute and chronic patients with magnetic resonance imaging-confirmed symptomatic lumbar disc herniations receiving high-velocity, low-amplitude, spinal manipulative therapy: a prospective observational cohort study with one-year follow-up.

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Abstract
OBJECTIVE: The purposes of this study were to evaluate patients with low-back pain (LBP) and leg pain due to magnetic resonance imaging-confirmed disc herniation who are treated with high-velocity, low-amplitude spinal manipulation in terms of their short-, medium-, and long-term outcomes of self-reported global impression of change and pain levels at various time points up to 1 year and to determine if outcomes differ between acute and chronic patients using a prospective, cohort design.

METHODS: This prospective cohort outcomes study includes 148 patients (between ages of 18 and 65 years) with LBP, leg pain, and physical examination abnormalities with concordant lumbar disc herniations. Baseline numerical rating scale (NRS) data for LBP, leg pain, and the Oswestry questionnaire were obtained. The specific lumbar spinal manipulation was dependent upon whether the disc herniation was intraforaminal or paramedian as seen on the magnetic resonance images and was performed by a doctor of chiropractic. Outcomes included the patient's global impression of change scale for overall improvement, the NRS for LBP, leg pain, and the Oswestry questionnaire at 2 weeks, 1, 3, and 6 months, and 1 year after the first treatment. The proportion of patients reporting "improvement" on the patient's global impression of change scale was calculated.
for all patients and acute vs chronic patients. Pretreatment and posttreatment NRS scores were compared using the paired t test. Baseline and follow-up Oswestry scores were compared using the Wilcoxon test. Numerical rating scale and Oswestry scores for acute vs chronic patients were compared using the unpaired t test for NRS scores and the Mann-Whitney U test for Oswestry scores. Logistic regression analysis compared baseline variables with "improvement."

**RESULTS:** Significant improvement for all outcomes at all time points was reported (P < .0001). At 3 months, 90.5% of patients were "improved" with 88.0% "improved" at 1 year. Although acute patients improved faster by 3 months, 81.8% of chronic patients reported "improvement" with 89.2% "improved" at 1 year. There were no adverse events reported.

**CONCLUSIONS:** A large percentage of acute and importantly chronic lumbar disc herniation patients treated with chiropractic spinal manipulation reported clinically relevant improvement.

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**KEYWORDS:** Chiropractic; Intervertebral Disc Displacement; Lumbar Vertebrae Manipulation, Spinal


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Publication types, MeSH terms

LinkOut - more resources
CLINICAL PRACTICE. Herniated Lumbar Intervertebral Disk.

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Hincapié CA, Tomlinson GA, Côté P, Rampersaud YR, Jadad AR, Cassidy JD.

Abstract

PURPOSE: Chiropractic care is popular for low back pain, but may increase the risk for acute lumbar disc herniation (LDH). Low back pain is a common early (prodromal) symptom of LDH and commonly precedes LDH diagnosis. Our objective was to investigate the association between chiropractic care and acute LDH with early surgical intervention, and contrast this with the association between primary care physician (PCP) care and acute LDH with early surgery.

METHODS: Using a self-controlled case series design and population-based healthcare databases in Ontario, Canada, we investigated all adults with acute LDH requiring emergency department (ED) visit and early surgical intervention from April 1994 to December 2004. The relative incidence...
RESULTS: 195 cases of acute LDH with early surgery (within 8 weeks) were identified in a population of more than 100 million person-years. Strong positive associations were found between acute LDH and both chiropractic and PCP visits. The risk for acute LDH with early surgery associated with chiropractic visits was no higher than the risk associated with PCP visits.

CONCLUSIONS: Both chiropractic and primary medical care were associated with an increased risk for acute LDH requiring ED visit and early surgery. Our analysis suggests that patients with prodromal back pain from a developing disc herniation likely seek healthcare from both chiropractors and PCPs before full clinical expression of acute LDH. We found no evidence of excess risk for acute LDH with early surgery associated with chiropractic compared with primary medical care.

KEYWORDS: Chiropractic; Epidemiologic methods; Intervertebral disc displacement; Low back pain; Primary health care; Risk

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[Indexed for MEDLINE]

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Abstract
Cervical artery dissection refers to a tear in the internal carotid or the vertebral artery that results in an intramural haematoma and/or an aneurysmal dilatation. Although cervical artery dissection is thought to occur spontaneously, physical trauma to the neck, especially hyperextension and rotation, has been reported as a trigger. Headache and/or neck pain is the most common initial symptom of cervical artery dissection. Other symptoms include Horner's syndrome and lower cranial nerve palsy. Both headache and/or neck pain are common symptoms and leading causes of disability, while cervical artery dissection is rare. Patients often consult their general practitioner for headache and/or neck pain, and because manual-therapy interventions can alleviate headache and/or neck pain, many patients seek manual therapists, such as chiropractors and physiotherapists. Cervical mobilization and manipulation are two interventions that manual therapists use. Both interventions have been suspected of being able to trigger cervical artery dissection as an adverse event. The aim of this review is to provide an updated step-by-step risk-benefit assessment strategy regarding manual therapy and to provide tools for clinicians to exclude cervical artery dissection. Key messages Cervical mobilization and/or manipulation have been suspected to be able to trigger cervical artery dissection (CAD). However, these assumptions are based on case studies which are unable to established direct causality. The concern relates to the chicken and the egg discussion, i.e. whether the CAD symptoms lead the patient to seek cervical manual-therapy or whether the cervical manual-therapy provoked CAD along with the non-CAD presenting complaint. Thus, instead of proving a nearly impossible causality hypothesis, this study provide clinicians with an updated step-by-step risk-benefit assessment strategy tool to (a) facilitate...
clinicians understanding of CAD, (b) appraise the risk and applicability of cervical manual-therapy, and (c) provide clinicians with adequate tools to better detect and exclude CAD in clinical settings.

**KEYWORDS:** Cervical artery dissection; carotid artery dissection; manipulation; manual-therapy; stroke; vertebral artery dissection

PMID: 30889367 DOI: [10.1080/07853890.2019.1590627](https://doi.org/10.1080/07853890.2019.1590627)
Dear Patient:

Every type of health care is associated with some risk of a potential problem. This includes chiropractic health care. We want you to be informed about potential problems associated with chiropractic health care before consenting to treatment. This is a legal requirement in California. This is called informed consent.

Chiropractic adjustments are the moving of bones with the doctor's hands or with the use of a mechanical device or machine. Frequently adjustments create a “pop” or “click” sound/sensation in the area being treated.

In this office we use trained staff personnel to assist the doctor with portions of your consultation, examination, x-ray taking, physical therapy application, traction, massage therapy, exercise instruction, etc. Occasionally when your doctor is unavailable, another clinic doctor will treat you on that day.

**Stroke:** Stroke means that a portion of the brain or spinal cord does not receive enough oxygen from the blood stream. The results can be temporary or permanent dysfunction of the brain, with a very rare complication of death. The literature is mixed or uncertain as to whether chiropractic adjustments are associated with stroke or not. Recent evidence suggests that it is not (2008, 2015, 2016), although the same evidence suggests that the patient may be entering the chiropractic office for neck pain/headaches or other symptoms that may in fact be a spontaneous dissection of the vertebral artery. If we think this is happening, you will be immediately referred to emergency services.

Anecdotal stories suggest that chiropractic adjustments may be associated with strokes that arise from the vertebral artery; this is because the vertebral artery is actually located inside the neck vertebrae. The adjustment that is suggested to increase the strain on the vertebral artery is called the “extension-rotation-thrust atlas adjustment.” We do not do this type adjustment on patients. Other types of neck adjustments may also potentially be related to vertebral artery strokes, but no one is certain. It is estimated that the incidence of this type of stroke ranges between 1 per every 400,000-3,000,000 upper neck adjustments. This means that an average chiropractor would have to be in practice for hundreds of years before they would statistically be associated with a single patient stroke.

Two other potential problems that are *not* quantifiable because they are extremely rare and may have no association with chiropractic adjusting are carotid artery injury and spinal dural tear resulting in a leak of cerebral spinal fluid.

**Disc Herniations:** Disc herniations that create pressure on the spinal nerve or on the spinal cord are frequently successfully treated by chiropractors and chiropractic adjustments, traction, etc. This includes both in the neck and back. Yet, occasionally chiropractic treatment (adjustments, traction, etc.) will aggravate the problem and rarely surgery may become necessary for correction. These problems occur so rarely that there are no available statistics to quantify their incidence.

**Cauda Equina Syndrome:** Cauda Equina Syndrome occurs when a low back disc problem puts pressure on the nerves that control bowel, bladder, and sexual function. Representative symptoms include leaky bladder, or leaky bowels, or loss of sensation (numbness) around the pelvic sexual organs (the saddle area), or the inability to urinate or to start a bowel movement. Cauda Equina Syndrome is a medical emergency because the nerves that control these functions can permanently die, and those functions may be lost or compromised forever. The standard approach is to surgically decompress the nerves, and the window to do so may be as short as 12-72 hours,
depending. If you have any of these symptoms, tell us immediately, and if we can’t be reached, go the emergency department.

**Soft Tissue Injury:** Soft tissues primarily refer to muscles and ligaments. Muscles move bones and ligaments limit joint movement. Rarely a chiropractic adjustment, traction, massage therapy, etc., may overstretch some muscle or ligament fibers. The result is a temporary increase in pain and necessary treatments for resolution, but there are no long term affects for the patient. These problems occur so rarely that there are no available statistics to quantify their incidence.

**Rib and other Fractures:** The ribs are found only in the thoracic spine or middle back. They extend from your back to your front chest area. Rarely a chiropractic adjustment will crack a rib bone, and this is referred to as a fracture. This occurs only on patients that have weakened bones from such things as osteoporosis. Osteoporosis can be noted on your x-rays. We adjust all patients very carefully, and especially those who have osteoporosis on their x-rays. These problems occur so rarely that there are no available statistics to quantify their incidence.

**Physical Therapy Burns:** Some of the machines we use generate heat. We also use both heat and ice, and recommend them for home care on occasion. Everyone's skin has different sensitivity to these modalities, and rarely, both heat or ice can burn or irritate the skin. The result is a temporary increase in pain, and there may even be some blistering of the skin. These problems occur so rarely that there are no available statistics to quantify their incidence. Never put a home ice pack directly on the skin, always have an insulating towel between.

**Soreness:** It is common for chiropractic adjustments, traction, massage therapy, exercise, etc. to result in a temporary increase in soreness in the region being treated. This is nearly always a temporary symptom that occurs while your body is undergoing therapeutic change. It is not dangerous, but please do tell your doctor about it.

**Other Problems:** There may be other problems or complications that might arise from chiropractic treatment other than those noted above. These other problems or complications occur so rarely that it is not possible to anticipate and/or explain them all in advance of treatment.

Chiropractic is a system of health care delivery, and, therefore, as with any health care delivery system we cannot promise a cure for any symptom, disease, or condition as a result of treatment in this clinic. We will always give you our best care, and if results are not acceptable, we will refer you to another provider whom we feel will assist your situation.

If you have any questions on the above, please ask your doctor. When you have a full understanding, please sign and date below.

__________________________________________________________  __________
Patient's Name Printed                              Today's Date

__________________________________________________________
Patient's Signature                                Parent or Guardian Signature For Minor