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Vertebral Subluxation Complex - The Research

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Chiropractic Vertebral Subluxation

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A report on the scientific literature

INTRODUCTION

Chiropractic was discovered in 1895 by Daniel David Palmer and further developed by his son, Bartlett James Palmer. Together, they helped coin the phrase "vertebral subluxation," yet to date, there has been little evidence of it in the literature. When we consider neuro-biomechanical pathological lesions that will degenerate (please refer to Wolff's Law) based upon homeostatic mechanisms in the human body we will better understand and be able to define the chiropractic vertebral subluxation and more specifically, the chiropractic vertebral subluxation complex (VSC). In addition, the literature has provided us with a vast amount of evidence on both the biomechanical dysfunction of the spine as well as the neurological consequence as sequelae to that biomechanical dysfunction.

Despite over a century of reported and literature-based clinical results, detractors both outside and inside the chiropractic profession argue to limit the scope of these spinal lesions because the literature has not yet caught up to the results. Additionally, the lack of contemporary literature has been reflected in "underperforming" chiropractic utilization in the United States for conditions that have been well-documented as responding successfully in outcome studies with chiropractic care.

Murphy, Justice, Paskowski, Perle and Schneider (2011) reported:

Spine-related disorders (SRDs) are among the most common, costly and disabling problems in Western society. For the purpose of this commentary, we define SRDs as the group of conditions that include back pain, neck pain, many types of headache, radiculopathy, and other symptoms directly related to the spine. Virtually 100% of the population is affected by this group of disorders at some time in life. Low back pain (LBP) in the adult population is estimated to have a point prevalence of 28%-37%, a 1-year prevalence of 76% and a lifetime prevalence of 85%. Up to 85% of these individuals seek care from some type of health professional. Two-thirds of adults will experience neck pain some time in their lives with 22% having neck pain at any given point in time.

The burden of SRDs on individuals and society is huge. Direct costs in the United States (US) are US\$10 billion annually and \$14 billion in lost wages were estimated for the years 2002-4. (p. 1)

In 2017, based upon Alioth Education, dollars adjusted for inflation equates to \$18,141, 895,182.64 in direct costs for spinal-related conditions that fall within the chiropractic treatment category and have proven to outperform other forms of care. When considering outcome assessments for efficacy of chiropractic in a population-based study, both Cifuentes, Willets and Wasiak (2011) and Blanchette, Rivard, Dionne, Hogg-

Johnson, and Steenstra (2017) offered evidence that the results are rooted in a "first healthcare provider" or "primary spine care" solution.

Cifuentes et al. (2011) compared different treatments of recurrent or chronic low back pain. They considered any condition recurrent or chronic if there was a recurrent disability episode after a 15-day absence and return to disability. Anyone with less than a 15-day absence of disability was excluded from the study. Please note that we kept disability outcomes for all reported treatment and did not limit this to physical therapy. However, the statistic for physical therapy was significant.

According to the Cifuentes, Willets and Wasiak (2011) study, chiropractic care during the disability episode resulted in:

- **24% decrease in disability duration of first episode compared to physical therapy.**
- **250% decrease in disability duration of first episode compared to medical physician's care.**
- **32% decrease in average weekly cost of medical expenses during disability episode compared to physical therapy care.**
- **21% decrease in average weekly cost of medical expenses during disability episode compared to medical physician's care.**

Cifuentes et al. (2011) started by stating, "Given that chiropractors are proponents of health maintenance care...patients with work-related LBP [low back pain] who are treated by chiropractors would have a lower risk of recurrent disability because that specific approach would be used" (p. 396). The authors concluded by stating, "After controlling for demographic factors and multiple severity indicators, patients suffering nonspecific work-related LBP who received health services mostly or only from a chiropractor had a lower risk of recurrent disability than the risk of any other provider type" (Cifuentes et al., 2011, p. 404).

Blanchette, Rivard, Dionne, Hogg-Johnson and Steenstra (2017) reported:

The type of first healthcare provider was a significant predictor of the duration of the first episode of compensation only during the first 5 months of compensation. When compared with medical doctors, chiropractors were associated with shorter durations of compensation and physiotherapists with longer ones. Physiotherapists were also associated with higher odds of a second episode of financial compensation. (p. 388)

Despite compelling evidence of chiropractic being the best option for primary spine care treatment of injuries related to disabilities and pain based upon outcomes, the reasons why chiropractic works have been elusive. Despite the lack of literature-based evidence, answers are still being sought because positive results are consistently being realized in clinical chiropractic practices. When Keating et al. (2005) wrote an opinion or debate article, they concluded, "Subluxation syndrome is a legitimate, potentially testable, theoretical construct for which there is little experimental evidence" (p. 13).

This statement is one of the most unifying statements that could serve to reduce pain and opiate utilization, prevent premature degeneration and increase bio-neuromechanical function for our society, while significantly increasing our utilization because chiropractic is part of the answer. However, the simple question is, "Why aren't we doing this specific research because the pieces of what is considered subluxation have been verified in the literature for quite some time?"

DISCUSSION

VSC starts with spinal biomechanics and when considering a pathological model, we need to define the normal functioning of the spine.

Panjabi (2006) reported:

The spinal column, consisting of ligaments (spinal ligaments, discs annulus and facet capsules) and vertebrae, is one of the three subsystems of the spinal stabilizing system. The other two are the spinal muscles and neuromuscular control unit. The spinal column has two functions: *structural* and *transducer*. The structural function provides stiffness to the spine. The transducer function provides the information needed to precisely characterize the spinal posture, vertebral motions, spinal loads etc. to the neuromuscular control unit via innumerable mechanoreceptors present in the spinal column ligaments, facet capsules and the disc annulus. These mechanical transducers provide information to the neuromuscular control unit which helps to generate muscular spinal stability via the spinal muscle system and neuromuscular control unit. The criterion used by the neuromuscular unit is hypothesized to be the need for adequate and overall mechanical stability of the spine. If the structural function is compromised, due to injury or degeneration, then the muscular stability is increased to compensate the loss. (p. 669)

Panjabi (2003) also reported:

It has been conceptualized that the overall mechanical stability of the spinal column, especially in dynamic conditions and under heavy loads, is provided by the spinal column and the precisely coordinated surrounding muscles. As a result, the spinal stabilizing system of the spine was conceptualized by Panjabi to consist of three subsystems: spinal column providing intrinsic stability, spinal muscles, surrounding the spinal column, providing dynamic stability, and neural control unit evaluating and determining the requirements for stability and coordinating the muscle response. (p. 372)

In defining spinal clinical instability, Panjabi (1992) previously reported:

Clinical instability is defined as a significant decrease in the capacity of the stabilizing system of the spine to maintain the intervertebral neutral zones within the physiological limits so that there is no neurological dysfunction, no major deformity, and no incapacitating pain. (p. 394)

Anatomically, we are starting with the vertebrate and more specifically, the articular facets indicating that VSI is a "complex" and not a simple problem as the anatomical pathology occurs in opposing facets. When looking at normal vertebral structures, Farrell, Osmotherly, Cornwall, Sterling and Rivett (2017) focused their study on the cervical spine.

Farrell et al. (2017) reported:

Cervical spine meniscoids, also referred to as synovial folds or intra-articular inclusions, are folds of synovium that extend between the articular surfaces of the joints of the cervical spine. These structures have been identified within cervical zygapophyseal, lateral atlantoaxial and atlanto-occipital joints, and have been hypothesized to be of clinical significance in neck pain through their mechanical impingement or displacement, as a result of fibrotic changes, or via injury as a result of trauma to the cervical spine. (p. 939)

Farrell et al. (2017) later stated:

An understanding of the basic structure of meniscoids is necessary to assess their potential role in cervical spine pathology. As described above, cervical spine meniscoids are folds of synovium that protrude into a joint from its margins. Meniscoids lie between the articular surfaces at the ventral and dorsal poles of their enclosing joint. Their basic structure includes a base, which attaches to the joint capsule, a middle region and an apex that protrudes approximately 1–5 mm into the joint cavity. In sagittal cross section, these structures are triangular in shape, and when viewed superiorly they often appear crescent-shaped or semi-circular. Cervical spine meniscoids are thought to function to improve

the congruence of articular structures, and to ensure the lubrication of articular surfaces with synovial fluid. (p. 940)

Should these synovial folds or "plicas" become trapped or "pinched" as described by Evans (2002), it would be the beginning of a "negative neurological cascade."

Evans (2002) reported:

Intra-articular formations have been identified throughout the vertebral column. Giles and Taylor demonstrated by light and transmission electron microscopy the presence of nerve fibers (0.6 to 1 mm diameter) coursing through synovial folds, remote from blood vessels, that were most likely nociceptive. They concluded, "Should the synovial folds become pinched between the articulating facet surfaces of the zygapophyseal joint, the small nerves demonstrated in this study may have clinical importance as a source of low back pain." (p. 252)

Figure 4: Images of meniscoid entrapment on flexion, on attempted extension, involving flexion and gapping and realigned.

Evans (2002) explained the images above as follows:

Meniscoid entrapment. 1) On flexion, the inferior articular process of a zygapophyseal joint moves upward, taking a meniscoid with it. 2) On attempted extension, the inferior articular process returns toward its neutral position, but instead of re-entering the joint cavity, the meniscoid impacts against the edge of the articular cartilage and buckles, forming a space-occupying "lesion" under the capsule. Pain occurs as a result of capsular tension, and extension is inhibited. 3) Manipulation of the joint involving flexion and gapping, reduces the impaction and opens the joint to encourage re-entry of the meniscoid into the joint space (4) [Realignment of the joint.] (p. 253)

Evans (2002) continued:

Bogduk and Jull reviewed the likelihood of intra-articular entrapments within zygapophyseal joints as potential sources of pain...Fibro-adipose meniscoids have also been identified as structures capable of creating a painful situation. Bogduk and Jull reviewed the possible role of fibro-adipose meniscoids causing pain purely by creating a tractioning effect on the zygapophyseal joint capsule, again after intra-articular pinching of tissue(p. 252)

Evans (2002) also noted:

A large number of type III and type IV nerve fibers (nociceptors) have been observed within capsules of zygapophyseal joints. Pain occurs as distension of the joint capsule provides a sufficient stimulus for these nociceptors to depolarize. Muscle spasm would then occur to prevent impaction of the meniscoid. The patient would tend to be more comfortable with the spine maintained in a flexed position, because this will disengage the meniscoid. Extension would therefore tend to be inhibited. This condition has also been termed a "joint lock" or "facet-lock," the latter of which indicates the involvement of the zygapophyseal joint...

An HVLAT manipulation [chiropractic spinal adjustment CSA], involving gapping of the zygapophyseal joint, reduces the impaction and opens the joint, so encouraging the meniscoid to return to its normal anatomic position in the joint cavity. This ceases the distension of the joint capsule, thus reducing pain. (p. 252-253)

When considering VSC in its entirety, we must consider the etiology as these forces can lead to complex path biomechanical components of the spine and supporting tissues. As a result, a neurological cascade can ensue that would further define VSC beyond the inter-articulation entrapments. Panjabi (2006) reported:

Abnormal mechanics of the spinal column has been hypothesized to lead to back pain via nociceptive sensors. The path from abnormal mechanics to nociceptive sensation may go via inflammation, biochemical and nutritional changes, immunological factors, and changes in the structure and material

of the endplates and discs, and neural structures, such as nerve ingrowth into diseased intervertebral disc. The abnormal mechanics of the spine may be due to degenerative changes of the spinal column and/or injury of the ligaments. Most likely, the initiating event is some kind of trauma involving the spine. It may be a single trauma due to an accident or microtrauma caused by repetitive motion over a long time. It is also possible that spinal muscles will fire in an uncoordinated way in response to sudden fear of injury, such as when one misjudges the depth of a step. All these events may cause spinal ligament injury. (p.668-669).

Panjabi (2006) goes on to explain what happens when the spinal column is affected by trauma:

The structural function provides stiffness to the spine. The transducer function provides the information needed to precisely characterize the spinal posture, vertebral motions, spinal loads etc. to the neuromuscular control unit via innumerable mechanoreceptors present in the spinal column ligaments, facet capsules and the disc annulus. These mechanical transducers provide information to the neuromuscular control unit which helps to generate muscular spinal stability via the spinal muscle system and neuromuscular control unit. The criterion used by the neuromuscular unit is hypothesized to be the need for adequate and overall mechanical stability of the spine. If the structural function is compromised, due to injury or degeneration, then the muscular stability is increased to compensate the loss. What happens if the *transducer* function of the ligaments of the spinal column is compromised? This has not been explored. There is evidence from animal studies that the stimulation of the ligaments of the spine (disc and facets, and ligaments) results in spinal muscle firing. (p. 669).

Panjabi (2006) described the mechanism that, coupled with the inter-articulation nociceptor "firing," further defines the "negative neurological cascade":

The hypothesis consists of the following sequential steps:

1. Single trauma or cumulative microtrauma causes *subfailure injury* of the spinal ligaments and injury to the mechanoreceptors embedded in the ligaments.
2. When the injured spine performs a task or it is challenged by an external load, the transducer signals generated by the mechanoreceptors are corrupted.
3. Neuromuscular control unit has difficulty in interpreting the corrupted transducer signals because there is a spatial and temporal mismatch between the normally expected and the corrupted signals received.
4. The muscle response pattern generated by the neuromuscular control unit is corrupted, affecting the spatial and temporal coordination and activation of each spinal muscle.
5. The corrupted muscle response pattern leads to corrupted feedback to the control unit via tendon organ of muscles and injured mechanoreceptors, further corrupting the muscle response pattern.
6. The corrupted muscle response pattern produces high stresses and strains in spinal components leading to further subfailure injury of the spinal ligaments, mechanoreceptors and muscles, and overload of facet joints.
7. The abnormal stresses and strains produce inflammation of spinal tissues, which have abundant supply of nociceptive sensors and neural structures.
8. Consequently, over time, chronic back pain may develop. The *subfailure injury* of the spinal ligament is defined as an injury caused by stretching of the tissue beyond its physiological limit, but less than its failure point. (p. 669-670)

One hallmark of determining vertebral subluxation complex for the chiropractic profession has been ranges of motion of individual motor units. Both hypo- and hypermobility have been clinically associated with muscle spasticity and have offered a piece of clinical history in the practice setting. *NOTE: Ranges of motion, like any other findings, are no more than pieces of evidence, all of which must clinically correlate.*

Radzimska, Weber-Rajek, Srączyńska and Zukow (2017) reported:

The definition of the neutral zone explains that it is a small range of motion near the zero position of the joint, where no proprioceptors are stimulated around the joint and osteoligamentous resistance is minimal (lack of centripetal response and, consequently, lack of central muscle stimulation).

Increasing the range of motion of the neutral zone is detrimental to the joint - it can lead to its damage. Delayed proprioceptive information about the current joint position that reaches the central system wi

give a muscle tone response, but it may turn out to be incompatible with external force acting on the joint. The reduced range of motion of the neutral zone is also unfavorable. If the stimulation of proprioceptors is too early it will result in an increased muscle tension around the joint. The neutral zone is disturbed by traumas, degenerative processes, and muscle stabilization weakness. (p. 72)

With VSC, the joint that has been misplaced creates abnormal biomechanics and abnormal pressure to the joint. This is called Wolff's Law, formulated and accepted since the 1800's, and is explained by Kohata, Itoha, Horiuchia, Yoshiokab and Yamashita (2017):

When mechanical stress is impressed upon bone, an electrical potential is induced; the area of bone under compression develops negative potential, whereas that under tension develops positive potential. This phenomenon is generated by collagen piezoelectricity, and the electrical potential generated in bone by collagen displacement has been well documented. (p. 65)

CONCLUSION

VSC is based upon both the macro- and microtrauma induced motor unit pathology, creating interarticular meniscoid nociceptor entrapment that triggers nociceptors and affects the lateral horn for a local reflex. It then innervates the thalamus through the spinothalamic tracts and periaqueductal grey matter which is then further distributed to various cortical regions to process in the body's attempt to compensate biomechanically. This, coupled with aberrant motor unit ranges of motion (hypo or hyper), subfailure injuries to the ligaments and the corrupted mechanoreceptors and nociceptor messages that innervate the lateral horn cause a "negative neurological cascade" both reflexively at the cord and the brain. This cascade can cause pain and inflammation and will cause premature degeneration if left uncorrected based upon Wolff's Law because of improper motor unit biomechanical failure. Should the correction be made after remodelling of the vertebral then care changes from corrective to management as the spine can never be perfectly biomechanically balanced as the segments (building blocks for homeostasis) have been permanently remodelled.

The research for VSC exists in its components. However, there needs to be a concise research program that combines all the pieces to further conclude the evidence that exists. Furthermore, we need more conclusive answers as to why chiropractic patients get well, answers that goes beyond pain or aberrant curves.

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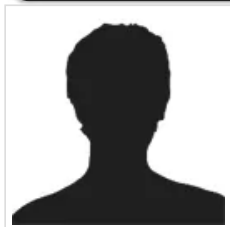
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