



The Chiropractic Vertebral Subluxation

Part 9: Complexes, Models, and Consensus

From 1979 to 1995

Simon A. Senzon, MA, DC

ABSTRACT

Objective: The purpose of this paper is to review and discuss the history of chiropractic vertebral subluxation (CVS) between 1979 and 1995, with an emphasis on complexes, models, and consensus.

Discussion: New models were developed and critiqued during this period. The first subluxation complex model was proposed by Faye. Other theorists such as Lantz and Dishman built upon his model. The complex models were integrated into consensus statements by the International Chiropractic Association and the American Chiropractic Association, and later by profession-wide processes. The plurality of the CVS encompassed known theories and included integration of stress models and biochemistry. The professional consensus around CVS was comprehensive as shown by the process models that included stakeholders in the profession. Calls for more empirical research and changes to terminology increased during this era. Influential articles from this period potentially contained errors and relied on older studies that may no longer be valid.

Conclusion: The challenges to researching this complex entity during that time were daunting for many and pointed to challenges of using the word “subluxation” to encompass the multiplicity that defined CVS. (*J Chiropr Humanit* 2018;25C:130-145)

Key Indexing Terms: *Chiropractic; History*

INTRODUCTION

Between 1979 and 1995, chiropractic vertebral subluxation (CVS) theories developed greater complexity and new theoretical models and were defined by several significant consensus statements, even while the terminology continued to be critiqued. In 1983, Leonard J. Faye published *Motion Palpation of the Spine*, which described the subluxation complex (SC) for the first time.¹ Other authors updated his model, such as Dishman’s chiropractic subluxation complex (CSC)² and Lantz’s vertebral subluxation complex (VSC).^{3,4} New models were developed during this period. Examples include Barge’s models⁵⁻⁹; Gitelman’s models¹⁰; Reinert’s cervical, lumbar, and sacral models¹¹⁻¹³; J. D. Grostic’s dentate ligament hypothesis¹⁴; and Gatterman’s extension of the fixation model to focus on pain.¹⁵

In the late 1980s, the American Chiropractic Association (ACA) and the International Chiropractic Association (ICA) developed separate CVS definitions.^{16,17} In the

early 1990s, Gatterman organized a conference around terminology at Canadian Memorial Chiropractic College (CMCC).¹⁸ By 1993, the consensus processes expanded to include stakeholders from chiropractic schools and organizations using consensus group processes, which led to several different definitions as well as textbooks.^{19,20}

The purpose of this article is to describe contributions to CVS theory, integrative approaches, and the CVS viewed as a complex. The discussion examines limitations of the critical literature, commonalities of models, and new perspectives. This paper contrasts some of the arguments about validity, which originated during this period, with recent approaches to CVS research.

DISCUSSION

CVS Models (1979-1995)

Four novel contributions to CVS theory emerged between 1981 and 1995. These models follow “lineages” that build upon previous theories. These theoretical lines include the Palmer line, the Loban line, the Gregory line, and the Canadian line (Fig 1).

Barge’s Model. Fred Barge graduated from the Palmer School of Chiropractic (PSC) in 1954 and completed 9 months of postgraduate studies in technic at Logan Chiropractic College (Logan) in 1955. He interned with Clarence Gonstead in the Gonstead Clinic at Mount Horeb.

School of Health and Human Sciences, Southern Cross University, Lismore, New South Wales, Australia.

Corresponding author: Simon A. Senzon, MA, DC, 218 E Chestnut Street, Asheville, NC 28801. Tel.: +1 828 251 0815.

(e-mail: Simon@institutechiro.com).

Paper submitted May 18, 2016; accepted May 15, 2018.
1556-3499

Copyright © 2018 by National University of Health Sciences.

<https://doi.org/10.1016/j.echu.2018.10.007>

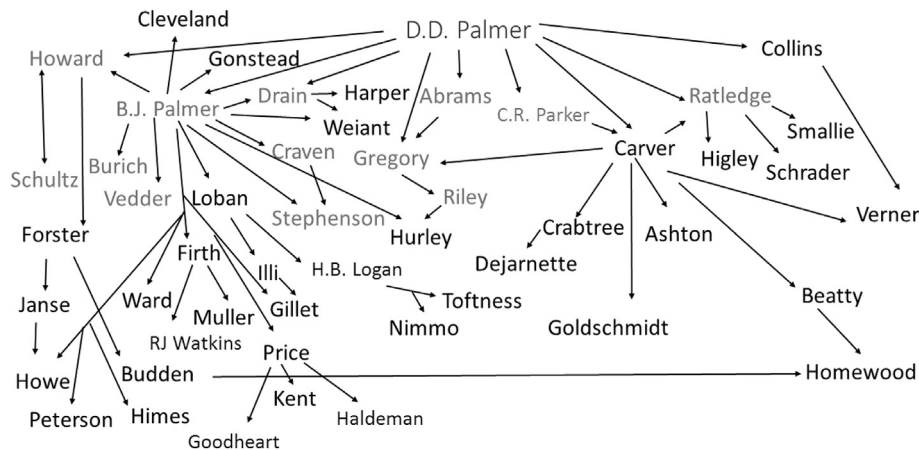


Fig 1. Teacher–student relationships originating from D. D. Palmer.

Barge was the ninth member of his family to become a chiropractor. His father, Henry Barge, graduated from PSC in 1923. He and his father practiced together in LaCrosse, Wisconsin, starting in 1957²¹ (Fig 2). Barge wrote a postgraduate thesis for his philosopher of chiropractic degree from PSC in 1965. This degree was awarded at PSC from 1908 until 1968.²² Barge’s thesis was based on his research into disc lesion CVS and was titled *Tortipelvis and the Intervertebral Disc Syndrome*.⁸ Between 1979 and 1982, Barge published 3 books based on his research to determine the major causes of “idiopathic” rotatory scoliosis. The books were titled *Torticollis*,⁵ *Scoliosis*,⁶ and *Tortipelvis: The Slipped Disc Syndrome; Its Cause and Correction*.⁷

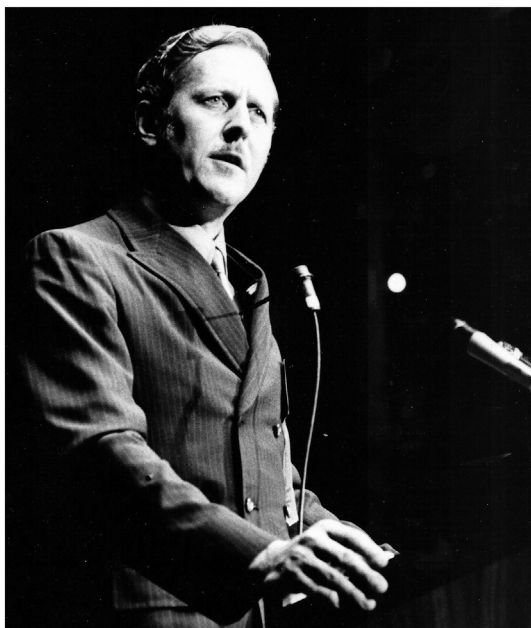


Fig 2. Fred Barge.

Barge considered CVS the integrator of science, art, and philosophy in chiropractic.⁸ In this, he highlighted the neurological element, including B. J. Palmer’s emphasis on interference,^{23,24} even though Barge largely attributed the interference concept to D. D. Palmer.⁸ He considered CVS to be involved in all known diseases not only when it was primary in the disease process but also when “subluxation plays its part in the body’s comprehension of the so-called disease or disease syndromes.”⁸ Pain syndromes and organic malfunctions were often the result of spinal fault or CVS (Fig 3).

In his 1987 book, *Life Without Fear*,⁸ Barge emphasized the radiographic analysis of CVS in relation to scoliosis, especially what he termed the disc block scoliosis or the wedging and rotational malposition leading to a narrowing of the foramina.⁸ He cited Sunderland, Cailliet, and Jackson, as well as chiropractic sources from Stephenson to the Palmers and from Homewood to Janse to emphasize the neurological interference associated with such a scoliotic CVS.⁸

In his 1990 book, *One Cause, One Cure*, Barge expanded on several important ideas related to CVS, such as its role as a primary cause of “tension,” leading to “aberration of internal functions,” setting the stage for “the

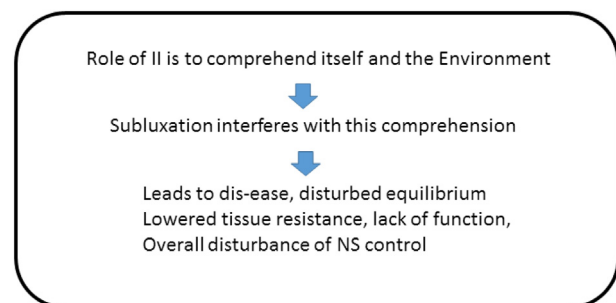


Fig 3. Barge’s model on II and subluxation etiology. II, Innate Intelligence; NS, nervous system.

Components of Subluxation	Abnormalities	Leads to
Hypermobility	• Failure of ligaments to restrain joint • ROM beyond natural limits • Altered structural attitude at the extremes of motion	• Neurological and circulatory disturbances • Encroachment on adjacent tissues
Hypomobility	• Fixation of joint • Chronic subluxation	• Pathological changes in joint surfaces
Structural Aberration	• Classic inter-articular disrelationship between joint surfaces • Joint components abnormally at rest and • “forced into an awry attitude” • Example: Lateral flexion malposition	• Inability for body to adapt and compensate

Fig 4. A. Reinert's 3 types of subluxation.

majority of disease syndromes.”⁹ In his book, he built upon the idea that the role of the body's Innate Intelligence was to comprehend itself and its environment. He suggested that the CVS interfered with this comprehension, leading to “dis-ease,” disturbed equilibrium, lowered tissue resistance, lack of function, and an overall disturbance in the nervous system's control of the body.⁹ He linked this theory to classic models from the PSC, including the Meric system, tone, and the 9 primary functions. Barge hypothesized that musculoskeletal pain syndromes were the body's way of warning, which might be used to direct the practitioner to the CVS. He emphasized the 4-part model developed by B. J. Palmer,²⁵ whereby CVS includes misalignment, occlusion, pressure, and interference.

Reinert's Theories (1984-1993). Otto Reinert graduated from Missouri Chiropractic College (MCC) in 1933. Reinert became dean of MCC in 1962 and then president. Henry Haring was president of MCC while Reinert was a student. Haring graduated from St. Louis Chiropractic College in 1926, during which time L. W. Ray was president and Alva Gregory was the lead teacher. The Palmer-Gregory Chiropractic College had merged with St. Louis Chiropractic College in 1913. Thus, Reinert's professional lineage can be traced back to Gregory, who was a student of Carver and learned from D. D. Palmer for 9 weeks.²⁶

In 1984, Reinert proposed a CVS model of the cervical spine C2 to C7.¹¹ To develop his model, Reinert integrated White and Panjabi's 1978 text on spinal biomechanics and several models of intervertebral discs from the 1970s.¹¹ He theorized that there were 3 important components to CVS: hypermobility, structural aberration, and hypomobility. He proposed that each was different and demanded individualized management. According to Reinert, hypermobility included a failure of ligaments to restrain the joint and a range of motion beyond natural limits. This could lead to

neurological and circulatory disturbances. Structural aberration was the classic interarticular disrelationship between joint surfaces. Hypomobility or fixation of the joint itself was suggested to be a chronic CVS with pathological changes. He explored the anatomy of each topic with diagrams and x-ray examples (Fig 4).¹¹

In 1988, Reinert published an article on the sacroiliac subluxation as a pretender.¹² He described a rationale based on research at Logan with motion studies, dissection, and full-spine x-ray. He wrote, “The hypothesis herein presented, that sacro-iliac ‘subluxation’ does not exist as a true entity.”¹² He purported that the apparent success of many techniques from Logan to Gonstead was due to indirect correction of lumbar CVS. The change in the lumbar influences any change in presumed sacral-iliac symptoms. Reinert challenged the profession to hold a conference on his findings to determine profession-wide agreement and standardization of methods.¹²

In 1993, Reinert expanded on his findings and proposed a hypothesis of the lumbar spine.¹³ Based on his selected references, he made a compelling case for the role of intervertebral disc in lumbar CVS. He referred to the process of correction as “discoplasty,” and he hypothesized that the nucleus of the disc shifts posterior with flexion, and with extension it may do the reverse. He proposed that this could lead to sacroiliac symptoms and suggested that passive extension should be used by chiropractors.¹³ Reinert's attempt to rewrite the anatomy of the sacral subluxation should be analyzed based on his use of the literature at the time.^{12,13}

His theory of the sacral pretender directly challenged the models that were central to Logan's Basic Technique. Logan described that the sacrum subluxated anterior and inferior.²⁷ Reinert felt this was impossible and that the observed symptoms were more likely due to a lumbar

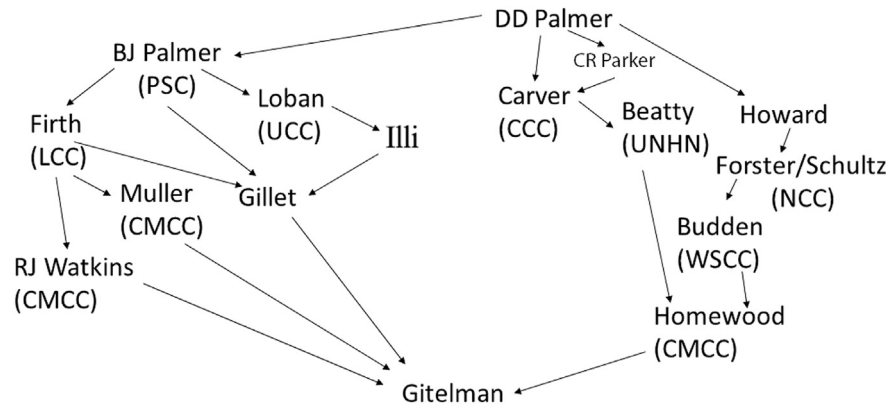


Fig 5. Teacher-student relationships from D. D. Palmer to Gitelman.

CVS.^{12,13} Reinert and Logan were forced to merge their schools in 1964.²⁶ Reinert became the head of the technic department at Logan,²⁶ and decades later, with this new theory about sacral subluxation, he worked to change the core theories of the Logan model.^{12,13}

Reinert's article "Sacro-iliac Subluxation: The Masked Pretender?" did not reference Kapandji's biomechanical studies of the sacroiliac joint or R. J. Watkins' papers on pelvic mechanics.^{28,29} Kapandji and Watkins both demonstrated sacroiliac motion in the 1960s. In 1995, Panzer and Gatterman published a chapter on the sacroiliac subluxation syndrome, which referenced Kapandji in their literature review.³⁰ The models of Watkins, Panzer, and Gatterman demonstrate that Reinert's sacroiliac hypothesis was not well supported by the literature. Reinert's other models of cervical and lumbar CVS may have merit for future study, model building, and technical application.^{11,13}

Gitelman's Somatovisceral Model (1984). Ron Gitelman was a 1961 graduate of CMCC and a student of both Homewood and Gillet (Fig 5). In 1965, he became the academic dean of CMCC, and from 1967 to 1977 he was director of research. Gitelman was instrumental in supporting research with Peterson's synchro-therme. In 1972, he started gathering "the archives" at CMCC with a focus on collecting all literature that supported the science of chiropractic³¹(Fig 5).

By 1984, Gitelman and Don Fitz-Ritson, a 1979 graduate of CMCC, suggested that based on scientific evidence, chiropractic had an important role to play in visceral disease.¹⁰ Gitelman and Fitz-Ritson described the intertwined connections between the autonomic system and somatic activities. They thought this was represented by intersegmental reflex mechanisms that were distributed throughout the body. They referred to the literature on somatovisceral reflexes in the work of Kuntz, Schmidt, Korr, Sato, and Coote. The last 2 authors had chapters in Haldeman's 1980 text, as did Gitelman.³² The 1984 article referred to CVS as a functional pathology of the locomotor system that may be related to visceral disorders via somatic sympathetic reflexes, intersegmental reflexes, and

suprasegmental reflexes, as well as somatocardiac, somatogastric, and somatorenal reflexes.¹⁰

Gitelman and Fitz-Ritson proposed 4 ways this might occur (Fig 6). The first was that vertebrogenic disorders and the related reflex systems could mimic disease processes. One example is pseudo-anginas related to lower cervical CVS. The second class included vertebrogenic lesions where CVSs are symptoms of internal disorders. Differential diagnosis relies on case history and symptomatology. The third type was proposed to be seen with chronic visceral diseases. The visceral somatic end of the reflex resulted in spinal dysfunction, which may continue after the internal disease process had gone. They proposed that these reflex changes were more extensive than with vertebrogenic lesions because multiple spinal segments were involved at various spinal levels. The final classification they proposed was when CVS directly caused internal disorders. They felt it would be possible to research this and recommended that the profession commence interdisciplinary clinical trials (Fig 6).¹⁰

Groscopic's Dentate Ligament–Cord Distortion Hypothesis. In 1988, John D. Grostic, son of John F. Grostic, developer of the Grostic Technique for upper cervical analysis, proposed the dentate ligament–cord distortion hypothesis. J. D. Grostic was director of research of the Sid E. Williams Research Center at Life Chiropractic College (LCC) and founder of the *Chiropractic Research Journal*. In the first issue of the *Chiropractic Research Journal*, he proposed the hypothesis.¹⁴

Grostic suggested that compression and proprioceptive models were inadequate to explain phenomena associated with upper cervical chiropractic care. He cited Homewood's description of proprioceptive insult related to the irritation of CVS and observed that this model did not explain the many clinical changes noticed by upper-cervical practitioners, especially related to symptoms of the lower spine and extremities, as well as other clinical observations such as warmth and "mild electric shock" in the lower extremities.¹⁴ J. D. Grostic wrote:

The Dentate Ligament – Cord Distortion Hypothesis, utilizes the unique anatomy of the cervical spine to

Classifications	Reflex Action	Defining Statement
Vertebrogenic disorders	Reflex Changes imitate internal disease	- No organic disease - Symptom picture mimics a visceral disorder
Vertebrogenic lesions	Reflex changes develop during acute stages of internal disorder	- Subluxations that are symptoms of visceral dysfunction - Result of nociceptive muscle spasm causing aberrant mobility - Leads to secondary subluxation
Chronic State of Visceral Disease	Extensive reflex changes affect more segments and multiple spinal levels	- Disordered viscera establishes the visceral somatic end of the reflex spectrum leading to spinal dysfunction - Pain pattern and symptomatology may be perpetuated after the internal dysfunction has subsided
Internal diseases and visceral pathology caused by vertebrogenic lesions and their reflex effects	Makes the internal organs corresponding segments more susceptible to other noxious impulses	- Clinical manifestations more likely to occur - Research could establish chiropractic as "the most powerful prophylactic system of health delivery in the world."

Fig 6. *Gitelman and Fitz-Ritson's 4 categories of CVS-related reflex processes. CVS, chiropractic vertebral subluxation.*

provide a model which explains how a misalignment of C-1 or C-2 can produce neurological insult directly via mechanical irritation of the spinal cord, and indirectly via vascular compromise of the cervical cord. This hypothesis states that misalignments of the upper cervical vertebrae, because of their unique attachments to the spinal cord by means of dentate ligaments, can directly stress and deform the spinal cord.¹⁴

In describing the hypothesis, J. D. Grostic addressed the literature in relation to what was known about dentate ligament attachments to vertebra in 1988 and other ways the ligament may distort the cord. He built upon previous research from B. J. Palmer's cord pressure model; the upper cervical approaches developed by J. F. Grostic, Gregory, and Sweat; as well as the Breig paradigm of adverse mechanical cord tension. J. D. Grostic proposed that the neurological significance of this hypothesis would help to explain many clinical phenomenon commonly found by upper cervical practitioners, which may be related to the upper cervical cord in relation to spinal-thalamic tracts and neurological structures.¹⁴

Integrating Models (1980-1994)

Several new approaches to integrating the various CVS models emerged at this time. This section summarizes 2 examples: Gatterman's approach to indications and contra-indications for treatment of pain-related CVS fixations and Leach's *Chiropractic Theories*.

Gatterman's Indications (1982). Meridel Gatterman graduated from Western States Chiropractic College (WSCC) in 1976. She was director of the division of chiropractic science at WSCC from 1978 to 1980, and by 1992, she held that same title at CMCC.^{15,33} In 1982, Gatterman published a paper with clinical indicators for spinal manipulation for treatment of back pain.¹⁵ She relied on Gillet's fixation as

the CVS definition and also cited a large portion of the current orthodox scientific literature as well as CVS literature from Faye, Sandoz, Vear, Homewood, Drum, Grice, and Nimmo, and older works like Carver, Budden, and *Modernized Chiropractic*. Her article may have been the first in the modern literature to note Smith, Langworthy, and Paxson's motion field approach to CVS.³⁴ Gatterman proposed that there was enough evidence to be precise and predict success in treating back pain by distinguishing among locked joints, hypermobile joints, and instability. In doing so, she suggested that chiropractic adjustments might be used for other purposes aside from pain management. She wrote:

The localized effects of such manipulation may be normalization of joint mobility and nerve function, in addition to pain reduction, with frequent compensatory changes in other areas of spinal function. The secondary effects can include changes in peripheral neurological function and may include relief from somatic pain syndromes, nerve compression syndromes, functional disorders of visceral origin, autonomic pain syndromes and psycho-somatic syndromes.¹⁵

Gatterman summarized several therapeutic methods used within the profession for treating pain. Gatterman's emphasis on hypo- and hypermobility CVS did not include a description of what Howe and Watkins referred to as the reversal CVS, which was proposed to resolve with reflex adjustments.^{28,35} Gatterman limited the usefulness of the reflex adjustment to the relief of pain syndromes from referred sites, which was consistent with the article's overall focus on pain relief.

Leach's Chiropractic Theories (1980-1994). Robert Leach graduated from LCC in 1978. He studied at LCC while R. J. Watkins was vice president of academic affairs and also chairman of the curriculum, research, and academic standards committees. Watkins was a 1942 graduate from Lincoln



Fig 7. Leonard Faye.

Chiropractic College, during which time Firth was president. LCC was founded by Sid Williams, a 1957 graduate of PSC. Williams asked Watkins to design the entire curriculum.²⁸ Some influence of Watkins' models was evident in Leach's first edition of *The Chiropractic Theories*, published in 1980. The second edition was published in 1986, the third in 1994, and the fourth in 2004.³⁶

In 1981, Leach summed up his textbook in a short article.³⁷ He provided a summary of theories up to 1980, which included nerve pressure, somatoautonomic pathways, vertebral artery dynamics, axoplasmic transport, and neurodystrophic phenomena. He suggested that the chiropractic theories were based on empirical and experimental evidence and that "the vast majority of studies of manipulation are unblinded."³⁷ The information implied that upper cervical CVS altered cord function and that lower cervical and lower lumbar CVS caused derangement of spinal nerves. To evaluate the theories further, he suggested research should be clinically controlled and blinded.³⁷ In the third edition of his text,³⁸ Leach attempted a comprehensive overview of all of the latest research on the topic. The book included a section and an appendix on the VSC; new sections on segmental dysfunction, hard and soft measures of dysfunction, and the facilitation hypothesis; and sections on practitioner/scientists and clinical outcomes research.

Subluxation Complex (1981-1995)

The acknowledgment by many in the profession in the last few decades that subluxation might best be described as the VSC started during this era. Several theorists were already referring to CVS as a complex.³⁹⁻⁴² The term "vertebral subluxation complex" was coined by Ralph Gregory to describe the misalignment as well as the connective tissues associated with the joint.⁴³ Gregory referred to the atlas subluxation complex syndrome, which he believed to be detectable by objective signs that were "activated" when there was a C1 CVS.⁴⁴ The first person to describe the VSC in distinct components and based on the latest literature was Faye.⁴⁵ His model was developed further by Dishman, and then Lantz popularized the modern term VSC.³

Faye's Vertebral Subluxation Complex (1981-1995). Leonard J. Faye graduated from CMCC in 1960 while Homewood was president (Fig 7). Faye practiced in England and studied with Gillet in Switzerland. Faye began teaching Gillet's motion palpation (MP) at the new Anglo European College of Chiropractic (AECC) in Bournemouth, England in 1967. He moved back to Canada in 1976 and taught MP for 1 year at CMCC. In 1979, he taught courses in the United States, which were based on Gillet's *Belgian Notes*.⁴⁵ Faye added x-ray material and insights from the latest literature. His notes were written down in 1980 and updated in 1983.¹ The notes contained one of the first references in the chiropractic literature to Breig's 1960 text on the biomechanics of the central nervous system.⁴⁶ Faye gave the keynote at the first annual ACA Technic Council in 1983 (Fig 7).⁴⁷

In 1966, Faye may have derived the VSC concept during preparation for his course at AECC.⁴⁸ He had read a paper from the *Journal of the ACA* on the model including neurobiology and joint dysfunction. It is not certain, but this may have been the CVS terminology brief compiled by R. J. Watkins and developed in 1966 by the first diplomates of the American Board of Chiropractic Roentgenologists,⁴⁹ or the initial meetings in 1965 of the Commission for the Standardization of Chiropractic Principles of the ACA composed of Bittner, Weiant, Harper, Janse, and Homewood.^{42,49-51} The definitions from both of these groups differentiated biomechanical from neurological and physiological components.^{52,53}

Faye included 5 components in his model: biomechanical, neurological, muscular, inflammatory, and the stress response. He wrote:

In 1967 at the Anglo- European Chiropractic College I developed class notes that quoted the following authors: Breig, Janda, Lewitt, Illi, Gillet, Wyke, Grice, Mennell, Sandoz, Homewood, Selye, Panjabi, White, and many others that were references for the subluxation complex model. The art of marrying the biomechanical, neurobiological, pathological, musculoskeletal, inflammatory and stress related research

5-Part Subluxation Complex	Pathophysiological Changes
Neuropathophysiology	• irritation/facilitation pathway via the Anterior, Lateral, or Posterior horn and • lead to hypertonic muscles • changes in the sympathetic vasomotor and sensory systems • may take the path of pressure/degeneration, • which leads to atrophy, sympatheticotonia, and anesthesia
Kinesiopathology	• Gillet's hypomobility • Illi's hypermobility • Mennel's loss of joint play • Compensation could lead to a combination of hyper and hypo mobility in the same motor unit.
Myopathology	• could be in the form of atonia or spasm, • which may be due to compensation • facilitation • or due to the feedback changes in the nerves controlling the muscles of the joint • Muscle spasm may lead to an activation of the visceromotor reflex.
Histopathology	• inflammatory process • edema
Biochemical	• related to the stress response including: • release of histamine, prostaglandins, and kinins

Fig 8. The 5 changes associated with Faye's subluxation complex.

into a uniquely chiropractic paradigm was a challenge to say the least.⁴⁷

Faye's model included muscle changes like spasms, hypertrophy, atrophy, and degeneration along with inflammatory responses based on Selye's stress syndrome.⁴² He wrote:

Rational explanation as to why some of our patients were observed to gain health benefits after suffering organ disease. These responses occurred not because of a simple relationship between a spinal nerve and the organ, but for much more complex reasons tied to the physical, mental and chemical causes, reducing the effects of stress and gaining the patients' confidence that instilled hope; all had a role to play.⁴²

Faye's model was congruent with those from previous theorists that CVS may lead to pathophysiology and then pathology.^{1,54} He hypothesized that normal physiological processes would be restored and the pathology would reverse by correcting the CVS. He proposed that the objective was to develop an examination rationale to look at the locomotor system as a whole with the spine as "part of a closed kinematic system."⁴² The rationale for adjusting included finding the fixation, mobilizing the fixation, and rechecking to confirm improvement. Faye described the CVS as "a complex clinical entity," comprising pathophysiological changes associated with "one or more of the following: Neuropathophysiology, Kinesiopathology, Myopathology, Histopathology, and Biochemical" (Fig 8).¹

In the 1990s, Faye reflected on 16 years of teaching MP.⁴⁷ He reasoned that the poor interexaminer reliability of MP may be due to his omission in teaching how to determine the

lingering pain sign. Faye never emphasized this pain response of inflamed joints because he assumed everyone could feel the fixation.⁴⁷ MP was developed to discover only 1 of the 5 components of the VSC. Case history, exam, x-ray, and lab procedures were developed to capture the other 4.

In the 1980s, Faye toured the country giving seminars and started *Dynamic Chiropractic* with his partner, Don Peterson, Sr. The publication was sent to every chiropractor in the United States. In 1989, Faye coauthored *Motion Palpation and Chiropractic Technic: Principles of Dynamic Chiropractic* with R. C. Schafer,⁵⁵ author of the ACA's *Basic Chiropractic Procedure Manual*.⁵⁶ In 1988, the president of the ACA wrote, "The ACA has always supported and emphasized the vertebral subluxation complex and its component parts as the foundation of chiropractic."¹⁶

Dishman's Chiropractic Subluxation Complex (1985-1988). Robert Dishman was a 1941 graduate of Southern California Chiropractic College while Clifford Eacrett was president. Eacrett was a 1925 graduate of Los Angeles Chiropractic College (LACC) when Charles Cale was president. Cale was taught by D. D. Palmer's student Thomas Storey.²⁶ Dishman was dean of Hollywood College of Chiropractic, which merged with LACC in 1962.

In 1985 and 1988, Dishman built upon Faye's model. Dishman called it the CSC.² He suggested that approaching CVS as a complex would allow researchers to study the clinical entity. Dishman started his review by proposing a chiropractic postulate from Faye: "The chiropractic subluxation complex (CSC) causes pathophysiology, which in turn causes pathology. Correction of the CSC restores normal physiological processes and the reversible pathology reverses."² His intention was to describe the literature on neurobiomechanical dysfunction as a component of

CSC. He then explored the literature on the 5 components of subluxation complex: kinesio pathology, neuropathophysiology, myopathology, histopathology, and biochemistry.

The emphasis of the 1985 review was the neuropathophysiological component. He included Speransky's approach to nervous disturbance,⁵⁷ Suh's nerve compression research,⁵⁸ and Korr's facilitation research.⁵⁹ He wrote, "The osteopathic lesion and chiropractic subluxation represents a facilitated segment of the spinal cord maintained by endogenous impulses entering the corresponding dorsal root."² He cited Sato's research on somatovisceral and somatosympathetic reflexes.⁶⁰ Dishman theorized that the mechanisms involved in a chiropractor's daily practice were so complex that a detailed understanding should be part of chiropractic training, especially because the segment of the spinal cord that was subluxated may be hyperexcitable.² This excitation could magnify through all of the various reflex systems associated with it. The lowered threshold at the segment should be taken into account during clinical intervention, especially regarding improving the "afferent input so that sympathetic hyperactivity is alleviated."² The chiropractic adjustment, he proposed, affects the kinesio component directly and the other components indirectly. The CSC was viewed by Dishman as a new paradigm for future research.

Lantz's Vertebral Subluxation Complex Model (1988-1995).

Charles "Skip" Lantz earned a PhD in pharmacology from the University of North Carolina in 1977 and graduated from LCC in 1987. In 1988, he worked at the Sid E. Williams Research Center at LCC. In 1990, Lantz was appointed the director of research at Life Chiropractic College West (LCCW). He felt that the conflicting ideas in chiropractic were due to the complexity of the topic and called for an expanded research agenda to study the mechanisms of CVS.^{3,4,61}

In 1988, Lantz wrote a literature review exploring Gillet's fixation hypothesis in relation to every facet of joint degeneration owing to immobilization.⁶¹ The emphasis was on biochemical changes to the connective tissues and their relation to biomechanical and functional properties of the tissues. It was an attempt to provide "a molecular basis for the theory and practice of chiropractic."⁶¹ Lantz emphasized the effect of remobilization on the joint. Lantz attributed the SC to Dishman's CSC, rather than to Faye, who developed it. Lantz preferred the term VSC used by Luedke, in 1988.^{3,16}

The immobilization degeneration model developed by Lantz emphasized the role of time. He suggested that it took time for degeneration to happen and it would take time to reverse the process. He proposed that the effects of inflammation and connective tissue changes should be evaluated by chiropractic researchers and include elements of the joint with an emphasis on the disc and also the role of the meninges, which are made of connective tissue.⁶¹

In 1989 and 1990, Lantz outlined his VSC in greater detail^{3,4}; he felt that there was enough literature in the

previous 2 decades to determine that CVS was "a real entity."³ Subluxation should be viewed as a dynamic process involving several levels of tissues and integration. Lantz suggested that the main controversies were not whether it exists but rather identifying the neurological involvement.

Lantz added several components to the 5-part VSC model. He proposed an 8-component model, which included the functional components like kinesio pathology and the inflammatory response; the tissue-level components such as neuropathology, myopathology, and connective tissue pathology; and vascular abnormalities. The histopathology included the structural component and biochemical abnormalities, which form the biochemical component. The VSC emphasized the immobilization degeneration process and the organizational hierarchy.

In 1995, Lantz contributed a chapter on the VSC in Gatterman's textbook.¹⁹ The chapter built upon Lantz's earlier writings with an emphasis on clinical relevance and the addition of pathophysiology to the model.¹⁹ In the second edition published in 2004, the chapter was replaced by a chapter of the same title, *Vertebral Subluxation Complex*, but the authors are Seaman and Faye.⁶²

Efforts at Consensus (1987-1995)

The history of consensus statements on CVS goes back to 1905. According to Drain, until that point chiropractors viewed CVS as the cause of disease, but after a convention, it was determined that "a subluxation was only the physical representative of the cause of disease, that the real cause of disease was lack of mental impulse being expressed in the tissue cells."⁶³ B. J. Palmer may have been the first to publish this particular definition and that it was "the physical representative of the cause of disease."⁶⁴ The first public talk using that definition may have been B. J. Palmer's student G. H. Patchen in 1907.⁶⁵ However, it was not until the 1960s and 1970s that CVS consensus statements were developed.^{49,53} These statements influenced the definitions of the 1980s and 1990s.

In 1987, the ICA defined CVS as: "Any alteration of the bio-mechanical and physiological dynamics of the contiguous spinal structures which can cause neuronal disturbances."¹⁷ This definition was consistent with the literature dating to the 1966 distinction made by the early radiologists.⁴⁹ It distinguished the anatomical and physiological elements of the CVS from the neurological consequences.

At about the same time, CVS was defined by the ACA in 1988 as:

An aberrant relationship between two adjacent articular structures that may have functional or pathological sequelae, causing an alteration in the biomechanical and/or neurophysiological reflections of these articular structures, their proximal structures, and/or body systems that may be directly or indirectly affected by them.⁶⁶

Delphi Panel Agreement	Definition
88%	• <i>Motion segment</i> – A functional unit made up of the two adjacent articulating surfaces and the connecting tissues binding them together
83%	• <i>Spinal motion segment</i> - Two adjacent vertebrae, and the connecting tissues binding them to each other
84%	• <i>Subluxation</i> – A motion segment, in which alignment, movement integrity and/or physiological function are altered although contact between joint surfaces remains intact.
81%	• <i>Manipulable subluxation</i> – A subluxation in which altered alignment, movement and/or function can be improved by manual thrust procedures
82%	• <i>Subluxation complex</i> – A theoretical model of motion segment dysfunction (subluxation) which incorporates the complex interaction of pathological changes in nerve, muscle, ligamentous, vascular and connective tissues.
83%	• <i>Subluxation syndrome</i> – An aggregate of signs and symptoms that relate to pathophysiology or dysfunction of spinal and pelvic motion segments or to peripheral joints.
91%	• <i>Manual therapy</i> – Procedures by which the hands directly contact the body to treat the articulations and/or soft tissues
91%	• <i>Manipulation</i> – A manual procedure that involves a directed thrust to move a joint past the physiological range of motion, without exceeding the anatomical limit.
88%	• <i>Mobilization</i> – Movement applied singularly or repetitively within or at the physiological range of joint motion, without imparting a thrust or impulse, with the goal of restoring joint mobility
87%	• <i>Adjustment</i> – Any chiropractic therapeutic procedure that utilizes controlled force, leverage, direction, amplitude, and velocity which is directed at specific joints or anatomical regions. Chiropractors commonly use such procedures to influence joint and neurophysiological function.

Fig 9. Agreement and definitions of 10 terms proposed at the 1991 Conference on Research and Education.

This ACA definition was an update to the 1973 ACA definition.⁵³ It included some of the latest models of reflex theory, differentiations between articular disrelationships and neurological dysfunctions, and the effects on body systems. This definition was approved by the House of Delegates in July 1987. In January 1988, the ICA and ACA agreed to present this definition to the World Health Organization.¹⁶

In 1991, CMCC initiated a 3-year consensus process to establish chiropractic terminology. Initial consensus terms were presented to a panel at the Conference on Chiropractic Research and Education in Monterey, California, and then to representatives from the Consortium for Chiropractic Research. Members of the Consortium on the panel were from CMCC, LCCW, Logan, Northwestern Chiropractic College, Palmer Chiropractic College West (PCCW), and WSCC and included a chiropractic student and a practicing chiropractor. A consensus process was initiated with an international panel of 60 people, including practicing chiropractors, members of the Research Consortium, and the Advisory Council on Technic. The representatives were from Royal Melbourne Institute of Technology, AECC, WSCC, University of Bridgeport, Texas Chiropractic College, Parker Chiropractic College, Palmer Chiropractic College, PCCW, Northwestern Chiropractic College, National Board of Chiropractic Examiners, National Chiropractic College, Motion Palpation Institute, LACC, Logan, LCCW, LCC, Foundation for Chiropractic Education, Council on Technic, Cleveland Chiropractic College,

Chiro Technique Journal, and the ACA; members of CMCC and members of Canada's Council on Chiropractic Education and Licensing Board.¹⁸

Greater than 80% consensus was found on every term (Fig 9). Four of the terms related to CVS or "the lesion treated by chiropractors"¹⁸: subluxation as the motion segment, the manipulable subluxation, subluxation complex defined as a "theoretical model" incorporating various pathological components, and subluxation syndrome or the signs and symptoms characteristic of subluxation pathophysiology of dysfunction. Journals and associations adopted the consensus definitions (Fig 9).^{18,20}

In 1995, Gatterman published the *Foundations of Chiropractic Subluxation*,¹⁹ which was the culmination of the "Subluxation Revisited" conference at CMCC in fall 1992. The book was dedicated to Homewood. The foreword was written by Vear, president of CMCC. He wrote, "This text is destined to become the authoritative work on the vertebral subluxation until such time as it is revised to include new research or refute material that is questioned by new investigative study."¹⁹ Gatterman emphasized that these definitions were not carved in stone but would continue to evolve. The book expanded upon the definitions from the consensus with 3 main sections: subluxation, subluxation complex, and subluxation syndromes. Gatterman coined *subluxation syndrome* in 1992 to differentiate it from the confusing term *complex*, which is often used in psychology. *Syndrome*, she argued, encompassed disease states or physical states.¹⁹

Critical Analysis

Several papers from this period require critical analysis because they are still cited in the literature. In addition, the literature from this era introduced new calls for validity and reliability studies. Some of the papers relied on early studies to support their arguments. Those arguments and the studies that rely on them should be scrutinized based on the most current research protocols and available data.

Theory Commonalities. There were commonalities throughout the CVS theories. For example, pathology as “modified physiology,” also known as *pathophysiology*, originated with D. D. Palmer.⁵⁴ This concept is found in the theories of Faye and Dishman,^{1,2} and their predecessors like Ratledge,⁶⁷ Loban,⁶⁸ Harper,⁵⁰ and Watkins.²⁸ Although Faye and Dishman suggest that the CVS led to pathophysiology, Triano proposed that CVS was a complex part of other pathologies and should be termed “functional spinal lesion.”^{1,2,69} Triano suggested that the overall CVS may be a subcomponent to other pathologies such as disc, facet, and soft tissue disorders, and concluded that because of its complexity, outcome measures were indirect. Triano wrote, “As outcome measure, then the subluxation complex can only be quantified by characterizing each of the associated findings independently.”⁶⁹ He noted that every element of the subluxation “complex” should be studied as an independent outcome measure in the context of the patient’s overall function.⁶⁹ He proposed that outcome measures related to the patient’s mobility, self-care, and function.⁶⁹ Both approaches to pathology and pathophysiology still warrant investigation.

Another commonality was the idea that excitation could reflect and magnify through the nervous system across reflex pathways, leading to various abnormalities and dysfunctions. This was found in Dishman’s model based on Korr’s facilitation and sympathetic hyperactivity.^{2,59} Similar concepts could be found in Homewood and Muller and ultimately go back to Verner’s theory of a feedback at the subluxated joint or “spillover” via the spinal cord and the internuncials.⁷⁰⁻⁷² Gitelman added several viscerosomatic reflex theories to this approach.¹⁰ As director of research at CMCC, he supported the publication of *Segmental Neuropathy*,⁷³ which could explain why his CVS theories were congruent with the text.³¹ Gitelman’s conclusion with Fitz-Ritson was that CVS led to various visceral disorders.¹⁰ This conclusion was also reached by the chiropractic pioneers based on their observations of clinical findings.^{54,68,74-78}

Review of Critical Literature. During this period, there was an increase in critical literature. Several papers were published during this time calling for more validity studies and changes to definitions of CVS terminology.⁷⁹⁻⁸⁴ Two examples are Brantingham and Charlton.

In 1984 and 1985, Brantingham wrote literature reviews on chiropractic hypotheses and “the chiropractic lesion.”^{79,80} He graduated from LACC in 1983 when Howe was chair of radiology. Citing the 1979 New Zealand Commission Report

on Chiropractic,⁸⁵ Brantingham observed that confusion existed around terminology, especially because of the widely accepted medical definition of the term *subluxation*. He proposed a new term based on reference to Sandoz’s description of an “interarticular dysfunction.”⁸⁶

Brantingham referred to intervertebral hypomobility, hypermobility, displacement, and reversed erratic motion.⁸⁰ Those aspects of CVS were derived in part from the work of Watkins, Howe, and other chiropractic radiologists.^{39,49,87-89} However, Brantingham did not include the other radiologists’ definitions, which included neurophysiological dysfunction.^{49,80} He asked, “Should the chiropractic profession accept the work of Korr, Denslow, Gillet, Gitelman, Howe, Lewit, Jirout, Haldeman, Grieve, Mennel, Stoddard, and Cassidy?”⁸⁰ And yet, many of those researchers emphasized the neurological dysfunction while he omitted it.

Brantingham explored the etiology of hypomobility along with questions about restricted motion, such as swelling, inflammation, tight muscles and ligaments, pain, and also nerve root and autonomic irritation.⁸⁰ He reasoned that the term *subluxation* alone was not comprehensive enough to capture the variability and complexity of his concerns and suggested the term should be abandoned. He hypothesized that if slight CVS could not be detected on plain-film x-rays, their replacement through manipulation could not be confirmed.^{79,80} Thus, he felt that the term *subluxation* should only be used in its classic medical definition. By 1988, he proposed that the manipulable joint lesion could be demonstrated and so the osteopathic term *somatic dysfunction* should replace CVS.^{80,81,90}

Keith Charlton, a 1975 graduate of National Chiropractic College, reviewed the literature on manual diagnosis of CVS for various pain syndromes.⁸³ Charlton considered cardiology research as the gold standard that manual methods should aspire to emulate. He wrote, “There is a chasm between morphological research and manual practice.”⁸³ He relied on Gillet’s model of fixation or “a dynamic notion of restriction of joint movement” with “the old static concept” of bone out of place.⁹¹ However, out of 94 references, the only chiropractic references in his paper include some editorials,⁹²⁻⁹⁴ Haldeman’s text,³² several reliability studies,⁹⁵⁻⁹⁸ the National Institute of Neurological and Communicative Diseases and Stroke proceedings, and the follow-up workshop.^{99,100} From this limited review of the chiropractic literature, Charlton concluded that no CVS researchers “have been able to prove the existence of it as an independently verifiable, clinically significant entity.”⁸³ Charlton suggested that imaging studies and reliability studies for manual diagnosis lack any consistent findings beyond anecdotal or intuitive methods and that chiropractic has not come up with any reliable ways to study manual diagnosis.⁸³

Shift in Perspective on Subluxation. In 1984, R. J. Watkins gave the keynote address at the second annual ACA Technic Council. Watkins was head of the chiropractic principles department at Cleveland Chiropractic College-Los Angeles. C. S. Cleveland asked him to emphasize

specificity in his talk. The title of the talk was “Gentleman, Your Chiropractic Is Too Small.”²⁸ Watkins implored the heads of technique departments from most of the schools that the chiropractic adjustment must be specific and aimed at retuning the neurophysiological coordination. He emphasized accurate palpation and nerve tracing along with instrumentation to determine the site of CVS.²⁸ Watkins wrote:

Subluxation is a new and unstable neurological entity with all its neuromuscular imbalance, abnormal heat pattern, distorted visceral function, and perverted sensations to its periphery, as well as symptomatic pain. The normal joint with the normal physiology is much more stable. Hence the one or even six spinal subluxations are like dominoes up on end. The normal spinal joints are like the stable dominoes lying flat. Jarring the table, shaking the floor, or turning on a fan to blow across the table will be MUCH more likely to stabilize everything by flattening the “on end” dominoes than it will be to upend the flat ones. It is generally easier to “fix” than to “unfix” spinal alignment. But of course one has to find the fault before he can fix it. Hence the need for palpation and nerve tracing which are basic fundamental arts to be continually practiced and improved.¹⁰¹

After the conference, Watkins sent his observations about the changes in the profession’s attitude to Carl Cleveland. Watkins summed up a major shift in perspective by reporting his “startling revelations” to Cleveland as 3 distinct phenomena: a representative from ACA’s Foundation for Chiropractic Education and Research claimed that chiropractic had not proven its efficacy, others questioned why the CVS must include a neurophysiological component, and some promoted the term “manipulable lesion” to replace CVS (Fig 10).²⁸

In 1986, Harry Rosenfeld, Esq., legal counsel to the ACA, wrote an article titled “Planning for Chiropractic’s Future.” Point 3 of his 10-point prescription was “Is Subluxation Necessary? Has chiropractic matured sufficiently as a profession to eliminate its traditional relation with subluxation?”¹⁰²

Historical Accuracy and Completeness. The phenomena R. J. Watkins pointed to suggested there was a lack of deep knowledge among his colleagues about research and theory since the 1950s. This was highlighted in some of the literature from the period. Several potential errors about the early chiropractic theories of the Palmers were referenced and re-referenced in the literature during this time. One common error was defining D. D. Palmer’s theory as “a bone out of place” (BOOP), rather than his definition, which was the disrelationship between 2 bones, or a joint, impinging on a nerve, causing pressure and too much or not enough function.^{54,103}

3 New Phenomena Noted by R.J. Watkins in 1984
1. New claims that chiropractic had not proven its efficacy.
2. Questions about why subluxation needed to include a neurophysiological component.
3. Promotion of the term manipulable lesion to replace subluxation.

Fig 10. Phenomena observed by Watkins in 1984.

In the first edition of his book, Leach attributed BOOP to D. D. Palmer and suggested modern chiropractic focuses on the joint.¹⁰⁴ A more accurate depiction would be that modern CVS focused on the joint because researchers like Verner, Watkins, Harper, and Homewood cited D. D. Palmer.^{28,50,70,71} Charlton also used BOOP to describe early chiropractic⁸³; however, there were some problems with the references used to support his work. Charlton wrote, “The chiropractic profession has begun to refine the old static concept of a ‘bone out of place’ with a dynamic notion of restriction of joint movement, the so-called fixation.”⁸³ The 2 references that should be examined to support his opinion on BOOP were in a book attributed to B. J. Palmer called *The Science of Chiropractic*,⁶⁴ published in 1911, and Janse’s 1947 text, which was based on Forster’s 1915 book that covered CVS theory during the early years of chiropractic.^{74,105}

The problem was the page reference to a B. J. Palmer book reportedly published in 1911 and titled *The Science of Chiropractic*. Two books were published by Palmer in 1911: the second edition of Vol. 3 titled⁶⁴ *The Philosophy and Principles of Chiropractic Adjustments*, and Vol. 6 or *The Philosophy, Science, and Art of Chiropractic Nerve Tracing*.¹⁰⁶ Furthermore, Vols. 1, 2, and 4 all included *The Science of Chiropractic* as the primary title, and none had editions published in 1911.¹⁰⁷ Thus an examination of Palmer’s books from that era makes it difficult to determine what source Charlton was referring to. This difficulty is compounded by searching for the reference in either the first or second editions of any of B. J. Palmer’s first 6 books. None of those books mention the misalignment component of the CVS on the page cited, thus this may be an error of citation.^{23,24,64,108,109} Even though the reference does not match the material that Charlton was trying to support, B. J. Palmer did develop a more complex BOOP model, which included 3 vertebrae; the vertebra misaligned with the one above or the one below, causing pressure and interference to the spinal cord or spinal nerves.¹¹⁰

Regarding Charlton’s historical reference to Janse’s 1947 text,¹⁰⁵ most of the chiropractic definitions of that book were originally written between 1915 and 1923 by

Forster.^{74,111} The new sections of that book included chapters on reflex techniques and spondylotherapy.¹⁰⁵ Thus several other models beyond the BOOP were described in the book. However, Charlton did not include them, which limited his historical perspective of CVS to BOOP.¹⁰⁵

I also take issue with Lantz, who attributed “the initial conception of vertebral subluxation” to B. J. Palmer’s compression model.^{3,4} Although the compression model was one influential theory, there were several others, including B. J. Palmer’s cord pressure model,^{64,110} D. D. Palmer’s neuroskeleton model,¹¹² Smith’s tight ligament model,¹¹³ Smith and Langworthy’s motion field model,³⁴ Davis’ inhibition and stimulation model,¹¹⁴ and Carver’s full-spine model.¹¹⁵ In addition, O. G. Smith inspired Swanberg to do an anatomical study and publish on the intervertebral foramina,^{116,117} which showed that a hard bone on a soft nerve was unlikely. This motivated other noncompression and articular models, such as Verner’s theories in the 1940s.⁷⁰ These early models shared similarities and all were built upon and evolved. Lantz’s VSC is an evolution of all of them.^{3,4}

Further, in 1988, Brantingham critically analyzed the CVS hypothesis regarding pain and health care.⁸¹ Brantingham suggested that D. D. Palmer “derided spinal movement palpation as unnecessary.”⁸¹ He stated that because D. D. and B. J. Palmer did not emphasize function or biomechanics, the profession was set backward, which was why “even today many chiropractors and chiropractic colleges continue to talk about ‘subluxation’ with absolutely no reference to loss of function as pre-eminent.”⁸¹ However, D. D. Palmer also taught palpation for heat, alignment, and paresthesias (nerve tracing) as his primary analysis method. Palmer had a good understanding of the joint movements and developed his own theory of field of motion of CVS.^{54,118-120} In addition, normal and abnormal function were the main emphases for both Palmers.^{23,103} For example, Brantingham’s 1988 article led to a series of letters to the editor of the *Journal of Manipulative and Physical Therapeutics* from Lantz, Brantingham, and Keating.^{81,121-123} Lantz accused Brantingham of begging the question about CVS terminology and observed that the article did not include any chiropractic definitions of CVS.^{121,124} Lantz writes, “What references support his stance?”¹²¹ In response to Brantingham’s semantic changes to subluxation terminology, Lantz writes, “If we call a subluxation by any other name would it be any more real?” In another letter by Keating,¹²² he took up his call for research based on an operational definition, which was a call he would repeat into the 1990s, with notable impact on the literature.¹²⁵⁻¹²⁸

Calls for Reliability and Validity. The literature from this period included the first reliability studies of modern chiropractic and several studies from physical therapy research.^{83,129-131} For example, Charlton and Keating relied on this literature in their critiques.^{83,130,132} Some of the citation patterns in more recent calls to dismiss CVS as an historical

artifact can be traced to the early papers, which relied on reliability studies to support their arguments.^{130,133,134}

In 2009, Holt and Russell reported that extensive training of examiners increased reliability for the classic chiropractic leg length inequality examination.¹³⁵ Holt was a research fellow for New Zealand College of Chiropractic (NZCC), and Russell was the NZCC Chiropractic Centre director.¹³⁵ They found that 8 training sessions of 45-minute duration over 16 weeks were required to develop agreement between novice and experienced examiners. The World Federation of Chiropractic reported on this study and highlighted the importance of extensive training of students.¹³⁶ The World Federation of Chiropractic report noted that after 5 sessions the reliability was no better than random, but after the sixth training session reliability was good.

In 2010, Cooperstein, Haneline, and Young reported that reliability for MP across examiners increased when examiner confidence was included as a continuous dataset throughout the assessment.¹³⁷ Cooperstein is the director of research at PCCW.¹³⁸ When examiners felt “very confident” they had found the most fixated segment, reliability was good, unlike many previous studies showing poor reliability without including confidence as a factor.¹³⁷

In 2013, Cooperstein et al conducted a reliability study of MP that emphasized continuous measures of the “most clinically relevant spinal site,” as opposed to general segment-by-segment exam associated with most other studies.¹³⁹ They found good reliability. They suggested that future studies use a similar methodology because they conclude, “It may be possible to repeat many other interexaminer reliability studies, including studies of examination procedures other than MP (thermography, X-ray line marking, etc) with similar design modifications that may more meaningfully assess examiner agreement than the mostly discrete analysis that has been used up until now.”¹³⁹

Holt and Russell et al developed an interexaminer reliability protocol that combined the confidence rating, continuous measures, and extensive training.¹⁴⁰⁻¹⁴² After a period of training, patients were examined using multidimensional criteria.¹⁴¹ Two examiners were trained and asked to rate their confidence levels and determine site of cervical, thoracic, and lumbar CVS using leg checks, soft tissue palpation, joint play, and motion palpation assessments, and they found that reliability was good. Until older studies are repeated with these protocols, arguments that rely upon the limited earlier studies as evidence to support arguments about the veracity of CVS detection should be considered tentative.

Limitations

This work is limited by the interpretations of 1 author. Others may analyze this material differently and derive alternative conclusions. A review of conference proceedings published during this era may have yielded more sources for summary and analysis.

CONCLUSION

Research and theory of CVS should be based on accurate historical facts, rigorous scientific research, and the most informed theoretical models and methodological applications. Arguments for or against the use of CVS in chiropractic should be rooted in the literature both past and present.

Triano observed that research itself grows more complex along with the complexity of models and theories.⁶⁹ This observation was prescient. Each multiplication of CVS components and mechanisms increases the research challenges. Many theorists have made similar observations over the decades. It is the complexity of the CVS that makes it so compelling, enduring, and meaningful to the chiropractic profession.

By mastering the history of CVS theory, current chiropractors may be better able to integrate the current literature and develop research strategies to push the profession forward. Only by knowing the recent history of chiropractic ideas and how those ideas are rooted in the long tradition of research, model building, and practice can the profession truly come to terms with its many challenges.

In the 1990s, Faye challenged the profession to go beyond reliance on clinical outcomes and study the literature.¹ He cited many references that were used in developing his model such as Breig, Illi, Gillet, Grice, Sandoz, Homewood, Selye, Panjabi, and White, and then he wrote, "If these names are not familiar to you. GET READING. *Subluxation* by Meridel Gatterman, BSc, DC is a good place to start."⁴⁷ He also recommended Haldeman's text and Bergmann and Peterson's *Chiropractic Technique*.^{32,143} When Faye started teaching chiropractic seminars in 1980, he asked his students to commit 2 years to reading 1 hour per day to gradually master the scientific and chiropractic literature.⁴⁷

The same type of commitment is needed today for chiropractors to understand the history of CVS theory. The theories from this period should be understood in the context of the literature that came before them, the research and theories they relied upon, and developments they inspired. By understanding how CVS models, theories, criticisms, and consensus statements from this period developed, modern chiropractors may more readily be able to interpret the literature, apply theory to practice, and help to generate new research hypotheses.

ACKNOWLEDGMENTS

The author acknowledges Brian McAulay, DC, PhD, David Russell, DC, Stevan Walton, DC, and the Tom and Mae Bahan Library at Sherman College of Chiropractic for their assistance.

FUNDING SOURCES AND CONFLICTS OF INTEREST

The author received funding from the Association for Reorganizational Healing Practice and the International

Chiropractic Pediatric Association for writing this series of papers. No conflicts of interest were reported for this study.

CONTRIBUTORSHIP INFORMATION

Concept development (provided idea for the research): S.A.S.
Design (planned the methods to generate the results): S.A.S.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): S.A.S.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): S.A.S.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): S.A.S.
Literature search (performed the literature search): S.A.S.
Writing (responsible for writing a substantive part of the manuscript): S.A.S.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): S.A.S.

Practical Applications

- This series of articles provides an interpretation of the history and development of chiropractic vertebral subluxation theories.
- This series aims to assist modern chiropractors in interpreting the literature and develop new research plans.

REFERENCES

1. Faye LJ. *Motion Palpation of the Spine*. Huntington Beach, CA: Motion Palpation Institute; 1983.
2. Dishman R. Review of the literature supporting a scientific basis for the chiropractic subluxation complex. *J Manipulative Physiol Ther*. 1985;8(3):163-174.
3. Lantz C. The vertebral subluxation complex: part 1. *Chiropr Res J*. 1989;1(3):23-26.
4. Lantz C. The vertebral subluxation complex: part 2. *Chiropr Res J*. 1990;1(3):19-38.
5. Barge F. *Torticollis*. Davenport, IA: Bawden Bros.; 1979.
6. Barge F. *Scoliosis*. Davenport, IA: Bawden Bros.; 1981.
7. Barge F. *Tortipelvis: The Slipped Disc Syndrome: Its Cause and Correction*. Davenport, IA: Bawden Bros.; 1982.
8. Barge F. *Life Without Fear: Chiropractic's Major Philosophical Tenets*. vol. V. Eldredge, IA: Bawden Brothers, Inc.; 1987.
9. Barge F. *One Cause, One Cure: The Health & Life Philosophy of Chiropractic*. La Crosse, WI: La Crosse Graphics; 1990.
10. Gitelman R, Fitz-Ritson D. Somatovisceral reflexes. *ACA J Chiropr*. 1984;18(4):63-64.
11. Reinert O. Anatomical characteristics of subluxation: C2 through C7. *ACA J Chiropr*. 1984, May:62-69.
12. Reinert O. Sacro-iliac subluxation: the masked pretender? *ACA J Chiropr*. 1988, December:63-65.

13. Reinert O. Structural failure in the lumbar spine: a subluxation hypothesis. *Chiropr Tech*. 1993;5(1):62-69.
14. Grostic J. Dentate ligament: cord distortion hypothesis. *Chiropr Res J*. 1988;1(1):47-55.
15. Gatterman M. Indications for spinal manipulation in the treatment of back pain. *ACA J Chiropr*. 1982;19(10):51-52.
16. Luedtke K. Chiropractic definition goes to World Organization. *J Am Chiropr Assoc*. 1988;25(6):5,16.
17. *International Chiropractor's Association definition of subluxation*. Washington, DC: ICA; 1987.
18. Gatterman M. Development of chiropractic nomenclature through consensus. *J Manipulative Physiol Ther*. 1994;17(5):302-309.
19. Gatterman M. *Foundations of Chiropractic Subluxation*. St. Louis, MO: Mosby; 1995.
20. Chance M, Peters R. What's in a name? *Chiropr J Aust*. 1994;24(3):81.
21. Keating J. Notes on the Barge family. *Natl Inst Chiropr Res*. 204, Feb 23.
22. Stout R. The Ph.C. degree: an affirmation of chiropractic philosophy, 1908-1968. *Chiropr Hist*. 1988;8(1):11-12.
23. Palmer BJ. *The Science of Chiropractic: Eleven Physiological*. Vol. 2. Davenport, IA: Palmer School of Chiropractic; 1907.
24. Palmer BJ. *Philosophy of Chiropractic*. Vol. 5. Davenport, IA: Palmer School of Chiropractic; 1909.
25. Palmer BJ. *Our Masterpiece*. Vol. 39. Davenport, IA: Palmer School of Chiropractic; 1966.
26. Keating J, Callender A, Cleveland C. *A History of Chiropractic Education in North America*. Davenport, IA: Association for the History of Chiropractic; 1998.
27. Logan H. *Logan Basic Methods*. St. Louis, MO: Logan; 1950.
28. Walton S. *The Complete Chiropractor: RJ Watkins, DC, PhC, FICC, DACBR*. Asheville, NC: The Institute Chiropractic; 2017.
29. Kapandji IA. *The Physiology of the Joints: Annotated Diagrams of the Mechanics of the Human Joints*. London, England: E. & S. Livingstone; 1970.
30. Gatterman M. A patient-centered paradigm: a model for chiropractic education and research. *J Am Chiropr Med*. 1995;1(4):371-386.
31. Vernon H. The life and contribution of Dr. Ronald Gitelman: a pioneer of modern chiropractic science. *J Can Chiropr Assoc*. 2013;57(1):10.
32. Haldeman S. *Modern developments in the principles and practice of chiropractic*. New York: Appleton-Century-Crofts; 1980.
33. Gatterman MI, Vear HJ. Statutory determinants and curriculum development in chiropractic colleges in the absence of university affiliation. *J Can Chiropr Assoc*. 1992;36(4):222.
34. Smith O, Langworthy S, Paxson M. *A Textbook of Modernized Chiropractic*. Cedar Rapids, IA: American School of Chiropractic; 1906.
35. Howe J. Preliminary observations from cineroentgenological studies of the spinal column. *ACA J Chiropr*. 1970;IV(S-65-S-70).
36. Leach R. *The Chiropractic Theories: A Textbook of Scientific Research*. 4th ed. Lippincott Williams & Wilkins; 2004.
37. Leach R. The chiropractic theories: discussion of some important considerations. *ACA J Chiropr*. 1981;15(S19-S25).
38. Leach R. *The Chiropractic Theories: A Textbook of Scientific Research*. 3rd ed. Baltimore, MD: Williams and Wilkins; 1994.
39. Howe J. A contemporary perspective on chiropractic and the concept of subluxation. *ACA J Chiropr*. 1976;X(S-165-S-169).
40. Janse J. History of the development of chiropractic concepts: chiropractic terminology. In: Goldstein M, ed. *The Research Status of Spinal Manipulative Therapy: A Workshop Held at the National Institutes of Health, February 2-4, 1975*. Vol. 15. Bethesda, MD: U.S. Department of Health, Education, and Welfare; 1975:25-42.
41. Jessen A. The syndrome of leriche. *ACA J Chiropr*. 1973;VII(Jul):S-53-S-56.
42. Faye LJ. The subluxation complex. *J Chiropr Humanit*. 1999;9.
43. Moon D. The flight from the subluxation. *Upper Cervical Monogr*. 1980;2(8):1-2.
44. Gregory RR. A chiropractic dialogue. *Upper Cervical Monogr*. 1980;2(8):10-11.
45. Faye LJ. *Course Lecture Notes*. Huntington Beach, CA: Motion Palpation Institute; 1981.
46. Breig A. *Biomechanics of the Central Nervous System: Some Basic Normal and Pathologic Phenomena*. Almqvist & Wiksell; 1960.
47. Faye LJJ. John Faye articles: 1996-1999. *Dyn Chiropr*. 1999.
48. Redwood D. 21st century chiropractic principles and practice: interview with Leonard J. Faye, DC. *Health Insights Today*. 2009;2(6):1-4.
49. Watkins RJ. Subluxation terminology. *J Am Chiropr Assoc*. September 1968. In: Walton S. *The Complete Chiropractor: RJ Watkins, DC, PhC, FICC, DACBR*. Asheville, NC: The Institute Chiropractic; 2017:341-342.
50. Harper W. *Anything Can Cause Anything: A Correlation of Dr. Daniel David Palmer's Principles of Chiropractic*. 3rd ed. San Antonio, TX: William D. Harper; 1974.
51. Committee on Standardization of Chiropractic Principles. *ACA J Chiropr*. July 1965:27.
52. Watkins RJ. Don't miss the boat. In: Walton S. *The Complete Chiropractor: RJ Watkins, DC, PhC, FICC, DACBR*. Asheville, NC: The Institute Chiropractic; 2017:115-118.
53. Bittner H, Harper W, Homewood A, Janse J, Weiant C. Chiropractic of today. *ACA J Chiropr*. 1973;VII(S-82-S-88).
54. Palmer DD. *The Science, Art, and Philosophy of Chiropractic*. Portland, OR: Portland Printing House; 1910.
55. Faye LJ, Schafer R. *Motion palpation and chiropractic technic*. Huntington Beach, CA: The Motion Palpation Institute; 1990.
56. Schafer R. *Basic Chiropractic Procedure Manual*. Des Moines, IA: ACA; 1973.
57. Speransky A. *A Basis for the Theory of Medicine*. 2nd ed. New York, NY: International Publishers; 1943.
58. Suh CH. Biomechanical aspects of subluxation. In: Goldstein M, ed. *The Research Status of Spinal Manipulative Therapy: A Workshop Held at the National Institutes of Health, February 2-4, 1975*. Vol. 15. Bethesda, MD: U.S. Department of Health, Education, and Welfare; 1975:103-118.
59. Korr I. *The Collected Papers of Irvin M. Korr*. American Academy of Osteopathy; 1979.
60. Sato A. The somatosympathetic reflexes: their physiological clinical significance. In: Goldstein M, ed. *The Research Status of Spinal Manipulative Therapy: A Workshop Held at the National Institutes of Health, February 2-4, 1975*. Vol. 15. Bethesda, MD: U.S. Department of Health, Education, and Welfare; 1975:163-172.
61. Lantz C. Immobilization degeneration and the fixation hypothesis of chiropractic subluxation. *Chiropr Res J*. 1988;1(1):21-46.
62. Gatterman M. *Foundations of Chiropractic Subluxation*. 2nd ed. St. Louis, MO: Mosby; 2005.
63. Drain J. *Chiropractic Thoughts*. 2nd ed. Asheville, NC: The Institute Chiropractic; 2013.
64. Palmer BJ. *The Philosophy and Principles of Chiropractic Adjustments: A Series of Twenty-Four Lectures*. Vol. 3. 2nd ed. Davenport, IA: Palmer School of Chiropractic; 1911.
65. Patchen GH. The chiropractic idea: the new method of analyzing symptoms and adjusting the physical representative of the cause of disease. New York: Health Culture Club; March, 1907/1908.

66. ACA. Chiropractic terminology: a report of the ACA Council on Technic. *ACA J Chiropr.* October 1988;46-57.
67. Smallie P, Ratledge T. *Ratledge Philosophy*. Vol. 1. P. Smallie; 1979.
68. Loban J. *Technic and Practice of Chiropractic*. 2nd ed. Loban Publishing Company; 1915.
69. Triano J. The subluxation complex: outcome measurement of chiropractic diagnosis and treatment. *Chiropr Tech.* 1990;2(3).
70. Verner J. *The Science and Logic of Chiropractic*. 8th ed. Brooklyn, NY: Dr. P.J. Cerasoli; 1956.
71. Homewood AE. *The Neurodynamics of the Vertebral Subluxation*. 3rd ed. Wildwood, Canada: Homewood; 1981.
72. Muller RO. *Autonomics in Chiropractic: The Control of Autonomic Imbalance*. Toronto, Canada: The Chiro Publishing Company; 1954.
73. Peterson A, Watkins RJ, Himes H, College CMC. *Segmental Neuropathy: The First Evidence of Developing Pathology*. Canadian Memorial Chiropractic College; 1965.
74. Forster A. *Principles and Practice of Spinal Adjustment*. Chicago, IL: The National School of Chiropractic; 1915.
75. Firth J. *Chiropractic Symptomatology*. Vol. 7. Davenport, IA: Palmer College of Chiropractic; 1914.
76. Gregory AS. *Spinal Adjustment: An Auxillary Method of Treatment*. Oklahoma City, OK: Self-published;.
77. Carver W. *Carver's Chiropractic Analysis*. 2nd ed. Oklahoma City, OK: Carver Chiropractic College; 1915.
78. Palmer BJ. *The Science of Chiropractic: Its Principles and Philosophies*. Vol. 2. Davenport, IA: Palmer School of Chiropractic; 1917.
79. Brantingham J. A review of some current and past literature regarding basic chiropractic hypotheses. *Dyn Chiropr.* 1984;2(8):6.
80. Brantingham J. A survey of literature regarding the behavior, pathology, etiology, and nomenclature of the chiropractic lesion. *ACA J Chiropr.* 1985;19(8):65-70.
81. Brantingham J. A critical look at the subluxation hypothesis. *J Manipulative Physiol Ther.* 1988;11(2):130-132.
82. Charlton K. Data and dogma: the use and abuse of information. *J Aust Chiropr Assoc.* 1987;17(2):46-48.
83. Charlton K. Approaches to the demonstration of vertebral subluxation: 1. introduction and manual diagnosis: a review. *Chiropr J Aust.* 1988;18.
84. Keating J, Nelson J, Mootz R. A model for clinical, scientific and educational development. *Res Forum.* 1986;2(4):103-104.
85. Hasselberg P. *Chiropractic in New Zealand: Report of a Commission of Inquiry*. Wellington, New Zealand: P.D. Hasselberg, Government Printer; 1979.
86. Sandoz R. Radiographic semiology of posterior vertebral arthroses. *Ann Swiss Chiropr Assoc.* 1969;4:107-154.
87. Watkins RJ. Subluxation terminology since 1746. *J CCA.* Fall 1968. In: Walton S. *The Complete Chiropractor: RJ Watkins, DC, PhC, FICC, DACBR*. Asheville, NC: The Institute Chiropractic; 2017:271-279.
88. Watkins RJ. Upper cervical mechanics. *J Clin Chiropr.* 1969;2(2). In: Walton S. *The Complete Chiropractor: RJ Watkins, DC, PhC, FICC, DACBR*. Asheville, NC: The Institute Chiropractic; 2017: 137-142.
89. Howe J. The role of x-ray findings in structural diagnosis. In: Goldstein M, ed. *The Research Status of Spinal Manipulative Therapy: A Workshop Held at the National Institutes of Health, February 2-4, 1975*. Vol. 15. Bethesda, MD: U.S. Department of Health, Education, and Welfare; 1975:239-247.
90. Kimberly PE. *Outline of Osteopathic Manipulative Procedures: The Kimberly Manual*. Kirksville, MO: Kirksville College of Osteopathic Medicine, Department of Osteopathic Manipulative Medicine; 1980.
91. Gillet H, Liekens M. *Belgium Chiropractic Research Notes*. 8th ed. 1970. Belgium.
92. Jamison J. Chiropractic and medical models of health care—a contemporary perspective. *J Manipulative Physiol Ther.* 1985;8(1):17-22.
93. Keating J, Young M. Who is the chiropractic scientific community. *J Aust Chiropr Assoc.* 1987;17(3):84-86.
94. De Boer K, Waagen G. The future role of the chiropractor in the health care system. *J Manipulative Physiol Ther.* 1986;9(3): 225.
95. Cassidy J, Potter G. Motion examination of the lumbar spine. *J Manipulative Physiol Ther.* 1979;2(3):151-158.
96. Wiles MR. Reproducibility and interexaminer correlation of motion palpation findings of the sacroiliac joints. *J Can Chiropr Assoc.* 1980;24(2):59.
97. Love RM, Brodeur R. Inter- and intra-examiner reliability of motion palpation for the thoracolumbar spine. *J Manipulative Physiol Ther.* 1987;10(1):1-4.
98. Deboer K, Harmon Jr R, Tuttle C, Wallace H. Reliability study of detection of somatic dysfunctions in the cervical spine. *J Manipulative Physiol Ther.* 1985;8(1):9-16.
99. Goldstein M. *The Research Status of Spinal Manipulative Therapy: A Workshop Held at the National Institutes of Health, February 2-4, 1975*. Vol. 15. Bethesda: U.S. Department of Health, Education, and Welfare; 1975.
100. Korr I. *The Neurobiologic Mechanisms in Manipulative Therapy*. Springer Science & Business Media; 1978.
101. Watkins RJ. Auricular proprioceptive postural reflex technic. *DCE.* 1992, December.
102. Rosenfield H. Planning for chiropractic's future. *ACA J Chiropr.* 1986;23(10):5.
103. Palmer DD, Palmer BJ. *The Science of Chiropractic*. Davenport, IA: The Palmer School of Chiropractic; 1906.
104. Leach R. *The Chiropractic Theories: A Synopsis of Scientific Research*. Mississippi State, MS: Mid-South Scientific Publishers; 1980.
105. Janse J, Houser RH, Wells BF. *Chiropractic Principles and Technic: For Use by Students and Practitioners*. 2nd ed. Chicago, IL: National College of Chiropractic; 1978.
106. Sinnott R. *The Greenbooks: A Collection of Timeless Chiropractic Works - by Those Who Lived It!* Mokena, IL: Chiropractic Books; 1997.
107. Faulkner F, Foley J, Senzon S. *Palmer Chiropractic Green Books: The Definitive Guide*. Asheville, NC: The Institute Chiropractic; 2018.
108. Palmer BJ. *The Philosophy, Science, and Art of Chiropractic Nerve Tracing: A Book of Four Sections*. Vol. 6. Davenport, IA: Palmer School of Chiropractic; 1911.
109. Palmer BJ. *The Philosophy and Principles of Chiropractic Adjustments: A Series of Thirty Eight Lectures*. Vol. 3. Davenport, IA: Palmer School of Chiropractic; 1908.
110. Palmer BJ. *The Subluxation Specific the Adjustment Specific*. Vol. 18. Davenport, IA: Palmer School of Chiropractic; 1934.
111. Forster A. *Principles and Practice of Chiropractic*. 3rd ed. Chicago, IL: The National Publishing Association; 1923.
112. Palmer DD. *The Chiropractor*. Los Angeles, CA: Press of Beacon Light Printing Company; 1914.
113. Faulkner T. *The Chiropractor's Protégé: The Untold Story of Oakley G. Smith's Journey with D.D. Palmer in Chiropractic's Founding Years*. Rock Island, IL: Association for the History of Chiropractic; 2017.
114. Davis AP. *Neuropathy: The New Science of Drugless Healing Amply Illustrated and Explained Embracing Ophthalmology, Osteopathy, Chiropractic Science, Suggestive Therapeutics, Magnetics, Instructions on Diet, Deep Breathing, Bathing Etc.* Cincinnati, OH: F.L. Rowe; 1909.

115. Carver W. *Carver's Chiropractic Analysis of Chiropractic Principles: As Applied to Pathology, Relatology, Symptomology and Diagnosis*. East Aurora, NY: Carver; 1922.
116. Swanberg H. *The Intervertebral Foramina in Man; The Morphology of the Intervertebral Foramina in Man, Including a Description of Their Contents and Adjacent Parts, With Special Reference to the Nervous Structures*. Chicago, IL: Chicago Scientific Publishing Co.; 1915.
117. Cramer G, Scott C, Tuck N. The holey spine: a summary of the history of scientific investigation of the intervertebral foramina. *Chiropr Hist*. 1998;18(2):13-24.
118. Bovine GDD. Palmer's adjustive technique for the posterior apical prominence: "Hit the High Places". *Chiropr Hist*. 2014;34(1):7-19.
119. Gaucher-Peslherbe P. *Chiropractic: Early Concepts in Their Historical Setting*. Chicago, IL: National College of Chiropractic; 1993.
120. Gaucher-Peslherbe P. DD Palmer as authentic medical radical. *J Neuromusculoskeletal Syst*. 1995;3(4):175-181.
121. Lantz C. A critical look at the subluxation hypothesis: to the editor. *J Manipulative Physiol Ther*. 1990;13(1):42.
122. Keating J. A critical look at the subluxation hypothesis: to the editor. *J Manipulative Physiol Ther*. 1990;13(6):350-351.
123. Brantingham J. In reply. *J Manipulative Physiol Ther*. 1989;12(2):154.
124. Lantz C. A critical look at the subluxation hypothesis: to the editor. *J Manipulative Physiol Ther*. 1989;12(2):152-154.
125. Boone W, Dobson G. A proposed vertebral subluxation model reflecting traditional concepts and recent advances in health and science. *J Vert Sublux Res*. 1996;1:19-36.
126. Owens E, Pennacchio V. Operational definitions of vertebral subluxation: a case study. *Top Clin Chiropr*. 2001;8(1):40-49.
127. Nelson C. The subluxation question. *J Chiropr Humanit*. 1997;7:46-55.
128. Toward a Keating J. *Philosophy of the Science of Chiropractic: A Primer for Clinicians*. Stockton, CA: Stockton Foundation for Chiropractic Research; 1992.
129. Boline P, Keating J, Brist J, Denver G. Interexaminer reliability of palpatory evaluations of the lumbar spine. *Am J Chiropr Med*. 1988;1(1):5-11.
130. Keating J. Science and politics and the subluxation. *Am J Chiropr Med*. 1988;1(3):107-110.
131. Mootz R, Keating Jr J, Kontz H, Milus T, Jacobs G. Intra- and interobserver reliability of passive motion palpation of the lumbar spine. *J Manipulative Physiol Ther*. 1989;12(6):440-445.
132. Keating J. To hunt the subluxation: clinical research considerations. *J Man. Phys Ther*. 1996;19(9):613-619.
133. Keating J, Charton K, Grod J, Perle S, Sikorski D, Winterstein J. Subluxation: dogma or science. *Chiropr Osteopat*. 2005;13(17):1-10.
134. Murphy D, Schneider M, Seaman D, Perle S, Nelson C. How can chiropractic become a respected mainstream profession? The example of podiatry. *Chiropr Osteopat*. 2008;16(10):1-9.
135. Holt K, Russell D, Hoffmann N, Bruce B, Bushell P, Haavik H. Interexaminer reliability of a leg length analysis procedure among novice and experienced practitioners. *J Manipulative Physiol Ther*. 2009;32(3):216-222.
136. Chapman-Smith D. Professional notes: interexaminer reliability - leg length analysis. *Chiropr Rep*. 2009;23(4).
137. Cooperstein R, Haneline M, Young M. Interexaminer reliability of thoracic motion palpation using confidence ratings and continuous analysis. *J Chiropr Med*. 2010;9(3):99-106.
138. Cooperstein R, Gleberzon B. *Technique Systems in Chiropractic*. Philadelphia, PA: Churchill Livingstone; 2004.
139. Cooperstein R, Young M, Haneline M. Interexaminer reliability of cervical motion palpation using continuous measures and rater confidence levels. *J Can Chiropr Assoc*. 2013;57(2):156-164.
140. Holt K, Russell D, Cooperstein R, Young K, Sherson M, Haavik H. Inter-examiner reliability of the detection of vertebral subluxations using continuous measures and confidence levels. *J Chiropr Educ*. 2016;30:59.
141. Holt K, Russell D, Cooperstein R, Young M, Sherson M, Haavik H. Interexaminer reliability of seated motion palpation in defined spinal regions for the stiffest spinal site using continuous measures analysis. *J Manipulative Physiol Ther*. 2018;41(7):571-579.
142. Holt K, Russell D, Cooperstein R, Young M, Sherson M, Haavik H. Interexaminer reliability of a multidimensional battery of tests used to assess for vertebral subluxation. *Chiro J Aust*. 2018;46(1):100-117.
143. Bergmann T, Peterson D. *Chiropractic Technique: Principles and Procedures*. 3rd ed. St. Louis, MO: Elsevier; 2011.