

ACKNOWLEDGMENT

This project was supported by a restricted grant from the National Chiropractic Mutual Insurance Company. I wish to extend my sincerest appreciation also to Gerald Clum, D.C., Arthur Croft, D.C., Meridel Gatterman, D.C., Dana Lawrence, D.C., Vincent Lucido, D.C., Jerome McAndrews, D.C., and Howard Vernon, D.C., for their critical review and thoughtful suggestions in the presentation of this manuscript.

FORWARD

The term subluxation is common currency among health professions. As such subluxation is surely one of the most hotly debated items used by chiropractors, yet with components of misalignment, altered motion and physiological dysfunction, the chiropractic subluxation differs not in kind but in degree from the medical subluxation. At issue is the means of detection of the more subtle lesion that responds to thrust procedures used by chiropractors as opposed to the radiologically determined [commonly hypermobile or unstable nonmanipulable] subluxation recognized by the medical profession.

Fanning the flames of controversy is the hegemony of vision that accepts visual cues as more reliable than other senses. Even Flexner noted that kinesthetic sensation, the basis of palpation, is less reliable than either the sense of vision or hearing. This may be in part due to the lengthy training and practice required for perfection of palpatory skills. This visual preference is exemplified in the interdisciplinary popularity of the so called Gillet palpatory test for sacroiliac function. The observer in many cases is focusing on the approximation of the thumbs through visual cues rather than perceiving the relative motion between the posterior superior iliac spine and the second sacral tubercle. To the rational thinker, detection of a lesion that responds to manual therapy through manual perception is a logical progression.

The term subluxation used by chiropractors to describe altered joint motion, misalignment of articular surfaces and related physiological changes significantly predates the grosser visually cued radiographic subluxation, yet greater than one hundred terms have been proposed to replace the Chiropractic subluxation. Changing the name when referring to the manipulable subluxation - whether to manipulable lesion, neurobiomechanical lesion or orthospondylodysarthritic lesion is no more helpful than calling it a spinal "boo boo," an adjustment seeking lesion, or saying that bad things happen to the spine.

Subluxation has meant an element of misalignment, altered motion, and dysfunction to chiropractors for more than a century. The recent definition of subluxation developed through consensus of the chiropractic college presidents under the auspices of the Association of Chiropractic Colleges in July of 1996 provides a rational and unifying definition for use by the chiropractic profession.

Subluxation is a complex of functional and/or structural and/or pathological changes that compromise neural integrity and may influence organ systems function and general health. A subluxation is evaluated, diagnosed and managed through the use of chiropractic procedures based on the best available rational and empirical evidence.

It is in this spirit of rationality and unity that I commend this monograph and the use of the term subluxation to both chiropractors and non chiropractors alike.

Meridel I. Gatterman, D.C., M.Ed.
Dean of Clinical and Chiropractic Science
Western States Chiropractic College
Portland, Oregon

INTRODUCTION I

Every profession, whether health-related or not, develops its own special set of technical terms; its own language, if you will. Those terms typically have a meaning and context either formally or informally agreed upon by most if not all of the members of that profession. How then do we view the chiropractic subluxation?

Few terms have so contentious a history. From its humble beginnings as 'less than a luxation', the term has grown to have myriad meanings within a profession growing in acceptance and usage by a grateful public. Attempts to define the term are regularly made, only to fall afoul of political considerations rather than scientific ones. Yet the term is the root metaphor for the chiropractic profession; it is what gives the profession meaning and identity. Why then does it remain so hard to come to grips with?

In part, this is due to the times; we know so much more now than we did when the term was coined and began its evolution. In the past one hundred years, so much new information has affected the chiropractic profession that a static definition was bound to fail of its own inability to take these many changes into account. Yet professional will has never been lacking within the chiropractic profession, and it is to the credit of a great many people that the term did evolve to where it is today. It can never again be static; it must change as new information becomes available. Its role in human health must be studied in even greater depth and detail than in the past, so that the chiropractic profession can better render its art and help bring back to optimal health those suffering people who seek our care. Subluxation goes beyond metaphor; it is at the heart of chiropractic. This being the case, we must follow where our studies take us, never fearing to modify our core beliefs even when it affects market share or reflects poorly upon our science. Science is mutable; it changes with new data. So, too, does the chiropractic profession. Efforts to better define and understand the subluxation can only help but take us into a brighter future.

Dana J. Lawrence, DC, FICC
National College of Chiropractic
200 E. Roosevelt Road
Lombard, IL 60148

INTRODUCTION II

In "The Role of Subluxation in Chiropractic," we find an important discussion of the emergence of subluxation thought and the historical and clinical evidence that supports the continued advancement of that thought. We also have the opportunity to contrast the evolution of our ideas relative to subluxation with those of the osteopathic profession.

The following monograph by Rosner and Patterson demonstrates many things to us. First and foremost, we learn of the long history of thought that has helped shape our current concepts of the vertebral subluxation. Second, we learn that over time we have successfully distanced the concept of a chiropractic subluxation from that of an orthopedic subluxation. This separation has allowed the appropriate development of each entity apart from the other. Finally, we learn that considerable evidence exists to support our conceptual model of subluxation and the philosophical paradigm within which we view that model as reasonable, scientifically valid and clinically profound.

At this point in our history, we see a coming together of divergent traditions within our discipline. It

has been our views of the subject of vertebral subluxation that have held our greatest strength as well as our most divisive weakness.

There have been those within our ranks that have viewed the subluxation as a figment of our imaginations and their counterparts who have held that addressing a subluxation was the extent of our clinical role and responsibility. Still more viewed a subluxation as a clinical finding - something similar to swelling or pain - while there exists a significant segment who view it as a diagnostic entity and in fact a complex of findings and diagnoses.

Over the decades we have been of many minds relative to our ideas of vertebral subluxation. "The Role of Subluxation in Chiropractic" is to some an emerging source of excitement and enthusiasm about chiropractic practice; to others the concept of vertebral subluxation is synonymous with chiropractic and its role has never been a question.

Through efforts such as those offered by Rosner and Patterson, these differences become illuminated and are either more firmly established or disappear completely. In addition, we are able to see the wisdom generated by our forebearers, the opportunity for the development of common clinical ground within our times, the pitfalls the future may hold for us and an agenda for the research needs of the chiropractic profession into the 21st century.

Gerald W. Clum, D.C.
President
Life Chiropractic College West
San Lorenzo, California .

THE ROLE OF SUBLUXATION IN CHIROPRACTIC

Having observed its centennial two years ago, chiropractic celebrated one year later another milestone in history: the bisecicentennial of its signature term, subluxation. In 1746, Hieronymous was one of the earliest to make the distinction between the terms luxation and subluxation, [1] which in many ways can be taken to reflect the conceptual differences between allopathic and chiropractic health care. As this monograph will attempt to demonstrate, subluxations are by their very nature less tangible than the pathologies which form the benchmark of allopathic medicine. As such, they may appear cryptic and elusive, thus contributing much to the controversy that has marked their existence and which lies at the heart of the chiropractic profession.

A. History:

On the basis of word derivations alone, subluxation is derived from the Greek *sub* and *lux*, literally meaning "less than a dislocation.[2] Hieronymous' own description of the term characterized subluxations as "lessened motion of the joints, by slight change in position of the articulating bones ... " [1] The next clue as to the development of the term comes in 1821 from the writings of Edward Harrison, who noted that:

When any of the vertebrae become displaced or too prominent, the patient experiences inconvenience from a local derangement in the nerves of the part. He, in consequence, is tormented with a train of nervous symptoms, which are as obscure in their origin as they are stubborn in their nature ... [3]

Adding more insight into the elusive nature of the subluxation was Harrison's statement three years later that "the articulating extremities are only partially separated, not imperfectly disjoined." Of major significance is the fact that Harrison not only used the spinous and transverse processes as levers for adjustment, but also recognized that both musculoskeletal and visceral conditions may be caused by subluxations. [3] Harrison's beliefs concerning the potential systemic effects of spinal adjustment were echoed in 1834 by William and Daniel Griffin, two physicians who described "spinal irritation" as the cause of visceral diseases. [3] Thus, even before the birth of D.D. Palmer, much of the foundation for chiropractic theory had been apparently laid in the medical literature. [3]

In much the same way that Freud's changing concepts of the unconscious suggested the emergence of a new branch of medicine, D.D. Palmer's changing concepts of subluxation from 1897 to 1914 - sometimes approached as a metaphor, sometimes approached as a testable theory - combined with the concept of Innate Intelligence to form the philosophical epicenter of a new science of manipulative health care that became known as chiropractic. An exhaustive historical overview on the subject has been provided by Keating. [4]

Beginning with Harvey Lillard's historical adjustment in September 1895 and published two years later, "Old Dad Chiro" suggested that he had practiced a form of magnetism, the treatments of which were more specific than the non-diagnostic magnetic methods performed by his competitors. [5] Applying hands to the body in one location was presumed to concentrate vitality into the part or organ that was diseased. Old Dad Chiro was quick to point out two details that are often lost in history; first, that he did not claim to cure all diseases but simply more than he had imagined five years previously; and secondly, that "medicine and medical doctors are necessary; we cannot get along without them." [5]

As part of his concept from the earliest days of his practice, D.O. Palmer developed the technique of

nerve tracing in which he "treated nerves, followed and relieved them of inflammation." [6] In trying to understand disease in the biomechanical terminology of his era, Palmer believed that chiropractic exceeded magnetic treatment in that, while the latter sought to cool inflamed tissue, chiropractic could prevent the friction which caused the inflammation in the first place. [7] The concept to remember in Palmer's comparison of the human body to a machine is that *displaced anatomy* is the cause of inflammation and disease. Here we have arrived at the first working definition of a chiropractic subluxation.

As with any maturation process, significant changes began to appear in Palmer's thinking, beginning in 1903. Integrity of neural function rather than displacement of any body part became central to chiropractic theory. In addition, the term adjustment, rather than manipulation, was invoked to describe chiropractic intervention, with the new term pointedly referred to as "non-therapeutic" and not to be combined with other therapeutical remedies. Finally, the term "educated" was implemented to distinguish a portion of the nervous system from the innate. [8] The final metamorphosis of Palmer's thinking appeared with his publication in 1910 of *The Chiropractor's Adjustor*, in which previous references to obstruction of the circulation of the blood were now purged and relegated to the osteopath's domain of interest. The nervous system was now elevated to prime importance, the "tone" of which formed a conceptual bridge between Old Dad Chiro's original concepts of subluxation and innate. Nerves were now conceived as a "meshwork stretched over the bony framework of the body; the normal tension of the nerves was determined by the proper alignment of the skeleton. [2] A disruption of this pattern could therefore be construed to constitute a subluxation, related to the nervous system in the alteration *but never the interruption* of nerve impulses. [9]

B. The Vertebral Subluxation Complex:

With the development of chiropractic into a cognitive as well as a therapeutic health care intervention, and with its incorporation of trigger-point and reflex techniques in addition to osseous adjustive procedures, it has become useful to expand the original "bone on nerve" concept of subluxation into a more systematic and unified "field theory." The concept of the Vertebral Subluxation Complex [VSC], having been developed over the past 20 years, [10-12] attempts to allow a broader field of chiropractic clinical management to be incorporated into a single conceptual model. It embraces the holistic nature of the human body, including health, well-being, and the doctor/patient relationship as well as the changes in nerve, muscle, connective, and vascular tissues which are understood to accompany the kinesiologic aberrations of spinal articulations. A complete description of the VSC has been recently provided by Lantz. [13]

The original 5-component model conceived by Gillet, [10] Faye, [11] and Dishman [12] included descriptions of cartilage degeneration, connective tissue pathology, vascular abnormalities and inflammatory response. In its latest version, [12] the model features kinesiopathology at its apex, since a major goal of chiropractic is commonly believed to be the restoration of normal motion, representing the functional end point of the combined efforts of those tissue components comprising its base. The proposed tissue constituents in the model are:

1. Myologic, since muscles affect movement;
2. Connective, since connective tissues guide, limit, and stabilize movement;
3. Vascular, acting as the essential nutritive, cleansing, and inflammatory conduit for the tissues involved in movement; and
4. Neurological, serving the communicative role in the tissues involved in movement.
5. Lymphatic, emphasizing the role of the immune system.

To emphasize the structural-functional relationship of each of these constituents as well as ground the entire model in everyday clinical practice, each component of the model demands our grasping

the basic sciences which govern its existence, as well as our understanding both the diagnostic and therapeutic procedures and outcomes which are involved in the chiropractor's clinical interventions. We therefore need to proceed by learning more precisely what the subluxation is, along with what chiropractic has presumed to be its local manifestations and effects throughout the body. In addition, we need to address the treatment of subluxations and the effects of such interventions elsewhere in the body. The remainder of this discussion will therefore address these issues.

C. Terminology:

The term "subluxation" has undergone considerable evolution. From its recent study by both nominal and Delphi panels, an attempt has been made to operatively define **subluxation as**

"a motion segment in which alignment, movement integrity, and/or physiologic function are altered, although contact between the joint surfaces remains intact." [2, 14]

Here one needs to recall that slight misalignments may not be detectable by any of the current technological methods, while gross misalignments which are detectable by plain film radiographs may reflect hypermobility, for which manipulation may *not* be indicated. The aberration of movement integrity [either deficient or excessive motion] would seem to offer a useful criterion for escaping this conundrum; however, reliable measurements of motion remain as elusive as the previously mentioned radiographical detection of subtle misalignments. [2, 15] This leads to the third condition, physiologic dysfunction, which may be present with or without pain and which may facilitate our understanding of [but not be construed to validate] chiropractic subluxations.

Any of these conditions must be met if a subluxation is to be suspected. While it is not necessary to have all three present simultaneously, it is appropriate to examine each of the conditions in more detail in order that we may appreciate the subtlety of subluxations. As suggested earlier, grosser abnormalities that are manifest by clear-cut pathologies [such as scoliosis or disc herniations] are beyond the scope of this discussion.

MISALIGNMENTS:

The concept of detecting postural and structural abnormalities dates from its introduction at the Palmer School of Chiropractic by B.J. Palmer [16] and the development of the structural theory by Willard Carver, [17] marking a logical extension of the popular static concept of subluxation of that period. Remember, however, that asymmetric developmental anomalies are common and can simulate true misalignments. [18] Many observed patterns are actually the *result* of apophyseal joint disease or long-standing developmental articular changes. [19] Static misalignment subluxations may demonstrate clinical significance through patterns of scoliosis, in which spinal misalignments may progress to 30° or more at skeletal maturity [20] and have on occasion been observed to diminish upon chiropractic treatment [21, 22] although such conservative interventions have not yet been assessed critically by a randomized controlled clinical trial.

The situation improves when one considers dynamic analyses; functional radiography, for example, can establish the presence of segmental or global hypomobility [fixation], aberrant motion, or hypermobility. [19, 23] With additional radiographs that may be required in this type of analysis or with the use of digital videotluoroscopy, [24, 25] concerns regarding exposure [26, 27] need to be answered by the benefits of the study outweighing the risk of ionizing radiation. In applying functional radiography, guidelines have been proposed: [19]

1. Persistent signs and symptoms or unsatisfactory response to a conservative trial of Chiropractic care;

2. Suggested persistent segmental dysfunction;
3. Suggested segmental instability;
4. When other appropriate imaging studies are inconclusive in establishing joint dysfunction.

Functional radiographs should be viewed as *qualitative* rather than precise quantitative indicators of spinal motion, given the lack of standardized patient positioning procedures in the field as well as the wide variations of spinal motion which exist in the normal population. Except in cases of obvious instability, there appears to be little evidence to confirm that too much or too little vertebral motion correlates with pain or disability. [19]

ABBERATIONS OF MOVEMENT INTEGRITY:

Some of the issues concerning joint movement have already been addressed in the foregoing discussion concerning functional radiography. Assessed changes in motion, however, require in addition the perspectives of biomechanical models as well as actual hand contact from the chiropractor. Each of these principles will be examined briefly.

According to Triano [28], subluxations may be described as functional spinal lesions which reflect **aberrant segmental mechanics**. These disorders of joint mobility may in turn be described by one of three theories of motion:

1. Fixations or limitations of range, predicting the effects of prolonged static loads, resulting in pain, reactive muscle response, and inflammation as the result of attempted movement of the affected joint;
2. Hypermobility or excessive range, reflecting excessive joint compliance as the result of an event, either congenital or traumatic; and
3. Altered kinematics, interrupting the smoothness of the path of motion through instantaneous aberrations of position, acceleration or deceleration of each joint complex.

As Farfan [29] has indicated, this perspective is essential for understanding the subluxation from the point of view of a clinical instability, as distinguished from the radiographic instability discussed above. The way in which this may be assessed by the chiropractor is by palpation.

In selecting the palpatory techniques that identify the subluxation, a manipulable lesion, Jull, Bogduk and Marsland [30] built upon the principles of motion palpation introduced by Gillet [10] and further developed by Faye and Schafer. [31] Jull's group selected [1] abnormal end feel, [2] abnormal quality of resistance to movement, and [3] local pain upon palpation. What was compelling about this study was the fact that the 20 patients evaluated were given diagnostic nerve blocks to unequivocally establish the vertebral level of the chronic neck pain they were experiencing, and what was observed by the blinded observers was that, in the 15 of 20 patients correctly identified with confirmed facet pain or dysfunction, *the correct segmental level was identified in all 15*. It was concluded that "manual diagnosis by a trained manipulative therapist can be as accurate as can radiologically controlled diagnostic nerve blocks in the diagnosis of cervical zygapophyseal syndrome. [30]

The foregoing study therefore could become a significant piece of evidence correlating a subluxation [detected by palpation] in a precise anatomical location with a specific clinical complaint.

According to Haas and Panzer, [32] however, the devil is in the details: these results have yet to be

replicated and cannot be generalized to other areas of the spine. Furthermore, 15 published studies encompassing different regions of the spine [cervical, thoracic, lumbar, and sacroiliac] all indicate that the interexaminer reliability of identifying motion or end feel restriction at specific segmental levels is poor. One is forced to ask, if the test seems to perform little better than guesswork: why should it be done at all? On the other hand, *intraexaminer* reliability is considerably better, [33, 34] the test is not performed in the absence of other examination data; and patient experience and favorable results tell us that patients

do in fact have positive outcomes with the chiropractor. [36, 36] The answer to this conundrum appears in questions yet to be researched:

1. Are patient positions, force used, perceptions and interpretations standardized? If not, how can the desired uniformity be accomplished?
2. Are palpatory procedures more valuable in certain patient populations than in others?
3. Is the specificity issue of palpation a "red herring?" In the larger sense, do we truly know the specific biomechanical and clinical effects of manipulation on the body?
4. Is specificity of the vertebral contact necessary to alleviate the "true" underlying manipulable subluxation?
5. Does specific adjustment of different manipulable subluxations have the same clinical effect?
6. Is restricted motion lost in sequential palpations?

PHYSIOLOGIC DYSFUNCTION:

A third line of investigations has commonly been offered to shed further light upon the concept of chiropractic subluxation. All pertain to what we consider to be physiological functions which we associate with, but have yet to validate, the chiropractic subluxation. These span from the firmest evidence offered by animal models recently reviewed in depth by Vernon [37] and summarized below in **Table 1** and extend to more circumstantial observations in humans, linking internal organ dysfunction with presumed aberrations of the spine [**Table 2**], together with changes in both metabolite levels [**Table 3**] and reported symptomatology [**Table 4**] following spinal manipulations. These findings lead to two immediate conclusions which are consistent with chiropractic principles. First, they support a central tenet of chiropractic theory which states that the spine is a dynamic entity, the neural state of which directly affects the overall health of the entire body. Second, they suggest that actual, identifiable pathological conditions may be ultimately attributable to what was referred to earlier in this discussion as chiropractic subluxations, which are traditionally thought of as eluding the concrete pathologies usually studied in allopathic medicine [since functional aberrations precede pathological entities].

Pain and its alleviation can be considered to be the driving force behind most health care interventions. Chiropractic care is no exception; yet musculoskeletal aberrations in the absence of inflammation often eluded treatment by the allopathic community, since they lack the objective measurements [other than range of motion] that allopaths were accustomed to following. That situation changed with the emergence of the electromyographic studies of Triano and Shultz, [38] which reflected a clear-cut difference in the EMG patterns between patients with or without restrictions of activities brought about by back pain. Patients with such afflictions fail to display the relaxation patterns of muscular activity typically seen between flexion and extension. Instead, muscle splinting upon flexion has a clear manifestation [**Figure 1**].

By traditional standards, the foregoing condition does not reflect any *anatomical* pathology; however,

it is clearly indicative of a *clinical* pathology. It suggests that changes in *function*, which chiropractors have suggested for decades to be significant indicators for health care management, may at last occupy a seat at the table of the objective measurements which have traditionally formed the currency of allopathic medical care. More importantly, it suggests that deviations measured by instrumentation without apparent anatomical deformities are useful in evaluating the health of the patient - something known in the traditional hospital chemistry laboratory for years but perhaps never fully appreciated.

Nonmusculoskeletal aberrations, with or without clinical symptoms, also need to be considered. Many clinical signs appear to diminish or disappear with spinal manipulation. This has led many in the chiropractic community to argue that this phenomenon represents the resolution of spinal derangements by chiropractic intervention. According to Dhami and DeBoer, the associations reported between spinal lesions and somatic dysfunctions and systemic [internal organ] disorders are:

“at least consistent with current chiropractic principles and practices and, at best, signal encouragement for further clinical and experimental research.” [39]

Excluding spinal trauma, milder spinal aberrations have been shown in the literature for at least 70 years to be associated with internal dysfunctions. **Table 1** summarizes diseases or simulations of disease involving viscera corresponding to problems in either the spinal joints or discs; these reports appear primarily in the medical literature. [40-45] More recently, the role of the spine in causing or maintaining visceral function has been suggested by Glick and colleagues, who studied both colonic and bladder myoelectric dysfunction in response to spinal aberrations. [46] Earlier reviews of case histories have implied for over 30 years that spinal aberrations appear to be a contributing factor to a variety of heart and other visceral disorders. [47-49]

Elsewhere, it has been argued that visceral diseases and their accompanying autonomic reflex responses may be mimicked by somatic pain. In this manner, afferent nociceptive signals are thought to provoke autonomic reflex responses which *simulate* rather than cause true visceral disease. [50] Other systemic responses associated with minor spinal derangements will be reviewed in Sections C and D below. Some can be induced by deliberately altering the configurations of spinal joints, as has been done in numerous studies using laboratory animals **[Section C]** Others can be reversed by deliberate, calculated manual intervention on the part of the health care practitioner **[Section D]**. Both lend strong support to the fact that spinal manipulation may be of benefit and contradict the findings of Nansel [50] described above. They also help to provide a clearer picture of the chiropractic concept of subluxation if not actual support.

D. Basic Scientific Evidence through the Use of Animal Models:

The most compelling lines of evidence in support of the subluxation have resulted from the use of laboratory animals, [37] the benchmark of most fundamental clinical studies in orthodox medical science. Although animals obviously cannot offer the behavioral dimensions of human subjects, the degree of control afforded by their study far exceeds what can be accomplished in clinical studies alone. For example:

1. It is possible to induce lesions that simulate the spinal disorders believed to constitute subluxations;
2. It is possible to extract tissue specimens and study at the morphological or cellular level the effects of these induced lesions; and
3. It is possible to mimic treatments by removing or reversing the lesions.

Typical of many surgically induced misalignments in animal studies was DeBoer's and Mcnigh's surgical implantation of a metal bar between adjacent spinous processes, with the intention of misaligning the middle one [Figure 2]. In this particular investigation, the possible traumatic effects of surgery were accounted for by inserting, then withdrawing, the metal bar in control animals. [51] The purpose of interventions such as this is to mimic what is believed to occur in some types of spinal subluxations.

Table 2 is a sampling of some of the outcome effects achieved in different animals as the result of different types of interventions, all supplying noxious stimuli. [52-62] Quite distinct from pain are the effects which extend far from the area of stimulation. With several of the investigations showing that nerve conductivity is specifically affected, [52, 53, 59] it is quite probable that the nervous system provides the link between the experimentally produced aberrations and the physiological changes observed.

More recent investigations using rats have been able to elicit decreases in both mean arterial pressure and nerve blood flow following saline injections into the ipsilateral L4/L5 facet joint. Thus, innocuous as well as noxious stimuli were judged to be capable of eliciting physiological responses, providing a much broader scope with which subluxations were presumably being represented in experimental research. [63]

With the spinal column having been known in scores of anatomical descriptive studies to be heavily innervated, [64] it becomes clearer how certain aberrations of the spine, however subtle, might be associated with physiological manifestations. Thus, we have just been able to appreciate the further demonstration of [together with limited evidence for] the third and final characteristic, the physiological domain, of the subluxation as previously proposed. [2]

It should become easier for us to carry this association one step further and envision the *causal* relationship of the state of the spine and physiological responses of the organism. Let us shift this discussion to the consideration of the human body and its specific responses to discrete chiropractic interventions. By so doing, our review of the multiple aspects of the subluxation as currently defined by chiropractic will be accomplished.

E. Nonmusculoskeletal Responses of the Human Body to Manipulation:

To complete the canvas depicting the properties of, and evidence for, vertebral subluxation, we must now apply our conclusions from the discussion above to the human organism. Here it will be evident that, in response to the specific adjustments that characterize chiropractic intervention, [2] discrete and significant physiological changes occur within the body that extend beyond simple relief from back pain.

Table 3 begins this survey by examining the evidence which pinpoints some of the biochemical changes that occur within the body following chiropractic adjustments. Much of this evidence resides within the group of responses classified as immunological. [65-67] Over 90 years later, it is oddly reminiscent of the long-discarded hypothesis from the era of D.D. Palmer stating that adjustments raise the ability of the patient to resist infection through the release of "Innate Intelligence." [4, 8] The respiration of white blood cells, reflecting oxygen consumption via the hexose monophosphate shunt, may be measured by a chemiluminescence assay. [65] The significance of the reported polymorphonuclear neutrophil respiratory increases 15 minutes following manipulation, [65, 66] for instance, lies in the fact that this measurement reflects the ability of the white blood cell to phagocytize invading particles and thus ward off infection. Substance P, a neurotransmitter, is

synthesized in the cells of the dorsal root ganglion and induces the proliferation of T cells and the chemotaxis of inflammatory cells in addition to a variety of other functions. Its increase is believed to induce the release of other biologically active cytokines, which in turn influence the respiratory burst of polymorphonuclear neutrophils. [65] Immunoglobulin levels [IgA, IgM, IgG] have also been proposed to increase following spinal manipulation; however, this very preliminary result must be interpreted with extreme caution since it was measured in only 4 patients, 3 responding. [67] In women of child-bearing age, increased prostaglandin levels and their effects upon the uterus are believed to be the biochemical basis for dysmenorrhea. Prostaglandin reductions following manipulation, therefore, provide an excellent mechanism for explaining the corresponding decrease of pain reported by adjusted patients. However, these hormones were also seen to diminish in groups of patients subjected to sham manipulations, although to a lesser extent. [68]

Vernon's finding of statistically significant increases of beta-endorphin levels in 9 normal subjects subjected to spinal manipulation [69] compared to sham and control groups is noteworthy in that it offers an explanation of the reduction of both pain and muscle hypertonicity, the two most evident clinical effects of spinal manipulation. Other investigators, however, have not been able to replicate these findings. [70] For confirmation, this particular study will require larger subject groups with serial sampling. Dhami and Coyle's preliminary report relating to increased melatonin levels following manipulation [71] offers the possibility that sympathetic neurons which fully innervate the pineal gland [a major component of the melatonin generating system in mammals] may be stimulated. To summarize, these systemic effects may shed light upon some of the plausible mechanisms as to how pain is alleviated following manipulation. More importantly, they also demonstrate once again how a presumed locus of minor intervertebral joint derangement, which is the subluxation, has historically been associated with many physiological activities throughout the body. Outside of animal models, however, it remains the goal of future research to more convincingly link what we consider to be the chiropractic subluxation with altered physiological states.

At the apex of this discussion regarding the subluxation and its manifestations is **Table 4**, summarizing the actual nonmusculoskeletal patient conditions which respond to chiropractic manipulation. [68, 72-98] While the majority of these findings are derived from case series or case studies, a few have been generated by more rigorous randomized clinical trials. [73, 79, 80] With two possible qualifications [which represent osteopathic lesions and interventions (73, 76)] these studies all share the common thread in that a variety of physiological phenomena, which may or may not reflect a subluxation, are reversed by the specific intervention strategy of chiropractic. At the very least, the subluxation becomes a model to *describe* what has occurred clinically.

Given adequate funding for research, the expectation is that over the next decade the successful chiropractic management of such conditions as shown in **Table 4** will become as well-documented as its treatment of low-back pain by manipulation. By means of extensive support in the literature, chiropractic intervention for low-back pain was able to secure recognition from both domestic and European government agencies for its effectiveness. [36, 99] Perhaps the growth of research from the group of physiological investigations just reviewed would facilitate broader recognition of the effectiveness of chiropractic care, extending to many of these non musculoskeletal conditions. Through its evolving concepts of subluxation which I have just attempted to outline in this monograph, it is clear that chiropractic research is gaining the necessary directives to acquire the types of data which it will need to achieve growing prominence in the restoration and maintenance of good health.

REFERENCES:

1 Hieronymous JH. De luxationibus et subluxationibus. Thesis, Jena, Dec 21, 1746.

2 Gatterman MI. What's in a word? In Gatterman M [ed]. Foundations of chiropractic:

- Subluxation. St. Louis, MO: Mosby-Year Book, 1995, pp. 5-17.
- 3 Terrett A. The search for the subluxation: an investigation of medical literature to 1987. *Chiro Hist* 1987; 7(1): 29-33.
 - 4 Keating JC. The evolution of Palmer's metaphors and hypotheses. *Philosophical Constructs for the Chiropractic Profession*. 1992; 2(1): 9-19.
 - 5 Palmer DD [ed]. The magnetic cure. Jan 1896; #15, Palmer College Archives.
 - 6 Bachop W. The warfare of science with philosophy in contemporary chiropractic. *Philosophical Constructs for the Chiropractic Profession*. 1991; 1 (1): 33-36.
 - 7 Palmer DD [ed]. The chiropractic. 1902; #29, Palmer College Archives.
 - 8 Palmer DD [ed]. The chiropractor: a monthly journal devoted to the interests of chiropractic. Dec 1904. 1 (1).
 - 9 Palmer DD. The Chiropractor. Los Angeles: Beacon Light Printing, 1914.
 - 10 Gillet H. Vertebral fixations, an introduction to movement palpation. *Ann Swiss Chiro Assoc* 1960; 1: 30.
 - 11 Faye LJ. Motion palpation of the spine. Huntington Beach, CA: Motion Palpation Institute Publication, 1983.
 - 12 Dishman RW. Review of the literature supporting a scientific basis for the chiropractic subluxation complex. *J Manipulative Physiol Ther* 1985; 8(3): 163-174.
 - 13 Lantz C. The vertebral subluxation complex. **III** Gatterman M [ed]. *Foundations of chiropractic: Subluxation*. St. Louis, MO: Mosby-Year Book, 1995, pp. 149-174.
 - 14 Gatterman M I. Development of chiropractic nomenclature through consensus. *J Manipulative Physiol Ther* 1994; 17(5): 302-309.
 - 15 Haas M. The reliability of reliability. *J Manipulative Physiol Ther* 1991; 14 (3): 199-208.
 - 16 Hildebrant RW. Chiropractic spinography and postural roentgenology. Part I. History of development. *J Manipulative Physiol Ther* 1980; 3 (1) 87-92.
 - 17 Carver W. Chiropractic red book. Oklahoma City, OK: 1923.
 - 18 Van Schaik JPJ, Verbiest H, Van Schaik FDJ. Isolated spinous process deviations. A pitfall in the interpretation of the lumbar spine. *Spine* 1989; 14(9): 970-976.
 - 19 Taylor, JAM. The role of radiography in evaluating subluxation. In Gatterman M [ed]. *Foundations of chiropractic: Subluxation*. St. Louis, MO: Mosby-Year Book, 1995, pp. 66-86.
 - 20 Weinstein SL, Ponseti IV. Curve progression in idiopathic scoliosis. *J Bone Joint Surg* 1983; 65A: 447-455.

- 21 Plaugher G, Cremata EE, Phillips RB. A retrospective consecutive case analysis of pre-treatment and comparative static radiological parameters following chiropractic adjustments. *J Manipulative Physiol Ther* 1990; 13(9): 498-506.
- 22 Lantz CA, Chen J. The effect of chiropractic full spine adjustments on adolescent idiopathic scoliosis with curves less than 20 degrees. *Proceedings of the International Conference on Spinal Manipulation*. Bournemouth, U.K. Foundation for Chiropractic Education and Research, October 1996.
- 23 Croft AC, Krage JS, Pate O, Young ON. Videofluoroscopy in cervical spine trauma: an interinterpreter reliability study. *J Manipulative Physiol Ther* 1994; 17(1): 20-24.
- 24 Breen AC, Allen R, Morris A. Spine kinematics: A digital videofluoroscopic technique. *J Biomed Engineering*. 1989; 11: 224-228.
- 25 Breen AC. Integrated spinal motion: A study of two cases. *J Can Chiro Assoc* 1991; 35(1): 25-30.
- 26 Anderson PE, Anderson PE, Van der Kooy P. Does reduction in radiography of the spine in scoliosis. *Acta Radiol Diag* 1982; 23: 251-253.
- 27 Hardman LA, Henderson OJ. Comparative dosimetric evaluation of current techniques in chiropractic full-spine and sectional radiography. *J Can Chiro Assoc* 1981; 25: 141-145.
- 28 Triano JJ. Interaction of spinal biomechanics and physiology. In Haldeman S [ed]. *Principles and practice of chiropractic*, 2nd edition. Norwalk, CT: Appleton & Lange, 1992, p.348.
- 29 Farfan H. *Mechanical disorders of the low back*. Philadelphia, PA: Lea & Febinger, 1973.
- 30 Jull G, Bogduk N, Marland A. The accuracy of manual diagnosis for cervical zygapophyseal joint pain syndromes. *Med J Aust* 1988; 148: 233-236.
- 31 Schafer RC, Faye LJ. *Motion palpation and chiropractic technique: Principles of dynamic chiropractic*. Huntington Beach, CA: Motion Palpation Institute, 1991.
- 32 Haas M, Panzer OM. Palpatory diagnosis of subluxation. In Gatterman M [ed]. *Foundations of chiropractic subluxation*. St. Louis, MO: Mosby-Year Book, 1995, pp. 56-67.
- 33 Mootz RD, Keating JC, Kontz HP Intra- and inter-examiner reliability of motion palpation] of the lumbar spine. *J Manipulative Physiol Ther* 1989; 12(6): 440-445.
- 34 Mior SA, King RS, McGregor M, Bernard M. Intra and interexaminer reliability of motion palpation in the cervical spine. *J Can Chiro Assoc* 1985; 29: 195-198.
- 35 Manga P, Angur D, Papadopoulos C, Swan W. *The effectiveness and cost-effectiveness of chiropractic management of low-back pain*. Richmond Hill, Ontario: Kenilworth Publishing, 1993.
- 36 Bigos S, Bowyer O, Braen G, et al. Acute low back pain in adults. Clinical practice guideline No. 14. AHCPR Publication No. 95-0642. Rockville, MD: Agency for Health Care

Policy and Research, Public Health Service, U.S. Department of Health and Human Services. December 1994.

- 37 Vernon H. Basic scientific evidence for chiropractic subluxation . .!D. Gatterman M [ed]. Foundations of chiropractic: Subluxation. St. Louis, MO: Mosby-Year Book, 1995, pp.35-55.
- 38 Triano JJ, Schultz A. Correlation of objective measure of trunk motion and muscle function with low-back disability readings. Spine 12(6): 561-565, 1987.
- 39 Dhami MSI, DeBoer KF. Systemic effects of spinal lesions . .!D. Haldeman S. Principles and practice of chiropractic, 2nd edition. Norwalk, CT: Appleton & Lange, 1992, pp. 115-135.
- 40 Carnett JB. The simulation of gall bladder disease by intercostal neuralgia of the abdominal wall. Ann Surg 1927; 86: 747-757.
- 41 Davis D. Respiration manifestations of dorsal spine radiculitis simulating cardiac asthma. 'Ann Intern Med 1950; 32: 954-959.
- 42 Love JG, Emmett JL. "Asymptomatic" protruded lumbar disc as a cause of urinary retention: Preliminary report. May Clin Proc 1967; 42: 249-257.
- 43 Kellgren JH. Somatic simulating visceral pain. Clin Sci Mol Med 1939; 4: 303-309.
- 44 Lewis T, Kellgren H. Observations relating to referred pain. Clin Sci 1939; 4: 47-71.
- 45 Josey AI, Murphy F. Ruptured intravertebral disc simulating angina pectoralis. JAMA 1946; 131: 581-587.
- 46 Glick ME, Meshkinpour H, Haldeman S. et al. Colonic dysfunction in patients with thoracic spinal cord injury. Gastroenterology 1984; 86: 287-294.
- 47 Kunert W. Functional disorders of internal organs due to vertebral lesions. Ciba Symp 1965; 13: 85-96
- 48 lewit K. The contribution of clinical observation to neurobiological mechanisms in manipulative therapy. in Korr, ed. The neurobiologic mechanisms in manipulative therapy. New York: Plenum Press, 1978, pp. 3-25.
- 49 Rychikova E. Vertebrogenic disorders in internal affections, their importance in therapy. in lewit K, Gutzmann G, eds. Rehabilitacia, Proceedings of the 10th Congress, International Federation of Manipulative Medicine, Prague; 1975; suppl 10-11: 94-95.
- 50 Nansel O, Szlazak M. Somatic dysfunction and the phenomenon of visceral disease simulation: A probable explanation for the apparent effectiveness of somatic therapy in patients presumed to be suffering from true visceral disease. J Manipulative Physiol Ther 1995; 18(6): 379-397.
- 51 DeBoer K, McKnight ME. Surgical model of a chronic subluxation in rabbits. J Manipulative Physiol Ther 1988; 11 (5): 366-372.
- 52 Triano J, Iuttges M. Subtle intermittent mechanical irritation of the sciatic nerve of mice. J Manipulative Physiol Ther 1980; 3(2): 75-80.

- 53 Israel V. Changes in nerve physiology in the rat after induced subluxation. M. Sc. thesis, summarized in *Articulations* Aug 1983; 9-10.
- 54 Sato A, Swenson R. Sympathetic nervous system responses to mechanical stress of the spinal column in rats. *J Manipulative Physiol Ther* 1984; 7(3): 141-147.
- 55 Christiansen J, Meyer J. Altered metabolic enzyme activities in fast and slow twitch muscles due to induced sciatic neuropathy in the rat. *J Manipulative Physiol Ther* 1987; 10(5): 227-231.
- 56 DeBoer KF, Schutz M, McKnight ME. Acute effects of spinal manipulation on gastrointestinal myoelectric activity in conscious rabbits. *Manual Med* 1988; 3: 85-94.
- 57 Brennan PC, Kokjohn K, Triano JJ, Fritz TE, Wardrip CI, Hondras MA. Immunologic correlates of reduced spinal mobility; preliminary observations of a dog model. *Proceedings of the International Conference on Spinal Manipulation*, Arlington, VA, 1991; 118-121.
- 58 Christiansen JA, Beals S, Burnham G, Magnani M, Urbanek S. Enzyme changes in rabbit muscles due to chronic compressive nerve irritation. *Proceedings of the World Federation of Chiropractic Congress*, Toronto, Ontario, 1991.
- 59 Gillette RG, Kramis RC, Roberts WJ. Characterization of spinal somatosensory neurons having receptive fields on lumbar tissues of cats. *Pain* 1993; 54(1): 85-98.
- 60 Hu JW, Yu X-M, Vernon H, Sessle BJ. Excitatory effects on neck and jaw muscle activity of inflammatory irritant injections into cervical paraspinal tissues. *Pain* 1993; 55: 243-250.
- 61 Sato A, Sato Y, Swenson RS. Effects of morphine on somatocardiac sympathetic reflexes in spinalized cats. *J Auton Nerv Syst* 1985; 12: 175-184.
- 62 Araki T, Ito K, Kurosawa M, Sato A. The somato-adrenal medullary reflexes in rats. *J Auton Nerv Syst* 1981; 3: 161-170.
- 63 Budgell B, Holtz H, Sato A. Spinovisceral reflexes evoked by noxious and innocuous stimulation of the lumbar spine. *J. Neuromusculo Sys* 1995; 3(3): 122-131.
- 64 Cramer GO, Darby SA. Anatomy related to spinal subluxation. **III** Gatterman M [ed]. *Foundations of chiropractic: Subluxation*. St. Louis, MO: Mosby-Year Book, 1995, pp. 18-34.
- 65 Brennan PC, Kokjohn K, Kaltinger CJ, Lohr GE, Glendening C, Hondras MA, McGregor M, Triano JJ. Enhanced phagocytic cell respiratory burst induced by spinal manipulation: Potential role of substance P. *J Manipulative Physiol Ther* 1991; 14(7): 399-408.
- 66 Brennan PC, Triano JJ, McGregor M, Kokjohn K, Hondras MA, Brennan DC. Enhanced neutrophil respiratory burst as a biological marker for manipulation forces: duration of the effect and association with substance P and tumor necrosis factor. *J Manipulative Physiol Ther* 1992; 15(2): 83-89.

- 67 Alcorn SM, Chiropractic treatment and antibody levels. *J Austr Chiro Assoc* 1977; 11 (3): 18-37.
- 68 Kokjohn K, Schmid OM, Triano JJ, Brennan PC. The effect of spinal manipulation on pain and prostaglandin levels in women with primary dysmenorrhea. *J Manipulative Physiol Ther* 1992; 15(5): 279-285.
- 69 Vernon HT, Dhami MSI, Howley TP, Annett R. Spinal manipulation and beta-endorphin: A controlled study of the effect of a spinal manipulation on plasma beta-endorphin levels in normal males. *J Manipulative Physiol Ther* 1986; 9(2): 115-123.
- 70 Christian GF, Stan GJ, Sissons O, How HY, Jamison J, Alder B, Fullerton M, Funder JW. Immunoreactive ACTH, B-endorphin, and cortisol levels in plasma following spinal manipulative therapy. *Spine* 1988; 13(12): 1411-1417.
- 71 Dharni MSI, Coyle BA. Evidence for sympathetic neuron stimulation by cervical spinal manipulation. *Proceedings of the Conference on Research and Education*. San Diego, CA: California Chiropractic Association, June 1986.
- 72 Liebl NA, Butler LM. A chiropractic approach to the treatment of dysmenorrhea. *J Manipulative Physiol Ther* 1990; 13(3): 101-106.
- 73 Boesler O, Warner M, Alpers A, Finnerty EP, Kilmore MA. Efficacy of high-velocity low-amplitude manipulative technique in subjects with low back pain during menstrual cramping. *J Amer Osteo Assoc* 1993; 93(2): 203-214.
- 74 Stude DE. The management of symptoms associated with premenstrual syndrome. *J Manipulative Physiol Ther* 1991; 14(3): 209-216.
- 75 Walsh MJ, Chandraraj S, Polus BI. The efficacy of chiropractic therapy on premenstrual syndrome: A case series study. *Chiro J Aust* 1994; 24(4): 122-126.
- 76 Degenhardt BF, Kuchera ML. Efficacy of osteopathic evaluation and manipulative treatment in reducing the morbidity of otitis media in children. *J Amer Osteo Assoc* 1994; 94(8): 673.
- 77 Froehle RM. Ear infection: A retrospective study examining improvement from chiropractic care and analyzing for influencing factors. *J Manipulative Physiol Ther* 1996; 19(3): 169-177.
- 78 Klougart N, Nilsson N, Jacobsen J. Infantile colic treated by chiropractors: a prospective study of 316 cases. *J Manipulative Physiol Ther* 1989; 12(4): 281-288.
- 79 Reed WR, Beavers S, Reddy SK, Kern G. Chiropractic management of primary nocturnal enuresis. *J Manipulative Physiol Ther* 1994; 17(9): 596-600.
- 80 Yates RG, Lamping DL, Abram NL, Wright C. Effects of chiropractic treatment on blood pressure and anxiety: a randomized, controlled trial. *J Manipulative Physiol Ther* 1989; 11 (6): 484-488.

- 81 Plaughter G, Brachman TR. Chiropractic management of a hypertensive patient. J Manipulative Physiol Ther 1993; 16(8): 544-549.
- 82 Egli AS. Spine and heart: Vertebrogeous cardiac syndromes. Ann Swiss Chiro Assoc 1965; 4: 95-105.
- 83 Tran TA, Kirby JD. The effects of upper cervical adjustment on the normal physiology of the heart. J Am Chiro Assoc 1977; 14: s59-s62.
- 84 Gamble A. Alternative medical approaches to the treatment of asthma. Altern Compl Ther 1995; 1 (2): 61-66.
- 85 Jamison JR, McEwen AP, Thomas SJ. Chiropractic adjustment in the management of visceral conditions: A critical appraisal. J Manipulative Physiol Ther 1992; 15(3): 171-180.
- 86 Ebrall PS. Descriptive report of the case-mix within Australian chiropractic practice, 1992. Chiro J Austr 1993; 23(3): 92-97.
- 87 Lines DH. A wholistic approach to the treatment of bronchial asthma in a chiropractic practice. Chiro J Austr 1993; 23(1): 4-8.
- 88 Dennis D, Golden D. Manipulative therapy an alternative treatment for asthma: a literature review. Chiropractic: J Chiro Res Clin Invest 1992; 8(2): 40-41.
- 89 Jamison J. Preventive chiropractic and the chiropractic management of visceral conditions. Chiro J Aust 1991; 21 (3): 95-101.
- 90 Lewit K. Ein Fall von Auftahurunfall. Manuelle Medizin 1975; 13: 71.
- 91 Pikalov AA, Kharin VV. Use of spinal manipulative therapy in the treatment of duodenal ulcer: a pilot study. J Manipulative Physiol Ther 1994; 17(5): 310-313.
- 92 Falk JW. Bowel and bladder dysfunction secondary to lumbar dysfunctional syndrome. Chiro Technique 1990; 2(2): 45-48.
- 93 Wagner T, Owen J, Malone E, Mann K. Irritable bowel syndrome and spinal manipulation: a case report. Chiro Technique 1995; 7(4): 139-140.
- 94 Golden L, VanEgmond C. Longitudinal case study: multidisciplinary care of child with multiple functional and developmental disorders. J Manipulative Physiol Ther 1994; 17(4): 279.
- 95 Goodman R, Mosby J. Cessation of a seizure disorder: correction of the atlas subluxation complex. Chiropractic: J Chiro Res Clin Invest 1990; 6(2): 43-46.
- 96 Coody D. Epileptic care of chiropractic patients. J Chiro Res 1989; 5(2): 34.
- 97 Frach JP, Osterbauer PJ, Fuhr AW. Treatment of Bell's Palsy by mechanical force, manually assisted chiropractic adjusting and high-voltage electrotherapy. J Manipulative Physiol Ther 1992; 15(9): 596-598.
- 98 Palmieri NF. Idiopathic facial paralysis: Mechanism, diagnosis and conservative

chiropractic management. Chiro Technique 1990; 1: 182-187.

99 Rosen M. Back pain. Report of a Clinical Standards Advisory Group Committee on back pain. May 1994, London: HMSO.

100 Triano JJ, Skogsbergh D, Kowalski MH. The use of instrumentation and laboratory examination procedures by the chiropractor. In: Haldeman S [ed]. Principles and practice of chiropractic, 2nd edition. Norwalk, CT: Appleton & Lange, 1992, p. 348.

Somatic Dysfunction in Osteopathic Medicine

Michael M. Patterson, Ph.D.
Professor of Osteopathic Principles and Practice
Professor of Physiology
Director of Basic Science Research
University of Health Sciences
2105 Independence Blvd.
Kansas City, MO 64124-2395

Somatic Dysfunction: impaired or altered function of related components of the somatic (body framework) system: skeletal, arthrodial, and myofascial structures, and related vascular, lymphatic and neural elements. Somatic dysfunction is treatable using osteopathic manipulative treatment. The positional and motion aspects of somatic dysfunction are best described using at least one of three parameters:

1. the position of a body part as determined by palpation and referenced to its adjacent defined structure,
2. the directions in which motion is freer, and
3. the directions in which motion is restricted. [1]

Foundations of the Concept

Since its founding by Andrew Taylor Still in 1874, the osteopathic profession has held to the view that the beginning of disease lies in disturbed physiological function. Disturbances can be caused by various means, including trauma, improper nutrition, genetic characteristics, psychological factors, the seemingly minor bumps and jars of everyday life, and many others. The results of most of these deviations from optimal function are either handled by the body's tendency toward normal function, or are diminished by the body's vast compensatory ability. This viewpoint led directly, early in the profession, to the concept of the "osteopathic lesion." Writing in 1903, Hulett [2] defined the osteopathic lesion as "the osteopathic concept which is any structural perversion which by pressure produces or maintains functional disorder". Still and his contemporaries postulated that disease began with a deviation from optimal function which could not be compensated by the body and which led to clinical symptoms. Still reasoned that the fully functional human being would remain healthy or return to health if the bodily functions were operating properly; also, that the body had within it the necessary materials to maintain health so long as nutrition was good and movement normal. In addition, he reasoned that the body was an integrated whole, and that dysfunction in any part of the body would affect function in all parts. This philosophy, while not new to Still, but codified in a way which provided new insights into the proper treatment of patients, led to the view that all disease states and functional problems had their roots in the loss of proper function in some part of the body. Thus, the osteopathic lesion was viewed from the inception of the osteopathic profession as the true beginning of disease.

Still and his colleagues were well versed in the newly emerging concept of the germ theory of disease. They accepted its tenets so far as they went. However, reasoning from the above philosophy, they felt that if the body was functioning normally, the "germs" would not be able to defeat the body's defenses and gain the foothold necessary to cause clinical disease. Thus, even with the evidence accumulating for the view that microorganisms caused" disease symptoms of various sorts, Still wrote in 1898 that "all diseases are mere effects, the cause being a partial or complete failure (of function)." pg 108

The early concept of the osteopathic lesion included all tissues; that is, a lesion could be in bony relationships, muscles and ligaments, or visceral structures. While structural problems in bony elements accounted for many of the disorders of function, muscle and ligaments could also be the primary cause, as could visceral organs. In short, the concept of the osteopathic lesion held that any tissue could be the cause of functional disorder. A second aspect of the definition was that the structural problem had to cause functional disorder. Thus, some structural perversions, such as a developmental change in spinal curvature, may not actually cause functional disorder because of complete compensation and therefore would not constitute an osteopathic lesion. Thus, the structural perversion must produce a disordered function to become an osteopathic lesion.

The osteopathic lesion could be caused by a disturbed positional relation of parts. Thus, a dislocation, subluxation or displacement would cause a functional disorder. Displacement of organs would also generally contribute to functional disorder. Muscle contractions or contractures or muscle weakness could contribute to disorder, as could disturbed size relationships of the various tissues, such as must be the case in a tumor or atrophy of tissues. It was conceived that the cause of the disordered function could be by direct pressure of bone on organs, this would decrease function, while pressure on arteries, veins

or lymph channels would also alter function. Pressure on nerves was viewed as an especially potent cause of a lesion. However, it was recognized that improper pressure in any area on any structure could cause disordered function, which would lead to "fertile ground" for the establishment of germ

growth or abnormal tissue development recognized as clinical disease. Thus, disease began with disturbed function.

Over the years, the concept of the osteopathic lesion was further refined, and a body of research work developed to assess the contribution of structural perversion on function. Louisa Burns, D.O., building on the research of others shortly after the turn of the century, established a research program which extended to the mid 1950s. She developed an animal model in the rabbit which allowed for the production of a vertebral strain pattern whose effects could be followed for months. She found various effects of such strains in both musculoskeletal and visceral tissues and in her later years, even on the cytology of motoneurons in the spinal cord serving the strained areas. In general, she found that long-term stresses of somatic structures could alter function of other musculoskeletal structures as well as those visceral organs associated with the disordered skeletal tissues. In her later work, she found that the motoneurons serving the areas which had been subjected to strains of the vertebral column showed signs of deterioration of the cytoplasmic matrix over time. Much of her work was published in the form of reports from her laboratories i.e., 4 rather than in refereed journals. Other work within the profession in the 1930-1950's, looked at the effects of manipulative treatment on various aspects of function, such as increasing immune response and resistance to infection.^{e.g.,6} The push toward research led to the establishment of one of the first x-ray or "skiagraphy" laboratories west of the Mississippi River, just before the turn of the century at the American School of Osteopathy in Kirksville (Still's original school), to look at circulation. Other work investigated the effects of osteopathic manipulative treatment on spinal excitability.

As the profession grew and other techniques became available, studies on various forms of manipulative treatment on visceral and musculoskeletal function were performed, all driven by the notion that structural alterations could produce functional disorder, and that manipulative treatment could restore proper function. The profession established an organized research effort in about 1910 with the establishment of the AT Still Research Institute, first directed by Wilburn J. Deason, D.O. and later by Louisa Burns, D.O. The research efforts of the profession underwent some slowing during the 1930-40s, when the middle period of osteopathic research began.

The Middle Period

In the period from about 1940-1960, the osteopathic profession continued to refine the concept of the osteopathic lesion as a dynamic factor in body function. With increasing clinical experience and understanding, it became more evident that the musculoskeletal system was an important component of overall function, and one which was under constant bombardment from various stressors. Osteopathic physicians recognized clearly that functional disturbances could begin in any structure and affect overall body function. Manipulative treatment was recognized as a method for breaking the "vicious cycle" of neural feedback between musculoskeletal and visceral systems, thus decreasing the disorder created by a functional disturbance begun in either system.

In the 1940's, research was begun which significantly contributed to the concept of the osteopathic lesion. J.S. Denslow, D.O., began work using the newly developed techniques for recording electrical signals from muscle (EMG) to look objectively at the effects of manipulation on muscle activity and at the alterations which osteopathic physicians described as the osteopathic lesion. Traditionally, the determination of an osteopathic lesion was made by palpating the patient, observing whether normal positional relationships were present, whether there was normal muscle tone and tissue feel, whether normal bony motion was present and whether the patient reported pain or tenderness in the area. Denslow found that areas which his palpation determined to be in lesion reliably showed lowered muscle activity thresholds to other stimuli.' In 1945, I.M. Korr, Ph.D. joined Denslow in this work, and together they found that Denslow could predict with almost complete accuracy from his palpatory diagnosis alone those areas of the paraspinal musculature which would exhibit abnormally low

thresholds to pressure stimuli applied to the spinous processes." They found that these "low threshold" areas tended to be different from individual to individual, long-lasting and not bounded by dermatomal lines. These low threshold muscle groups could become active to remote stimuli which did not cause activity within the level of stimulation, and could be activated as well by psychological stress. Korr⁸ postulated that these patterns of low-threshold activity represented levels of the spinal cord which were being held in a hyperexcitable state, presumably by tonic streams of afferent neural input from some source. The effect of these hyperexcitable areas not only involved the associated musculoskeletal system, but also the associated visceral organs through the sympathetic outflows, which were also hyperexcited." This work formed the basis of the concept of the "facilitated segment" put forward by Korr in 1947.⁹ He postulated that an osteopathic lesion caused alterations in afferent inputs to the spinal cord which resulted in a hyperexcited state of the involved neural tissue, resulting in disturbed quantity and patterning of outflows to those tissues which were served by those spinal areas. Thus those organs and tissues were put into a state of being functionally disrupted and not in synchrony with the rest of body function. This state of disrupted function would lead to greater susceptibility to disease or breakdown and over time could be manifest as chronic degenerative disease. These studies are collected in two works now available from the American Academy of Osteopathy in Indianapolis.""

The concept of somatic dysfunction was thus enhanced by the addition of neural alterations shown in the laboratory. The idea that the lesion involved a cyclic input-output relationship between the musculoskeletal and visceral systems took on a new meaning, and the validity of altering the aberrant cycle through normalizing the somatic component with manipulative treatment became more viable. Thus, by 1960, the evidence for a neural component as a function of all osteopathic lesions was established.

The Current Period

In about 1960, with growing acceptance of the osteopathic profession in American medical structures, there developed increasing concern over the term "osteopathic lesion." To the outside world, the phrase meant little. Despite the fact that the term had a tremendously rich clinical and research history and support, it was not accepted by outside entities. Ira Rumney, D.O., coined the term "somatic dysfunction" to replace the term osteopathic lesion. The new term was more palatable to governmental and insurance agencies who were paying for treatment of the osteopathic lesion. The term became widespread in the profession and was officially adopted as the term for the former osteopathic lesion in the mid 1960s. Over the next several years, the Educational Council on Osteopathic Principles (ECOP) refined the definition of the term somatic dysfunction to its current form (see 1, glossary).

From about 1970 to the present, research within and outside the osteopathic profession has proceeded with increasing speed on various aspects of the somatic dysfunction concept. Clinical studies have shown positive effects of manipulative treatment on the manifestations of somatic dysfunction.^{13, 14} The significance of the findings of Denslow and Korr with the long-lasting hyperexcitable neuron pools has been given underpinnings with discovery that neural excitability alterations are produced by afferent inputs to the spinal cord. Such inputs can produce short acting excitability increases, lasting seconds or minutes," intermediate term increases lasting for hours or days, and longer lasting or permanent alterations in spinal neuron excitability." These data support the clinical observations that a somatic dysfunction may be long-lasting despite apparently successful treatment; such neural excitability alterations may even underlie some types of chronic pain patterns and reflex sympathetic dystrophies.

Equally important for the concept of somatic dysfunction is the growing understanding of the extensive and pervasive interactions between visceral and somatic structures through the spinal cord.

Known as somatovisceral and viscerosomatic interactions, these neural circuits were virtually unexplored by the scientific community until the 1970s. Recent research has revealed the neural basis in the spinal cord of the effects of somatic afferent inputs on autonomic outflows and of inputs from visceral structures on somatic neural control. A recent symposium¹⁷ summarized these interactions and their relevance to the somatic dysfunction. It is now evident that there are very extensive and potent intraspinal connections between afferent inputs from visceral and somatic structures which allow the effects of either to be exhibited on neural activity to both sets of structures. Thus, the inputs from a compromised heart undergoing a myocardial infarct produce symptoms in the muscles of the left shoulder or arm, where pain is also felt. Likewise, tense muscles of the shoulder can cause sympathetic output alterations to the heart, compromising blood flow in the coronary vessels." These findings, coupled with the increasing understanding of neural excitability alterations, go far in explaining the complexities of the somatic dysfunction. In another symposium, the integration of function of psychological, neural and immune systems was examined." The evidence is becoming overwhelming for the view that somatic inputs alter not only visceral activity, but brain activity and function as well. In addition, it is now evident that the sympathetic nervous system innervates and controls much more than was previously recognized. For example, sympathetic neurons innervate even bone marrow where they control production of various blood cells. Thus, the role of the sympathetic nervous system is vastly greater than is generally recognized. Even more importantly, it now appears that mechanoreceptor inputs from the musculoskeletal system have a potent effect on the activity of the sympathetic system." Various areas of the musculoskeletal system are extensively and richly innervated with mechanoreceptors, especially around the spinal column, which seems to operate as one vast proprioceptor organ. Disturbances in this complex musculoskeletal structure could have important implications for sympathetic outflow and neural excitability. Thus, evidence continues to extend the view that disturbances in any body system can affect the function of all systems and the ability of the body to respond to challenges or remain healthy. With this understanding comes a greater acknowledgment of how the use of manipulative treatment has significant effects on restoring and maintaining optimal function and health. Given these research findings, the role of the somatic dysfunction in bringing about functional disorder is difficult to overstate. What appears to be a simple somatic or musculoskeletal problem has ramifications far beyond the inability to perform a simple movement. The irritation produced by a visceral disturbance alters musculoskeletal tone which itself produces changes in patterns and quantity of neural inputs. These disrupt the body's normal function, reducing its ability to defend against stressors. The ground is laid for disease.

The concept of somatic dysfunction has a long and rich history in the osteopathic profession where it is supported by a growing body of clinical experience. The concept is buttressed by current clinical and basic research, as well as by an increasing understanding of human health and disease processes.

For more information on this area, please see the text *Foundations for Osteopathic Medicine*, 1996, Williams & Wilkins.

References

- 1 Foundations for Osteopathic Medicine, Ward, R.C. (Ed.) Williams and Wilkins, 1996
- 2 Hulett, G.D. A Textbook of the Principles of Osteopathy, Journal Printing Company, Kirksville, MO, 1903
- 3 Still, A.T. Autobiography of Andrew T. Still, Published by the Author, Kirksville, 1897
- 4 Burns, L. The Pathology of the Vertebral Lesion: Bulletin No.4 of the A.T. Still Research

Institute. The Abingdon Press, Chicago, 1917

- 5 Lane, M.A. A new method of osteopathic treatment for the cure of infections. J. Osteopathy. 29(12), 729-733, 1919
- 6 Lane, M.A. On increasing the antibody content of the serum by manipulation of the spleen. J. Osteopathy. 27(6), 361-364, 1920
- 7 Denslow, J.S. and Hassett, C.C. The central excitatory state associated with postural abnormalities. J. Neurophysiol, 5, 393-402, 1942
- 8 Denslow, J.S., Korr, 10M. and Krems, A.D. Quantitative studies of chronic facilitation in human motoneuron pools. Am. J. Physiol. 150,229-238, 1947
- 9 Korr, 10M. The neural basis of the osteopathic lesion. JAOA, 47,191-198,1947
- 10 Korr, 10M., Thomas, P.E. and Wright, H.M. Patterns of electrical skin resistance in man. ~ Neural Transmission, 17, 77-96, 1958
- 11 The Collected Works of Irvin M. Korr. The American Academy of Osteopathy, Indianapolis, IN, 1979
- 12 Selected Papers of John Stedman Denslow. D.O. The American Academy of Osteopathy, Indianapolis, IN, 1993
- 13 Sucher, B.M. palpatory diagnosis and manipulative management of carpal tunnel syndrome; Part 2. "Dou~le crush" and thoracic outlet syndrome. JAOA, 95(8), 471-479, 1995
- 14 Johnston, W.L. and Kelso, A.F. Changes in presence of a segmental dysfunction pattern associated with hypertension: Part 2. A long-term study. JAOA. 95(5), 315-318, 1995
- 15 Groves, P.M. and Thompson, R.F. Habituation: A dual process theory. Psychological Review. 77, 419-450,1972
- 16 Patterson, M.M. and Steinmetz, J.E. Long-lasting alterations of spinal reflexes: A basis for somatic dysfunction. Manual Medicine, 2, 38-42, 1986
- 17 The Central Connection: SomatovisceralViscero-somatic Interaction. 1989 International Symposium. Patterson, M.M. and Howell, J.N. (Eds), American Academy of Osteopathy, Indianapolis, IN, 1992
- 18 Patterson, M.M. and Wurster, R.D. Neurophysiologic system: Integration and disintegration. In Foundations for Osteopathic Medicine, Ward, R.C. (Ed), Williams and Wilkins, 137-154, 1996
- 19 Nociception and the Neuroendocrine-Immune Connection. 1992 International Symposium. Willard, F.H. and Patterson, M.M. (Eds), American Academy of Osteopathy, Indianapolis, IN, 1994
- 20 Victor, R.G., Rotto, D.M., Pryor, S.L. and Kaufman, M.P. Stimulation of renal sympathetic

activity by static contraction: Evidence for mechanoreceptor-induced reflexes from skeletal muscle. *Circulation Research*, 64(3), 592-599, 1989