

Review Article

Chiropractic: A Critical Evaluation

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Abstract

*Chiropractic was defined by D.D. Palmer as “a science of healing without drugs.” About 60,000 chiropractors currently practice in North America, and, worldwide, billions are spent each year for their services. This article attempts to critically evaluate chiropractic. The specific topics include the history of chiropractic; the internal conflicts within the profession; the concepts of chiropractic, particularly those of subluxation and spinal manipulation; chiropractic practice and research; and the efficacy, safety, and cost of chiropractic. A narrative review of selected articles from the published chiropractic literature was performed. For the assessment of efficacy, safety, and cost, the evaluation relied on previously published systematic reviews. Chiropractic is rooted in mystical concepts. This led to an internal conflict within the chiropractic profession, which continues today. Currently, there are two types of chiropractors: those religiously adhering to the gospel of its founding fathers and those open to change. The core concepts of chiropractic, subluxation and spinal manipulation, are not based on sound science. Back and neck pain are the domains of chiropractic but many chiropractors treat conditions other than musculoskeletal problems. With the possible exception of back pain, chiropractic spinal manipulation has not been shown to be effective for any medical condition. Manipulation is associated with frequent mild adverse effects and with serious complications of unknown incidence. Its cost-effectiveness has not been demonstrated beyond reasonable doubt. The concepts of chiropractic are not based on solid science and its therapeutic value has not been demonstrated beyond reasonable doubt. *J Pain Symptom Manage* 2008;35:544–562. © 2008 U.S. Cancer Pain Relief Committee. Published by Elsevier Inc. All rights reserved.*

Key Words

Cerebrovascular accident, clinical trials, cost-effectiveness, evidence-based medicine, side effects

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Introduction

Chiropractic is a popular form of health care for which many definitions can be found^{1–12} (Table 1). “The ‘raison d’être’ of the chiropractic profession is the detection and correction of spinal subluxations.”¹³ In the “earliest known” publication¹⁴ on the subject, its founder (Daniel David Palmer) stated that, “chiropractic is a science of healing without drugs.”¹⁵

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Table 1
Recent Definitions of Chiropractic

Date	Definition/description (quotes)	Source (Ref.)
1998	A system of healthcare...which is based on the belief that the nervous system is the most important determinant of a person's state of health.	Segen ¹
1994	A drugless, non-invasive manual form of outpatient treatment for musculoskeletal, functional and other chronic disorders.	Oths ²
1996	A therapeutic system based on the premise that structure and function in the human body are closely related and, in particular, the relationship between the spinal column and the nervous system is the most important.	Lott ³
1998	A system of healing based on the belief that health is maintained when the spinal column is in its proper position and the nervous system is not impinged.	Bimonte ⁴
1998	Chiropractic...is based on the body's ability to heal itself. Central to improving the body's ability to heal itself, chiropractors assert, is the removal, or correction, of malalignments of the spine (called subluxations) through the use of spinal manipulation (called spinal adjustments).	Shekelle ⁵
1998	The medical profession that specializes in manual therapy and especially spinal manipulation.	Kaptchuk ⁶
1999	A health profession concerned with the diagnosis, treatment and prevention of mechanical disorders of the musculoskeletal system and the effects of these disorders on the function of the nervous system and general health. There is an emphasis on manual treatments, including spinal manipulation or adjustment.	World Federation of Chiropractic ⁷
1999	A profession which specializes in the diagnosis, treatment and overall management of conditions which are due to mechanical dysfunction of the joints, particularly those of the spine, and their effects on the nervous system.	British Chiropractic Association ⁸
1999	A branch of the healing arts which is concerned with human health and disease processes.	American Chiropractic Association ⁹
2000	A branch of the healing arts...based on the premise that good health depends, in part, upon a normally functioning nervous system.	Sportelli ¹⁰
2000	The chiropractic is not a technique. It is a health care profession, it has an exclusive body of information which teaches, certifies, polices, purveys and sometimes attempts to validate.	Halder ¹¹
2003	A form of health care that focuses on the relationship between the body's structure, primarily of the spine and function.	NCCAM ¹²

Today, some chiropractors view chiropractic as an "alternative form of healthcare,"¹⁶ but in most countries, chiropractic is seen as an adjunct to rather than a replacement of conventional medicine. Chiropractors have legal recognition in about half of the world, whereas in the other half, such recognition is lacking. In India, China, former Russia, parts of Europe, and most of South Africa,¹⁷ chiropractic is not legally recognized.

In the United States, between \$2.4 and \$4.0 billion is spent each year on chiropractic care.^{18,19} Chiropractic is covered by Medicare, a substantial proportion of private and public insurance plans, all state-workers compensation systems, all forms of managed care, most health maintenance organizations, and private health insurance plans.²⁰ All 50 U.S. states, Puerto Rico, the District of Columbia, and the Virgin Islands license chiropractors.^{3,21} About 60,000 chiropractors currently practice in North America, a number that has tripled between 1970 and 1990.^{16,22} The proportion of the population using chiropractic services has doubled in the last two decades.²² The

chiropractic profession is thus growing rapidly; more than 4,000 students graduate each year from about 30 chiropractic colleges in the United States, and the total number of U.S. chiropractors is predicted to reach 100,000 by 2010.^{23,24}

This article critically analyzes the history, rationale, and practice of chiropractic. It asks the question: Does chiropractic generate more good than harm? It draws mainly on the published chiropractic literature, including several articles that have previously reviewed chiropractic.^{6,10,11} The scarcity of critical in-depth analyses is noted; its implications are described.

History

The history of chiropractic is "rooted in quasi-mystical concepts."²⁰ Bonesetters of various types are part of the folk medicine of most cultures,²⁵⁻²⁷ and bonesetting also formed the basis on which chiropractic developed. The birthday of chiropractic is said to be September 18, 1895. On this day, D.D. Palmer

manipulated the spine of a deaf janitor by the name of Harvey Lillard, allegedly curing him of his deafness.²⁸ Palmer's second patient, a man suffering from heart disease, was also cured.²⁹ About one year later, Palmer opened the first school of chiropractic.²⁹

There is evidence to suggest that D.D. Palmer had learned manipulative techniques from Andrew Taylor Still (1828–1917), the founder of osteopathy.³⁰ He combined the skills of a bonesetter with the background of a magnetic healer and claimed that “chiropractic was not evolved from medicine or any other method, except that of magnetic.”³¹ He coined the term “innate intelligence” (or “innate”) for the assumed “energy” or “vital force,” which, according to the magnetic healers of that time, enables the body to heal itself. The “innate” defies quantification. “Chiropractic is based on a metaphysical epistemology that is not amenable to positivist research or experiment.”³²

The “innate” is said to regulate all body functions but, in the presence of “vertebral subluxation,” it cannot function adequately. Chiropractors therefore developed spinal manipulations to correct such subluxations, which, in their view, block the flow of the “innate.”³³ Chiropractic is “a system of healing based on the premise that the body requires unobstructed flow through the nervous system of...innate intelligence.”³⁴ Anyone who did not believe in the “innate” or in “subluxations” was said to have no legitimate role in chiropractic.³⁵

“Innate intelligence” evolved as a theological concept, the representative of Universal Intelligence (=God) within each person.³⁶ D.D. Palmer was convinced he had discovered a natural law that pertained to human health in the most general terms. Originally, manipulation was not a technique for treating spinal or musculoskeletal problems, it was a cure for *all* human illness: “95% of all diseases are caused by displaced vertebrae, the remainder by luxations of other joints.”³⁷ Early chiropractic pamphlets hardly mention back pain or neck pain, but assert that, “chiropractic could address ailments such as insanity, sexual dysfunction, measles and influenza.”³⁸

D.D. Palmer was convinced that he had “created a science of principles that has existed as long as the vertebra.”³⁹ Chiropractors envision

man as a microcosm of the universe where “innate intelligence” determines human health as much as “universal intelligence” governs the cosmos; the discovery of the “innate intelligence” represents a discovery of the first order, “a reflection of a critical law that God used to govern natural phenomena.”³⁴

Chiropractic as a Religion

Early chiropractic displayed many characteristics of a religion. Both D.D. Palmer and his son, B.J. Palmer, seriously considered establishing chiropractic as a religion.³⁴ Chiropractic “incorporated vitalistic concepts of an innate intelligence with religious concepts of universal intelligence,” which substituted for science.⁴⁰ D.D. Palmer declared that he had discovered the answer to the timeworn question, “What is life?” and added that chiropractic made “this stage of existence much more efficient in its preparation for the next step—the life beyond.”³⁹

Most early and many of today's chiropractors agree: “Men do not cure. It is that inherent power (derived from the creator) that causes wounds to heal, or a part to be repaired. The Creator...uses the chiropractor as a tool...chiropractic philosophy is truly the missing link between Religion or Power of the various religions.”⁴¹ Today, some chiropractors continue to relate the “innate” to God.⁴² Others, however, warn not to “dwindle or dwarf chiropractic by making a religion out of a technique.”⁴³

External Conflict

Initially, the success of chiropractic was considerable. By 1925, more than 80 chiropractic schools had been established in the United States. Most were “diploma mills” offering an “easy way to make money,”²⁹ and many “were at one another's throats.”⁴¹ Chiropractors believed they had established their own form of science,⁴⁴ which emphasized observation rather than experimentation, a vitalistic rather than mechanistic philosophy, and a mutually supportive rather than antagonist relationship between science and religion. The gap between conventional medicine and chiropractic thus widened “from a fissure into a canyon.”³⁴ The rivalry was not confined to conventional medicine; “many osteopaths asserted that chiropractic was a bastardized version of osteopathy.”³⁰

Rather than arguing over issues such as efficacy, education, or professional authority, the American Medical Association insisted that all competent health care providers must have adequate knowledge of the essential subjects such as anatomy, physiology, pathology, chemistry, and bacteriology.³⁴ By that token, the American Medical Association claimed, chiropractors were not fit for practice.²⁸ Some “martyrs,” including D.D. Palmer himself, went to jail for practicing medicine without a licence.^{6,41}

Chiropractors countered that doctors were merely defending their patch for obvious financial reasons (ironically, chiropractors today often earn more than conventional doctors³⁰), that orthodox science was morally corrupt and lacked open-mindedness.³⁴ They attacked the “germo-anti-toxins-vaxiradi-electro-microbi-slush death producers”⁴⁴ and promised a medicine “destined to the grandest and greatest of this or any age.”³¹

Eventually, the escalating battle against the medical establishment was won in “the trial of the century.”⁶ In 1987, sections of the U.S. medical establishment were found “guilty of conspiracy against chiropractors,”⁴⁵ a decision which was upheld by the U.S. Supreme Court in 1990.⁶ In other countries, similar legal battles were fought, usually with similar outcomes.^{46,47} Only rarely did they not result in the defeat of the “establishment.” In 1990, a Japanese Ministry of Health report found that chiropractic is “not based on the knowledge of human anatomy but subjective and unscientific.”⁴⁸

Internal Conflict

These victories came at the price of “taming” and “medicalizing” chiropractic.⁴⁶ In turn, this formed the basis of a conflict within the chiropractic profession—the dispute between “mixers” and “straights”—a conflict which continues to the present day.

The “straights” religiously adhere to D.D. Palmer’s notions of the “innate intelligence” and view subluxation as the sole cause and manipulation as the sole cure of all human disease. They do not mix any nonchiropractic techniques into their therapeutic repertoire, dismiss physical examination (beyond searching for subluxations) and think medical diagnosis is irrelevant for chiropractic.³³ The

“mixers” are somewhat more open to science and conventional medicine, use treatments other than spinal manipulation, and tend to see chiropractors as back pain specialists.^{6,28} Father and son Palmer warned that the “mixers” were “polluting and diluting the sacred teachings” of chiropractic.³⁹ Many chiropractors agreed that the mixers were “bringing discredit to the chiropractic.”⁴¹

The “straights” are now in the minority but nevertheless exert an important influence. They have, for instance, recently achieved election victories within the British General Chiropractic Council.⁴⁹ Today, two different chiropractic professions exist side by side—“one that wishes to preserve the non-empirical, non-positivist, vitalist foundations (the straights) and the other that wishes to be reckoned as medical physicians and wishes to utilize the techniques and mechanistic viewpoint of orthodox medicine (the mixers).”³² The International Chiropractic Association represents the “straights” and the American Chiropractic Association the “mixers.”

Core Concepts

The three main hypotheses of modern chiropractic have been summarized as follows:¹⁶

- There is a functional relationship between the spine and health mediated through the nervous system.
- Subluxations adversely affect health.
- Correction of subluxation by spinal manipulation improves or restores health.

“Give me a simple mind that thinks along single tracts, give me 30 days to instruct him, and that individual can go forth on the highways and byways and get more sick people well than the best, most complete, all around, unlimited medical education of any medical man who ever lived.”⁵⁰ This remark by B.J. Palmer implies that naivety is required to accept the implausibility of the chiropractic concepts. The founders of chiropractic created myths and denied scientific discoveries; B.J. Palmer, for instance, rejected the existence of the sympathetic nervous system,¹⁴ and early chiropractors denied the existence of the germ theory of disease, which has important implications for public health today (see below).

The “mixers,” however, saw the insistence on the “innate” as “religious baggage.”⁵¹ Today many chiropractors are anxious to sever all links with this concept,⁶ fearing that it might jeopardize chiropractics’ acceptance into the mainstream.^{52–54}

Subluxation

Some chiropractors prefer terminology such as “vertebral subluxation complex,”⁵⁵ “manipulable spinal lesion,”⁵⁶ “chiropractic lesion,”⁵⁷ or “vertebral blockage,”⁵⁸ yet most modern chiropractors accept the concept of subluxation.¹³ The term as used in chiropractic means something different from subluxation in regular medicine. Here, I refer to the term as used in chiropractic. For D.D. Palmer, it was “a static malalignment of a single vertebra.”⁶ Subluxations are believed to impinge on spinal nerves, therefore blocking the flow of the “innate intelligence” (according to “straights”) or causing disease in some other way (according to “mixers”).

Many “straights” adhere to B.J. Palmer’s theory that atlas subluxations impinge on the spinal cord;⁴⁰ “chiropractic gets sick people well by adjusting vertebral subluxations of atlas and axis only.”⁵⁹ This “narrowed the search for specific causes of patients’ maladies by narrowing the area of the search to the upper spine.”¹⁴ Until recently, such chiropractic theories were left unquestioned and untested.⁶⁰ Chiropractic was (and arguably is) a matter of belief rather than evidence.

Several theories have been advanced to explain how subluxations might cause health problems,^{61–63} for example, through edema around intervertebral foramina⁶⁴ or twisting the dura mater.⁶⁵ However, none of these have been independently confirmed and the specific mechanisms involved are not known.^{29,66} In fact, subluxations have never been proven to constitute a relevant entity. Critics have repeatedly pointed out that even severe nerve root compression does not cause organic disease.^{67–69} Regardless of such doubts, the U.S. Association of Chiropractic Colleges reached a consensus in 1996 that “chiropractic is concerned with the preservation and restoration of health and focuses particular attention on the subluxation. A subluxation is a complex of functional and/or pathological articular changes that compromise neural

integrity and may influence organ systems function and general health.”⁷⁰ One year later, the U.S. Foundation for Chiropractic Education and Research published a monograph stating that subluxation “embraces the holistic nature of the human body, including health, well-being, the doctor/patient relationship, and the changes in the nerve, muscle, connective tissue, and vascular tissues which are understood to accompany the kinesiological aberrations of spinal articulations.”⁷¹ Today, 88% of U.S. chiropractors believe that subluxation contributes to over 60% of all visceral ailments and 90% think it should, therefore, not be limited to musculoskeletal conditions.⁷² In other countries, for example, Canada, these percentage figures are usually lower.⁷³

Spinal Manipulation

Subluxations can be corrected with spinal manipulations or “adjustments,” a term preferred by some chiropractors.²⁰ Today most chiropractors agree with D.D. Palmer that spinal manipulation has to be specific, that is, at the correct spinal segment.⁷⁴ There is, however, less agreement on the optimal direction or the level of manipulation.^{75,76} Chiropractors even disagree about the term spinal manipulation.^{77,78} In its broadest definition, it describes the “application of a load (force) to specific body or tissues with therapeutic intent.”²⁰

Spinal manipulation moves vertebrae beyond their physiological range of motion (chiropractors speak of “end feel” and “paraphysiological space”)¹³ but not far enough to destroy joint structures:⁶ “between the normal range of motion and the limits of its normal integrity.”¹³ Chiropractors believe that spinal manipulation breaks fibrous adhesions within joints, or that it “releases small tags from the joint capsule that might be entrapped within the joint,” or that it affects the mechanoreceptors of the joint, or that it modulates central nervous system excitability,²¹ or that it inhibits C-fiber mediated pain perception.⁷⁹ None of these theories are, however, supported by sound evidence.⁸⁰

Numerous forms of spinal manipulation exist but “the short-lever technique—touching the vertebrae directly at high velocity and low amplitude, i.e., by moving a small distance—with the

spinal or transverse process as a fulcrum, is considered the typical chiropractic manoeuvre.”⁶

Chiropractic Practice

The Profession(s)

Many chiropractors (mixers) view themselves as primary care providers^{30,81} or general practitioners with “an important role in health promotion and injury or disease prevention.”^{82,83} “Integrative medicine” is often seen as “the next step in gaining access to patients.”⁸⁴

Overall, estimates of the use of chiropractic services by the general population range from 3% to 18%.²¹ Health care professionals usually prefer other forms of complementary/alternative medicine to chiropractic.^{85,86} Chiropractors predominantly treat patients with musculoskeletal problems, about 60% of whom suffer from low back pain. In the United States, 13% of all back pain sufferers consult a chiropractor.⁸⁷ Another domain is neck pain, which chiropractors usually treat with upper spinal manipulation. One report indicates, however, that only 11% of all cervical manipulations are “appropriate.”⁸⁸

Spinal manipulation is also practiced in other professions (e.g., osteopaths, physiotherapists, and doctors) but chiropractors deliver more than 90% of all spinal manipulations.²⁰ Treatment is often continued for over three months, even in the absence of clinical improvement.⁸⁹ Consultations last for an average of 22 minutes.⁹⁰ Many U.S. chiropractors use “practice building seminars” (often organized by Scientologists) to convince their patients of the value of their treatments.⁹¹ Chiropractors work mostly in single practices (67%) and have an average of 3.8 years of basic training.⁹⁰ Their income frequently exceeds that of conventional primary care physicians.³⁰

The Treatments

In addition to spinal manipulations, “mixers” also use other modalities such as heat, cold, and electrotherapy; they also may advise on supplement usage, lifestyle, weight loss, or relaxation.²⁰ Maintenance chiropractic care is promoted as a preventative measure for both musculoskeletal and visceral problems⁹² even though “such unnecessary manipulation

might present a risk to patients.”⁹³ Some chiropractors refer patients to homeopaths, iridologists, or paranormal healers.⁹⁴ Many chiropractors use unproven or disproven methods themselves such as homeopathy (46%), applied kinesiology (38%),⁹⁵ or traction.⁹⁴ In fact, applied kinesiology is rated to be among their most reliable diagnostic methods.⁷⁷

“Widespread unjustified claims which chiropractors routinely make” have become a concern even for some chiropractors.⁹⁶ A comparison of practice guidelines issued by various chiropractic organizations disclosed “discrepancies in the strength of recommendations, the type of recommendations and even the evidence upon which the recommendations have been based.”³²

Patients

About 90% of chiropractic patients are self-referred,⁸⁴ and payment often comes (35%) directly from the patient.⁹⁰ Chiropractic patients are more likely than medical patients to be obese, lack a regular doctor, have few chronic conditions, take few drugs, and be uninsured and dissatisfied with health care.⁹⁷ A sizable proportion of U.S. chiropractic patients (20%–30%) receive in excess of 11 treatment sessions.⁸¹ For neck pain, an average number of 25 visits was recently reported, and 2% of these patients received more than 80 treatment sessions.⁹⁸ In other countries, for example, Canada, these percentages may be considerably lower.⁹⁹

Reasons for patients not to consult chiropractors include the fear of adverse effects and “lack of scientific proof.”⁸⁴ In general, the public seems to prefer medical doctors as their primary care providers.¹⁰⁰ In some parts of Canada (British Columbia and Ontario), chiropractic services have recently been delisted, and the Ontario government estimated that \$100 million will be saved through this move.¹⁰¹

Indications

Chiropractic services are used mostly, but by no means exclusively, for the management of musculoskeletal conditions. The American Chiropractic Association stresses, however, that chiropractic care is “not limited to back pain, neck pain” or other neuromusculoskeletal

disorders;⁹ 11%–19% of all chiropractic patients suffer from nonmusculoskeletal conditions.^{102,103} This figure seems to be considerably lower outside the United States.^{94,104}

Most chiropractic texts discuss spinal manipulation as a treatment for visceral disorders,^{13,16,105,106} and it has been noted that, “there have been over 1,200 published studies linking spinal trauma to visceral disease.”¹⁰⁷ Nonmusculoskeletal problems regularly treated by chiropractors include respiratory conditions, nonspinal injuries, digestive system disorders, menstrual problems, ear infections, pregnancy-related conditions, infectious and parasitic conditions, dermatological diseases, and acute urinary conditions.⁸¹ Chiropractors cite uncontrolled studies in support of spinal manipulations for indications such as dysmenorrhea, asthma, otitis media, hypertension, IBS, and peptic disorders.^{108–112} The chiropractic literature is rife with claims related to nonspinal indications, for example, “the judicial use of chiropractic services in cancer patients appears to offer many economical and effective strategies for reducing the pain and suffering of cancer patients....”¹¹³

Diagnostics

The reliability of diagnostic techniques used by chiropractors is generally poor.^{75,114–121} Plain static radiograph and functional radiograph investigations are viewed as the most reliable methods for diagnosing subluxations.⁷⁷ Thus, practically all new (96.3%) and most continuing (80%) U.S. chiropractic patients undergo radiography, with an average number of views per new patient of 3.4.¹⁰² Yet, guidelines state that a competent chiropractor “does not do routine radiographs on every patient.”¹²² The majority of U.S. chiropractors (86%) have their own X-ray equipment,¹⁰² whereas elsewhere, for example, in Holland, this figure is lower (58%).⁹⁴ Although most patients consulting a chiropractor have a radiograph taken,¹²³ only 4% of UK back pain patients in general practice have the procedure.¹²⁴ Most experts today caution that radiographic investigations for nonspecific back pain are frequently unnecessary¹²⁵ and harmful.¹²⁶

Many U.S. chiropractors also do blood and urine analyses and some engage in minor surgery.⁸¹ In Oregon, chiropractors are allowed to

deliver babies,¹²⁷ but in most U.S. states, obstetrics is specifically prohibited to them. Conventional U.S. doctors are unlikely to make formal referrals to chiropractors.¹²⁸

Ethics

A comparison of Californian disciplinary actions (1998–2002) against chiropractors and medical doctors showed that there were 4.5 such actions per 1,000 chiropractors per year, a figure which was 98% higher than that for doctors. The incidence rate per 1,000 for fraud was 1.99 for chiropractors, 895% higher than that for doctors. The incidence rate for sexual boundary transgressions was 1.01 for chiropractors, 339% higher than that for doctors.¹²⁹

Informed consent is a serious concern in chiropractic practice. Of 150 randomly selected UK chiropractors, only 23% reported always discussing serious risks with their patients before treatment, a behavior that clearly is in conflict with the UK ethical code.¹³⁰

Research

The terms “research” and “science” appear frequently in the chiropractic literature with a variety of meanings “unfamiliar to most scientists”³³ (Table 2). Many early chiropractors felt the need to obtain an “aura of scientific respectability” as marketing ploys for promoting their practice to the public.³³ This attitude seems to be still prevalent. A leading Canadian chiropractor, for instance, was quoted saying that research “is something that you have to do, no question. We have to have the research to be accepted properly.”¹³¹ The concept that research is a means of improving future health care does not seem widespread within the chiropractic profession.

The little research that did take place during the early years of chiropractic was of remarkably low quality. Research was initiated to prove rather than to test chiropractic.³³ The data that thus emerged were subject to “zealous overinterpretation.”³³ For instance, observational studies were wrongly characterized as controlled clinical trials.¹³² The current chiropractic research literature continues to be overtly biased. An evaluation of the 29 recent reviews of spinal manipulation for back pain concluded that those authored by

Table 2
Quotes from the Chiropractic Literature Related to Science

Date	Author	Quote
1897	Palmer DD	Chiropractic is a science of healing without drugs
1906	Palmer DD, Palmer BJ	The science of chiropractic
1910	Palmer DD	The science, art and philosophy of chiropractic
1911	Palmer BJ	The philosophy, science and art of chiropractic nerve tracing
1917	Carvor	The first scientific statement of the science of chiropractic
1946	Ratledge TF	The ultra-scientific nature of the chiropractic concept
1985	Dishman	Scientific basis for the chiropractic subluxation complex
1994	Martin SC	The demonstration of a new scientific law that healed the sick was an important contribution to the revealing of God's beneficence

chiropractors tended to generate positive results, whereas the others failed to demonstrate effectiveness.¹³³

Today's "straight" chiropractors believe that research "never establishes truth"⁴² and deny the relevance of science to chiropractic.³⁵ "We cannot second guess whether the innate intelligence of the body can heal a disease."⁴² Belief in subluxation is an essential prerequisite for any chiropractor—so much so that questioning this belief is grounds for banishment from the profession; therefore, scientific investigation of chiropractic, which obviously requires questioning that belief, is (by definition) not possible for chiropractors.³³

There is "a shortage of chiropractic clinicians who have the experience and training to conduct clinical research."¹¹² A survey of Californian chiropractic students suggested that 52% of them are interested in research, 26% have research experience, 19% thought research training should be in their curriculum but "most students...were reluctant to take on extra courses in research."¹³⁴ It is, therefore, not surprising that "many of the key clinical trials...were conducted in Europe and Canada."¹³

Current Evidence

Efficacy

Kusserow noted that, "overtly aggressive marketing [is]...deliberately aimed at misleading patients and the public regarding the efficacy of chiropractic care."¹³⁵ In fact, unsubstantiated claims regarding the efficacy of chiropractic continue to be made, not merely by overenthusiastic individuals but also by official organizations. For instance, a patient brochure published by the UK General Chiropractic Council (the body that oversees

chiropractic in Great Britain) stated that "chiropractors primarily treat: spine, neck and shoulder problems, joint, posture and muscle problems, sciatica, sports injuries, tension headaches and benefit may also be seen for some types of asthma, digestive disorders, migraine, infant colic, menstrual pains."¹³⁶ This statement clearly implies that chiropractic is helpful for these indications. Yet the evidence from rigorous clinical trials fails to confirm this.

Numerous controlled clinical studies of chiropractic are now available, but their results are far from uniform. Rather than selecting single studies according to their findings, it is, therefore, preferable to consider the totality of this evidence. Table 3 gives an overview of the most up-to-date systematic reviews by indication.¹³⁷⁻¹⁴⁴ These systematic reviews usually include trials of spinal manipulation regardless of who administered it. Thus, they are not exclusively an evaluation of chiropractic. Collectively, their results fail to demonstrate that spinal manipulation is effective. The only possible exception is back pain. For this condition, manipulation may be as effective (or ineffective) as standard therapy.¹³⁷

Many national guidelines recommend chiropractic for acute or chronic low back pain.¹⁴⁵⁻¹⁴⁹ The reason may not be the convincingly demonstrated effectiveness of chiropractic care but the fact that no therapy so far has been shown to make a real difference for back pain sufferers. Recent studies suggest that a prospectively identifiable subgroup of patients with back pain may benefit from spinal manipulation, whereas others do not.¹⁵⁰⁻¹⁵³ If this turns out to be true, it could help to explain the so far unconvincing trial results. Other recent data suggest that, for back pain, educational programs may be preferable to treatments such as spinal

Table 3
Systematic Reviews of (Chiropractic) Spinal Manipulation

First Author (Year)	Interventions	Condition	n	Meta-analysis	Overall result ^a	Comment
Assendelft et al. (2004) ¹³⁷	Any type of SM	Low back pain	39	Yes	No evidence that SM is superior to other standard treatments for acute or chronic low back pain	Also included RCTs of mobilization
Gross et al. (2004) ¹³⁸	Any type of SM and mobilization	Neck problems	33	Yes	...evidence did not favor SM/ mobilization done alone	Combined with exercise, SM was beneficial
Fernandez-de-las-Penas et al. (2006) ¹³⁹	All types of manual therapies (3 trials of spinal manipulation)	Tension type headache (TTH)	6	No	"...no rigorous evidence that manual therapies have a positive effect on the evolution of TTH"	2 RCTs were of high quality but generated contradictory results
Ernst (2003) ¹⁴⁰	Chiropractic SM	Neck pain	4	No	The notion that chiropractic SM is more effective than conventional exercise...was not supported by rigorous trial data	Included only RCTs of chiropractic SM.
Proctor et al. (2001) ¹⁴¹	Any type of SM	Primary and secondary dysmenorrhea	5	No	There is no evidence that SM is effective	4 of the 5 RCTs were of high velocity, low amplitude thrusts
Husereau et al. (2003) ¹⁴²	Any type of SM	Infantile colic	4	No	No convincing evidence	Most trials were of low methodological quality
Balon and Mior (2004) ¹⁴³	Chiropractic care	Asthma/allergy	6	No	No evidence to support the use of chiropractic SM	4 of the 6 trials tested SM; 3 of these studies were negative
Reid and Rivett (2005) ¹⁴⁴	Manual therapy mainly manipulation and mobilization	Cervicogenic dizziness	9	No	...there is limited evidence at present to support the use of manual therapy in treating cervicogenic dizziness.	Only one of the trials was randomized.

This table includes all indications for which systematic reviews are available. If for any indication more than one systematic review exists, the most recent one was chosen.

n = number of trials included, SM = spinal manipulation, RCT = randomized clinical trial.

^aQuote from authors' conclusions.

manipulation, which tend to medicalize back pain sufferers.¹⁵⁴

Few of the primary studies have been adequately controlled for placebo effects, an objective which is difficult but not impossible to achieve. Thus, some of the benefit reported in the above-mentioned studies could be due to a placebo response. A survey of 34 Australian "leaders of the chiropractic profession" suggested that the majority of chiropractors agree that the placebo effect is a major contributor

to the perceived benefit of chiropractic. Some even felt that "at least half" of the chiropractic success is due to placebo effects.¹⁵⁵

According to the chiropractic literature, absolute contraindications of chiropractic include osteoporosis, local malignancies, bone fractures, bone infections, and bleeding disorders,²¹ as well as active inflammatory arthropathy, ligamentous laxity, hypermobility, local metastases, dislocations, myelopathy, and cauda equina syndrome.¹⁶ Relative

contraindications include severe spondylosis, distant malignancies/metastases, local benign tumors, spinal trauma, chronic spondylarthropathy, history of spinal surgery, acute soft tissue or disc injuries, history of vertebrobasilar insufficiency, and osteopenia.¹⁶

Safety

Direct Risks. “Chiropractic is safe”⁸²—in the chiropractic literature, statements like this can be found abundantly. Table 4^{156–164} depicts some of the arguments currently used by chiropractors to deny that spinal manipulation can cause harm or to trivialize its risks.

In 2001, a systematic review of five prospective studies concluded that mild-to-moderate, transient adverse effects are experienced by about half of all chiropractic patients.¹⁶⁵ Local or radiating pain, headache, and tiredness are the most frequent adverse effects. Since then, two further prospective studies ($n = 465$ and 336 , respectively) reported that such adverse effects occur in 61% and 30% of patients.^{166,167} Therefore, there is undeniable evidence that chiropractic is associated with an exorbitantly high incidence of minor adverse effects.

Spinal manipulation of the upper spine has frequently been associated with serious vascular accidents. A systematic review summarized the data up to November 2001,¹⁶⁸ and an

update reviewed the latest evidence.¹⁶⁹ In total, this disclosed around 700 serious complications and about 50 deaths. Five surveys have been published asking doctors to report instances where their patients have experienced serious adverse effects after spinal manipulation.^{170–174} The results invariably disclosed a multitude of complications after chiropractic manipulation. More importantly, they demonstrated that these instances had not previously been reported in the medical literature. In other words, underreporting had been 100%. Therefore, it seems highly doubtful whether reliable incidence figures can presently be calculated. A recent systematic review found 14 cases of adverse effects of spinal manipulation in children, 10 of which involved serious complications such as subarachnoid hemorrhage or paraplegia.¹⁷⁵ Table 5 lists a selection of recently published case reports^{176–191} associating chiropractic treatments with serious complications.

Indirect Risks. Further safety concerns relate to indirect risks of chiropractic. The above-named review¹⁷⁵ noted 20 cases of delayed or missed diagnoses through consulting a chiropractor. A similar but better researched indirect risk is the attitude of many chiropractors toward immunization. The early chiropractic literature is littered with statements against immunization. Palmer’s original concepts

Table 4
Quotes from the Recent Chiropractic Literature Regarding Safety

Date	Author	Quote	Ref. No.
2001	Cohn	The occurrence of cerebral vascular accidents (CVAs) in the general population is 0.224% while the occurrence of CVAs in the chiropractic population is 0.000008%.	156
2001	Filippi	...this latest ungrounded association [of chiropractic] with stroke etiology serves as a final straw in a long and tedious process of professional identity.	157
2002	Michaud	...vigorous manipulation of the upper cervical spine is possible without injuring an already damaged vertebral artery.	158
2003	Haneline et al.	The medical literature does not support a clear causal relationship between chiropractic manipulative therapy and internal carotid artery dissection.	159
2003	Haneline and Croft	...a causal relationship [between chiropractic manipulation and internal carotid artery dissection] is not supported by the literature.	160
2003	Mirallas-Martinez	...mortality due to surgical interventions of lumbar spine is 300 times greater than due to post-cervical manipulation stroke.	161
2004	Refisch and Bischoff	...the relationship between cervical manipulation and lesions of the cervical arteries...must be negated.	162
2004	Oliphant	An estimate of the risk of spinal manipulation causing a clinical worsened disk herniation or cauda equina syndrome...is calculated...to be less than 1 in 3.7 million.	163
2005	Haneline and Triano	The direct evidence suggests that the healthy vertebral artery is not at risk from properly performed chiropractic manipulative procedures.	164

Table 5
Recent (2001–2006) Case Reports of Serious Adverse Events After Chiropractic Spinal Manipulation

First Author (Year)	Patient(s)	Adverse Event	Outcome
Jeret (2001) ¹⁷⁶	34-year-old man with neck pain after whiplash injury	Dural tear, positional dizziness	Full recovery
Siegel and Neiders (2001) ¹⁷⁷	33-year-old woman with headache	Vertebral artery dissection followed by pontine infarct	Permanent, severe neurological deficit
Parwar et al. (2001) ¹⁷⁸	44-year-old man with shoulder pain	Dissection of right internal carotid artery, Horner's syndrome	Not reported
Schram and Vosik (2001) ¹⁷⁹	47-year-old man with neck and shoulder pain	Phrenic nerve injury, diaphragmatic paralysis, severe dyspnea	Residual dyspnea
Jeret and Bluth (2002) ¹⁸⁰	31-year-old woman	Dissection of left vertebral artery	Complete recovery
Sedat et al. (2002) ¹⁸¹	42-year-old woman with neck pain	Dissection of extracranial port of the right PICA	Residual headache and stiffness on discharge from hospital
Jay et al. (2003) ¹⁸²	26-year-old woman with headache and sinusitis	Bilateral dissection of vertebral arteries followed by bilateral occipital-parietal hemorrhagic infarction and visual impairment	Not mentioned
Menendez-Gonzalez et al. (2003) ¹⁸³	33-year-old patient	Dissection of vertebral artery followed by Wallenberg's syndrome	Not mentioned
Wojcik et al. (2003) ¹⁸⁴	46-year-old female patient with neck pain	Dural tear	Complete recovery
Beck et al. (2003) ¹⁸⁵	40-year-old female patient	Wallenberg syndrome	No information provided
Nadgir et al. (2003) ¹⁸⁶	34-year-old man	Bilateral internal carotid and vertebral artery dissection	Residual left-side hemianesthesia and dysesthesia
Oehler et al. (2003) ¹⁸⁷	31-year-old woman with headache	Bilateral dissections of vertebral arteries	Not mentioned
Yokota et al. (2003) ¹⁸⁸	38-year-old man	Dissection of left vertebral artery followed by Dejerine syndrome	Not mentioned
Izquiedo-Casas et al. (2004) ¹⁸⁹	37-year-old woman	Dissection of vertebral artery followed by tetraparesis	Fibrinolysis resulted in complete recanalization of the artery
Saxler and Barden (2004) ¹⁹⁰	27-year-old woman	Epidural hematoma extending from cervical to sacral spine	Complete recovery
Tome et al. (2004) ¹⁹¹	40-year-old patient	Multiple cervical disc herniation	Not mentioned

In all cases, causality was deemed to be certain or likely, and in all instances was the therapist a chiropractor.

were seen by chiropractors as a complete explanation of all medical conditions, their prevention, and treatments. Infectious diseases, therefore, put the gospel of D.D. Palmer in doubt (see above); consequently, their existence was denied, and so was the benefit of immunization. The faculty and administration of Williard Carver's "Chiropractic Research University" were even jailed for refusing "to submit to the compulsory vaccination law of the District of Columbia."¹⁴

The current chiropractic literature continues to promote "hostile opposition to health prevention based upon immunization procedures"¹⁹² and repeatedly stresses that immunization is hazardous and ineffective.^{193,194} In doing so, facts are distorted: "Smallpox vaccination was stopped in the

U.S. and U.K. because it was realized that the vaccinated suffered the worst effects of the disease;"¹⁹⁵ or the risks of immunization are exaggerated: "The dangers of vaccination to the young child are profound... in some cases, the vaccine acts non-specifically to increase a child's pre-existing chronic disease tendency."¹⁹⁶ Other sources state that immunization is useless and harmful: "Immunisation programmes continue on the premise of prevention" but "it cannot be said that the... programme has been proven successful...and the complication rates for the vaccines continues to claim the lives of children via disability and/or death."¹⁹⁷ Others again report that, "vaccination appears to increase the risk of allergies and related respiratory symptoms."¹⁹⁸ There is no shortage of strong statements in the

chiropractic literature warning patients of “having toxic filth squirted into the bodies” of their children.¹⁹² Even though some chiropractors would probably deny this, the anti-immunization lobby of chiropractors is still very strong; the only place where chiropractors are prohibited from lobbying against immunization is in Ontario, Canada.¹⁹⁹

A U.S. survey was aimed at identifying chiropractors' attitudes toward immunization.²⁰⁰ A random sample (1%) of all U.S. chiropractors was provided with a choice of policy statements. One-third of the sample agreed with the statements that there is no scientific proof that immunization prevents disease, that it causes more disease than it prevents, and that contracting an infectious disease is safer than immunization. Another survey was performed on 150 licensed chiropractors from Boston. About 30% of them reported to recommend active immunization and 7% recommended their clients against immunization.²⁰¹ A Canadian interview study recently confirmed that some chiropractors provide to their patients “information of a negative, anti-vaccination nature.”²⁰²

Cost

A World Health Organization-sponsored, systematic review of cost analyses in complementary medicine included seven investigations related to spinal manipulation or chiropractic care.²⁰³ It concluded that “there is no evidence to suggest that chiropractic is a more cost-effective treatment option than physiotherapy or hospital outpatient treatment for low back pain.”²⁰³ Since then, several new studies have become available. A UK trial compared disability scores after spinal manipulation (carried out by chiropractors, osteopaths, or physiotherapists), exercise classes, or manipulation followed by exercise in addition to care for chronic back pain by general practitioners.²⁰⁴ Exercise was superior to primary care at three months but not after one year. Manipulation alone or followed by exercise generated better outcomes than primary care at 3 and 12 months. Effect sizes were, however, small to moderate. The mean incremental treatment cost relative to general practitioner care was £195 for manipulation, £140 for exercise, and £125 for the combined treatment. The authors estimated the cost

per Quality Adjusted Life Years as £3,800 for combined treatment and £4,800 for manipulation.

A retrospective analysis of the U.S. worker's compensation payment data from a single insurer analyzed the figures from individuals suffering from work-related low back injuries between 1999 and 2002.²⁰⁵ The results showed that restrictive payment policies were associated with lower cost of chiropractic care and lower number of services per visit, but did not affect the visits or services per person.

Legorreta et al.²⁰⁶ retrospectively analyzed claims data of more than one million members of a U.S. health care plan. Access to chiropractic care was associated with lower cost for neuromuscular complaints and back pain. This effect could be due to these patients being younger and healthier than nonchiropractic patients.²⁰⁷ Others have noted that users of chiropractic are also high users of conventional health services,²⁰⁸ which renders cost savings an unlikely prospect.

Conclusion

This overview will be rejected by proponents of chiropractic for being biased or one-sided, but its purpose was to offer a *critical* evaluation. At present, such an assessment has not been provided by chiropractors, yet progress in any field is difficult without critical evaluation.

Chiropractors' belief in the “innate,” subluxation, or spinal manipulation is not rational. Current chiropractic practice raises numerous concerns. The effectiveness, safety, and cost of spinal manipulation are uncertain. More and better quality studies are, therefore, required. Until convincing data are available, we might question the value of this popular approach to health care.

References

1. Segen JC. Dictionary of alternative medicine. Stamford, CT: Appleton and Lange, 1998.
2. Oths K. Communication in a chiropractic clinic: how a D.C. treats his patients. *Cult Med Psychiatry* 1994;18:83–113.

3. Lott CM. Integration of chiropractic in the Armed Forces health care system. *Mil Med* 1996; 161:455–459.
4. Bimonte HA. Laboratory testing in chiropractic practice. *Lab Med* 1998;29:291–295.
5. Shekelle PG. What role for chiropractic in healthcare? *New Engl J Med* 1998;339:1074–1075.
6. Kaptchuk TJ, Eisenberg DM. Chiropractic: origins, controversies, and contributions. *Arch Intern Med* 1998;158:2215–2224.
7. World Federation of Chiropractic. Toronto: WFC, 1999. <http://www.wfc.org>.
8. British Chiropractic Association. Chiropractic...a helping hand for you and your patients. Undated brochure. 2003.
9. American Chiropractic Association. About chiropractic. Available at <http://www.amerchiro.org/pdf/va-report.pdf>. Accessed January 21, 2008.
10. Sportelli DC. A natural method of health care, Introduction to chiropractic, 10th ed. Palmerton, PA: Practice Makers, 2000.
11. Hadler NM. Chiropractic. *Rheum Dis Clin North Am* 2000;26:97–102.
12. National Center for Complementary and Alternative Medicine. About chiropractic and its use in treating low-back pain. Accessed April, 2006. www.nccam.nih.gov/health/chiropractic/index.htm.
13. Redwood D. Chiropractic. In: Micozzi MS, ed. *Fundamentals of complementary and integrative medicine*, 3rd ed. St. Louis, MI: Elsevier, 2006.
14. Keating JCJ, Green BN, Johnson CD. “Research” and “science” in the first half of the chiropractic century. *J Manipulative Physiol Ther* 1995; 18:357–378.
15. Palmer DD. The chiropractic. Davenport, IA: Palmer College Archives, 1897;Jan:1.
16. Gay RE. Chiropractic. In: Yuan C-S, Bibber EJ, Brent AB, eds. *Textbook of complementary and alternative medicine*, 2nd ed. Abingdon, VA: Informa Healthcare, 2006.
17. Ong CK, Bodeker G, Grundy C, Burford G, Shein K. WHO global atlas of traditional, complementary and alternative medicine. Kobe, Japan: WHO Centre for Health Development, Kobe, 2006.
18. Shekelle PG. The use and costs of chiropractic care in the health insurance experiment. Publication MR-401-CCR. Santa Monica, CA: RAND/Agency for Health Care Policy and Research, 1994.
19. Stano M. The chiropractic services market: a literature review. In: Scheffer R, Rossiter L, eds. *Advances in health economics and health services research*, 13. Greenwich, CT: JAI Press, 1992: 191–204.
20. Meeker WC, Haldeman S. Chiropractic: a profession at the crossroads of mainstream and alternative medicine. *Ann Intern Med* 2002;136:216–227.
21. Dagenais S, Haldeman S. Chiropractic. *Prim Care Clin Office Pract* 2002;29:419–437.
22. Coulter ID, Hurwitz EL, Adams AH, et al. Patients using chiropractors in North America. *Spine* 2002;27:291–298.
23. Foundation for the Advancement of Chiropractic, Tenets and Sciences, FACTS Bulletin, VI. Arlington, VA: Foundation for the Advancement of Chiropractic, Tenets and Sciences, 1999.
24. Cooper RA, Stoflet SJ. Trends in the education and practice of alternative medicine clinicians. *Health Aff* 1996;15:226–238.
25. Cooter R. Bones of contention? Orthodox medicine and the mystery of the bone-setter’s craft. In: Bynum WF, Porter R, eds. *Medical fringe and medical orthodoxy. 1750–1850*. London: Croom Helm, 1987:158–173.
26. LeVay D. British bone-setters. *Hist Med Q* 1971;3:13–15.
27. Papet J. Cases that bonesetters cure. *BMJ* 1867; 1:1–4.
28. Wardwell W. Chiropractic: History and evolution of a new profession. St. Louis, MI: Mosby-Year Book, 1992.
29. DeVocht JW. History and overview of theories and methods of chiropractic: a counterpoint. *Clin Orthop Relat Res* 2006;444:243–249.
30. Baer HA. The drive for legitimation by osteopathy and chiropractic in Australia: between heterodoxy and orthodoxy. *Comp Health Pract Rev* 2006; 11:77–94.
31. Palmer DD. *Textbook of the art, science and philosophy of chiropractic*. Portland, OR: Portland Printing, 1910.
32. Villanueva-Russell Y. Evidence-based medicine and its implications for the profession of chiropractic. *Soc Sci Med* 2005;60:545–561.
33. Keating JCJ. Purpose-straight chiropractic: not science, not health care. *J Manipulative Physiol Ther* 1995;18:416–418.
34. Martin SC. “The only truly scientific method of healing” Chiropractic and American science. 1895–1990. *Isis* 1994;85:207–227.
35. Gold R. Presentation at the Los Angeles College of Chiropractic, November 18, 1994.
36. Fuller RC. *Alternative medicine and American religious life*. New York, NY: Oxford University Press, 1989.
37. Homola S. *Bonesetting, chiropractic and cultism*. Panama City, FL: Critique Books, 1963.
38. Palmer BJ. *Chiropractic proofs*. Iowa: Davenport, 1903.
39. Palmer DD. *The chiropractor’s adjutor*. Portland, OR: Portland Printing House, 1910.

40. Haldeman S. The evolution and importance of spinal and chiropractic research. *J Manipulative Physiol Ther* 1992;15:31–35.
41. Keating JCJ, Cleveland CS. Cleveland chiropractic: the early years, 1917–1933. *J Manipulative Physiol Ther* 1996;19:324–343.
42. Strauss JB. Refined by fire: the evolution of straight chiropractic. Levittown, PA: Foundation for the Advancement of Chiropractic Education, 1994.
43. Beideman RP. Seeking the rational alternative: the National College of Chiropractic from 1906 to 1982. *Chiropr Hist* 1983;3:17–22.
44. Palmer DD. The science of chiropractic: Its principles and adjustments. Davenport, IA: The Palmer School of Chiropractic, 1906.
45. Getzendanner S. Permanent injunction order against AMA. *JAMA* 1988;259:81–82.
46. Dew K. Apostasy to orthodoxy: debates before a Commission of Inquiry into chiropractic. *Sociol Health Illn* 2000;22:310–330.
47. O'Neill A, Willis E. Chiropractic and the politics of health care. *Aust J Public Health* 1994;18:325–331.
48. The Ministry of Health and Welfare of Japan. Health science research report on manipulative therapy for diseases of spinal origin. 1990.
49. Wight CJK. Elections in the UK. The chiropractic choice 2002;Sept:18.
50. Palmer BJ. Palmer tells benefits of advertising. Davenport, IA: Fountainhead News, November 1, 1919.
51. Waagen G. Origin and development of traditional chiropractic philosophy. In: Haldeman S, ed. Principles and practice of chiropractic. Norwalk, CT: Appleton & Lange, 1992:29–43.
52. Winterstein JF. Is traditional “chiropractic philosophy” valid today? *Philos Constructs Chiropract Profession* 1991;1:37–40.
53. DeBoer KF. Commentary: eine kleine nacht musing. *Am J Chiropract Med* 1988;1:41.
54. Homola S. Chiropractic: history and overview of theories and methods. *Clin Orthop Relat Res* 2006;444:236–242.
55. Lantz CA. The vertebral subluxation complex, I: Introduction to the model and the kinesiological component. *Chiropract Res J* 1989;13:23–26.
56. Haldeman S. Spinal manipulation therapy: a status report. *Clin Orthop* 1983;179:62–70.
57. Keating JCJ. Shades of straight: diversity among the purists. *J Manipulative Physiol Ther* 1992;15:203–209.
58. Lewit K. Manipulative therapy and rehabilitation of the locomotor system. Woburn, MA: Butterworth-Heinemann, 1993.
59. Palmer BJ, Shermann LW, Coulter WW. Hematological changes under specific chiropractic adjustment: research on 1054 cases in the B.J. Palmer Chiropractic Clinic. Number 1 in a series of scientific laboratory experiments proving the effectiveness of specific chiropractic technic. Davenport, IA: Palmer School of Chiropractic, undated (c. 1949).
60. Johnson C. Editorial: modernized chiropractic reconsidered: beyond foot-on-hose and bones-out-of-place. *J Man Phys Ther* 2006;29:253–254.
61. Triano JJ. Biomechanics of spinal manipulative therapy. *Spine J* 2001;1:121–130.
62. Drake JD, Aultman CD, McGill SM, Callaghan JP. The influence of static axial torque in combined loading on intervertebral joint failure mechanics using a porcine model. *Clin Biomech* 2005;20:1038–1045.
63. Vera-Garcia FJ, Brown SH, Gray JRMSM. Effects of different levels of torso coactivation on trunk muscular and kinematic responses to posteriorly applied sudden loads. *Clin Biomech* 2006;21:443–455.
64. Lantz CA. Inflammation hypothesis. In: Leach RA, ed. The chiropractic theories. A textbook of scientific research, 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins, 2004:131–136.
65. Grostic JD. Dentate ligament: cord distortion hypothesis. *Chiropractic Res J* 1988;1:47–55.
66. Henderson W. CNR: animal models in the study of subluxation and manipulation: 1964–2004. In: Gatterman MI, ed. Foundations of chiropractic. Subluxation, 2nd ed. St. Louis, MI: Elsevier Mosby, 2005:47–103.
67. Crelin ES. A scientific test of the chiropractic theory. *Am Scientist* 1973;61:574–580.
68. College of Physicians and Surgeons of the Province of Quebec. A scientific brief against chiropractic. *New Physician* September 1996. <http://www.chiobase.org/OSRB/CPSQ/06.html>. Accessed January 21, 2008.
69. Nansel D, 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* 1991;18:379–397.
70. Association of Chiropractic Colleges. A position paper on chiropractic. *Physiol Ther* 1996;19:633–637.
71. Rosner A. The role of subluxation in chiropractic. Des Moines, IA: Foundation for Chiropractic Education and Research, 1997.
72. McDonald W, Durkin K, Iseman S, et al. How chiropractors think and practice. Ada, OH: Institute for Social Research, Ohio University, 2003.
73. Biggs L, Hay D, Mierau D. Canadian chiropractors' attitudes towards chiropractic philosophy and

scope of practice: implications for the implementation of clinical practice guidelines. *J Can Chiropr Assoc* 1997;41:145–154.

74. O'Malley JN. How real is the subluxation? *J Manipulative Physiol Ther* 1997;20:482–487.

75. Mootz RD, Keating JC Jr, Kontz HP, Milus TB, Jacobs GE. Intra- and interobserver reliability of passive motion palpation of the lumbar spine. *J Manipulative Physiol Ther* 1989;12:440–445.

76. Nansel DD, Peneff AL, Jansen RD, Cooperstein R. Interexaminer concordance in detecting joint-play asymmetries in the cervical spines of otherwise asymptomatic subjects. *J Manipulative Physiol Ther* 1989;12:428–433.

77. Walker BF, Buchbinder R. Most commonly used methods of detecting spinal subluxation and the preferred term for its description: a survey of chiropractors in Victoria, Australia. *J Manipulative Physiol Ther* 1997;20:583–589.

78. Vernon H, Mrozek J. A revised definition of manipulation. *J Manipulative Physiol Ther* 2005;28:68–72.

79. George SZ, Bishop MD, Bialosky JE, Zeppieri G Jr, Robinson ME. Immediate effects of spinal manipulation on thermal pain sensitivity: an experimental study. *BMC Musculoskeletal Disord* 2006;15:68.

80. Keating JC Jr, Charlton KH, Grod JP, et al. Subluxation: dogma or science? *Chiropr Osteopat* 2005;13:17.

81. Barnett K, McLachlan C, Hulbert J, Kassak K. Working together in rural South Dakota: integrating medical and chiropractic primary care. *J Manipulative Physiol Ther* 1997;20:577–582.

82. Killinger LZ. Chiropractic and geriatrics: a review of the training, role, and scope of chiropractic in caring for aging patients. *Clin Geriatr Med* 2004;20:223–235.

83. Evans MWJ, Rupert R. The Council on Chiropractic Education's new wellness standard: a call to action for the chiropractic profession. *Chiropr Osteopat* 2006;23.

84. Menke JM. Principles in integrative chiropractic. *J Manipulative Physiol Ther* 2003;26:254–272.

85. Freymann H, Rennie T, Bates I, Nebel S, Heinrich M. Knowledge and use of complementary and alternative medicine among British undergraduate pharmacy students. *Pharm World Sci* 2006;28:13–18.

86. Torkelson C, Harris I, Kreitzer MJ. Evaluation of a complementary and alternative medicine rotation in medical school. *Alt Ther* 2006;12:30–34.

87. Carey TS, Evans AT, Halder NM, et al. Acute severe low back pain. A population based study of prevalence and care seeking. *Spine* 1996;21:339–344.

88. Coulter I, Hurwitz E, Adams A, et al. The appropriateness of manipulation and mobilization of the cervical spine. Santa Monica, CA: RAND, 1996:18–43.

89. Pincus T, Vogel S, Breen A, Foster N, Underwood M. Persistent back pain—why do physical therapy clinicians continue treatment? A mixed methods study of chiropractors, osteopaths and physiotherapists. *Eur J Pain* 2006;10:67–76.

90. Yeh GY, Phillips RS, Davis RB, Eisenberg DM, Cherkin DC. Visit time as a framework for reimbursement: time spent with chiropractors and acupuncturists. *Altern Ther Health Med* 2003;9:88–94.

91. Baer HA. Practice-building seminars in chiropractic: a Petit Bourgeois response to biomedical domination. *Med Anthropol Q* 1996;10:29–44.

92. Rupert RL. A survey of practice patterns and the health promotion and prevention attitudes of US chiropractors. Maintenance care: part I. *J Manipulative Physiol Ther* 2000;23:1–9.

93. Homola S. Seeking a common denominator in the use of spinal manipulation. *Chiropractic Technique* 1992;4:61–63.

94. Assendelft WJJ, Pfeifle C, Bouter LM. Chiropractic in the Netherlands: a survey of Dutch chiropractors. *J Manipulative Physiol Ther* 1995;18:129–139.

95. Christensen M, Kollasch M, Ward R, et al. Job analysis of chiropractic. Greeley, CO: National Board of Chiropractic Examiners, 2005:135–138.

96. Keating JCJ, Hansen DT. Quackery vs. accountability in the marketing of chiropractic. *J Manipulative Physiol Ther* 1992;15:459–470.

97. Hurwitz EL, Chiang LM. A comparative analysis of chiropractic and general practitioner patients in North America: findings from the joint Canada/United States Survey of Health, 2002–03. *BMC Health Serv Res* 2006;6:49.

98. Haneline MT. Symptomatic outcomes and perceived satisfaction level of chiropractic patients with a primary diagnosis involving acute neck pain. *J Manipulative Physiol Ther* 2006;29:288–296.

99. Waalen DP, White TP, Waalen JK. Demographic and clinical characteristics of chiropractic patients: a five year study of patients treated at the Canadian Memorial Chiropractic College. *J Can Chiropr Assoc* 1994;38:75–82.

100. Teitelbaum M. The role of chiropractic in primary care: findings of four community studies. *J Manipulative Physiol Ther* 2000;23:601–609.

101. Dales J. Delisting chiropractic and physiotherapy: false saving? *CMAJ* 2005;172:166.

102. Plamondon RL. Summary of 1994 ACA Annual Statistical Study. *J Am Chiropract Assoc* 1995;32:57–63.

103. Phillips RB. A survey of Utah chiropractic patients. *Am Chiro Assoc J Chiro* 1981;15: S113–S129.
104. Leboeuf-Yde C, Hennius B, Rudberg E, Leufvenmark P, Thunman M. Chiropractic in Sweden: a short description of patients and treatment. *J Manipulative Physiol Ther* 1997;20:507–510.
105. Wiles MR. Visceral disorders related to the spine. In: Gatterman MI, ed. *Chiropractic management of spine-related disorders*. Baltimore, MD: Williams & Wilkins, 1990:379–396.
106. Swenson RS. Clinical investigation of reflex function. In: Haldeman S, ed. *The modern developments in the principles and practice of chiropractic*, 2nd ed. Norwalk, CT: Appleton & Crofts, 1992: 105–114. rev.
107. Faridi TJ, Ponsonby DP. Spinal manipulation and visceral disease: science rediscovers an ancient art. *Texas J Chiropractic* 1995;July;27–32.
108. Gorman RF. The treatment of presumptive optic nerve ischemia by spinal manipulation. *J Manipulative Physiol Ther* 1995;18:172–177.
109. Froehle RM. Ear infection: a retrospective study examining improvement from chiropractic care and analyzing for influencing factors. *J Manipulative Physiol Ther* 1996;19:169–177.
110. Stude DE, Bergmann TF, Finer BA. A conservative approach for a patient with traumatically induced urinary incontinence. *J Manipulative Physiol Ther* 1998;21:363–367.
111. Keating JC. Chiropractic management of primary nocturnal enuresis. *J Manipulative Physiol Ther* 1995;18:638–641.
112. Sawyer C, Haas M, Nelson C, Elkington W. Clinical research within the chiropractic profession: status, needs and recommendations. *J Manipulative Physiol Ther* 1997;20:169–178.
113. Evans RC, Rosner AL. Alternatives in cancer pain treatment: the application of chiropractic care. *Semin Oncol Nurs* 2005;21:184–189.
114. Troyanovich SJ, Harrison DD, Harrison DE. Motion palpation: it's time to accept the evidence. *J Manipulative Physiol Ther* 1998;21:568–571.
115. Christensen HW, Vach W, Vach K, et al. Palpation of the upper thoracic spine: an observer reliability study. *J Manipulative Physiol Ther* 2002;25: 285–292.
116. French SD, Green S, Forbes A. Reliability of chiropractic methods commonly used to detect manipulable lesions in patients with chronic low-back pain. *J Manipulative Physiol Ther* 2000;23: 231–238.
117. Hestbaek L, Leboeuf-Yde C. Are chiropractic tests for the lumbo-pelvic spine reliable and valid? A systematic critical literature review. *J Manipulative Physiol Ther* 2000;23:258–275.
118. Hawk C, Phongphua C, Bleecker J, et al. Preliminary study of the reliability of assessment procedures for indications for chiropractic adjustments of the lumbar spine. *J Manipulative Physiol Ther* 1999; 22:382–389.
119. Maher C, Adams R. Reliability of pain and stiffness assessments in clinical manual lumbar spine examination. *Phys Ther* 1994;74:801–811.
120. Panzer DM. The reliability of lumbar motion palpation. *J Manipulative Physiol Ther* 1992;15: 518–524.
121. Haas M, Peterson D. A roentgenological evaluation of the relationship between segmental motion and malalignment in lateral bending. *J Manipulative Physiol Ther* 1992;15:350–360.
122. Curtis P, Bove G. Family physicians, chiropractors, and back pain. *J Fam Pract* 1992;65:551–555.
123. Ernst E. Chiropractors' use of X-rays. *Br J Radiol* 1998;71:249–251.
124. Scheurmier N, Breen AC. A pilot study of the purchase of manipulation services for acute low back pain in the United Kingdom. *J Manipulative Physiol Ther* 1998;21:14–18.
125. Refshauge KM, Maher CG. Low back pain investigations and prognosis: a review. *Br J Sports Med* 2006;40:494–498.
126. Herzog P, Rieger CT. Risk of cancer from diagnostic X-rays. *Lancet* 2004;363:340–341.
127. South Dakota Board of Chiropractic Examiners. Information Hotline, Vol. 1, Issue 6. Accessed May 7, 2007. Available at <http://www.state.sd.us/doh/chiropractic/Publications/April2007.pdf>.
128. Greene BR, Smith M, Allareddy V, Haas M. Referral patterns and attitudes of primary care physicians towards chiropractors. *BMC Complement Altern Med* 2006;6:5.
129. Foreman SM, Stahl MJ. Chiropractors disciplined by a state chiropractic board and a comparison with disciplined medical physicians. *J Manipulative Physiol Ther* 2004;27:472–477.
130. Langworthy JM, le Fleming C. Consent or submission? The practice of consent within UK chiropractic. *J Manipulative Physiol Ther* 2005;28:15–24.
131. Kelner M, Wellman B, Welsh S, Boon H. How far can complementary and alternative medicine go? The case of chiropractic and homeopathy. *Soc Sci Med* 2006;2617–2627.
132. Palmer BJ. *Chiropractic controlled clinical trials*. Davenport, IA: Palmer School of Chiropractic, 1951.
133. Canter PH, Ernst E. Sources of bias in reviews of spinal manipulation for back pain. *Wien Klin Wochenschr* 2005;117:333–341.
134. Zhang JQ. Research attitudes among chiropractic college students. *J Manipulative Physiol Ther* 1996;19:446–453.

135. Kusserow RP. Chiropractic services under Medicare. Office of Analysis and Inspections, Office of the Inspector General. Chicago, IL: U.S. Department of Health and Human Services, 1986;May:8.
136. General Chiropractic Council. Protecting patients. What can I expect when I see a chiropractor? ISBN: 1-903559-09-X. 2003. http://www.gcc-uk.org/files/link_file/whatcanIExpect_Sep07_Web.pdf. Accessed January 21, 2008.
137. Assendelft WJJ, Morton SC, Yu Emily I, Suttrop MJ, Shekelle PG. Spinal manipulative therapy for low-backpain. The Cochrane Database of Systematic Reviews 2004;(Issue 1)10.1002/14651858. Art No.: CD000447.pub2.
138. Gross AR, Hoving JL, Haines TA, et al. Manipulation and mobilisation for mechanical neck disorders (Cochrane Review). In: The Cochrane Library, Issue 1, 2004. Chichester, UK: John Wiley & Sons, Ltd, 2004.
139. Fernandez-de-Las-Penas C, Alonso-Blanco C, Cuadrado ML, et al. Are manual therapies effective in reducing pain from tension-type headache?: a systematic review. *Clin J Pain* 2006;22:278–285.
140. Ernst E. Chiropractic spinal manipulation for neck pain—a systematic review. *J Pain* 2003;4:417–442.
141. Proctor ML, Hing W, Johnson TC, Murphy PA. Spinal manipulation for primary and secondary dysmenorrhoea. The Cochrane Database of Systematic Reviews 2001;(Issue 4)10.1002/14651858. Art. No: CD002119.pub2.
142. Husereau D, Clifford T, Aker P, Leduc D, Mensinkai S. Spinal manipulation for infantile colic. Technology report no 42. Ottawa: Canadian Coordinating Office for Health Technology Assessment, 2003:i–36.
143. Balon JW, Mior SA. Chiropractic care in asthma and allergy. *Ann Allergy Asthma Immunol* 2004;93:S55–S60.
144. Reid SA, Rivett DA. Manuel therapy treatment of cervicogenic dizziness: a systematic review. *Man Ther* 2005;10:4–13.
145. Bigos S, Bowyer O, Braen G, et al. Acute low back problems in adults. Clinical practice guideline No. 14. AHCPR Publication No. 95-0642. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, US Department of Health and Human Services, 1994.
146. Bogduk N. Australasian Faculty of Musculoskeletal Medicine for the National Musculoskeletal Medicine Initiative. Evidence-based clinical guidelines for the management of acute low back pain. Canberra, Australia: National Medical Research Council, 1999.
147. Royal College of General Practitioners. Clinical guidelines for the management of acute low back pain. London: Royal College of General Practitioners, 1999.
148. Manniche C, Ankjær-Jensen A, Olsen A, et al. Low-back pain: frequency, management and prevention from an HTA perspective. Copenhagen: Danish Institute for Health Technology Assessment, 1999.
149. van Tulder MW, Goossens M, Waddell G, Nachemson A. Conservative treatment of chronic low back pain. In: Nachemson A, Jonsson E, eds. Neck and back pain: The scientific evidence of causes, diagnosis, and treatment. Philadelphia, PA: Lippincott, Williams and Wilkins, 2000:217–304.
150. Childs JD, Fritz JM, Flynn TW, et al. A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: a validation study. *Ann Intern Med* 2004;141:920–928.
151. Fritz JM, Childs JD, Flynn TW. Pragmatic application of a clinical prediction rule in primary care to identify patients with low back pain with a good prognosis following a brief spinal manipulation intervention. *BMC Fam Pract* 2005;6:29.
152. Brennan GP, Fritz JM, Hunter SJ, et al. Identifying subgroups of patients with acute/subacute “nonspecific” low back pain: results of a randomized clinical trial. *Spine* 2006;31:623–631.
153. Fritz JM, Brennan GP, Leaman H. Does the evidence for spinal manipulation translate into better outcomes in routine clinical care for patients with occupational low back pain? A case-control study. *Spine J* 2006;6(3):289–295.
154. Heymans MW, van Tulder MW, Esmail R, Bombardier C, Koes BW. Back schools for nonspecific low back pain: a systematic review within the framework of the Cochrane Collaboration Back Review Group. *Spine* 2005;30:2153–2163.
155. Jamison JR. Chiropractic holism: accessing the placebo effect. *J Manipulative Physiol Ther* 1994;17:339–346.
156. Cohn A. A review of the literature regarding stroke and chiropractic. *J Vertebral Subluxation Research* 2001;4:52–59.
157. Fillippi MR. Approaches to unsubstantiated criticism: an editorial rejoinder on the stoke (sic) issue. *J Vertebral Subluxation Research* 2001;4:65–67.
158. Michaud TC. Uneventful upper cervical manipulation in the presence of a damaged vertebral artery. *J Manipulative Physiol Ther* 2002;25:472–483.
159. Haneline MT, Croft AC, Frishberg BM. Association of internal carotid artery dissection and chiropractic manipulation. *Neurologist* 2003;9:35–44.
160. Haneline MT, Croft AC. Internal carotid artery dissection following chiropractic. *JACA* 2003;40:20–24.
161. Mirallas-Martinez JA. Cerebral vascular complications post-cervical spine manipulation. [in Spanish]. *Rehabilitacion* 2003;37:33–38.

162. Refisch A, Bischoff P. Manipulation and lesions of the cervical arteries More than a temporal coincidence?. [in German]. *Manuelle Med* 2004;42:109–118.
163. Oliphant D. Safety of spinal manipulation in the treatment of lumbar disk herniations: a systematic review and risk assessment. *J Manipulative Physiol Ther* 2004;27:197–210.
164. Haneline M, Triano J. Cervical artery dissection. A comparison of highly dynamic mechanisms: manipulation versus motor vehicle collision. *J Manipulative Physiol Ther* 2005;28:57–63.
165. Ernst E. Prospective investigations into the safety of spinal manipulation. *J Pain Symptom Manage* 2001;21:238–242.
166. Cagnie B, Vinck E, Beernaert A, Cambier D. How common are side effects of spinal manipulation and can these side effects be predicted? *Man Ther* 2004;9:151–156.
167. Hurwitz EL, Morgenstern H, Vassilaki M, Chiang LM. Frequency and clinical predictors of adverse reactions to chiropractic care in the UCLA neck pain study. *Spine* 2005;30:1477–1484.
168. Stevinson C, Ernst E. Risks associated with spinal manipulation. *Am J Med* 2001;112:566–570.
169. Ernst E. Adverse effects of spinal manipulation: a systematic review. *J R Soc Med* 2007;100:330–338.
170. Lee KP, Carlini WG, McCormick GF, Albers GW. Neurologic complications following chiropractic manipulation: a survey of Californian neurologists. *Neurology* 1995;45:1213–1215.
171. Lynch P. Incidence of neurological injury following neck manipulation. *Irish Med J* 1998;91:130.
172. Stevinson C, Honan W, Cooke B, Ernst E. Neurological complications of cervical spine manipulation. *J Roy Soc Med* 2001;94:107–110.
173. Dupeyron A, Vautravers P, Lecocq J, Isner-Horobeti ME. Complications following vertebral manipulation—a survey of a French region physicians. *Annales de readaptation et de médecine physique* 2002;46:33–40.
174. Egizii G, Dupeyron A, Vautravers P. Spinal manipulation: survey of French medical physicians who graduated with the national diploma of osteopathy from Strasbourg university. *Ann Readapt Med Phy* 2005;48:623–631. doi:10.1016/j.anmmp.2005.04.013.
175. Johnston BC, Cramer K, Humphreys K, Vohra S. Adverse events associated with spinal manipulation in children: a systematic review. Conference Abstracts. CARE Program, Department of Pediatrics, Alberta, Canada. May/June 2006:52–53.
176. Jeret JS. More complications of spinal manipulation. *Stroke* 2001;32:1136–1137.
177. Siegel D, Neiders T. Vertebral artery dissection and pontine infarct after chiropractic manipulation. *Am J Emerg Med* 2001;19:172–173.
178. Parwar BL, Fawzi AA, Arnold AC, Schwartz SD. Horner's syndrome and dissection of the internal carotid artery after chiropractic manipulation of the neck. *Am J Ophthalmol* 2001;131:523–524.
179. Schram DJ, Vosik W. Diaphragmatic paralysis following cervical chiropractic manipulation: case report and review. *Complement Altern Med Asthma* 2001;119:638–640.
180. Jeret JS, Bluth M. Stroke following chiropractic manipulation. Report of 3 cases and review of the literature. *Cerebrovasc Dis* 2002;13:210–213.
181. Sedat J, Dib M, Mahagne MH, Lonjon M, Paquis P. Stroke after chiropractic manipulation as a result of extracranial postero-inferior cerebellar artery dissection. *J Manipulative Physiol Ther* 2002;25:588–590.
182. Jay WM, Shah MI, Schneck MJ. Bilateral occipital-parietal hemorrhagic infarctions following chiropractic cervical manipulation. *Semin Ophthalmol* 2003;18:205–209.
183. Menendez Gonzalez M, Garcia C, Suarez E, Fernandez Diaz D, Blazquez Menes B. Wallenberg's syndrome caused by chiropractic manipulation. [in Spanish]. *Rev Neurol* 2003;37:837–839.
184. Wojcik W, Pawlak JK, Knaus R. Doctor! I can't stand the noise in my ear!. *J Neurol Neurosurg Psychiatr* 2003;April;55–59.
185. Beck J, Raabe A, Seifert V. Intracranial hypotension after chiropractic manipulation of the cervical spine. *J Neurol Neurosurg Psychiatry* 2003;74:820–826.
186. Nadgir RN, Loevner LA, Ahmed T, et al. Simultaneous bilateral internal carotid and vertebral artery dissection following chiropractic manipulation: case report and review of the literature. *Neuroradiology* 2003;45:311–314.
187. Oehler J, Gandjour J, Fiebach J, Schwab B, Beidseitige A. Vertebralis-Dissektion nach chiropraktischer Behandlung (Dissection of vertebral artery after chiropractic therapy). *Orthopade* 2003;32:911–913.
188. Yokota J, Amakusa Y, Tomita Y, Takahashi S. The medial medullary infarction (Dejerine syndrome) following chiropractic neck manipulation. [in Japanese]. *No To Shinkei* 2003;55:121–125.
189. Izquierdo-Casas J, Soler-Singla L, Viva-Diaz E, et al. Disecion vertebral como causa del sindrome de enclaustramiento y opciones terapeuticas con fibrinolis intraarterial durante la fase aguda (Locked-in syndrome due to a vertebral dissection and therapeutic options with intraarterial fibrinolysis in acute phase). *Rev Neurol* 2004;38:1139–1141.
190. Saxler G, Barden B. Extensive spinal epidural hermatoma—an uncommon entity following cervical chiropractic manipulation. [in German]. *Z Orthop Ihre Grenzgeb* 2004;48:79–84.

191. Tome F, Barriga A, Espejo L. Multiple discal herniation after chiropractic manipulation. [in Spanish]. *Rev Med Univ Navarra* 2004;48:39–41.
192. Anderson R. Chiropractors for and against vaccines. *Med Anthropol* 1990;12:169–186.
193. Kent C, Gentempo P. Immunisation; facts; myths and speculation. *ICA Rev Chiro* 1990;Nov/Dec;13–21.
194. Koren T. The vaccine dilemma: another viewpoint on the issue. *Chiro J* 1993;Sept;1–28.
195. Durant A. Vaccination, antibiotics and paediatrics: where do we stand. *Oregon Doctors of Chiropractic* 1993;3:4–12.
196. Peet PM, Peet J. Chiropractic pediatric and prenatal reference manual, 2nd ed. South Burlington, VT: Baby Adjustors, Inc., 2001.
197. Swenson RL. Pediatric disorders. In: Lawrence SJ, ed. *Fundamentals of chiropractic diagnosis and management*. Baltimore: Williams and Wilkins, 1999:510–530.
198. Hurwitz EL, Morgenstern H. Effects of diphtheria-tetanus-pertussis or tetanus vaccination on allergies and allergy-related respiratory symptoms among children and adolescents in the United States. *J Manipulative Physiol Ther* 2000;23:81–90.
199. College of Chiropractors of Ontario. Accessed May 7, 2007. Available at http://www.cco.on.ca/standard_of_practice_s-015.htm.
200. Colley F, Haas M. Attitudes on immunization. A survey of American Chiropractors. *J Manipulative Physiol Ther* 1994;17:584–590.
201. Lee ACC, Li DH, Kemper KJ. Chiropractic care for children. *Arch Pediatr Adolesc Med* 2000;154:401–407.
202. Page SA, Russell ML, Verhoef MJ, Injeyan HS. Immunization and the chiropractor-patient interaction: a Western Canadian study. *J Manipulative Physiol Ther* 2006;29:156–161.
203. Thompson Coon J, Ernst E. A systematic review of the economic evaluation of complementary and alternative medicine. *Perfusion* 2005;18:202–214.
204. UK BEAM Trial Team. United Kingdom back pain exercise and manipulation (UK BEAM) randomised trial: cost effectiveness of physical treatments for back pain in primary care. *BMJ* 2004;329:1381.
205. Wasiak R, McNeely E. Utilization and costs of chiropractic care for work-related low back injuries: do payment policies make a difference? *Spine* 2006;6:146–153.
206. Legorreta AP, Metz RD, Nelson CF, et al. Comparative analysis of individuals with and without chiropractic coverage: patient characteristics, utilization, and costs. *Arch Intern Med* 2004;164:1985–1992.
207. Ness J, Nisly N. Cracking the problem of back pain: is chiropractic the answer? *Arch Intern Med* 2004;164:1953–1954.
208. Sibbritt D, Adams J, Young AF. A profile of middle-aged women who consult a chiropractor or osteopath: findings from a survey of 11,143 Australian women. *J Manipulative Physiol Ther* 2006;26:349–353.