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TYPESETTING

Thistle Printing Limited
35 Mobile Drive, Toronto, Ontario M4A 2P6

JCCA

Journal of the Canadian Chiropractic Association

(Formerly the Canadian Chiropractic Association Journal)
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Published by the Canadian Chiropractic Association and issued quarterly

EDITORIAL AND EXECUTIVE OFFICES,
186 SPADINA AVENUE, SUITE 6, TORONTO, CANADA M5T 3B2

General Information: The Journal of the Canadian Chiropractic Association is the official quarterly publication by the Canadian Chiropractic Association. The JCCA is published quarterly by the Canadian Chiropractic Association as a medium of communication between the Association and its members and is a forum for fair comment and discussion of all matters of general interest to the chiropractic profession and the Association. Readers are invited to comment and express their opinions on relevant subjects. Views and opinions in editorials and articles are not to be taken as official expression of the Association's policy unless so stated. Publication of contributed articles does not necessarily imply endorsement in any way of the opinions expressed therein and the Journal and its publisher does not accept any responsibility for them. Business correspondence should be addressed to: the Editor of JCCA, 186 Spadina Avenue, Suite 6, Toronto, Canada M5T 3B2.

INDEXING SERVICES

JCCA is indexed by PubMed Central, CINAHL (Cumulative Index to Nursing and Allied Health Literature), MANTIS (formerly CHIROLARS), AMED, PASCAL, British Library Complementary Medicine Index, Index to Chiropractic Literature, and selectively by SPORTDiscus.

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Why not everyone with low back pain chooses chiropractic care

Simon Dagenais, DC, PhD, MSc*



Dr. Simon Dagenais DC, PhD, MSc

Introduction

It has been estimated that low back pain (LBP) will affect 84% of the general adult population at some point in their life, with 49% reporting some LBP in the previous 6 months, 23% suffering from chronic LBP, and 11% experiencing physical impairment due to LBP.^{1,2} Numerous therapies are available for LBP from a variety of clinicians, including primary care providers (PCPs), pain

management specialists, spine surgeons, physical therapists, and chiropractors. This vast array of therapies available for LBP was previously compared to a supermarket in which patients can wander down a particular aisle to choose among the many competing products and brands vying for their attention through marketing claims.³

Each clinician likely perceives that the care they offer for LBP is superior to the alternatives, and would like to believe that they hold the solution to the vast public health and economic problem presented by LBP. Chiropractors are probably no different in this regard, believing that nearly everyone with LBP would benefit from receiving spinal manipulation therapy (SMT). However, various surveys suggest that only 5-10% of adults in Canada and the United States visit a chiropractor in any given year.⁴⁻¹⁰ The goal of this commentary is to speculate about some of the reasons why not everyone with LBP chooses to seek chiropractic care, which are presented below as factors related to LBP, public perceptions about chiropractic, patient preferences, and the chiropractic profession.

Factors related to low back pain

Not all low back pain is amenable to chiropractic

It is estimated that 80-90% of LBP is of nonspecific or mechanical origin, and therefore cannot be attributed to an identifiable anatomical structure or disease process.¹¹ However, such estimates cannot easily be interpreted as the proportion of LBP that should receive chiropractic care, as some individuals have LBP associated with potentially serious spinal pathology (e.g. cancer, infection, fracture) or substantial neurologic involvement (e.g. progressive motor deficit, incapacitating radiculopathy, cen-

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tral stenosis), while others may have contraindications to SMT.¹² Although the validity of proposed clinical prediction rules for LBP remains unclear, it is highly unlikely that all patients with LBP would in fact benefit from chiropractic care.¹³

Not all low back pain requires health care

Many patients with acute nonspecific LBP experience a marked improvement within a few weeks, making watchful waiting a reasonable initial approach, though of course chronic LBP has a greater probability of recurrence and decreased likelihood of complete resolution.¹⁴ Most episodes of LBP are of relatively mild or moderate severity and do not greatly impair physical function, making it possible for individuals to carry on with their normal activities despite the pain.¹⁵ If watchful waiting proves inadequate to improve symptoms, patients may also choose to manage LBP themselves using heat, ice, over-the-counter analgesics, stretching, exercise, activity modification, or other methods that may not require a health care provider at all, let alone a chiropractor.

Factors related to public perceptions about chiropractic

Negative patient perceptions about chiropractic

Many individuals with LBP have never been to a chiropractor and may not be open to trying it for the first time for a variety of reasons, including negative public perceptions about chiropractic.¹⁶ It may not be possible to clearly identify the origins of this perception, which could be related to negative prior experiences reported by friends, family, or colleagues, dubious advertising claims by chiropractors, or negative reports about chiropractic in the media. Although chiropractors may disagree with those who have negative views about their profession and hope to demonstrate their merits if given the chance, such negative perceptions may prevent that opportunity.

Negative perceptions about chiropractic by physicians and other health care professionals

Another factor that may influence the use of chiropractic for those with LBP is negative perceptions about chiropractic held by physicians, surgeons, and other health care professionals.¹⁷ Older physicians may have been trained in an era where collaboration with chiropractors was con-

sidered unethical, while younger ones may be echoing the opinions from senior colleagues during their residency or fellowship training. Other factors may also be involved, including general medical skepticism about the unknown, passive mistrust of non-physician clinicians, enmity toward complementary or alternative medicine, or the belief that chiropractic is not effective. Such perceptions likely dissuade a substantial proportion of those with LBP from seeking chiropractic care or being referred to chiropractors when they first seek care elsewhere.

Fear of potential harms

Many have likely heard about the possibility that chiropractic care may cause serious harms, including vertebral artery dissection (VAD) leading to stroke, paralysis, or death. However, few are likely aware that VAD itself may result in neck pain, prompting individuals to seek care, whether from chiropractors, PCPs, or other providers, after which attempts will be made to link serious harms to a variety of activities involving the cervical spine, including SMT, sports, archery, driving, roller coasters, sex, or sneezing.^{18,19} This situation is troubling for all stakeholders, particularly since the extreme rarity of these events makes it very difficult for researchers to study them more closely. Nevertheless, the fear of harms associated with SMT in the cervical spine may deter many individuals from seeking this type of care, even if cervical SMT does not play an important role in chiropractic management of LBP.

Patient preferences

Other therapies may be preferred

Patients have an abundance of options if they choose to seek care for their LBP, and some of the therapies available may be more appealing than others based on awareness, previous experiences, recommendations from friends and family, general preferences about health care, availability, proximity, religious beliefs, or various other reasons. When confronted with numerous therapies with somewhat equivalent effectiveness and safety, patient preference is an important consideration, and may in fact influence the outcomes achieved if beliefs related to expectations are fulfilled.²⁰ In such situations, patients should be encouraged to first seek the type of health care they most prefer.

Financial considerations

Chiropractic continues to be excluded from many public and private health insurance plans, despite a suggestion two decades ago that it could be financially advantageous to payers and society to do so.²¹ The decision to pay for chiropractic out of pocket requires that patients weigh associated costs and benefits against alternative uses for those funds, including other forms of health care or even basic necessities. Concerns related to excessive care, including prolonged treatment plans that continue beyond maximum therapeutic benefit, additional charges for x-rays or other diagnostic tests that may not be medically necessary, or recommendations to purchase nutritional supplements, pillows, or braces sold by some chiropractors, may exacerbate these financial concerns and deter patients from choosing chiropractic care.

Concerns about lack of effectiveness

Chiropractors have seen countless patients walk into their offices grimacing from LBP and leave with a smile shortly after receiving care. However, the assumption that SMT is universally effective for LBP has been challenged by randomized controlled trials, systematic reviews and clinical practice guidelines. Although their findings are generally positive, they suggest that by itself, SMT offers mainly modest, relatively short-term improvements in pain and function that is similar to other approaches such as analgesics and exercise therapy.^{22,23} Some patients with LBP may therefore not be interested in chiropractic care because they've tried it previously and found it ineffective, or have heard similar experiences from others.

Factors related to chiropractic profession

Ambiguous public identity

Chiropractors can expend considerable energy debating the merits of being evidence-based, primary care spine clinicians vs. remaining true to their historical origins as clinicians who detect and correct spinal subluxations to minimize nerve interference. However, such discussions likely do little to foster public confidence when choosing a clinician for LBP. Focused expertise is likely a desirable trait for a health care profession, being simple to grasp and easy to remember. For example, patients like knowing they can go to the dentist when their tooth hurts, and don't need dentists to also claim expertise in cardiology,

obstetrics, and toxicology – despite possible oral manifestations of many related diseases – to appreciate the benefits of dentistry. Claims by some chiropractors that they can treat virtually any disease remotely associated with the spine likely dilute their perceived expertise in managing LBP. Other clinicians now showing an interest in SMT (e.g. physical therapists, osteopaths) will only intensify the ambiguous public identity of chiropractors as experts in LBP.

Lack of standardization in chiropractic

It is quite difficult for many stakeholders, including patients, chiropractors, other health care providers, third-party payers, and the government to know precisely what will happen when a patient presents to a chiropractor to receive care for LBP. Ideally, any chiropractor would complete a thorough history and physical and neurologic examination to identify serious spinal pathology, substantial neurologic involvement, nonspinal causes, and identify risk factors for chronicity, and offer education, reassurance, instructions on self-care and exercise, and SMT.¹¹ However, reality often clashes with such ideals, and patients may instead be offered “diagnostic” machines with flashing lights and high-pitched sounds indicating “subluxation”, assessment of “nutritional deficiencies” through manual muscle strength testing, x-rays to identify “spinal misalignment”, “detoxifying” foot baths or even, “healing” crystals. Since there is no easy method to predict the type of care that any given chiropractor will deliver for LBP some patients will choose to look elsewhere.

Summary

Some of these reasons described above may not play a role when someone with LBP is trying to choose among the many available therapies, while others that were not mentioned (e.g. lack of awareness, lack of availability) may be the deciding factors. Truth be told, deciphering the reasons why someone does *not* do something is in many ways more challenging for researchers than explaining why someone with LBP *did* choose to seek chiropractic care, requiring some degree of speculation. Although data to support some of the proposed reasons are lacking, it should not be necessary to await findings from independently validated, peer-reviewed, large, publicly funded research teams to acknowledge that empty waiting rooms

cannot solely be attributed to the general public failing to appreciate what chiropractors have to offer.

At its best, chiropractic consists of quality, affordable, effective, personalized, safe, patient-centered care that is delivered by highly skilled, empathetic, and honorable clinicians who want to help their patients achieve the best health possible. At its worst, chiropractic provides shelter for unscrupulous individuals to offer scientifically dubious services and engage in ethically questionable practices under the guise of providing alternative health care. Should the current utilization of chiropractic somehow be perceived as too low by some chiropractors, which is unclear, any attempt to change this situation will require a long-term, comprehensive and concerted effort involving educational institutions, accrediting agencies, licensing boards, professional associations, researchers, clinicians, continuing education providers, policy makers, third-party payers, government, and patients to promote and reward the former, while identifying and discouraging the latter. Although such efforts may prove difficult for the chiropractic profession to initiate and enforce, they are likely preferable to kneejerk legislative mandates enacted as a consequence of common negative perceptions about chiropractic care for LBP and other conditions.

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The life and contribution of Dr. Ronald Gitelman: a pioneer of modern chiropractic science

Howard Vernon DC, PhD, FCCS, FCCPOR, FICC*

Objective: The life and contribution to chiropractic science of Dr. Ronald Gitelman is reviewed.

Methods: Sources for this article included review of the notes prepared by Dr. Joseph Keating in his "biography" of the Canadian Memorial Chiropractic College (CMCC); review of the important articles published by Dr. Gitelman; review of the important projects undertaken by him along with various colleagues; notes from reminiscences obtained from many of these colleagues and discussions with his family.

Discussion: Dr. Gitelman's academic career spanned from 1963 to the late 1980's. During that time, he made foundational contributions to the development of chiropractic science including: developing the Archives (1974), the first collection of scientific articles supporting chiropractic science (which was subsequently published as the Chiropractic Archives Research Collection (CRAC)); delivering one of the few chiropractic papers at the seminal NINCDS conference (1975) and, developing the collaboration between CMCC and Dr. Kirkaldy-Willis at the University of Saskatoon (1976). He practiced in Toronto from 1961 to 2007.

Summary: Dr. Gitelman was a pioneer in the development of chiropractic science. He died on October 7, 2012.

KEY WORDS: Gitelman, NINCDS, pioneer

Objectif : Analyse de la vie du Dr Ronald Gitelman et de sa contribution à la science chiropratique.

Méthodologie : Les sources de cet article comportent notamment l'examen des notes préparées par le Dr Joseph Keating dans sa « biographie » du Canadian Memorial Chiropractic College (CMCC), l'examen des articles importants publiés par le Dr Gitelman, l'examen des projets importants qu'il a entrepris avec divers collègues, les notes obtenues à partir des souvenirs de beaucoup de ces collègues et des discussions avec sa famille.

Discussion : La carrière universitaire du Dr Gitelman a englobé la période de 1963 jusqu'à la fin des années 1980, pendant laquelle il a contribué de façon fondamentale au développement de la science chiropratique, notamment par : l'organisation des archives (1974), la première collection d'articles scientifiques à l'appui de la science chiropratique (qui a ensuite été publiée dans le cadre de la collection Chiropractic Archives Research Collection (CRAC)); la présentation d'un des rares articles chiropratiques à la conférence NINCDS (1975); et, le renforcement de la collaboration entre le CMCC et le Dr Kirkaldy-Willis à l'Université de Saskatoon (1976). Il a exercé la chiropratique à Toronto, de 1961 à 2007.

Résumé : Dr Gitelman était un pionnier dans le développement de la science chiropratique. Il est décédé le 7 octobre 2012.

MOTS CLÉS : Gitelman, NINCDS, pionnier

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Introduction

On October 7, 2012, the chiropractic profession lost one of its greatest scientific founders – Dr. Ronald Gitelman. As a patient, colleague and friend, I knew Dr. Gitelman from 1971-2012. I was close to him as he achieved some of his greatest accomplishments and I witnessed how much he impacted the development of chiropractic science in the modern era. I hope this article provides a proper memorial for the sake of those who knew or knew of him. For those who are not aware of his career, I hope it provides an opportunity to posthumously meet someone to whom all of the chiropractic profession should be most grateful.

Methods

This article is based on a number of sources including: review of the notes prepared by Dr. Joseph Keating¹ in his “biography” of the Canadian Memorial Chiropractic College (CMCC); review of the important articles published by Dr. Gitelman; review of the important projects undertaken by him along with various colleagues; notes from reminiscences obtained from many of these colleagues and discussions with his family.

Results and Discussion

The early years

Dr. Gitelman was born in 1937 in the town of Trenton, Ontario, about two hours east of Toronto. He grew up loving the outdoors. This love would stay with him for the rest of his life.

Ron was a natural athlete. Playing tennis as a teen, he developed a shoulder problem and the orthopaedic specialist in Kingston, Ontario told him an operation was needed and that that would be the end of his tennis career. Ron could not accept this so he rode his bike up the mountain to the “strange man’s” office. The kids had always called him a quack and said he broke bones but Ron thought perhaps this man could save him. His name was Dr. Halett. He was Trenton’s chiropractor. He examined the shoulder and had Ron back on the courts, free of pain in two weeks^a.

That encounter ignited the spark that led Ron to the Canadian Memorial Chiropractic College. He entered CMCC in 1956. During his student years, he was already

showing signs of the kind of career he would eventually forge. One of his close friends, Dr. Len Faye, recounts the following anecdote:

“Did you know as a student, he got an introduction from (Dr.) Herb Vear, to the U of T (University of Toronto) medical pathology department and he learned to prepare pathology slides that he then produced in a special lab at CMCC? We all studied from Ronnies’ slides, with the new microscopes the college also purchased. In the end, the U of T department were using his slides as well for the medical students. He became a master at it, like most other things he got interested in”.

Ron required an extra year to graduate, owing to a health scare that turned out to be a false alarm. He graduated CMCC in 1961. According to the records summarized in Keating’s work¹, by 1963 Dr. Gitelman had become a member of the Board of Directors of the College. His career as an upstart in the profession was well underway! It appears from these records that Dr. Gitelman was given assignments on the Board that clearly related to the scientific support of chiropractic. The leadership of CMCC appears to have understood that it was critical to the success of the College and the Canadian profession that the profession “get its scientific house in order”. Pressures from external sources such as the Ontario medical profession and the Ontario government were requiring that chiropractic account for itself and properly enter the realm of legitimate, science-based health care professions. Some of this pressure came in the form of governmental inquiries into chiropractic; some involved the effort of Ontario chiropractors to obtain inclusion in the provincial “medicare” system. Otherwise, the natural maturation of the profession drove this effort to modernize the science of chiropractic, and Dr. Gitelman was front and center in this effort at CMCC.

Within another two years, Dr. Gitelman had been appointed as one of a trio of academic deans of the College. He held the post of Dean of Students for about two years after which time he remained on staff as a lecturer in orthopedics as well as a driving force in a newly developed effort to conduct research at CMCC. He remained CMCC Director of Research from 1967-1977. The early years were concentrated on the development of a new

^a My appreciation to Mrs. Joan Gitelman for this anecdote.

device to measure skin temperature over the spine – the Synchrotherme. It was thought at the time that this device would overcome some of the deficiencies of older devices such as the neurocalometer, and provide valid insight into the function of the autonomic regulation of spinal blood flow. Dr. Gitelman led an effort to review the usefulness of this new device and to develop studies using it.

In 1969, Dr. Scott Haldeman joined the CMCC and began to participate in these efforts. He recalled that there were a number of scientific papers on spinal function and on autonomic regulation of the spine in the office housing the Syndrotherme.

“When I arrived they asked me to do research on the Synchrotherme. CMCC had spent a lot of money developing the instrument. I cannot recall everyone involved but it included Ron, Adrian (Grice), Dave Drum and others. They were very enthusiastic about somatovisceral reflexes and had a broad vision that was often illustrated in Dave’s drawings. There was a large stack of research papers in a cupboard that had been collected and piled in a corner and I spent time reading them. We had monthly meetings that were basically reviews of research papers.”

Dr. Haldeman went on to author two papers on the Synchrotherme^{2,3}, however, CMCC’s interest in this device faded as the 1970’s began.

1970-1986:

Dr. Haldeman recalled that the monthly research meetings “eventually led to discussion on forming the CCS. We continued with these discussions which eventually led to the formation of the FCCS that we all decided to grandfather into.” Here, he is referring to the development of one of the first two “Specialty” Colleges in Canadian chiropractic, the College of Chiropractic Clinical Sciences (CCS) whose members were conferred the status of “Fellows”. Dr. Gitelman was one of the driving forces behind the development of this College which has been in existence ever since as a major source of scholarship and expertise in the Canadian chiropractic profession. The success of this College, and its Residency programme at CMCC (the first of its kind in chiropractic) in developing teachers, graduate education at CMCC, researchers

and chiropractors who contributed greatly to policy development and other leadership within the profession is a wonderful testament to the vision Dr. Gitelman and his colleagues espoused at the start of the 1970’s.

Dr. Haldeman’s reference to “monthly meetings to discuss research papers” speaks to the other critical development undertaken by Dr. Gitelman in the early 1970’s. Several of the founding CCS Fellows appear to have been dismayed at the lack of an organized collection of scientific information, in the form of published articles, on chiropractic. They talked about ways to remedy that situation and, in 1972, Dr. Gitelman undertook one of his most important endeavours – the development of the “Archives”⁴.

Ron is on record as acknowledging the inspiration for this effort as coming from one of the founding Fellows – Dr. J. O. Edgar Houle, then a teacher at CMCC. Ron proposed to formally and systematically collect all of the literature that supported the science of chiropractic. He got assistance from the CMCC Library Staff (especially Ms. Claire Callaghan) and he organized a small group of senior students to assist him. In short order, this group began to manually search all of the journals to date which might contain relevant articles, including standard journals such as the Journal of Bone and Joint Surgery, Clinical Orthopedics and Related Research, the Journal of the American Osteopathic Association and others. Also included were the profession’s in-house journals such as the ACA Journal, the Swiss Annals, the Journal of the Canadian Chiropractic Association and others. Every potential article found by the team was reviewed by Ron for relevance to the project and, if that was found, a permanently housed copy was made along with an abstract, typed by hand onto an index card which was numbered and stored in a separate database. Remember, this was in the era before any computers for word processing and filing!

In his Preface to the 1974 publication of “The Archives”, Dr. Gitelman stated:

“The dissemination of information contained in this book is long overdue. With some of the literature dating back to the early 1900’s, it is clearly established that support for the chiropractic approach to health, with emphasis on spinal adjustive procedures, has existed in professional publications for a long time. Had this book been published forty or

fifty years earlier, the term “unscientific cult” would never have been levelled against chiropractic”.

Ron described the work of the team as “extensive literature searches, translating the abstracts, annotating an author index and devising a key word index that would handle the diverse topics of this publication”. This key word index was, itself, 20 pages long, while the total number of articles included in the 1974 edition was 914. Dr. Gitelman acknowledged the support of both of the Ontario and Canadian Chiropractic Associations as well as CMCC. Indeed, *The Archives* was published as a CMCC product with the following editors: Drs. R. Gitelman, G. G. Murdoch, B. E. Embree and V. G. Dyck, the last three men being recent CMCC graduates.

Dr. Gitelman’s summary of *The Archives* project was amazingly visionary:

“We are entering a new era in chiropractic, a scientific era, ushered in by the work of chiropractors, osteopaths, medical doctors and scientists. Many researchers....are working in parallel fields and are not aware that the product of their research is supportive to chiropractic science. The accumulated literature in this volume will bear tangible evidence to this fact”

The Archives was published in a plastic, three-ring binder! It became an instant hit at CMCC. As a student from 1973 – 1977, I can attest to this, as we began to regularly consult this invaluable resource for our education. The very idea that there was supportive literature that went beyond the pronouncements of our teachers was thrilling. Much time was taken up searching the indexes (subject and author), identifying stimulating studies and photocopying them in whole. I still have some of these papers!

As the methods of publication matured in our profession, and as the era of computers dawned, *The Archives* was re-published in the early 1980’s by CMCC as the *Chiropractic Research Archives Collection – CRAC*! The first of four soft-bound volumes was published in 1984 and the last in 1986. In all, 6000 articles were collected. Figure 1 shows Dr. Gitelman around that time with one of his heroes, Dr. Joseph Janse.

Looking back, it is obvious that this monumental ef-



Figure 1. Dr. Gitelman with Dr. J. Janse, (1982). [From CMCC stock footage]

fort presaged the development of the computer databases that were to come. Indeed, the *Index to Chiropractic Literature* emerged in the mid-1970’s, first as hard-bound volumes and, later, as a web-based database. Not long after the last *CRAC* volume, the *Index to Medical Literature* (later PubMed) blossomed into the largest electronic database in health science, eventually including, first, the *Journal of Manipulative and Physiologic Sciences* (born in 1978) and then, later, numerous other chiropractic and manipulation-related journals (including the *JCCA*!). The CMCC *Archives* is now, indeed, in the CMCC archives!

Dr. Haldeman had the following recollection about the next important development in Dr. Gitelman’s career:

“I was invited to be a member of the NINCDS committee that organized the (1975) conference. When I searched the literature and visited multiple colleges I had difficulty identifying any clinicians who had some understanding of the literature and the ability to provide a presentation that would be coherent to a wide audience. I fell back on my experience at CMCC and nominated Adrian (Grice) and Ron (Gitelman). My recommendations were accepted by the committee and they did an excellent job.”

And so we come to what was originally called the NINCDS (National Institute for Neurological Diseases

and Stroke) Conference. Dr. Gitelman was one of 15 chiropractic participants, and one of 6 chiropractic speakers. Along with Dr. David Drum, he represented the Canadian chiropractic profession on the podium.

No one in chiropractic after 1975 should be unaware of the NINCDS Conference (actually published by the newly re-named National Institute of Neurological and Communicative Diseases and Stroke (NINCDS)).⁵ Dr. Gitelman's visionary understanding of the "new era in chiropractic, a scientific era, ushered in by the work of chiropractors, osteopaths, medical doctors and scientists" was fully realized at this seminal conference, the first by the US government to investigate the scientific basis of chiropractic. Scholars and researchers from all of these professions and sciences gathered together to hear papers, discuss issues, try to reach consensus and otherwise try to develop long-overdue collegiality.

Dr. Gitelman's NINCDS paper, *The treatment of pain by spinal manipulation*⁶, is a classic. The only regret is that, being published in a monograph, it is not available in the indexed literature^b. Otherwise, it would have been cited by hundreds of subsequent authors. The paper first provided a full review of the clinical studies to that date on spinal manipulation for pain, citing published work from as early as 1932, and including what were then the most authoritative case series reports. The latest of these was the 1974 study by Kane et al. published in the *Lancet*.⁷

Then, Gitelman reviewed the various mechanisms that had been posited to explain the effect of spinal manipulation on pain. The following remark is truly amazing, given that it was written in 1974, as it is still completely valid today:

"...(pain) is not merely the stimulation of receptors... that stimulus enters a nervous system that is already a total of past experience, trauma, anxiety, cultural factors, etc. These higher processes, these past experiences, and the state of the nervous system at the time of stimulus, participate in the selection, abstraction and synthesis of information from the total sensory input"⁷.

In understanding the mechanism of action of spinal manipulation, he urged an understanding of "the combination of functional reflexes which are disturbed". From personal communication with Dr. Gitelman, I know that he was referring to the full panoply of pain-modulated reflexes that have become so well-studied since that time: somato-sensory reflexes that promote pain referral and chronicity; somato-motor reflexes that promote muscular reactions to spinal pain, both segmentally and regionally, including the full postural and motor-control mechanisms that act at the level of the entire person; somato-autonomic reflexes that underlie the response to spinal pain in the sympathetic system, again, both locally and more widely distributed so as to affect not only pain mechanisms, but visceral function as well. Gitelman presciently urged "manipulation scientists" and chiropractors in general to eschew narrowly defined limits of the subluxation:

"It would seem to me that one thing is clear: if we direct all of our efforts into investigation of nerve compression at the intervertebral foramina, we will obtain only partial answers to our questions. Foraminal compression is the end result of a pathological process. We must investigate the process itself... understanding the normal and abnormal mechanics of the spine and the effects of joint function on the afferent side of the nervous system. Somato-somatic and somatovisceral reflexes must be clearly understood if we are ever to appreciate the mechanism of vertebrogenic pain and other symptomatology and their relief by manipulation"⁷.

These words were a perfect prescription for the agenda of future chiropractic scientific efforts, and they did inspire a generation of such activity.

Two important developments followed the 1975 NINCDS Conference. The first involved two conferences in which Ron participated. The first was the staging of a second so-called "NINCDS" conference in 1977 at the University of Michigan, East Lansing, MI, under the direction of osteopath Dr. P. Greenman, and published under the editorship of Dr. Irwin Korr.⁸ Dr. Gitelman was one of only two chiropractors invited as participants at that conference. I was fortunate to accompany him to that confer-

^b http://www.canadianchiropracticresearchfoundation.com/uploads/9/1/4/9/9149010/ninds_article.pdf

ence and see, first-hand, how highly regarded he was by all of the conference attendees.

The second conference was the seminal scientific conference in chiropractic, *Modern Developments in the Principles of Chiropractic* at which Ron delivered another classic paper on the chiropractic approach to the lumbar spine and pelvis.⁹ This chapter was reprised in the second edition of Haldeman's classic text (See: Figure 2).¹⁰

The second, and, arguably, much more important post-NINCDS development arose out of the promise of funding for research from the NIH following the conference. In an initially unrelated, but later much-related, development, an esteemed orthopedic surgeon had recently taken up a post at the Royal Saskatoon Hospital, Saskatoon, Saskatchewan. His name was Dr. William Kirkaldy-Willis. He had recently been practicing Kenya, where he had used local manual therapists in his management of orthopedic conditions. Upon settling into Saskatoon, he set about finding a chiropractor to work with and came upon a CMCC graduate – Dr. Gordon Potter – who had recently completed his MD degree. They began a clinical collaboration on spinal pain patients.

At one point, possibly because of the news of the very recent NINCDS conference, Dr. Kirkaldy-Willis mentioned an interest in conducting some research into chiropractic for low back pain. Dr. Potter advised contacting CMCC and, in short order, Drs. Gitelman and Grice were assigned to respond. I can recall that there were several visits by Ron and Adrian to Saskatoon, where they carefully explained the chiropractic approach to back pain, greatly impressing the medical team. Convinced that he had found excellent collaborators, Dr. Kirkaldy-Willis agreed to begin developing a proposal for a clinical trial of chiropractic for back pain to be submitted for the post-NINCDS NIH funding. In advance of receiving the award, Dr. Gitelman appointed a newly graduated chiropractor who was practicing in his first year as an associate in Dr. Gitelman's office – Dr. David Cassidy – to go to Saskatoon to begin setting the project up. The proposal was submitted to the NIH, but was not accepted for funding. Dr. Cassidy decided to remain in Saskatoon and pursue an observational study involving low back pain patients who were referred to his private practice by Dr. Kirkaldy-Willis. This collaborative work eventuated in publication of this study¹¹ as well as several chapters in important texts^{12,13}. It formed the basis for all of the work

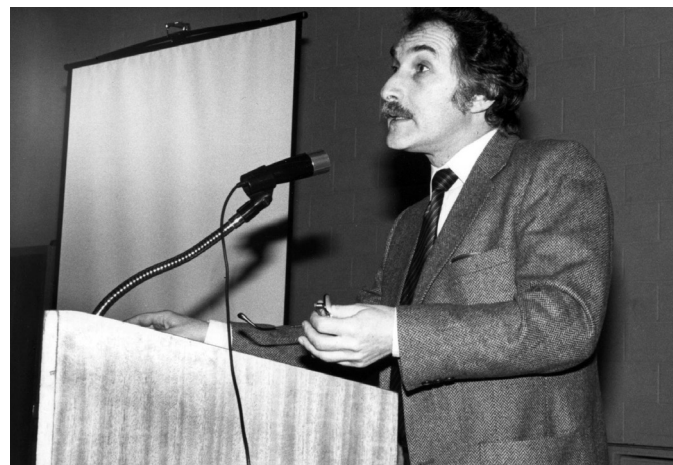


Figure 2. *Dr. Gitelman lecturing (from CMCC files)*

subsequently so ably pursued by Dr. Cassidy while he remained in Saskatoon, including the establishment of a clinical placement in Saskatoon for the CMCC Clinical Sciences Residency Programme.

While Ron played no role in these subsequent developments, he was always proud that he had “been there on the ground floor” of what, arguably, became the most important clinical research programme in Canadian chiropractic in the twentieth century.

In 1985, Ron authored an article for the ACA Journal in which he reviewed the profession's scientific developments.¹⁴ His breadth of knowledge and vision were in full bloom in this article. He minced no words in describing the profession's sorry past with respect to lack of academic and scientific credibility. He praised the recent developments around the NINCDS conference, but wisely noted that this was barely a start and that so much more was needed. He called on the profession to turn away from practice building “gurus” and make the clinician scientists of our future the proper role models for the profession. He expressed his hope for a chiropractic profession fully integrated into the health care system while still retaining our holistic approach^c.

Ron's academic career ended in 1986 with the publica-

c My appreciation to Dr. Lou Sportelli for providing me with this article as well as his thoughtful recollections.

tion of the final volume of CRAC, although he authored one more paper¹⁵ and he was a guest speaker at several important Canadian research conferences in the following years (See Figure 3).

Clinical Practice:

Dr. Gitelman established a clinical practice in Toronto in 1961 and practiced continually until 2007. During that time, it is estimated by his family that he treated about 40,000 patients. He was greatly beloved by his patients. It is the greatest testament to a chiropractor when your practice refuses to let you go! It took Ron over five years to fully retire.

Ron was universally acknowledged by his peers as a consummate chiropractor. He was a superb diagnostician, and no case seemed too difficult for his acumen. He was an outstanding adjuster. I have been told by many ex-patients that they would never let anyone else adjust them after receiving chiropractic from Ron.

Ron had a unique ability to interact with the highest level of medical colleagues and other academics. By the time he met Dr. Kirkaldy-Willis in 1975, he had already made numerous presentations to medical audiences and had made many friends and clinical colleagues with Toronto orthopedists, neurologists and psychiatrists, many of whom became his patients! He had a similar impact in the medico-legal world, where he was widely regarded as an excellent expert witness. He continued to do this kind of work right up to his retirement.

Honors:

Dr. Gitelman was a Fellow of the College of Chiropractic Clinical Science (CAN) and a Fellow of the International Chiropractic College (1990). Among many honors he received were Chiropractor of the Year, Ontario Chiropractic Association (1975) and the Award of Merit, Canadian Chiropractic Association (1984).

Personal life:

Ron and Joan Gitelman were married for 52 years. They had three children who all grew up to become successes in their own rights. His daughter bore him his only grandchild, Jennifer.

Ron was an ultra-avid outdoorsman. He was an expert fly-fisherman, tying his own award-winning flies. He travelled far and wide to fish... up in the north of Canada,

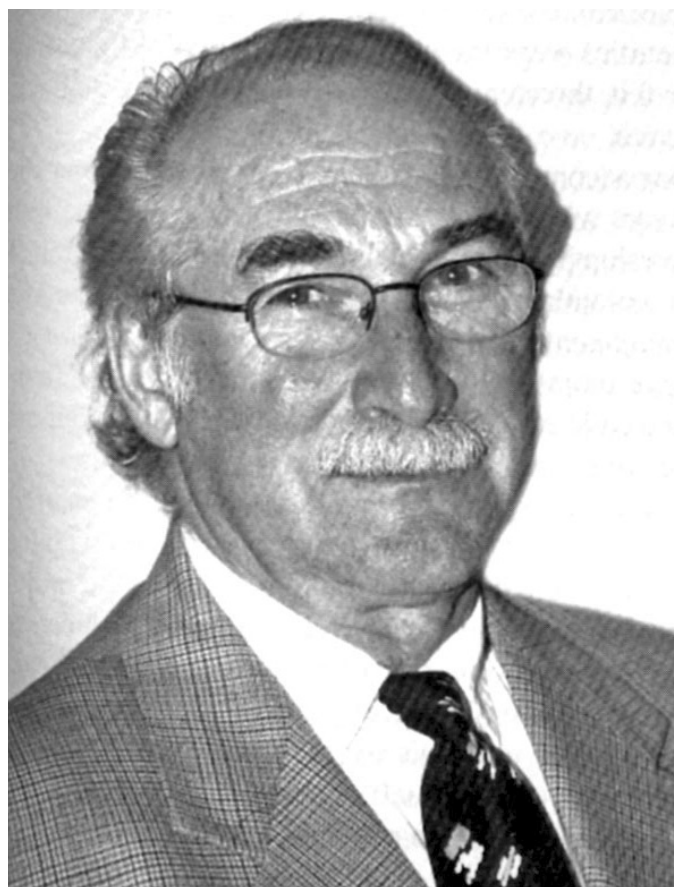


Figure 3. Dr. Gitelman, 1999. From *J Can Chirop Assoc*, with permission.

and to other great rivers of the world. In his later years, he became an expert wood craftsman, playing off of years of work with tools, especially at his beloved country chalet on the banks of the Beaver River.

Ron contracted pancreatic cancer in July of 2012. He remained at home, dying peacefully with his family surrounding him.

My last conversation with him was two weeks before he died. He was still very interested in wholistic chiropractic care. He asked me pointedly if I thought that the role of chiropractic in somato-visceral disorders was lost to our modern profession. I told him that I hoped that wasn't the case, and that more and better research could help resolve this. But he knew that already, because he had already

decided to donate \$10,000 to a research project just getting underway at CMCC entitled “Physiologic responses to spinal manipulation”. He knew that I, along with lead author Dr. Brian Budgell and our colleagues, Dr. John Srbely and Drs. Stephen and Julita Injeyan, had already drawn up a proposal to investigate autonomic nervous system effects of cervical adjustment, and he wanted to make sure that this project got done. His last great act for our profession was to make this donation to what we are calling the Dr. Ronald Gitelman Project.

As Ron’s health failed, he said he had a great go of life and his bucket was empty, although he thought there might be one last ‘permit’ still in the bucket (still hoping to catch the big one!). He challenged his illness like he did every other problem in life – head on and with a sense of determination.

We know that Ron would want us to ‘catch and release’, stop and smell the forest, laugh at a good joke and celebrate life the way he did. He would want us all to aspire to greatness in chiropractic, but with humility about the marvels of the human body and the complexities of the people that are our patients. We’ve lost a great friend, healer and teacher.

Acknowledgements:

I would like to thank the following people for their help in writing this article: Joan Gitelman, Ron’s wife of almost fifty years; Drs. Scott Haldeman, Len Faye and Lou Sportelli; Mr. Jay Bowes for help with the photos.

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Assessing the attitudes, knowledge and perspectives of medical students to chiropractic

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Objective: *To assess second-year medical students' views on chiropractic.*

Methods: *A three-step triangulation approach was designed, comprising a 53-item survey, nine key informant interviews and one focus group of 8 subjects. ANOVA was used to assess attitude-response survey totals over grouping variables. Constant comparison method and NVivo was used for thematic analysis.*

Results: *112 medical students completed the survey (50% response rate). Subjects reporting no previous chiropractic experience/exposure or interest in learning about chiropractic were significantly more attitude-negative towards chiropractic. Thematically, medical students viewed chiropractic as an increasingly evidence-based complementary therapy for low back/chronic pain, but based views on indirect sources. Within formal curriculum, they wanted to learn about clinical conditions and benefits/risks related to treatment, as*

Objectif : *Évaluer les opinions des étudiants de deuxième année de médecine sur la chiropratique.*

Méthodologie : *Une approche de triangulation en trois étapes a été conçue, comprenant un questionnaire de 53 points, neuf entretiens avec des informateurs clés et un groupe de réflexion de 8 participants. La méthode analytique ANOVA a été utilisée pour évaluer le nombre de réponses d'un sondage sur les attitudes par les variables de regroupement. La méthode de comparaison constante et le logiciel NVivo ont été utilisés pour l'analyse thématique.*

Résultats : *112 étudiants en médecine ont rempli le questionnaire (taux de réponse 50 %). Les répondants n'ayant signalé aucune expérience ou exposition en chiropratique ni un intérêt à apprendre la chiropratique avaient une attitude significativement plus négative à l'égard de la chiropratique. Sur le plan thématique, les étudiants en médecine considèrent la chiropratique de*

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Funding: This project received private funding from Independent Assessment Services, Toronto, Ontario, which funded the cost of the appreciation gift cards for key informant and focus group participants. This project was awarded the Student Research Award from the Ontario Chiropractic Association and the Canadian Memorial Chiropractic College, and the First Prize Student Poster Award at the World Federation of Chiropractic Congress 2011.

Competing Interests: The author AM was a medical student at the University of Toronto but was not a part of the study population. The author DKG is a guest lecturer at the Faculty of Medicine of the University of Toronto. The author KW is a faculty member in the Faculty of Medicine, University of Toronto.

greater understanding was needed for future patient referrals.

Conclusion: *The results highlight the importance of exposure to chiropractic within the formal medical curriculum to help foster future collaboration between these two professions.*

KEY WORDS: attitudes, medical, students, survey, interprofessional

plus en plus comme une thérapie complémentaire fondée sur des preuves, pour la lombalgie ou les douleurs chroniques, mais ces opinions étaient basées sur des sources indirectes. Dans le contexte d'un programme d'études officiel, les étudiants voulaient en apprendre davantage sur les conditions cliniques et les avantages et risques liés au traitement, car une plus grande compréhension était nécessaire pour l'aiguillage des patients futurs.

Conclusion : *Les résultats mettent en évidence l'importance de l'exposition à la chiropratique dans le contexte du programme d'études officiel en médecine pour aider à favoriser la collaboration future entre ces deux professions.*

MOTS CLÉS : attitudes, médical, étudiants, sondage, interprofessionnel

Introduction

Over the last two decades, an increasing number of North Americans have sought out complementary and alternative medicine (CAM) to address their health concerns.¹⁻⁶ Chiropractic was the most frequently accessed CAM therapy in 2005, with a utilization rate of 11% reported by Statistics Canada, for addressing musculoskeletal conditions.^{4,7-9} This is likely due to high patient satisfaction with the quality of care^{10,11}, and growing evidence around the effectiveness^{7,12-17} and safety^{18,19} of chiropractic treatments.

Recent efforts in Canada and worldwide have emphasized the importance of interprofessional education (IPE) and collaboration to reform the healthcare system.²⁰⁻²² In 2010, the World Health Organization produced a framework to position interprofessional collaboration in educational and practice settings as a strategy for mitigating global health workforce crises.²⁰ In Canada, a focus on health professional education has moved academic programs toward curricular reforms involving IPE.²³ Simi-

lar international models have increasingly appeared in peer-reviewed literature and have been incorporated into governmental policies²⁴, with researchers examining how health professionals interact with and perceive each other. Studies have explored how medical students view CAM²⁵⁻²⁸, noting that medical students tend to receive less CAM education than other healthcare students²⁸, despite having an interest to learn more about CAM²⁵⁻²⁷. Medical students^{26,28-34} and practicing physicians³⁵ alike recommended the inclusion of CAM education within formalized medical curriculum especially in the early years^{6,36-38}, and this has been shown to improve attitudes towards CAM^{25,36,39}. With increasing utilization and research with chiropractic, some view the profession as moving away from CAM and towards mainstream healthcare.^{39,40}

A literature search in the Medline database (inception to 2008) was performed, using a combination of MeSH terms and keywords related to medical students, chiropractic and CAM. Reference lists of relevant articles were hand searched for additional articles. A review of the lit-

erature indicated that there were no studies that explored medical students' views on chiropractic independent of other CAM therapies at the start of this study. Therefore, the purpose of this study was to assess the attitudes, knowledge and perspectives of medical students specifically towards chiropractic. Understanding how medical students perceive chiropractic may help facilitate collaboration and enhance interprofessional relationships between the two professions in the long term.

Methods

This study utilized a mixed-methods design with three data collection approaches: a survey questionnaire, key informant interviews and a focus group. The purpose of the *three-step triangulation* approach was to gather rich and in-depth quantitative and qualitative data on potentially diverse views towards chiropractic, with increasingly detailed probes between the key informant interviews and focus group. First, a 53-item survey was developed by the research team to obtain overall attitude, knowledge and perspective scores on chiropractic and then administered to a group of second year medical students. Information from the survey results helped to inform the semi-structured interview guide used in the interviews. The views of medical students to chiropractic were then qualitatively assessed with key informant interviews, which provided an opportunity for medical students to clarify their personal views.⁴¹ Finally, a focus group of 8 medical students was convened to gather thoughts on chiropractic when presented with potentially differing views of their colleagues.

The target population was second year, pre-clerkship medical students (n=224) in a four year program at the Faculty of Medicine, University of Toronto (UT). Second year students were selected because, at that point, they had one year of formalized education in medical school but no formal curriculum on chiropractic. Previous literature also suggests that early year (years 1-2) medical students are more likely to be enthusiastic about learning CAM than later years (years 3-4).^{29,36}

Inclusion criteria included willingness to participate and fluency in English. Exclusion criteria included failure to provide written consent. The study protocol underwent expedited research ethics board review with approvals from UT and the Canadian Memorial Chiropractic College (CMCC) in Toronto, Canada.

Quantitative Stage 1 – Survey:

The methods described by Boynton (2004) and Boynton & Greenhalgh (2004) outlining processes of creating, piloting and administering questionnaires were utilized.^{42,43} The study's self-administered questionnaire was developed through a literature review to discern thematic areas suggested by current studies (Appendix) on medical students' perceptions of CAM therapies. The questionnaire was then reviewed by an experienced qualitative researcher who consulted with the research team and pre-tested on 4 medical students who were not a part of the study population, resulting in modifications to the order and wording of questions. The research team introduced the survey to medical students following a second year community health lecture with the course director's permission. Demographic information (sex and age) was collected to describe the study population, without nominal identifiers. To maintain participants' anonymity, surveys were returned via a dropbox at the classroom exit.

Qualitative Stages 2 and 3:

Key informant and focus group participants had volunteered after an approved classroom announcement was made and subsequent emails were sent to university email accounts. Semi-structured question guides were developed through a literature review and expert advice from an experienced qualitative researcher who consulted with the research team, then revised based on trends from survey results. The qualitative researcher also trained two investigators (JJW and LD) in conducting key informant interviews. Written informed consent was obtained from each participant to participate and audiotape the interviews. Data were transcribed verbatim into written text from the audiotape. Gift cards of \$20.00 (with courtesy lunch at the focus group) were provided to each participant in appreciation of their time.

Stage 2 – Key Informant Interviews:

Key informant interviews followed the analysis of questionnaire results and employed one-on-one, semi-structured interviews of approximately 20 minutes. Purposeful sampling was conducted by researchers to identify medical students willing to share in-depth perspectives on chiropractic and elaborate on survey themes. The interviews were conducted until thematic saturation was reached, with saturation being the point where no new

data was obtained.⁴¹ Saturation (identified through simultaneous and iterative sampling, data collection and analysis) was achieved at 9 key informants. After the first 3 interviews, interviewers reviewed all responses and determined, by consensus, that one additional interview probe was needed to elaborate on an early trend. The additional probe was, “Do you think it is important for your medical school curriculum to include education on chiropractic?” The interviewers did not reveal the participants’ identities, but instead assigned pseudonyms to each participant during the transcription process.

Stage 3 – Focus Group:

A one-hour focus group was conducted with 8 medical students, as research suggests that focus groups should be composed of 6-10 individuals.⁴⁴ This format can elicit ideas that participants might not have considered on their own and inspire additional thoughts.⁴⁴ The purpose of this focus group was for medical students to discuss recommendations for addressing possible barriers to collaboration, in light of differing views of their colleagues. For the most comfortable setting possible, the focus group was conducted in a private setting on UT campus by a research investigator (AM) who was a medical student and not a part of the study population.

A copy of the survey and semi-structured questions for the key informant interviews and focus group is available by contacting the principal investigator.

Statistical Analysis – Survey Questionnaire:

Descriptive statistics (frequencies) were recorded for sex, age and current level of chiropractic understanding. Determined by team consensus, the questionnaire included 15 question-items assessing knowledge of chiropractic, 4 question-items assessing perspective towards chiropractic and 30 question-items assessing attitude towards chiropractic. These questions utilized a 5-point Likert scale of strongly disagree(1), disagree(2), undecided/don’t know(3), agree(4) and strongly agree(5). From the 30 question-items assessing ‘attitude towards chiropractic’, response-totals for attitude-positive (agree/strongly agree), attitude-negative (disagree/strongly disagree) and undecided/don’t know were obtained for each individual to formulate summary measures of attitudes towards chiropractic.

ANOVA was used to assess between-group differences

Table 1.
Demographic Data (N = 112 respondents)

		N	%
Gender	Male	53	47.3
	Female	59	52.7
Age	20-24	64	57.1
	25-29	42	37.5
	30-34	5	4.5
	35-39	1	0.9

on the attitude-response totals over various grouping variables. Since the response totals for attitude (positive, negative and undecided) were stratified and compared over 10 different grouping variables, a Bonferonni corrected p value of 0.005 was used as the standard for statistical significance. Additionally, where a significant p value (<0.005) was found on a grouping variable with 3 or more levels, post hoc comparisons were done using t tests with a further adjusted significance level of 0.005/ (# of levels in grouping variable). R-Project quantitative software was used to perform the analysis.⁴⁵

Thematic Analysis – Key Informant Interviews and Focus Group:

Each transcript was independently analysed by two investigators (JJW and LD) using the constant comparison method, where the data was compared and contrasted for significant phrases and sentences.⁴⁶ The two researchers met to harmonize individual interpretations until consensus was reached on themes, categories and sub-categories. The open coding structure and transcript data were entered into NVivo (v2.0, QSR International Pty. Ltd., Melbourne) for data organization and retrieval.

Results

Quantitative Results:

Demographics:

Of the 224 potential subjects, 112 (50% response rate) completed the survey. There was a relatively equal male (47%) and female (53%) gender split, with the majority (94%) of participants in the age range of 20-29 years (Table 1).

Table 2.
Attitude towards Chiropractic:
Positive, Negative and Undecided/Don't Know Responses by Grouping Variables (N=112 respondents)

		# Positive responses	# Negative responses	# Undecided / don't know responses
	N	Mean(SD)	Mean(SD)	Mean(SD)
Current level of understanding of Chiropractic				
Good	24	16.42 (7.23)	4.54 (5.64)	8.04 (5.71)
Satisfactory	35	12.09 (7.80)	8.49 (7.96)	8.43 (5.92)
Poor	53	10.77 (6.91)*	5.45 (6.32)	12.77 (7.00)**
Previous Chiropractic Experience?				
Yes	49	14.94 (7.80)	4.78 (5.60)	9.29 (6.75)
No	63	10.41 (6.72)**	7.32 (7.58)	11.27 (6.67)
Received Chiropractic treatment?				
Yes	30	15.50 (8.41)	5.43 (6.46)	8.07 (7.06)
No	82	11.26 (6.88)*	6.49 (7.03)	11.26 (6.47)*
Friend/Family member is a Chiropractor?				
Yes	19	18.10 (5.43)	3.53 (3.41)	7.37 (5.29)
No	93	11.23 (7.38)**	6.75 (7.28)	11.02 (6.87)*
Considered Chiropractic as a career option?				
Yes	4	24.50 (2.89)	1.00 (2.00)	3.50 (2.38)
No	108	11.94 (7.27)**	6.40 (6.92)	10.66 (6.73)*
Is interprofessional education (IPE) important to you?				
Yes	94	13.06 (7.67)	5.96 (6.67)	9.98 (6.50)
No	3	7.33 (7.51)	13.33 (12.86)	8.33 (6.66)
Unsure	14	9.86 (5.10)	6.71 (6.72)	12.43 (7.08)
Are you aware of the current scientific evidence for Chiropractic treatment?				
Yes	11	17.26 (7.16)	6.55 (7.99)	5.18 (3.82)
No	82	12.18 (6.80)	5.50 (5.55)	11.32 (6.28)
Unsure	19	10.47 (9.70)	9.05 (10.32)	9.47 (8.61)*
Would you like to learn more about Chiropractic care?				
Yes	75	13.59 (7.25)	4.65 (4.89)	10.76 (6.36)
No	12	6.75 (4.41)	15.58 (10.59)	6.67 (7.40)
Unsure	24	12.00 (7.05)*	6.58 (6.52)***	10.42 (6.52)
* p < 0.05 between groups in ANOVA; ** p < 0.005 between groups in ANOVA ; *** p < 0.0005 between groups in ANOVA				

Attitude towards Chiropractic:

Table 2 shows the effect of different grouping variables on totals for attitude-positive, attitude-negative and undecided/don't know responses. Respondents self-reported a wide range of 'level of understanding of chiropractic', with 24 respondents (21.4%) selecting 'good', 35 respondents (31.3%) selecting 'satisfactory' and 53 respondents (47.3%) indicating 'poor'. Individuals with a poor 'current level of understanding of chiropractic' had significantly more undecided/don't know responses than their counterparts ($p < 0.005$). However, results of post hoc multiple comparisons of 'current level of understanding of chiropractic' on undecided/don't know responses totals yielded no specific pairwise differences following further adjustment. Individuals who reported previous experience with chiropractic were significantly more attitude-positive ($p < 0.005$). Specifically, those with a friend or family member who was a chiropractor ($p < 0.005$), considered chiropractic as a career option ($p < 0.005$) or had received chiropractic treatment ($p < 0.05$) were more attitude-positive towards chiropractic. With regards to the question "Would you like to learn more about Chiropractic care?", post hoc comparisons identified individuals that responded "No" as being significantly different from individuals that responded "Yes" ($p < 0.0001$) and individuals that responded "Unsure" ($p < 0.0001$). Thus, individuals with no interest in learning more about chiropractic care were significantly more attitude-negative towards the profession.

Knowledge on Chiropractic:

Fourteen items were used to assess subjects' knowledge regarding chiropractic care/treatment. Participants were asked to select agree, disagree or undecided/don't know about various types of care (e.g. acute, chronic, preventive) and types of treatment modalities (e.g. joint manipulation, soft tissue therapy, exercise prescription) provided by chiropractors. When asked about the types of treatment chiropractors can provide within their scope of practice, subjects either indicated an incorrect response or selected undecided/didn't know 50.4% of the time. Subjects lacked knowledge in the following care/treatment areas: nutritional information (84%), acute care (74.1%), acupuncture (72.3%), preventative care (67.2%), and therapeutic modalities (66.1%). 9.9% of respondents indicated that they were aware of current scientific evidence

Table 3.
Perspective on Chiropractic (N=112)

	Category	N	%
Chiropractic is <i>mainstream</i> profession in health care.	Strongly disagree	5	4.5
	Disagree	26	23.2
	Undecided/do not know	49	43.8
	Agree	30	26.8
	Strongly agree	2	1.8
Chiropractic is a <i>complementary and alternative medicine (CAM)</i> profession.	Strongly disagree	1	0.9
	Disagree	4	3.6
	Undecided/do not know	22	19.6
	Agree	69	61.6
	Strongly agree	16	14.3
From your experience, UT medical school educators are knowledgeable about chiropractic.	Strongly disagree	5	4.5
	Disagree	37	33.0
	Undecided/do not know	60	53.6
	Agree	5	4.5
	Strongly agree	0	0
	N/A	5	4.5
Is interprofessional education (IPE) important to you?	Yes	94	83.9
	No	3	2.7
	Unsure	14	12.5
	N/A	1	0.9

on chiropractic care and treatment, while 73.2% indicated that they were not aware and 16.9% were unsure if they were aware.

Perspective on Chiropractic:

Four questions explored the perspectives of medical students on chiropractic. These were differentiated from attitude questions on the basis that 'perspective' responses did not have a positive or negative connotation, but were neutral instead. These questions explored whether medical students considered 1) chiropractic a mainstream or CAM profession (2 questions) 2) their medical school educators knowledgeable regarding chiropractic and 3) IPE as important (Table 3). In regards to whether chiropractic was a mainstream or CAM profession, there were 21/112 (18.8%) respondents who endorsed both beliefs.

Qualitative Results:

Participants' use of specific dialogue in the key informant interviews and focus group provided a context for assessing their attitudes, knowledge and perspectives toward chiropractic. The following themes were identified:

Exposure to and knowledge on chiropractic:

The subjects' knowledge of chiropractic and its education process was limited to the program length (4 years), general anatomy and treatment technique components. They were not familiar with other courses in the chiropractic curriculum. Some participants viewed the intensity and basic course work of chiropractic training similar to that of medical students. Their limited chiropractic knowledge was largely based on indirect sources of information, such as conversations with friends, small group tutors and in student clubs, without formal lectures on chiropractic in their medical curriculum up to that point in second year. Some experiences gave them a negative impression of chiropractic.

"I do remember hearing some injuries that can be caused when people have some specific condition, but I don't think we've ever had anything really too positively that I can recall in lecture." (FG:23)

Chiropractic in medical education:

Participants were interested in learning about chiropractic in their undergraduate medical education, particularly regarding conditions that chiropractors treat, rather than intricacies of treatment methods. Barriers to the inclusion of chiropractic in the curriculum were thought to include lack of emphasis from the medical school administration and lack of time amidst the heavy curricular workload.

"Our professors or curriculum may not be recognizing the importance of giving the value of learning what chiropractic does and the value to us, so I think part of the barriers would be advocating toward those who develop the curriculum to engrain it in our syllabus." (FG:141)

To address these barriers, some students suggested that the information should be taught in appropriate residency specialties, such as family medicine and orthopaedics. Participants noted that the school's IPE program did not formally include chiropractic and may be a well-suited avenue for chiropractic information.

"We did have an interprofessional development day...

and there weren't any alternative medicine or chiropractors, and I feel that would be a good opportunity to introduce students to it." (KI 6:284)

Role of chiropractic in health care:

The medical students felt that the chiropractic profession was becoming more evidence-based, but were not fully aware of the chiropractic literature. There was mention of concern regarding safety issues around chiropractic.

"If I were the practicing physician, I may not choose (chiropractic) treatment for a patient just because I don't understand it. If I understood the risks and benefits to particular patients, I would definitely have a positive attitude towards it and know when to access it." (KI 7:138)

All focus group participants agreed that chiropractic belonged in CAM. The reasons behind this were unclear, as some students mentioned it was because chiropractic was not formally taught in the medical curriculum, while others again questioned the evidence and legitimacy behind chiropractic. There was confusion surrounding the differences between chiropractic and CAM.

"(Chiropractic) is not really part of the curriculum, so I don't really consider it conventional mainstream." (FG:224)

"It's been told before in lecture that CAM is not necessarily based on randomized-controlled trials and evidence." (FG:74)

Chiropractic in clinical settings:

In practical settings, the respondents viewed chiropractors as practitioners commonly treating low back and chronic pain with spinal manipulation. Most subjects were aware that chiropractors performed manipulations, but were not familiar with the details of this procedure. There was confusion around the differences in educational training, treatment, and government funding between chiropractors, physiotherapists, and registered massage therapists.

"The focus of chiropractors is the spine specifically versus physiotherapists would work on virtually anything, and not limited to the spine...though I don't know that's an exclusion per se." (FG:238)

"The funding model of healthcare doesn't cover chiropractic as much as they do physiotherapy, which might have won over the general public's belief but is probably shifting as we speak in terms of healthcare today." (FG:301)

To transition from education to practice, participants felt that the benefits of learning about and collaborating with chiropractors were based around patient-centred principles. The understanding of chiropractic and its evidence was associated with greater comfort in referring future patients, but subjects wanted to know when to refer and for what conditions.

"If (chiropractors) are part of the same healthcare team then it would be easier for the patient to access all the services in the same place and part of the same group of circle of care." (FG:274)

Discussion

The majority of respondents considered chiropractic a CAM therapy that was becoming more evidence-based. A number of respondents (18.8%) endorsed both beliefs that chiropractic was a mainstream and CAM therapy, which may reflect the increasing utilization and research with chiropractic that has shifted the perception of the profession from CAM and towards mainstream healthcare.^{39,40} No previous experience with chiropractic or interest in learning about chiropractic were significantly associated with more negative attitudes towards the profession. When asked about scope of practice and treatment modalities of chiropractors, approximately half of respondents had either incorrect or undecided responses. This limited chiropractic knowledge was mainly based on personal conversations or informal discussions at school, some of which promoted a negative impression of chiropractic.

Generally, most respondents were unaware of the current scientific evidence on chiropractic and wanted to learn more about the profession. In key informant and focus group discussions, barriers to the inclusion of chiropractic in the medical curriculum were hypothesized as lack of time, heavy course load and perceived lack of importance given by faculty. The participants suggested that IPE and appropriate residency specialties, such as family medicine and orthopaedics, were suitable routes for adding additional chiropractic content into the medical curriculum. In one-on-one and group discussions, the majority of participants wanted to learn about conditions deemed most appropriate for chiropractic treatment by its reported effectiveness and safety in research literature. The main motivating factor behind learning about chiropractic was the facilitation of appropriate referrals to chiropractors for patient-centred care.

These findings generally reflect trends in other research that examined medical students' view on chiropractic amid other CAM therapies. Similar to a 2007 paper-and-pencil survey of 260 (response rates were 65% of all first year students, 91% of all second year students) early year medical students, the majority of subjects wanted education on chiropractic (deemed the second most desired CAM profession to learn about, after acupuncture) to sufficiently advise patients and refer for its use.²⁵ In previous studies, medical students often relied on external sources for information¹⁵, and wanted formal CAM education in the medical curriculum^{26,28-34}, as increased knowledge has been associated with more positive attitudes towards that profession^{25,36,39}. To address this, Wetzel et al. (2003) suggested that medical curricula define a core curriculum on CAM, which incorporates CAM into patient cases in standard lectures and offers student exchanges with other professions for experiential learning.⁴⁷ This is a multi-faceted approach that has also been suggested for IPE.⁴⁸ Having identified heavy course load and lack of time as barriers, which parallels the concerns of this study's respondents, this method may be used to introduce chiropractic in an integrated and longitudinal fashion into existing medical curricula.

Specifically, respondents wanted information on the evidence and role of chiropractic treatments for musculoskeletal conditions, particularly spinal manipulation. This was also reflected in the number of undecided/don't know responses in the questionnaire, though the percentage of these responses did not vary much across Table 2, which suggests that these respondents were the same individuals. Since spinal manipulation is generally supported by practice guidelines^{49,50}, systematic reviews⁵¹⁻⁵⁴ and literature synthesis⁵⁵ for musculoskeletal complaints, one barrier to chiropractic understanding may be the limited exposure to its evidence. Safety concerns by some medical students in the study's qualitative sessions may also reflect the lack of exposure to most recent evidence, particularly around stroke. Although earlier reports suggested an association with vertebrobasilar artery dissection and cervical manipulation⁵⁶⁻⁵⁸, recently published high-quality methodological studies have failed to confirm this association^{21,22}. In 2008, an ecological study failed to confirm an association between increased chiropractic use and increased risk of stroke¹⁸, while a population-based case-control and case-crossover study failed to confirm an association

between chiropractic care and increased risk of stroke as compared to primary care¹⁹. In light of feedback from our participants, it is recommended that evidence-based research on chiropractic efficacy^{49-54,59-64}, safety^{18,19}, and cost-effectiveness^{16,62-64} should be highlighted in course lectures on chiropractic⁶⁵⁻⁶⁷.

With respect to scope of practice, the respondents perceived chiropractors as mostly treating low back and chronic pain with spinal manipulation, but remained uncertain about when to refer patients to chiropractors. This lack of clarity regarding the role of chiropractors in collaborative practice may become a barrier to collaboration in the clinical setting. This was also suggested by Branson in his 2004 evaluation of a 10-year hospital-based chiropractic program.⁶⁸ In a 2009 mail survey of 487 (49% response rate) orthopaedic surgeons in North America, Busse et al also found that orthopaedic surgeons had diverse views on chiropractic, ranging from extremely negative to very positive, and only 51.4% of surgeons referred some patients to chiropractors each year, mainly due to patient request.³⁵ Improved understanding of chiropractic training and evidence for chiropractic treatment may help medical students later develop a trusting relationship and patient referral network with chiropractors, which is integral to successful collaboration.⁶⁹ The main reason that our respondents wanted to learn about chiropractic was to improve patient care, and appropriate exposure is suggested to positively impact their future collaboration with chiropractors.²⁹

Other authors have postulated that until education about chiropractic is implemented early in the medical curriculum, medical students may be susceptible to developing negative attitudes.²⁹⁻³⁶ Parsell et al identified more negative attitudes at later stages of training and, therefore, education about chiropractic early in the curriculum³⁷ or at younger years³⁸ may help minimize this occurrence⁷⁰. Since participants expressed a desire to learn, an issue may be that students interested in IPE need support from faculty, as recommended by Hoffman et al.⁷¹ A lack of formal curriculum may further impede positive learning, as reflected in reports of “hidden curriculum” in medicine⁷² and marginalization of minor professions by medicine⁷³. Hidden or informal curriculum occurs when knowledge regarding certain topics is obtained through unintended lessons in education that may promote unplanned inequalities.⁷⁴ The negative discussions expressed by this

study’s participants coincide with findings of Busse et al, where 28.6% of orthopaedic surgeons had been exposed to information on chiropractic during medical school, of which only 7.2% reported favourable information.³⁵

This is likely to have further implications in clinical practice. A recent qualitative study, involving focus groups of health professionals, suggested a need for formalized and standardized teaching in interprofessional collaboration at the student level to enable future health professionals to work in teams.⁷⁵ This need to develop collaboration among different health care students may begin with addressing negative attitudes that may be present prior to their medical education or start early on in their training.

Strengths and Limitations:

To the research team’s knowledge and based on a thorough literature search, there are no existing studies that specifically explore medical students’ views on chiropractic independent of CAM. However, this study has limitations. First, the results may have limited generalizability to medical students as a whole. A survey response rate of 50% (112/224) does not allow for confidence that non-responders would have had similar responses to those provided by responders, though their views were likely explored in the key informant and focus group discussions. Medical schools similarly structured to UT may have comparable results, whereas schools that integrate chiropractic in the formal academic setting may yield a different outcome. For instance, the Osher Institute at the Harvard Medical School has been reported to use an innovative integrated care team that includes a chiropractor among other complementary and mainstream professions, which may influence the model of care at its medical school.⁷⁶

The survey included a response option to certain questions as “undecided/don’t know”. However, ‘undecided’ is not the same as ‘don’t know’, and the use of this category is therefore a limitation to the study. The survey questions were also all in the same direction on the Likert scale and this may have introduced an inherent response bias. Since the study involved one focus group, additional groups may have yielded different information, though saturation was likely reached through the combination of key informant and focus group sessions. The effectiveness of the three-step triangulation approach was not evaluated, so future studies that utilize either key inform-

ant interviews or focus groups alone may yield varying results.

Future Direction:

The research team is currently examining the same group of medical students' attitudes after an educational intervention (a one-hour lecture) about chiropractic provided in their third year, to identify any future changes in attitudes longitudinally.²⁹ This study's results will act as baseline views on chiropractic in the second study. In an earlier study, a one-hour lecture was found to be effective in changing attitudes of students.²⁶ Based on our results, it is important that this one-hour lecture covers the evidence supporting chiropractic treatments for certain conditions, scope of practice and the role of chiropractors in healthcare teams. Eisenberg et al. found that when healthcare providers were trained together, it was beneficial to future collaboration in practice^{1,2}, so the lecture may ideally include other healthcare students and utilize an interprofessional context.

Future research could include a number of possible directions. The study's mixed-methods approach could be used by others when examining interactions among a variety of healthcare professions. Further research could also be conducted once students enter into their clinical training years to identify attitudes, knowledge and perspective of medical students towards chiropractic when transitioning from education to practical application in clinical practice. The one-to-one associations found in this study may have the potential to build a model in future studies that explore how the grouping variables affect one another when combined. Finally, further research evaluating the effectiveness of this *three-step triangulation* methodological approach may also be of value.

Conclusion

The medical students participating in this study expressed an interest in learning about the best available evidence behind chiropractic treatments in order to better understand the role of chiropractors within the healthcare system. This emphasizes the importance of having chiropractic formally taught in the early years of medical curricula and as a part of an IPE program. Further, this formal education will aim to minimize the need for medical students to rely on anecdotal or informal sources of information on chiropractic, and provide a consistent, evidence-based

and accurate understanding of the profession. Improving interprofessional relations between medicine and chiropractic through educational reform and research has the potential of benefiting the patient in practice. Ultimately, one can hope to ensure best patient-centred care by empowering future physicians with the understanding of when to collaborate and appropriately refer patients to chiropractors.

Acknowledgements:

The research team would like to acknowledge the contributions of: Dr. Ian Johnson at the University of Toronto (UT) with respect to the research ethics submission and survey administration; Natasha Kachan at UT for her input on qualitative methodology and training in conducting key informant interviews; Daniel Rosenfield at UT for his input on study design and training in conducting focus groups; and Dr. Silvano Mior at the Canadian Memorial Chiropractic College for his guidance on the use of NVivo software.

Authors' contributions:

Authors JJW, LD, AK, KY, AM, and DKG contributed to the design of the study, data analysis, and drafting of the manuscript. Authors DS and KW contributed to data analysis and interpretation, and critical revision of the manuscript. All authors have read and approved the manuscript as submitted.

Abbreviations:

CAM: Complementary and Alternative Medicine; IPE: Interprofessional Education; UT: University of Toronto

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Appendix:

Relevant articles from literature review considered in development of survey questionnaire

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Frequency of use of diagnostic and manual therapeutic procedures of the spine taught at the Canadian Memorial Chiropractic College: A preliminary survey of Ontario chiropractors. Part 1 – practice characteristics and demographic profiles

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Background: Students learn a plethora of physical examination and manual therapy procedures over the course of their chiropractic education. However, it is uncertain to what extent they continue to use these procedures in practice after graduation.

Objective: The purpose of this study was to determine which diagnostic and therapeutic procedures of the spine are most commonly utilized by chiropractors practicing in Ontario. In Part 1 of this study (presented here), the demographics and practice patterns of the respondents are presented. Part 2 of this study will present the results of the utilization rates of diagnostic and therapeutic procedures used by respondents.

Methods: The study consisted of a paper-based survey that was sent to 500 pseudo-randomly selected Ontario chiropractors who responded confidentially. Survey questions inquired into demographic and practice style characteristics.

Contexte : Les étudiants apprennent une pléthore d'examen physiques et de procédures de thérapie manuelle au cours de leur formation en chiropratique. Cependant, on ne sait pas dans quelle mesure ils continuent à utiliser ces procédures dans la pratique après l'obtention du diplôme.

Objectif : Le but de cette étude était de déterminer les procédures diagnostiques et thérapeutiques de la colonne vertébrale les plus couramment utilisées par les chiropraticiens qui exercent en Ontario. Dans la première partie de cette étude, décrite ici, les données démographiques et les habitudes de pratique des répondants sont présentées. La deuxième partie de cette étude présentera les résultats des taux d'utilisation des procédures diagnostiques et thérapeutiques utilisées par les répondants.

Méthodologie : L'étude était basée sur un questionnaire qui a été envoyé à 500 chiropraticiens de l'Ontario, choisis de manière pseudo-aléatoire, qui ont répondu de façon confidentielle. Les questions du sondage enquêtaient sur les données démographiques et les caractéristiques des styles de pratique.

Résultats : Il y avait 108 répondants au sondage, soit un taux de réponse de 22,4 %. De nombreux chiropraticiens se sont définis comme possédant plus d'une caractéristique de style de pratique. Par exemple, 72,4 % des chiropraticiens qui disent traiter en fonction

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Results: *There were 108 respondents to the survey, giving a response rate of 22.4%. Many chiropractors self-identified themselves with more than one practice style characteristic such as 72.4% of the self-described pain-based chiropractors who also described themselves as evidence-based, compared with 51.9% of subluxation-based chiropractors who also described themselves as evidence-based. Diversified technique was the most commonly employed technique used by 90.7% of respondents, followed by trigger point therapy indicated by 57.4% of respondents.*

Conclusions: *Despite a low response rate, respondents reported practice characteristics in this study that were similar to practice characteristics previously published, particularly in terms of professional demographics and techniques employed. While Diversified was the most commonly used technique, respondents reported higher levels of use of proprietary soft tissue techniques systems and upper cervical techniques than have been previously reported.*

KEY WORDS: chiropractors, manual therapy, physical examination, survey

des douleurs, disent également prescrire des traitements fondés sur des preuves, alors que 51,9 % d'entre eux qui traitent les subluxations disent aussi prescrire des traitements fondés sur des preuves. La technique diversifiée est la technique la plus couramment employée par 90,7 % des répondants, suivi par le traitement de points de déclenchement indiqué par 57,4 % des répondants.

Conclusions : *Malgré le faible taux de réponse, les répondants de cette étude ont manifesté des caractéristiques de pratique qui étaient semblables aux caractéristiques de pratique d'études publiées précédemment, notamment du point de vue des données démographiques et des techniques professionnelles employées. Bien que la technique diversifiée ait été la technique la plus couramment utilisée, les répondants ont indiqué avoir utilisé beaucoup plus qu'auparavant des techniques exclusives de tissus mous et des techniques de manipulation des vertèbres cervicales supérieures.*

MOTS CLÉS : chiropraticiens, thérapeutique manuelle, examen physique, sondage

Introduction

Chiropractic students are taught numerous diagnostic and therapeutic procedures during their undergraduate education (UE) and clinical internships (CI). These procedures are principally directed to the cervical, thoracic, lumbar and pelvic regions (the 'spine') and the peripheral joints, although students are also taught assessment of other structures (eyes, ears, heart and so on) as well. The focus on the joints of the spine and peripheral joints is not surprising since the chiropractic scope of practice in many Canadian provinces specifically emphasize these regions (i.e. Ontario, Alberta, British Columbia)¹⁻³ and some authors have argued that chiropractic's cultural authority lays in adopting a 'spinal care specialist' model^{4,5}, essentially

focusing on diagnostic and therapeutic procedures of the spine and peripheral joints.

Previous work in this area has involved surveying clinicians at the Canadian Memorial Chiropractic College (CMCC) outpatient clinics only, focusing on the degree of vertical integration between the undergraduate (preclinical) program and the clinical internships at that particular institution.^{6,7} Although a significant degree of vertical integration was reported in those studies, it was found that a variety of the tests taught in CMCC's curriculum were not often used and/or were not recommended to be used by clinicians supervising interns at that institution's student clinics.^{6,7}

The overall purposes of this study were to: (i) char-

acterize practice patterns and demographic information of a pseudo-random sample of Ontario chiropractors; (ii) determine which diagnostic tests of the spine and (iii) which therapeutic procedures of the spine were utilized by a pseudo-randomized sample of Ontarian chiropractors as well as how often (i.e. at what frequency) they were being used. As this was a descriptive survey, there were no hypotheses to be tested. Compared with previous work in this area^{6,7} this study was unique in that it evaluated field practitioners for their patterns of use of different diagnostic and manual therapy procedures, as the results in this population may be different from those working in an academic clinical setting (clinicians supervising interns, for example). In addition, while the Job Analysis published semi-annually by the National Board of Chiropractic Examiner's (NBCE) in the United States does ask questions regarding physical examination and therapeutic procedures used in practice, it does not inquire into the frequency of use of specific tests and therapies.⁸

Methods

The CMCC Research Ethics Board (REB) provided approval of this study (project #112019). Funding was provided by the CMCC Division of Graduate Education and Research. Subjects did not receive compensation for participation in the study, but postage was provided, and subjects had the opportunity to be informed of the final study results. No deceit was used in this study.

Study design:

The study consisted of a paper-based survey of a pseudo-randomized sample of 500 licensed Ontario chiropractors. The authors weighed the option of distributing the survey on-line or by mail. Because the survey was over 16 pages in length, and because licensing bodies are reluctant to provide an updated list of member's e-mail addresses, it was decided to use a hard-copy paper survey (survey available from author).

Licensed Ontario chiropractors were selected via a pseudo-randomized method using the directory from the College of Chiropractors of Ontario (CCO), employing a systematic pseudo-random sampling method. Taking the last names listed in the CCO directory and starting at the beginning of each letter of the alphabet, every 6th name from the directory was selected for inclusion. Selected chiropractors were mailed a survey, which includ-

ed a cover sheet explaining the purpose of the study, the manner in which confidentiality was to be protected, and instructions as to how to complete the survey (including two examples). It was emphasized that completion of the survey was voluntary. Respondents were required to sign and date an informed consent sheet (as per REB protocol). Respondents were given the option to receive the results of the study. If they chose that option, they were required to provide the investigators with the email address. Due to budget constraints, a second mailing could not be undertaken, nor could an advanced notice mailing or final reminder. A postage-paid addressed envelope was provided for the return of the completed survey and consent sheet.

Inclusion criteria:

Inclusion criteria consisted of being a practicing chiropractor registered with the CCO, and being involved in patient care (either performing third party assessments or providing patient care) and those who provided signed informed consent to participate in the study. Respondents could be graduates of any chiropractic college. Exclusion criteria consisted of subjects not being involved with patients at all (i.e. involved in teaching or research activities alone, or being retired or out of practice) and those who did not sign the included informed consent sheet.

Sample size:

An initial sample size of 500 was determined as it represented approximately one in six chiropractors in Ontario being surveyed. This sample size was also determined ad hoc to be feasible for the scope of this descriptive survey.

Confidentiality:

Participants were able to respond in anonymity and were assured confidentiality. The randomly selected chiropractors were each assigned a sequentially numbered code maintained on a Master list using Microsoft Excel. Subjects were mailed the survey package to the address they provided on the College of Chiropractors of Ontario directory. Each returned survey and informed consent form was marked with the numbered code for that chiropractor. Although each respondent had to sign the consent form allowing the investigators to review their survey results, anonymity was maintained as each sheet was separated from the survey itself prior to data analysis and stored separately in a safe location (a locked file cabinet). The Master

list containing the codes corresponding to the respondents' names and addresses was destroyed upon completion of the study. Returned surveys were kept in a locked filing cabinet and destroyed using confidentiality-preserving means (i.e. shredding) upon completion of the study.

Survey Items:

Previous surveys by one of the authors were used to inform the development of the current survey instrument.^{6,7} The survey consisted of demographic questions (i.e. chiropractic college of graduation, year of graduation, age, gender) and practice pattern questions (style of practice, chiropractic techniques used). In addition, several tables were provided that listed all of the diagnostic/examination procedures and manual mobilization and spinal manipulative therapies taught in the CMCC curriculum. The list of procedures was generated by auditing the course outlines for all relevant clinical diagnosis courses as well as psychomotor skills (technique) lab courses. Additional sources of information included internally-published laboratory manuals of the Physical, Orthopaedic and Neurological (PON) diagnostic courses⁹ and a manual of Diversified mobilization and manipulation taught at college CMCC.¹⁰ Moreover, the Principal Investigator (PI) of this study teaches in both the orthopaedic and technique labs and had a working knowledge of which procedures were taught.

For this study, it was decided to focus only on physical, orthopedic and neurological assessment procedures of the spine as well as only manual mobilization and manipulative procedures of the spine. Other treatment modalities (such as nutritional advice, lifestyle coaching, prescription of exercises or orthotics or other supportive devices, electrical modalities and/or soft tissue techniques) were not included in the survey instrument.

In order to further enhance the comprehensibility of each listed procedure, a descriptor was provided alongside the name of each one, explaining how each named procedure was performed. This was to circumvent the possibility that a practitioner may not recall the exact name of a procedure but does perform it in private practice, and this strategy avoided the possibility that the name of a certain procedure may have changed since the time it was taught to the survey respondents.

Response scale:

Each procedure had a six-point scale for participants to indicate how frequently they perform these procedures. These responses varied from "Never used" to "Rarely used", "Sometimes used", "Often used", "Almost always used", and "No clinical cause to use this test" (with a suitable description of each category provided).

Pre-test:

As this was a descriptive survey, no pilot study was deemed necessary. The survey was essentially the same (albeit expanded) version of the survey instruments used in two previous studies^{6,7}; therefore, those previous studies were deemed as the equivalent of a 'pretest' of the survey used in this study. However, as an over-abundance of caution, the survey was submitted to an independent external chiropractor for completion. She indicated that it was straight-forward and easy to complete and comprehend. This chiropractor took twenty minutes to complete the survey and did not have any recommendations for changes to it. Her responses were not included in the data analysis. It should be added that no recommendations to alter the survey instrument were made by the REB that approved this study.

Statistical analysis:

The returned survey data was entered into a Microsoft Excel spreadsheet. Descriptive statistics such as determining proportions were employed to determine the overall frequency with which the different procedures were performed, along with the results of the demographic and practice pattern questions. Response rates for the survey were also determined. The responses to the PON and manual therapy procedure frequency questions were collapsed from six categories as described above down to four categories: (1) Never / Rarely; (2) Sometimes; (3) Often / Almost Always; (4) Haven't had a patient to cause them to use it. This was done to aid with the readability of the survey results and to aid in analysis of practitioner self-reported practice style characteristics.

Results

From the 500 surveys mailed to pseudo-randomly selected Ontario chiropractors during August 2011, 108 were returned completed and deemed acceptable for inclusion giving a raw response rate of 21.6%. As mentioned above,

Table 1.
Demographic Results

Practice Style	Raw values and percentages of respondents
Male	75/108 = 69.4%
Female	33 / 108 = 30.6%
25 to 34 years old	28 / 108 = 25.9%
35 to 44 years old	44 / 108 = 40.7%
45 to 54 years old	22/108 = 20.4%
55 to 64 years old	9/108 = 8.3%
65 to 74 years old	4/108 = 3.7%
75 years old or greater	1/108 = 0.9%
CMCC graduates	81/108 = 75.0%
NYCC graduates	7/108 = 6.5%
National University of Health Sciences graduates	6/108 = 5.6%
Logan University graduates	5/108 = 4.6%
Palmer College (Iowa) graduates	4/108 = 3.7%
Northwestern Health Sciences University graduates	2/108 = 1.9%
Life University, Southern California University of Health Sciences, or Palmer West graduates	1/108 each = 0.9% each
Involved in patient care	108/108 = 100%
Involved in research	3/108 = 2.9%
Involved in teaching	12/108 = 11.1%
Conduct 3 rd party assessments	21/108 = 19.4%

Table 2.
Frequency of self-reported practice style characteristics+*

Practice Style	Raw values and percentages of respondents who indicated adhering to certain practice style
Function-based	73/108 = 67.6%
Pain-based	58/108 = 53.7%
Subluxation-based	54/108 = 50.0%
Structure-based	36/108 = 33.3%
Tonal-based	12/108 = 11.1%
Evidence-based	68/108 = 63.0%
Tonal-based who also indicated subluxation-based	10/12 = 83.3%
Pain-based who also indicated functional-based	52/58 = 89.7%
Pain-based who also indicated evidence-based	42/58 = 72.4%
Subluxation-based who also indicated evidence-based	28/54 = 51.9%
<p>* Surveyed chiropractors were permitted to select all characteristics they felt described their practice activities, thus the total percentages and raw numbers exceed 100% + In general, chiropractors who characterize themselves as <i>pain-based</i> use pain and other symptoms as indicators to identify the clinical target for intervention. A <i>functional-based</i> chiropractor would rely on joint play, static and motion palpation as well as orthopedic tests to identify the clinical target, whereas a <i>structural-based</i> chiropractor who emphasize the importance of posture, as assessed visually or by x-ray line marking. A <i>subluxation-based</i> chiropractor would posit that their principle role is to identify and correct subluxations, with or without the presence of symptoms. A <i>tonal-based</i> would posit that the spine cord has an optimal inherent vibratory tone or frequency, similar to the strings of a guitar, and that this optimal vibratory tone is compromised in the presence of vertebral subluxation.¹¹</p>	

subsequent mailings were not performed due to budget constraints. Three subjects who returned their surveys were excluded, two because they were not actively involved in patient care (and thus did not complete the survey but still returned it to the authors), and one because they did not sign the informed consent sheet. Eighteen surveys were returned due to a change in practice location

of the doctors in question, thus the adjusted response rate was 22.4%.

Demographic and Practice Pattern data

Table 1 provides the demographic information of the 108 included respondents, including gender, age, and college of graduation, along with indication of the professional

activities in which respondents are involved. All of the respondents (100%) indicated being involved in patient care (as was required for inclusion in the study).

Practice Patterns and Self-Reported Practice Characteristics

Subjects could indicate more than one style of practice, the results of which are depicted in Table 2. Predictably, when cross-tabulated, 83.3% of Ontario chiropractors who characterized themselves as 'tonal-based' also characterized themselves as 'subluxation-based', and 89.7% of chiropractors who identified themselves as 'pain-based' also identified themselves as 'functional-based'. Of particular interest, however, was the finding that 72.4% of self-described 'pain-based' chiropractors also characterized themselves as 'evidence-based' and, by contrast, only 51.9% of 'subluxation-based' chiropractors characterized themselves as 'evidence-based'.

Therapeutic Procedures Used for Patient Care

Respondents in this study reported they primarily use Diversified technique (since respondents could list all techniques they used in private practice, the percentage of techniques used exceeded 100%). However, there were high utilization rates of soft tissue therapies, most notably trigger point therapy (57.4%), Active Release Technique/Myofascial Release (38.9%) and Graston technique (13.9%). After Diversified technique (indicated by 90.7% of respondents), the most commonly used technique system was Activator (53.7%), Thompson Terminal Point (33.3%) and Upper Cervical techniques (14.8%); over a dozen other chiropractic technique systems were reportedly used in declining frequencies (see Table 3).

Discussion

Studies from health care educational disciplines have emphasized that there ought to be a relatively seamless transition from a student's UE, through their CI and ultimately to clinical practice.¹²⁻¹⁵ Arnold and Willoughby¹², who examined clinical integration in a medical program, reported that early exposure to integration resulted in increased context and relevance, ensuring a deeper level of learning. Wilkerson and Ablemann surveyed Harvard graduates who reported the most frequently reported reason medical students appreciated their education was when there was an emphasis on integration between basic

Table 3.
*Frequency of therapeutic procedures
used for patient care**

Technique	Raw values and percentages of respondents who indicated using therapeutic procedure
Diversified	98/108 = 90.7%
Trigger point therapy	57.4%
Activator	58/108 = 53.7%
Active Release Techniques / Myofascial Release Technique	42/108 = 38.9%
Thompson	36/108 = 33.3%
Upper cervical	16/108 = 14.8%
Graston	15/108 = 13.9%
Flexion-Distraction	14/108 = 13.0%
Gonstead	12/108 = 11.1%
Cranial-sacral	10/108 = 9.3%
Sacro-occipital technique	8/108 = 7.4%
Chiropractic Biophysics	8/108 = 7.4%
Acupuncture	7/108 = 6.5%
Applied Kinesiology	7/108 = 6.5%
Torque Release Technique, Trigenics, Spinal decompression, Proadjustor	3/108 each = 2.8% each
Arthrostim	2/108 = 1.9%
Contact Release Analysis, Network, VF-Adjustor, Chirodantics, SFMA, VMTX, Stucky Integrated, Kinesiotape	1/108 each = 0.9% each
* Surveyed chiropractors were permitted to select all therapeutic procedures they use for patient care; thus the total percentages and raw numbers exceed 100%	

sciences education and clinical practice.¹³ A study by Wilgner-Meijer et al¹⁴ surveyed six Dutch medical school programs and reported that curriculum with vertical integration made more definitive career choices earlier after graduation, needed less time and fewer applications to obtain residency positions and felt more prepared for practice than did graduates from non-vertically integrated medical programs.

Leone¹⁶ and Watkins and Saranchuk¹⁷ ascertained

graduates' perception with respect to the relationship between the curriculum taught to chiropractic students and their practice activities. Leone¹⁶ reported there was positive relationship between manual therapeutic procedures taught to students and the ones they used upon graduation. Watkins and Saranchuk found that, in general, respondents to a survey opined that felt prepared for professional practice and that there was a linkage between it and their undergraduate education.¹⁷ Of interest, graduates reported that it was their opinion too much time was devoted in the curriculum to embryology and histology; the results of that study, in addition to student surveys, have resulted in curricula changes that have compressed the amount of time devoted to those subjects (PI, personal communication).

The development of course content involves (i) the use of scientifically proven procedures (proven in terms of diagnostic sensitivity and specificity as well as therapeutic effectiveness, and published in the peer-reviewed literature) and (ii) the necessity to meet regulatory obligations and adherence to requirements set by chiropractic educational accreditation agencies (Canadian Federation of Chiropractic Regulatory and Educational Accrediting Board, or CFCREAB, in Canada).¹⁸ That said, other less authoritative pressures exert force on curricular structure as well, including the importance of reflecting the cultural authority bestowed upon the profession by society, the influences of particular chiropractic educators (who may champion the continued use of various preferred- although as of yet unproven- procedures), and the propagation of pedagogical theory.^{6,7} Not only that but components of any chiropractic curriculum often reflect the continuation of procedures taught by tradition.^{6,7} and based on personal observation by the

PI) It is important to learn if students continue to use these procedures taught to them upon graduation and, if they do, how often this or that procedure is actually used for patient assessment and care. If practitioners either infrequently use procedures taught to them during their chiropractic education that lack a evidence base during their professional practice activities or, worse still, do not use them at all, this ought to be reflected in revised curriculum content. On the other hand, if practitioners do not use a procedure taught to them in a course that does have a strong evidence base behind it then this may speak to the issue of knowledge transfer (KT), an issue that has been the topic of considerable concern over the past few years.^{19,20}

Nevertheless, some interesting results were identified though this sample, unrepresentative of all Ontarian chiropractors though they may be. Not surprisingly since this survey was conducted in Ontario, three-quarters of respondents were CMCC graduates, and almost 7% were graduates of the New York Chiropractic College, the college closest geographically to Ontario. One out of every four respondents was under the age of 34, approximately two-thirds were under the age of 44 years and over two-thirds of respondents were male.

With respect to practice pattern, we believe ours is the first study to inquire what percentage of respondents were involved in Independent Chiropractic Examinations (ICEs) or third-party assessments, and 19.4% of respondents indicated they were involved in this aspect of the profession. It was also noteworthy that 11% of respondents indicated they were involved in teaching.

This study inquired as to how surveyed chiropractors would self-characterize their practice styles. Since many of the diagnostic tests in the curriculum of CMCC are geared to reproduce pain, it is not surprising that two-third of respondents identify themselves as '*function-based*' and just over half of respondents identified themselves as '*pain-based*'. Despite the fact that CMCC would not be characterized as having a traditional, subluxation-based curriculum, 50% of respondents identified themselves as '*subluxation-based*', although only approximately one in ten adhere to a '*tonal-based*' practice model. One-third of respondents identified themselves as '*structural-based*' and over 60% stated they considered themselves to be '*evidence-based*'. This speaks to the cross-identification many chiropractors seem to have about themselves, and how many chiropractors seem to resist being labelled with only one descriptor. It bears noticing that 72.4% of self-identified pain-based but only 51.9% of self-identified subluxation-based chiropractors stated they were also evidence-based.

These strong ideological self-identifiers were similarly reported in an early study by Biggs, Mierau and Hay, published in 2002.²¹ In that study, based on data derived from 393 data sets in 1994, Biggs et al reported that Canadian chiropractors fell into three categories: what these investigators classified as 'rationalists' (presumably 'evidence' or 'science-based'), 'empiricists' (those who rely on traditional chiropractor dogma) and those chiropractors who fall somewhere in-between the two. Biggs et al

reported 14.9% of respondents characterized themselves as rationalists, 28.4% as empiricists and 56.8% as in-between moderates, although the researchers did note that moderates tended to lean towards the empiricist end of the philosophy index, a scale derived from survey responses to create a continuum between rationalists and empiricists.⁵ This data also showed that 23.5% of Canadian chiropractors accepted traditional chiropractic philosophy as espoused by D.D. Palmer, 36.7% rejected it and 39.7% of respondents were neutral. However, there was stronger support for the traditional chiropractic tenets of B.J. Palmer, with 37.1% of respondents indicating support, 26.6% rejected them and 36.3% claiming neutrality. It must be emphasized that Biggs et al did report there were significant differences based on province and college of graduation, with CMCC graduates reporting a lower score (more 'rationalist') on the Philosophy Index than non-CMCC graduates and chiropractors practicing in Saskatchewan demonstrating a more 'rational-based' approach whereas chiropractors in Quebec demonstrated a more 'empirical' slant. Lastly, there were no distinct philosophical trends with respect to time of graduation or level of income.²¹

Ninety percent of the respondents in this survey reported using the "Diversified" chiropractic technique system, an eclectic non-proprietary corpus of high-velocity, low-amplitude (HVLA) manipulative thrusts often accomplished by cavitation²², and 74.4% of respondents indicated they 'primarily' use Diversified technique for patient care. This is not surprising since Diversified is the only named technique system taught at CMCC, although the college has also recently incorporated instrumented soft-tissue therapies (such as Graston) as well. However, as reported in several recent surveys as well as the data dating back to the early 1990s, Ontarian (and other Canadian) chiropractors typically inculcate other technique systems for patient care, most notably instrumented adjusting (activator), drop-table (Thompson Terminal Point) adjusting as well as any number of soft tissue techniques, many of them proprietary (i.e ART, Graston).^{17, 23-25} This finding is virtually identical to the findings from chiropractors in five Canadian provinces (including Ontario) by Mykietiuk et al.²⁵ In fact, the finding from this survey are quite consistent with previous studies in that Ontario chiropractors gravitate towards those technique systems most similar to Diversified technique in private

practice.^{17,23-25} Specifically, in the Canada-wide survey by Mykietiuk et al²⁵, after Diversified, chiropractors reported most commonly using Activator, Active Release Technique and Thompson Terminal Point. As indicated in that study, there is a notable trend towards the use of proprietary soft tissue therapies (ART, Graston) for patient care in addition to various chiropractic technique systems and other therapeutic procedures.²⁵ Respondents in this survey reported they used Upper Cervical techniques more commonly than acupuncture, Sacro-Occipital Technique (SOT) or Gonstead; this is a rather unique finding compared to other studies published over the past 20 years.

Limitation of this Study

The response rate for this survey was disappointing and that is the main limitation of this study. However, it was not out of line with previous response rates in surveys of chiropractors.²⁶ The response rate could have been improved through the use of advance notice mailings and sending reminder mailings²⁶; however as mentioned previously, this was not feasible due to budget constraints, but could have been alleviated if we procured additional external funding. Participation in this cross-sectional study was completely voluntary as participants were not provided with added incentive to complete the survey and this factor can hinder response rates as well.²⁷ In addition, the survey was quite lengthy and time consuming despite the best efforts of the authors to minimize it, but due to the nature of the research question such length was necessary. Breaking the survey into smaller distinct components may have improved the response yield. The lower response rate may call into question how representative the sample is of the overall population of Ontario chiropractors and possibly add in an element of non-response bias, however using the pseudo-randomized sampling method should enhance the representativeness of the results. The authors considered distributing the survey electronically (via Survey Monkey for example) but licensing boards and advocacy associations are reluctant to provide current lists of member's current emails. With the benefits of hindsight, the authors are considering replicating this study electronically using the older email lists of Ontario chiropractors that are available or else by seeking external funding to allow for additional mail outs (pre-notification and reminders) to be conducted.

Since the data included non-CMCC graduates, it is pos-

sible that those chiropractors taught at other chiropractic colleges used the different therapeutic techniques taught in the curricular of those other colleges. This may have skewed the results. Lastly, although different 'technique clubs' go in and out of fashion at CMCC (PI- personal communication), it is possible they had an effect on utilization rates of this or that chiropractic technique system not taught in the curriculum; however, the degree of this effect is unknown and possibly unknowable. Finally, the ad hoc sample size determination could be again viewed as a limitation and a formal sample size calculation would have been beneficial, but the ad hoc sample size determination was pre-determined to be sufficient for the purposes of this study.

Conclusions

In general, the demographic profile of respondents to this survey was similar to respondents to previously published surveys. Respondents in this study were mostly male and graduates of CMCC. Most reportedly used Diversified technique and, notwithstanding the fact that is the principle technique taught to them, many field doctors continue to also use proprietary soft tissue techniques and often other chiropractic technique systems and therapeutic procedures not formally taught to them. Unlike previous studies, a relatively high number of respondents in this study reportedly used Upper Cervical techniques.

Respondents reported having more than one professional revenue stream, with almost one in five stating they were involved with performing third-party assessments and one in ten stating they were involved in education. Virtually all chiropractors in this study stated they had overlapping practice styles, typically pain-and-functional based or tonal-and-subluxation based; that said, the percentage of respondents who stated they were 'evidence-based' was substantially higher among self-identified pain-based chiropractors compared to self-identified subluxation-based chiropractors.

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Sternal insufficiency fracture related to steroid-induced osteoporosis: A case report

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Osteoporosis often results in fractures, deformity and disability. A rare but potentially challenging complication of osteoporosis is a sternal insufficiency fracture. This case report details a steroid-induced osteoporotic male who suffered a sternal insufficiency fracture after minimal trauma. Prompt diagnosis and appropriate management resulted in favourable outcome for the fracture, though a sequelae involving a myocardial infarction ensued with his osteoporosis and complex health history. The purpose of this case report is to heighten awareness around distinct characteristics of sternal fractures in osteoporotic patients. Discussion focuses on the incidence, mechanism, associated factors and diagnostic challenge of sternal insufficiency fractures. This case report highlights the role primary contact practitioners can play in recognition and management of sternal insufficiency fractures related to osteoporosis.

KEY WORDS: sternal fracture, osteoporosis, insufficiency fracture

L'ostéoporose cause souvent des fractures, des difformités et l'invalidité. Une complication rare, mais potentiellement grave, de l'ostéoporose est la fracture par insuffisance osseuse du sternum. Ce rapport décrit en détail le cas d'un mâle atteint d'ostéoporose causée par les stéroïdes et qui a subi une fracture par insuffisance osseuse du sternum après un traumatisme minime. Grâce à un diagnostic rapide et une gestion appropriée, on a obtenu de bons résultats pour la fracture, mais des séquelles ont été laissées sous forme d'un infarctus du myocarde en raison de ses antécédents médicaux complexes. Le but de cette étude de cas est de sensibiliser sur les caractéristiques distinctes des fractures du sternum chez les patients ostéoporotiques. La discussion porte sur l'incidence, le mécanisme, les facteurs associés et la difficulté de diagnostic des fractures par insuffisance osseuse du sternum. Cette étude de cas met en évidence le rôle que peuvent jouer les chiropraticiens qui offrent des soins primaires dans le diagnostic et la gestion des fractures par insuffisance osseuse du sternum liées à l'ostéoporose.

MOTS CLÉS : fracture du sternum, ostéoporose, fracture par insuffisance osseuse

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Conflict of interest: none

Consent: Patient gave written consent to use his file and images for the purpose of this case report. Approval for the case report was given by the Research Ethics Board at the Canadian Memorial Chiropractic College.

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Introduction

Osteoporosis affects approximately 1.4 million Canadians, mainly postmenopausal and elderly individuals.¹ Patients with one or more vertebral fractures are 4-5 times more likely to have a subsequent vertebral fracture.² There is also significant risk for fractures at the hip^{3,4} and wrist⁵, leading to further disability and increased economic burden to society. Authors have proposed that sternal fractures, a rare complication of osteoporosis, are not well understood.⁶⁻⁸ Pathogenesis of this condition in osteoporotic patients, and its impact on subsequent fracture risk and overall health, is unclear. Although the clinical presentation and management of isolated sternal fractures are well known in the general population^{9,10}, they may have distinct characteristics in those with osteoporosis, making it difficult for recognition and management among primary contact providers.

This case report (event timeline outlined in Table 1) describes a steroid-induced osteoporotic patient, with a history of multiple vertebral compression fractures, suffering a sternal insufficiency fracture, and later experiencing a complex sequelae involving a myocardial infarction (MI) related to his osteoporosis and co-morbidities. The incidence, mechanism, associated factors and diagnostic characteristics of sternal fractures in the osteoporotic population will be discussed. In light of the MI that occurred in this patient's long-term follow-up, the case also discusses the potential relationship between MI and low bone mineral density (BMD) with osteoporosis.

Case Report

A 56 year-old steroid-induced osteoporotic male presented to his orthopaedic surgeon for post-operative follow-up. Ten weeks prior to this follow-up appointment, he had recurrent back pain diagnosed as vertebral compression fractures, for which he received two-stage kyphoplasty to T12, L1 and L4 (first stage), and L2, L3 and L5 (second stage), completed two days apart. The patient reported immediate improvement in pain and was discharged the next day after an uneventful post-operative course. He was given oxycodone/acetaminophen and scheduled for follow-up in 6-8 weeks. His medical history was remarkable for asthma, chronic obstructive pulmonary disease, rheumatoid arthritis, multiple previous chest infections and previous compression fractures (treated with kyphoplasty at T9, T10, and T11). His long-standing

Table 1:
Timeline of Events

Week	Event
1	Two-stage kyphoplasty for new compression fractures (T12-L5)
8	Onset of chest pain after reaching into refrigerator
10	Diagnosis of sternal insufficiency fracture (confirmed on radiographs) Treatment with pain medication and monitoring
26	Resolution of symptoms related to sternal insufficiency fracture Diagnosis of new compression fractures (T7-T8)
27	Kyphoplasty for compression fractures (T7-T8)
33	Onset of left rib pain and recurrence of upper thoracic pain Treatment with pain medications and monitoring
35	Onset of chest pain radiating to left arm – sent to emergency Diagnosis of ST-elevated myocardial infarction Treatment with medication; discharge 2 days later in stable condition

use of medications consisted of methylprednisone for rheumatoid arthritis (4 mg once daily, patient titrated as needed); albuterol (four puffs 4 times daily, and every 2 hours as needed), budesonide (two puffs 2 times daily), budesonide/formoterol inhaler (two puffs 2 times daily), and ipratropium bromide inhaler (two puffs 4 times daily) for asthma and chronic obstructive pulmonary disease; a course of alendronic acid/colecalciferol (had completed course of teriparatide), calcium and vitamin D for osteoporosis. The patient was a non-smoker with no personal/family history of coronary artery disease.

At follow-up with the orthopaedic surgeon, his pain from compression fractures was significantly reduced, but he was now presenting with anterior midline chest and upper thoracic pain of two weeks' duration that started after reaching into the refrigerator. Presenting after minimal trauma, the pain was localized to mid-sternum and midline upper thoracic spine. No neurological symptoms were reported. At this time, the patient was not taking any medication for the pain. On physical examination, severe anterior head carriage and thoracic kyphosis was noted, visually estimated to be 70-80 degrees of thoracic kyphosis with the curve apex at the mid-thoracic spine



Figure 1: *Lateral spot-view radiograph of the sternum reveals fracture of the sternal body. There is interval development of a new fracture in the proximal portion of the sternal body (arrow).*

level. The patient used a cane minimally and was slow in ambulation due to postural imbalances related to his severe kyphosis. Light palpation of mid-sternum in the anterior-to-posterior direction revealed crepitation and reproduced the chest pain. Sternal radiographs revealed a fracture subluxation with slight step deformity in mid-portion of the sternum, corresponding to the painful area

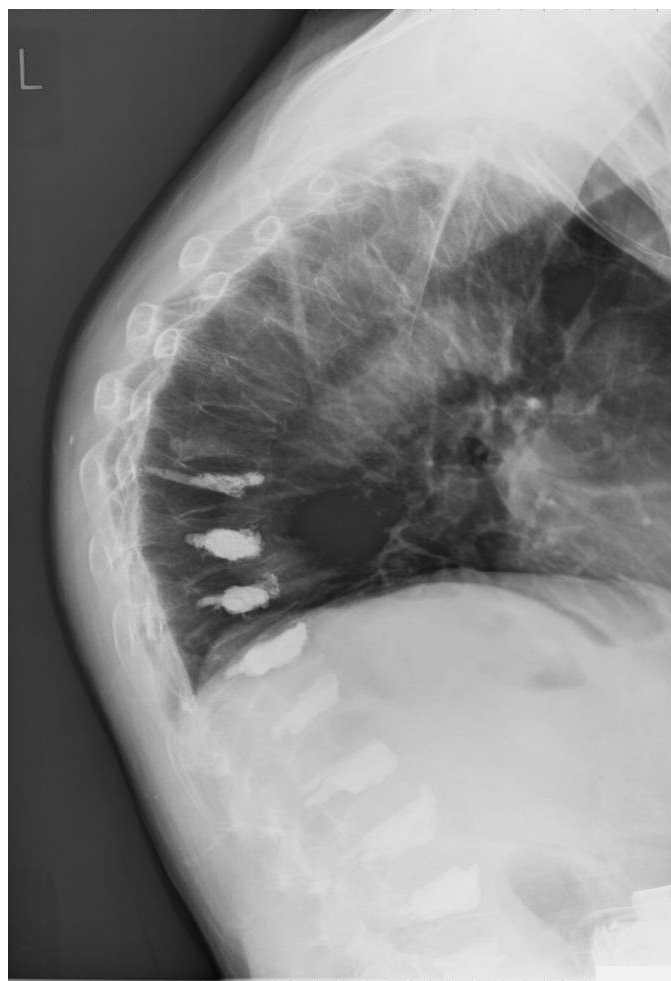


Figure 2: *Lateral thoracolumbar radiograph reveals previous kyphoplasty procedures at T9, T10, T11, T12, L1, L2, L3, L4 and L5. Contrast agents are confined to the vertebral bodies with no significant leaks. Old compression fractures suspected at T7 and T8. There is generalized decrease in bone density and multilevel degenerative changes.*

clinically (Figure 1). Thoracic radiographs revealed no new fractures in the upper thoracic spine (Figure 2). Since the sternal fracture was evident on radiograph and clinically correlated with his symptoms, a diagnosis of sternal fracture was given and no additional tests were ordered at the time. The isolated sternal fracture was managed conservatively with oxycodone (1-2 tablets every 4-6 hours

as needed), acetylsalicylic acid (325 mg once daily for 30 days, then 81 mg once daily) and monitoring.

With monitoring, the sternal fracture pain improved with pain medication and clinically resolved after 16-17 weeks. However, the patient experienced recurrent back pain, confirmed as new compression fractures at T7 and T8 at visits with the orthopaedic surgeon, and the pain decreased significantly after kyphoplasty to these segments. Six weeks after kyphoplasty, the patient presented with diffuse pain in the left mid ribs and a recurrence of upper thoracic pain, and watchful waiting was decided upon.

Long-Term Follow-up:

Two weeks later, the patient reported midline chest pain 40-60 minutes prior to his arrival to the emergency department, of 8/10 in severity that radiated to his left arm. There was no nausea, vomiting, shortness of breath or diaphoresis. One week prior, the patient went to a walk-in clinic for recurrent left shoulder and arm pain and received pain medication. On examination, the patient was alert, oriented, in no acute distress and able to complete full sentences. Cardiovascular, respiratory, abdominal and neurological examinations were normal. The patient had distal pulses positive and cool extremities bilaterally, but no tender calves or significant edema.

Laboratory results revealed troponin at less than 0.01 and creatine kinase of 36. Chest radiographs found no obvious consolidation or sternal fracture. Echocardiogram and coronary angiography revealed an inferior ST-elevated MI, a 100% occlusion (< 1 mm) of a small distal pulmonary venous branch of right coronary artery and mild inferior hypokinesis. Due to the small occlusion size, the ST-elevated MI was managed with clopidogrel bisulfate, acetylsalicylic acid, heparin, antibiotics and a refill of respiratory medications, while respiratory status was monitored in the coronary care unit. On discharge 2 days later, the patient was neurologically intact, in stable condition and was to continue post-MI management at home with follow-up from his medical doctor, specialists and community care services.

Discussion

Incidence:

Sternal fractures are rare, with a reported incidence of 0.5% of all bony fractures⁶, and often by major trauma

like motor vehicle accidents. Of all sternal fractures presenting to emergency in a 6.5-year timeframe, 92.3% of 272 cases were related to motor vehicle accidents and 7.7% were due to direct sternal trauma.⁹ Few reports have documented a sternal fracture in an osteoporotic individual, known as an insufficiency or fragility fracture, which is a stress fracture in bones with decreased mineralization and elastic resistance.⁷ In a retrospective survey of all insufficiency fractures except spinal fractures, only one sternal fracture (1.1%) was identified among 91 insufficiency fractures.⁸ In a recent review, most sternal insufficiency fractures were due to some form of high or low degree of trauma, such as a fall from standing.⁷ However, the sternal fracture in our case was from reaching into a refrigerator, which is considered minimal trauma, occurring 10 weeks after kyphoplasty was performed for multiple compression fractures. This warrants a closer investigation on the role osteoporosis may have on the sternum.

Mechanism and Associated Factors:

While the etiology of sternal insufficiency fractures is not well understood, generalised bone changes in osteoporosis plays an important role. Trabecular bone changes during osteoporosis have been shown to increase risk for subsequent fractures. Known as the fracture cascade phenomenon of osteoporosis¹¹, this may occur in sites other than the spine, but to a lesser extent. For example, a vertebral fracture also increases the risk of subsequent hip fracture by 3-fold.³ Histomorphometric bone analyses from iliac crest have reportedly found anisotropic trabecular changes in individuals with osteoporotic vertebral fractures, including fewer trabeculae, greater trabecular spacing, lower osteocyte density and reduced cortical thickness.¹¹ Since the sternum is a flat bone comprised of two thin layers of compact bone surrounding trabecular bone, it may be susceptible to such microarchitectural disruption.

Biomechanical factors may compound trabecular effects and increase fracture risk. Some propose that increased thoracic kyphosis from compression fractures transfer axial force loads from spine to sternum and increases fracture risk.^{6,7,12,13} A recent dynamic systems model describes multidimensional risk factors to osteoporotic fractures, including altered bone quality and density, local and global spine changes, and aberrant biomechanics.¹² While load transference in biomechanics is discussed in this model, its impact on bony structures anteriorly, such

as the sternum, is not considered; the model is limited to changes along the spine and paraspinal musculature. This case report sheds further light on this cascade and may suggest the need for a broader anatomical perspective when considering altered biomechanics and trabecular changes in osteoporosis.

In this patient, a number of factors may have contributed to the sternal fracture. In addition to his severe thoracic kyphosis and longstanding osteoporosis, the patient had a two-stage kyphoplasty procedure 10 weeks prior to the sternal insufficiency fracture, where he laid prone on a surgical table that supported the weight of his chest through a padded horizontal chest bolster across the sternum. In subsequent kyphoplasties, the placement of bolsters on the surgical bed was changed to two vertical bolsters from the iliac crest to the shoulders to prevent direct pressure on his sternum. For patients undergoing kyphoplasty and had previously suffered a sternal insufficiency fracture, this simple, no-cost repositioning of the surgical table bolsters may be indicated to decrease pain and risk of further complications at the sternal fracture site.

Clinical Presentation and Significance:

The variable clinical presentation of sternal fractures can be a diagnostic challenge in differentiating it from other conditions. Chen reported that in 7 cases of sternal insufficiency fractures, 2 buckling fractures were asymptomatic while 5 non-buckling fractures were painful.¹³ However, Min and Sung reported that 5 of 7 patients with buckling sternal fracture had chest pain.¹⁴ Two previous cases also presented with such severe anterior chest pain that they were suspected as myocardial infarctions.⁷ Our patient complained of moderately intense anterior chest pain of two weeks duration, noted as local tenderness and crepitation during sternal palpation. A clinical index of suspicion for sternal fracture allowed for appropriate management, which involved sternal radiographs to confirm the diagnosis. Although sternal fractures as a complication of osteoporosis are relatively rare, it should be recognized that clinical presentation can range from asymptomatic to severe pain and should be a differential diagnosis for osteoporotic patients with chest pain.

Literature is mixed regarding prognosis and calls for differentiation between traumatic and insufficiency fractures. In traumatic cases, it has been suggested that computed tomography should follow radiographs to evaluate

the extent of sternal and episternal injuries.¹⁰ However, isolated sternal fractures, likely in the case of insufficiency fractures, have a very good outcome¹⁵, as sternal fractures alone are reportedly not indicative of significant myocardial, mediastinal or thoracic aorta damage⁹. Our patient's sternal insufficiency fracture was successfully managed with pain medication, and appeared to have healed within 16-17 weeks from onset.

Long-Term Sequelae of this Case:

Despite the favourable outcome of the sternal insufficiency fracture, the patient had complications related to his osteoporosis and complex health history. Two weeks after his sternal fracture appeared to have healed, he suffered a ST-elevated MI, which required immediate reperfusion therapy to avoid cardiogenic shock, especially within 12 hours of symptom onset and without contraindications.¹⁶ In this case, the recurrent anterior chest pain in our patient was not dismissed as residual pain from the preceding sternal fracture; instead, thorough investigation was conducted to rule out MI. The prompt diagnosis and management within 1 hour of symptom onset enabled the MI to be successfully managed medically with favourable short-term outcome.

Growing literature suggests a significant link between cardiovascular disease and low BMD, particularly between MI and future osteoporotic fracture risk. For instance, lower femoral neck and hip BMD has been significantly associated with increased risk of MI in both men and women, even after adjusting for smoking, hypertension, hypertriglyceridemia and diabetes.¹⁷ Conversely, in a matched cohort study, a substantial increase in fracture risk (in all fracture sites) in survivors of MI was observed, a trend that has markedly increased over the past 3 decades.¹⁸ This population-based study noted an emerging association between MI and the risk of osteoporotic fracture in the community, a novel finding that was not observed in the general population.

Although there are possible confounders to the increased risk of fractures in MI survivors, recent literature suggests that these factors take a smaller role than previously thought. First, vitamin D and calcium supplements have been suggested to increase MI risk.¹⁹⁻²¹ Second, pharmacological agents could play a role, since MI patients often have comorbidities being managed pharmacologically.²²⁻²⁴ This includes medications for cardiovascular dis-

ease like heparin, oral anticoagulants and loop diuretics that can lead to drug-induced osteoporosis.²⁵ However, the well-controlled 30-year longitudinal population-based study by Gerber et al still found a steady increase in osteoporotic fracture risk after MI, even after considering 19 serious comorbid conditions and stratifying for ST-elevated MI individuals who tend to be less frail and healthier.¹⁸ These analyses indirectly argue against the role of certain comorbidities and/or medications as primary explanations for the increase in fracture risk after MI, and emphasize the importance of considering a substantial fracture risk at all fracture sites in osteoporotic MI survivors.

It is important for chiropractors to be aware of potential complications associated with osteoporosis, particularly sternal insufficiency fractures and increased fracture risk after MI, as these patients may present on a monthly or annual basis. In 2010, in a combined online and mail survey of American chiropractors conducted by the National Board of Chiropractic Examiners with 3938 out of 9839 respondents (40% response rate), it was found that 3.7-3.8% of chief complaints from patients were related to chest pain.²⁶ Although fractures were rarely (1-10x/year) seen by respondents in the past year, osteoporosis was more often seen by respondents, at a rate of 1-3x/month, where 70% of these cases were co-managed.²⁶ Since sternal fractures in these patients may be biomechanically linked with high degrees of thoracic kyphosis, similar to previous sternal fracture cases with multiple compression fractures^{13, 27} and/or severe osteoporosis^{6,7}, these individuals being seen by the chiropractor may be more frail, have more complex health conditions and require participation in secondary prevention programs and physical activity in preventing bone loss and falls²⁸⁻³⁰.

Conclusion

Although rare, sternal insufficiency fractures can present as challenges in the clinical setting, as they have variable clinical presentations and are often biomechanically linked to high degrees of thoracic kyphosis from multiple compression fractures in severe osteoporosis. This case report detailing a sternal insufficiency fracture in an osteoporotic male heightens awareness of their distinct characteristics in the osteoporotic population, aiding diagnosis and management by primary contact providers. In addition, this case report discusses the consideration

of an increased fracture risk after a MI in osteoporotic patients, highlighting the integral role chiropractors can play in incorporating fracture prevention strategies in this patient population.

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A diachronic study of the language of chiropractic

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This study investigates how the language of chiropractic has changed over time. A collection of material, published up until approximately 1950 and consisting of textbooks, monographs and lecture notes from Canadian Memorial Chiropractic College, was analyzed to identify commonly occurring words and phrases. The results were compared to a corpus of recent articles from the Journal of the Canadian Chiropractic Association. This permitted the identification of words which were over-represented in the historical literature and therefore likely have become somewhat archaic or represent themes which are of less import in the modern chiropractic literature. Words which were over-represented in the historical literature often referred to anatomical, pathological and biomechanical concepts. Conversely, words which were comparatively over-represented in the modern chiropractic literature often referred to concepts of professionalism, the clinical interaction and evidence-based care. A detailed analysis

Cette étude examine l'évolution du langage de la chiropratique au fil du temps. Une collection de documents, publiés jusqu'à environ 1950 et comprenant des manuels, des monographies et des notes de cours du Canadian Memorial Chiropractic College, a été analysée pour relever les mots et expressions fréquemment rencontrés. Les résultats ont été comparés aux corpus d'articles récents du Journal de l'Association chiropratique canadienne. Cela a permis de détecter des mots qui étaient surreprésentés dans la documentation ancienne, et, donc, susceptibles de devenir quelque peu archaïques ou de représenter des thèmes qui sont moins importants dans la documentation chiropratique moderne. Les mots qui étaient surreprésentés dans la documentation ancienne se rapportaient souvent à des concepts anatomiques, pathologiques et biomécaniques. À l'inverse, les mots qui ont été relativement surreprésentés dans la documentation chiropratique moderne se rapportaient souvent aux concepts du professionnalisme, de l'interaction clinique et des soins factuels. Une analyse détaillée des tendances

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Funding: This work was supported by funds from the Canadian Chiropractic Historical Association.

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is presented of trends in the use of the conceptually important terms *subluxation* and *adjustment*.

KEY WORDS: chiropractic, corpus linguistics, diachronic, lexicon, subluxation, adjustment

Introduction:

A number of linguistics studies have examined the modern language of diverse disciplines in biomedicine and health including nursing¹, public health², midwifery³ and chiropractic⁴. A common finding of these studies is that the language of biomedicine and health is more complex than that of general English and employs an esoteric vocabulary.⁵ Furthermore, each of the disciplines studied appears to have its own distinctive lexicon and conventions of expression. By way of example, and not surprisingly, the language of midwifery is characterized by frequent reference to the mother and child, and the experience of childbirth.³ Perhaps less intuitive, is the overabundance of female references in the modern nursing literature¹ versus the dominance of male references in the modern Canadian chiropractic literature⁴.

With regard to the modern Canadian chiropractic literature, we have previously reported that there is a high prevalence of words related to the clinical environment; words such as *treatment*, *pain*, *care* and *patient*. Words which might be regarded as conceptually important to chiropractic, such as *subluxation* and *adjustment*, had relatively low prevalences, although, as might be expected, they occur significantly more often in the chiropractic literature than in the literature of other health care professions.⁴ On the other hand, examination of the original data set (<http://www.bmhlinguistics.org/joomla2/chiropractic>) shows that specific physiological and pathological terms, such as names of diseases, are relatively uncommon. It is not certain whether the findings of the above study can be extrapolated to the literature of the profession in other countries, nor whether the rather heavy clinical weighting

de l'utilisation des termes importants sur le plan conceptuel, *subluxation* et *ajustement*, est présentée.

MOTS CLÉS : chiropratique, linguistique de corpus, diachronique, lexique, subluxation, ajustement

of the modern literature is a recent phenomenon. Thus, the present study was undertaken to compare the lexicon of the modern Canadian chiropractic literature with the core literature of the educational curriculum of approximately a half century ago.

Methods:

A corpus, an electronic archive of texts, was created by digitizing a selection of textbooks, monographs and teaching notes employed at Canadian Memorial Chiropractic College from 1946 until the early 1950s (Table 1). The electronic files were reviewed to correct errors in the digitizing process and were saved as XML files. We refer to this corpus herein as the 'historical chiropractic corpus.' The historical chiropractic corpus was analyzed using the software programme WordSmith Tools V5.0 (Oxford University Press). The results of the analysis are expressed in terms of *tokens* and *types*, where a *token* may be thought of as each word on a page, whereas a *type* is each unique word regardless of its number of occurrences in the text. For example, in the sentence 'the doctor treated the patient,' there are 5 *tokens* but only 4 *types*, since the *type* 'the' occurs twice.

The frequency of each type was calculated and compared to the frequency of the same type in a corpus derived from the 2005-2008 volumes of the Journal of the Canadian Chiropractic Association.⁴ This permitted identification of types in the historical chiropractic corpus which occurred significantly more often than would be expected based on their frequency in modern chiropractic literature. Such over-represented types are referred to in linguistics as 'keywords'.⁶ The historical corpus was then

Table 1.
Texts comprising the historical chiropractic corpus.

Title/Publisher/Year of Publication	Genre/Author	Tokens
Autonomics in Chiropractic – The Control of Autonomic Imbalance/ The Chiro Publishing Company; Toronto, Canada/1954	Textbook/ R.O. Muller	28,568
Chiropractic Principles and Technic/National College of Chiropractic; Chicago, Illinois/1939	Textbook/ W.A. Biron, B.F. Wells, R.H. Houser	140,236
Chiropractic Symptomatology/James N.Firth; Davenport, Iowa/1921	Textbook/J.A. Firth	147,350
Chiropractic Textbook/Palmer School of Chiropractic; Davenport, Iowa/1948	Textbook/R.W. Stephenson	112,731
Sacro-Occipital Technic of Spinal Therapy/National College of Chiropractic; Chicago, Illinois/1939	Textbook/M/B. DeJarnette	178,719
The Chiropractor/Beacon Light Printing Company; Los Angeles, California/1914	Textbook/D.D. Palmer	47,701
The Chiropractor in Canada/The Dominion Council of Canadian Chiropractors/1953	Monograph/D. McPhail, H.A.Yates	4,225
The Science and Logic of Chiropractic/J.Robinson Verner/1947	Textbook/J.R. Verner	68,397
The Science, Art and Philosophy of Chiropractic/Portland Printing House Company; Portland, Oregon/1910	Textbook/D.D. Palmer	391,187
Assorted Teaching notes from CMCC 1946-1950	Teaching notes/Various authors	20,932

searched for exemplars of usage of the most prevalent keywords in order to resolve how they were used in context. More detailed analyses were conducted of two conceptually important keywords, *subluxation* and *adjustment*. Specifically, using the collocation function in WordSmith Tools, the types most commonly associated with *subluxation* and *adjustment* were identified. Additionally, using the concordancer function, all instances were extracted in context and processed to construct ‘word trees’ which model use of these two keywords.

Results:

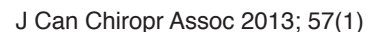
All data sets referred to in this article may be accessed as Excel worksheets through the project worksite at <http://www.bmhlinguistics.org/joomla2/chiropractic>

The historical chiropractic corpus consisted of 1,140,046 tokens (the total ‘word count’) made up of 28,694 types (unique words). The complete list of words may be accessed through the project URL listed above.

The corpus of modern Canadian chiropractic lit-

erature consisted of approximately 280,000 tokens (the total ‘word count’). In comparison to the corpus of modern Canadian chiropractic, 463 types were significantly over-represented⁷ in the historical chiropractic corpus (log-likelihood of >15.13, $p < 0.01$), i.e. were ‘keywords’⁶. The most prevalent keywords are displayed in Figure 1, wherein font size is proportional to the relative prevalence of each type. The original data on which this figure is based may be accessed through the project URL listed above.

The 10 most prevalent types in the historical chiropractic corpus were *the*, *of*, *and*, *is*, *to*, *a*, *in*, *or*, *are* and *that*. In linguistics, such words which have a role in sentence structure, but contain little meaning in and of themselves, are called function words. The 10 most prevalent content (‘meaningful’) words (and their % prevalence in the corpus) were *body* (0.32%), *nerve* (0.32%), *nerves* (0.26%), *spinal* (0.24%), *chiropractic* (0.21%), *side* (0.22%), *patient* (0.21%), *normal* (0.20%), *disease* (0.19%) and *system* (0.17%). All of these words were keywords in the



Words derived from the root *adjust*, including *adjustment(s)*, *adjusting*, *adjusted* and *adjuster* had a col-

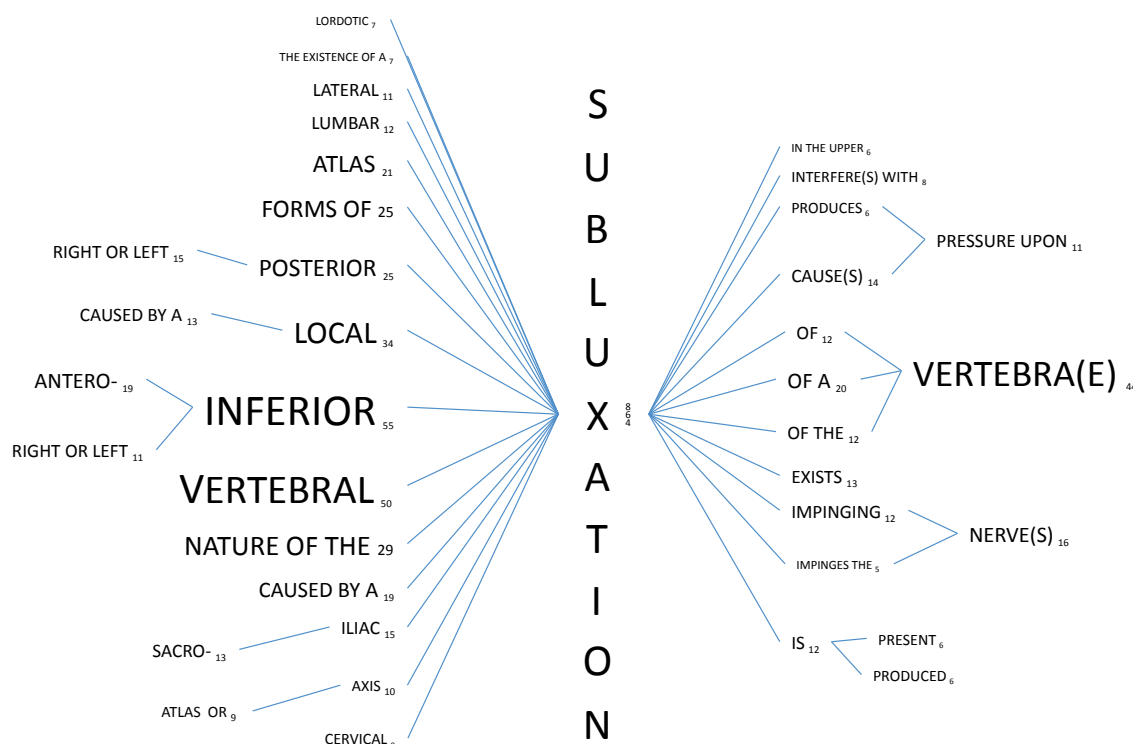


Figure 2. Word tree representing the most common contexts for the token **subluxation**. Subscripts show number of occurrences in the corpus.

lective prevalence of 0.31% versus 0.05% in the corpus of modern Canadian chiropractic. *Subluxation* and *subluxations* had a combined prevalence of 0.12%, compared with 0.04% in the corpus of modern Canadian chiropractic.

In the historical literature, the term *subluxation* was presented as an established and tangible entity which was a cause of disease and which could be effectively treated by *adjustment*. The types with which *subluxation* was most commonly associated (and the number of their occurrences in the corpus) were: *vertebrale* (87), *inferior* (67), *caused* (61), *vertebral* (52), *local* (44), *atlas* (38), *nerves* (38), *posterior* (36), *right* (34) and *left* (31). The nuances of *subluxation* are revealed to a degree in Figure 2, constructed from all 864 instances of use of the type *subluxation* (i.e. excluding other members of the word family, such as *subluxations*) in the historical chiropractic corpus. This word tree presents only 'branches' which

include a content word which occurred at least 5 times in the entire corpus. Font size is scaled to represent relative prevalence. In Figure 2, the subscript following each term or phrase indicates the absolute number of occurrences in the entire corpus. The original data set on which this figure is based can be accessed through the project URL listed above.

The types with which *adjustment* was most commonly associated (and the number of their occurrences in the historical chiropractic corpus) were: *vertebrale* (71), *chiropractic* (52), *spinal* (51), *first* (39), *patient* (39), *specific* (35), *contact* (29), *lumbar* (27), and *indicated* (26). Figure 3 presents a word tree constructed from 1482 instances of the use of the type *adjustment* (i.e. excluding other members of the word family, such as *adjustments*) in the historical chiropractic corpus. As above, font size is scaled to be representative of relative prevalence and the subscript following each term or phrase indicates the absolute num-

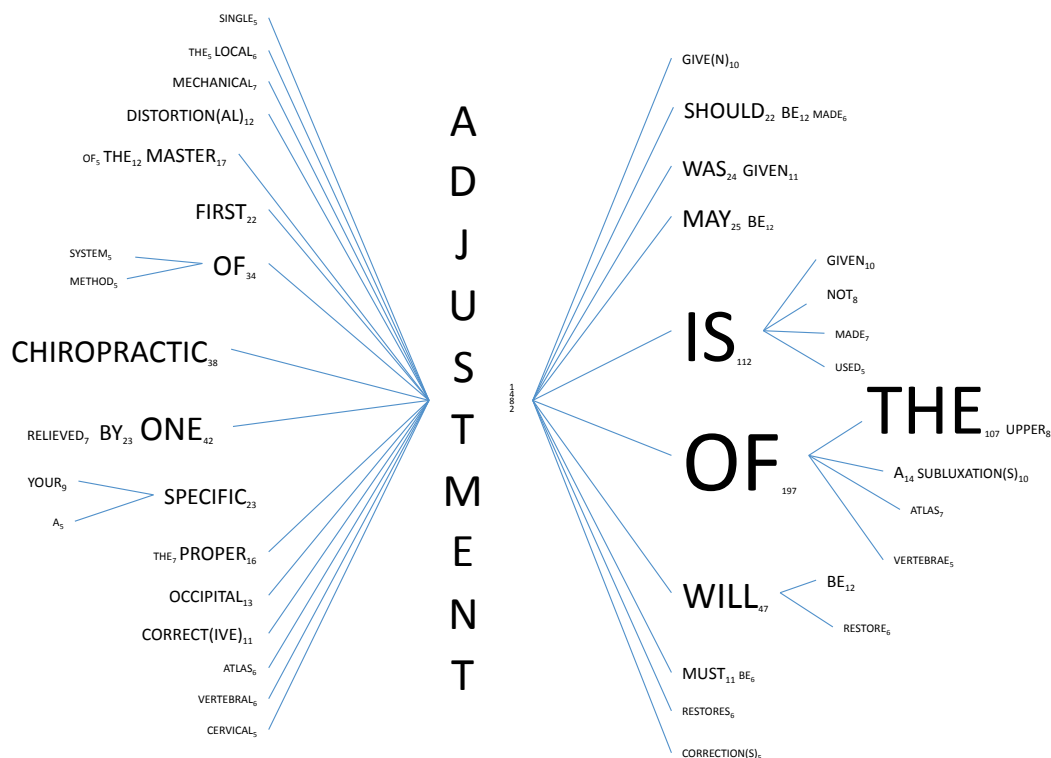


Figure 3. Word tree representing the most common contexts for the token *adjustment*. Subscripts show number of occurrences in the corpus.

ber of occurrences in the entire corpus. The original data set on which this figure is based can be accessed through the project URL listed above.

Discussion:

The corpus of historical chiropractic literature created for this study provides a sampling of the written language used within the profession around the time that Canadian Memorial Chiropractic College (CMCC) was established and the profession was undergoing growth and maturation following the Second World War. Thus, while the earliest texts in our corpus date from the beginning of the 20th century, they were included in the curriculum when CMCC was established in 1946. The comparison corpus comprised the 2005-2008 volumes of the Journal of the Canadian Chiropractic Association.⁴ Thus the texts compared were separated by a maximum of approximately a century.

For the most part, differences between the two cor-

pora seem to reflect shifts in salient professional themes. Whereas the lexicon of the modern Canadian chiropractic literature is dominated by terms related to the clinical encounter, research and professionalism, the historical chiropractic corpus is heavily weighted with terms pertaining to the structure of the human body and the relationship between structure and health. In particular, words related to posture, balance and the nervous system were highly prevalent.

The important concepts of *subluxation* and *adjustment* have been subject to the effects of fashion. These two words and their derived terms (e.g. *subluxations*, *adjustments*) were highly prevalent in the historical literature. In the modern literature *subluxation* and *subluxations* may have been displaced by the types *restriction* and *restrictions* which approximately quadrupled in prevalence. In the modern literature the word family of *adjustment* has been displaced to a degree by *manipulation* and *mobilization*. In the corpus of historical chiropractic, there were

12 instances (prevalence: 0.0011%) of *mobilize* and its derived terms versus 117 instances (prevalence: 0.041%) of *mobilize*, or some variation thereof, such as *mobilization*, *mobilizations*, in the corpus of modern Canadian chiropractic. *Manipulation* and its derived terms occurred 64 times (prevalence: 0.0056%) in the historical chiropractic corpus, versus 405 occurrences of *manipulation* or some variation thereof (prevalence: 0.142%) in the corpus of modern Canadian chiropractic literature. Thus, the evolution of language in the chiropractic literature mirrors certain established trends in modern English, such as shifts in the use of modal verbs^{9,10}, noun phrase structure¹¹ and gendered terms⁸. Additionally, there have been changes which may reflect the evolution in the biomedical and health sciences in general. These would include increased attention to evidence-based and patient-centred care. Finally, there are language changes which are likely particular to chiropractic, and reflect a movement toward a lexicon which is shared across manual medicine professions rather than chiropractic-specific. This hypothesis could be tested by comparing the corpus of modern Canadian chiropractic literature⁴ to a corpus of literature from another of the manual medicine professions, such as osteopathy.

In conducting this analysis, it is acknowledged that differences between the two bodies of literature may be due not only to evolution through time, but also due to the differences in the types of literature analyzed. The corpus of modern chiropractic literature comprised articles from a professional journal, whereas the corpus of historical chiropractic literature consisted overwhelmingly of textbooks, since there was no comparable body of research literature during the earlier period.

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Canadian Chiropractors are not alone: external advocacy in Ontario, 1902-2012

Douglas M. Brown, DC*

This article focuses primarily on Ontario, identifying a number of the profession's allies and their advocacy effectiveness, under two main headings: The Ontario Chiropractic Association; and the Canadian Memorial Chiropractic College during the period of 1902 to 2012. While part of our success in gaining recognition has been attributed to intense lobbying by the profession, here the public support of several labour unions is reviewed. The part played by various politicians, educators, entrepreneurs, legal counsel, academic administrators and historians is also discussed.

KEY WORDS: chiropractic, advocacy, Ontario, historical

Cet article cible principalement l'Ontario et distingue un certain nombre d'alliés de la profession et illustre leur efficacité de promotion pendant la période de 1902 à 2012, sous deux rubriques principales : l'Ontario Chiropractic Association et le Canadian Memorial Chiropractic College. Bien qu'une partie de notre succès à accroître une notoriété ait été attribuée à la pression considérable exercée par notre profession, on examine ici le soutien public de plusieurs syndicats. Le rôle joué par divers responsables politiques, enseignants, entrepreneurs, avocats, administrateurs universitaires et historiens est également examiné.

MOTS CLÉS : chiropratique, promotion, Ontario, historique

Introduction

There is an old joke that resonates with the chiropractic profession: "Just because I'm paranoid, you don't have to pick on me." Paranoia has been defined as "delusions of persecution." Since the obscure birth of chiropractic in 1895, its persecution has been real, not imaginary and includes: internecine squabbling, occupational isolation, roadblocks to higher education, marginalization, polit-

ical treachery and legislative apathy. Yet surprisingly, our members have prevailed, thanks in large part to external support from a variety of sources. This article focuses primarily on Ontario, identifying a number of our allies and their effectiveness, under two main headings: The Ontario Chiropractic Association; and the Canadian Memorial Chiropractic College – 1902 to 2012.

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The Ontario Chiropractic Association (OCA)

Labour Unions

In 1902 the first chiropractor landed in Ontario¹ and in 1925 they were included in legislation under the Drugless Practitioner Act. While part of our success in winning legal recognition has been attributed to intense lobbying by the profession, we also received public support from labour unions and the *United Farmers of Ontario* (UFO).² All but forgotten today, the UFO was founded in 1914 by the union of various farmers' organizations. The UFO entered politics in 1918 and in 1919 surprised everyone by winning 45 seats and forming a minority government in Ontario, with Ernest Drury as Premier. Following its defeat in 1923, the UFO declined steadily and disappeared in 1944, when it became part of the Ontario Federation of Agriculture.³ In 1937, organized labour played a key role in another significant source of legitimacy for chiropractic; acceptance under the Ontario Workmen's Compensation Act. "However, by the early 1950s that connection had all but disappeared. In 1952 Harry Yates, DC, then President of the Ontario Chiropractic Association (OCA), met with A.F. MacArthur, President of the Ontario Federation of Labour (OFL) to discuss the inclusion of chiropractic services in union contracts." Yates learned that labour had little knowledge of chiropractic or what it had to offer and was advised by MacArthur to undertake a national public relations program to raise our profile within the unions. The OCA accepted MacArthur's advice and initiated a national campaign which proved successful. "By the early 1960's chiropractic services were covered by a number of health and accident insurance companies, mostly via union contracts."

The OCA and Canadian Chiropractic Association (CCA) realized they could directly influence roughly four million Canadians via the trade unions. In briefs to Royal Commissions on Workmen's Compensation, in 1950 and 1970, organized labour consistently supported the provision of chiropractic services and the right of workers to choose their own practitioners. Both Royal Commissions took the demands of labour seriously, rejecting attempts by the College of Physicians and Surgeons, Ontario (CPSO) and Ontario Medical Association (OMA) to remove the services of drugless practitioners from the Workmen's Compensation Act and recommending "that the freedom to choose a practitioner was a right and not

simply a privilege, and that this right should be enshrined in legislation."⁴

The federal Liberal Party put a health care plank in its 1919 election platform but nothing came of it. During the Great Depression, the push for government assistance with health care costs gained momentum. By 1956, 50 percent of Canadians were covered by voluntary private or non-profit prepayment plans and there was increasing demand for a universal program to protect the public from catastrophic expense.⁵ Back in 1945, Percy Bengough, President of the Trades and Labour Congress, appeared before the Committee on Social Security urging the inclusion of chiropractic services under any planned public health insurance schemes. "Similar resolutions were made by the Civil Service Federation of Canada (1962), the Professional Institute of the Public service of Canada (1964), the Canadian Union of Public Employees, the Oshawa and District Labour Council (1965) and the Ontario Federation of Labour (1970)."⁶ Other pleas were made to the Royal Commission on Health Services by the British Columbia and Nova Scotia Federations of Labour.⁷

Politicians

Established in 1929, the OCA soon discovered it was necessary to lobby members of the legislature. This involved getting to know them professionally and personally by submitting briefs, keeping Members of the Provincial Parties (MPPs) up to date on a variety of issues, seeking their advice on others, inviting members to speak at OCA conventions, frequenting Parliament and hosting collegial dinners. As well, a number of members and/or their families were receiving chiropractic care.

The OCA's efforts bore fruit. One of their converts was Murray Gaunt, a popular Liberal MPP from Huron County. Raised on a beef cattle farm near Lucknow, Gaunt was precocious and competitive. A member of the local beef club since age 12, he won the prestigious Queen's Guineas, at the Toronto Royal Winter Fair in 1955, and graduated from the Ontario Agricultural College at the University of Guelph, in 1956.

Following graduation, Gaunt developed a large turkey broiler operation on his father's farm before accepting a job at CKNX, in Wingham, where he appeared on TV and radio. In 1962, when John Hanna, the local MPP for Huron-Bruce died suddenly, Gaunt was asked to fill the void. He won the Liberal nomination and the by-election

that year and remained in politics until his so-called “retirement” in 1981.⁸

In 1964, Gaunt boldly charged the Minister of Health with discrimination and pressed for inclusion of chiropractic services under Medicare, raising the issue again in 1965 and 1966. Then, in 1968 and 1969 he introduced an amendment to the Ontario Medical Services Insurance Plan (OMSIP) asking the government to immediately add paramedical groups, including chiropractic. Both amendments, also supported by the New Democratic Party (NDP), were defeated.

While the majority of pro chiropractic members belonged to the Liberal party (the official opposition), there were exceptions. *Alex Carruthers*, was the Progressive Conservative (PC) member for Durham and served in the legislature from 1959 through 1975. In 1969, he spoke forcibly on behalf of Gaunt’s resolution, particularly as it related to chiropractic services.⁹ Carruthers’ support was fortified by personal conviction. He and his family had benefited from chiropractic care for many years.¹⁰

The medical profession was vehemently opposed to chiropractic joining Medicare and its position was buttressed by the 1964 Report of the Royal Commission on Health Services and the 1963 Report of the Ontario Medical Services Commission, both of which advised against including chiropractic services within universal health programs. It was traditional in Ontario for Ministers of Health to be medical doctors and Matthew Dymond, who served in this position from 1959 to 1969, was no exception. Dr. Dymond had practiced in Port Perry, Ontario in 1942, before leaving to serve in the Canadian Army Medical Corps, for the duration of World War II.¹¹ Ironically, Port Perry was the childhood home of Daniel David Palmer, the founder of chiropractic and Dymond was destined to become “the greatest stumbling block to the inclusion of chiropractic services in Ontario’s Medicare program.”¹² Fortunately, in 1969 the Ontario government amended its legislation, enabling it to meet federal laws, and the Ontario Health Services Insurance Plan (OHSIP) was passed. This rendered Dymond’s position politically untenable, causing his resignation and replacement by *Thomas Wells*, the first non-medical practitioner to hold that position (Figure 1).

Tom Wells was born in Toronto and educated at the University of Toronto, joining the campus PC association and playing football with William Davis. Wells was first elected to the Ontario legislature in 1963. His 1969 ap-



Figure 1. *Thomas Wells*.

pointment as Minister of Health, was welcomed by the profession since he “did not need to be ‘sold’ on the merits of chiropractic care or on the fact that chiropractors should be included in OHSIP... he and his department were more concerned about the costs of chiropractic care...”¹³ July 1, 1970, chiropractic services were included in what would become the Ontario Hospital Insurance Plan (OHIP). Robert Wingfield, DC, then President of the OCA, “was struck by Tom Wells’ concept that there should be no discrimination in the application of coverage under universal health care.” Wells felt patients deserved freedom of choice and wanted all prime contact health practitioners to become portals of entrance, unlike the British system where family medical doctors were the only point of entry. [Wingfield, interview by Brown, July 10, 2008]

In 1970 chiropractic coverage was \$5 a visit up to \$100 per fiscal year, plus \$25 for x-rays. By 1989 we had reached maximum OHIP payments of \$9.65 a visit up to \$220 a year, including \$40 for x-rays. October 1, 1990, Robert (Bob) Rae became the first New Democratic (NDP) premier of Ontario. In 1991 Rae passed “Social Contract” austerity legislation, imposing wage freezes, cutbacks and “Ray Days” (mandatory unpaid days off) on most professionals.

June 26, 1995, Rae and the NDP lost the provincial election and were replaced by Mike Harris and the PCs. Mean-



Figure 2. *John Duckworth.*

while, by 1992 Tom Wells had retired from politics and was appointed Chair of a bipartite Chiropractic Review Committee (CRC) comprising representatives of the Ontario Ministry of Health and the OCA. Important recommendations in the CRC's 1994 Final Report were: removing barriers to chiropractic services; accessing relative diagnostic procedures; and funding chiropractic education in universities, in the same manner as other health professions.¹⁴

In 1995 the PC government began negotiating certain CRC proposals with the OCA and in September 1997, Jim Wilson, Minister of Health under Harris, was scheduled to appear at the OCA convention to announce the improved benefits. At the last minute, Wilson cancelled his appearance. In October that year he was replaced by Elizabeth Witmer and December 1998, chiropractic services were cut by one third, to \$150. There were no changes to chiropractic coverage from 1998 until 2003. October 23 that year Dalton McGuinty, leader of the Liberal party, was elected Premier of Ontario. December 1, 2004, "despite heroic efforts of the OCA and other organizations, the government... brought to an end more than 30 years of public funding for chiropractic services in Ontario."¹⁵

Medicare was born in Saskatchewan July 1944, when its father, *Tommy Douglas* (as leader of what would become the NDP), was elected Premier. By 1946, everyone in his province had comprehensive hospital coverage and

July 1962, thanks to federal funding under PC Prime Minister *John Diefenbaker*, NDP Premier *Woodrow Lloyd* was able to install full Medicare in Saskatchewan. December 1966, the Canadian Parliament, under Liberal Prime Minister *Lester Pearson*, passed federal Medicare legislation that had been completely implemented in all provinces by 1972.

When chiropractic was delisted by OHIP in 2004, it rocked the foundations of universal health care in Ontario, causing tremors that would affect our patients coast to coast.

The Canadian Memorial Chiropractic College

Educators

Since 1945, the Canadian Memorial Chiropractic College (CMCC) has relied on "outsiders" to fulfill the College's academic faculty requirements, particularly in the realm of basic sciences. In October, 1946, Acting Dean, Rudy Muller, DC, reported that "At the present time, we have enrolled a total of 227 students,"¹⁶ and by 1948 there were 346.

That year CMCC's faculty consisted of five full-time "Chiropractic Professors" and four full-time "Basic Subjects Professors," who had university degrees but no chiropractic credentials. Two of these, *LH Colbeck* and *HB Stevens*, held the rank of Major in the Canadian Armed Forces during World War II. Five part-time Chiropractic Professors and seven part-time students completed the basic sciences roster. The Clinic Director was a chiropractor and one of his Supervisors a student. A chiropractor was in charge of the Clinic x-ray staff, assisted by two students and the Laboratory was operated by a biologist, aided by two students. Muller declared this to be a far cry from "Ninety per cent of the Colleges in the United States (that) have anywhere from fifty to seventy-five per cent of their instruction given by under-graduates."

By 1950 no students remained on staff but the benefits of interdisciplinary education had eroded. Only three of 16 faculty members had a primary degree in a discipline other than chiropractic and in 1965 there was only one. Though the College "took steps to rectify this situation," when Allan Adams, DC, became Dean (1979-1984), he felt "that CMCC was weak in the basic sciences," and "hired *John Duckworth*, MBBCh, MD," as Professor of Anatomy (Figure 2), along with "several University of

Toronto (U of T) faculty to teach basic sciences.” [Interview, Alan Adams by Joseph Keating, July 14, 1995].

Dr. Duckworth began teaching at CMCC in 1979, having served as a “storied” Professor and subsequent Head of the Anatomy Department at the U of T, 1952- 58. A Queen’s Physician and renowned anatomist, Duckworth “was instrumental in setting up relationships with the Chief Coroner’s Office to develop a viable body donation program.” The curriculum he established transformed “the anatomy department into a modern, fully enabled teaching entity with the tools essential to delivering first-rate anatomical instruction.”¹⁷ Dr. Duckworth has been described as a classically trained anatomist who believed the best way to learn the subject was by performing dissections. He died November 8, 1994, at age 82, still teaching at CMCC. In 1995, the College fulfilled one of John’s dreams; dedicating the JWA Duckworth Memorial Museum of Anatomy, “As a tribute to his life and service.”

The Entrepreneur

From 1959 to 1968 CMCC was embroiled in a horrendous fight with the City of Toronto over the expropriation and destruction of a major portion of the buildings on our first, one acre campus, at 252 Bloor Street West, during construction of the Bloor Street subway. The College sued the City for \$1.5 million but after a nine year struggle, the case was settled for a paltry \$143,000 plus interest but with no costs. By then CMCC was half a million dollars in debt. With title to the expropriated property not yet returned and a prohibition on building permits as the subway ran directly beneath the College, several parties were interested in buying the land but no one was willing to risk making a firm offer – except *Gerhard Moog*. Mr. Moog was a prominent land developer and a satisfied chiropractic patient, with financial and political clout (Figure 3).

In April 1968, we traded our Bloor Street campus to Moog for two acres of land and two buildings, to be erected at 1900 Bayview Avenue. December 18, 1968, classes commenced at the new facilities totalling 54,000 square feet of space compared to 30,000 on Bloor Street. Whereas the old College had been evaluated at about \$1.5 million, the new College was appraised at close to \$2.5 million, but our original debt of \$500,000 was now close to \$1 million.¹⁸ June 5, 1971, Gerhard W. Moog received an honorary Doctor of Humanities degree, at CMCC’s convocation, in recognition of “his contributions to the College.”

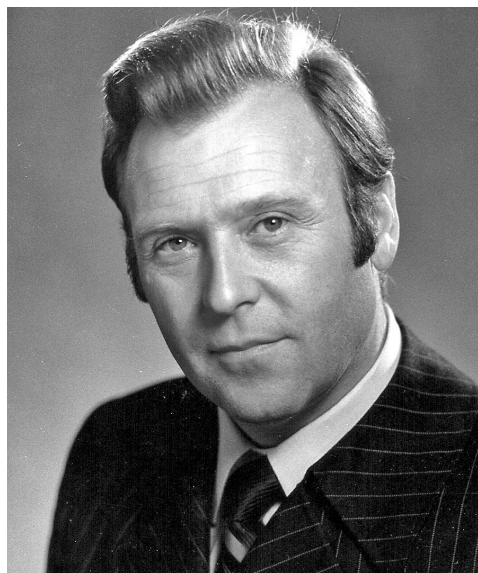


Figure 3. *Gerhard Moog*.

Legal Counsel

John Burton was called to the Bar in 1927, and was practicing law in Vancouver, BC, when he married the daughter of Walter Sturdy in 1932. Dr. Sturdy is credited with being a driving force behind the creation of what would become the CCA, in 1943 and CMCC in 1945. Burton laboured tirelessly beside his father-in-law whom he joined as a founding director of both the CCA and CMCC. In 1943 Burton was appointed General Secretary and Solicitor for the CCA. That year he travelled 22,000 miles, and penned over 1,000 letters, organizing chiropractors across the country. In 1953 Burton helped obtain a federal charter for the CCA and succeeded in obtaining chiropractic legislation in British Columbia, Saskatchewan and Manitoba.

“Although John’s first profession was law, his second was most certainly chiropractic. He was undoubtedly the most knowledgeable layman in matters pertaining to our profession.”¹⁹ In May 1975, two years before his retirement, John S. Burton was the second person to receive an honorary Doctor of Humanities degree, “In appreciation for many years of service to the CCA as Legal Counsel and General Secretary,” during CMCC’s convocation.

Allan Freedman is an avid academic and distinguished lawyer, who has shared his talents, energy and substance with Canadian chiropractors for 36 years (Figure 4). In

Figure 4. *Allan Freedman.*

September 1976, Freedman started his love affair with CMCC, teaching “risk management for chiropractors” to the 4th year class. Rising through the ranks from Lecturer to Full Professor, he expanded and refined his courses into what became, “Health Care Jurisprudence and Practice Development.” Prof. Freedman’s innovations included a “virtual reality” project, requiring his students to formulate a detailed business plan they could implement upon graduation. His classes became standards of excellence in chiropractic education and the envy of other colleges.

Freedman believes in lifetime learning. Since 1978 he has assisted with CMCC’s Department of Continuing Education, been a keynote speaker at many College events, appearing dozens of times before provincial and national Canadian chiropractic associations, societies, regulatory boards, medical, legal and university bodies. His resumé lists more than 40 peer-reviewed documents and he has written several substantial papers not yet published.

By 1979-80, Freedman was acting as legal counsel to the College and its Board of Governors, where he remains devoted to solving the myriad judicial problems that beset CMCC on a daily basis, wise during negotiations with a variety of professional, political and government bodies and vigilant in protecting the College from harm, while enabling it to move ever forward. Freedman’s virtuosity and conflict resolution skills have benefitted other organ-

Figure 5. *David Chapman-Smith.*

izations with ties to CMCC such as the OCA, the CCA and its Journal, the College of Chiropractors of Ontario, the Canadian Chiropractic Protective Association and the Canadian Chiropractic Examining Board.²⁰

Dr. Allan Gotlib, Freedman’s boyhood friend, long ago “realized that Allan was filled with and fulfilled by, idealistic ambition. Over the years he has demonstrated extraordinary determination in the face of serious challenges. For his many traits but particularly for this, Allan has held my steadfast respect for over 46 years.” [Email, Gotlib to Brown, May 25, 2007]

David Chapman-Smith was introduced to chiropractic as counsel for the New Zealand Chiropractors’ Association, before the New Zealand Commission of inquiry into chiropractic, 1978-79 (Figure 5). In 1982 Chapman-Smith took a two year leave from his law partnership, moving to Toronto as a legal consultant, to assist the OCA during the development of new legislation to regulate the practice of chiropractic in Ontario.²¹ Convoluted negotiations were protracted and the Regulated Health Professions Act, containing the new Chiropractic Act, did not receive Royal Assent until 1991. “A two year process took nearly 10, however it produced a new approach to regulating the health professions that was widely admired and subsequently followed in other provinces and then internationally.”

Shortly after arriving in Toronto Chapman-Smith began acting as a CCA consultant, “working increasingly with CCA provincial associations on legislative issues.” Two memorable meetings were in Newfoundland, in preparation of their Chiropractic Act, which was passed in 1991. “Finally all Canadian provinces had law to regulate chiropractic practice.”

In 1987-88 Chapman-Smith began publishing his newsletter, *The Chiropractic Report* (TCR) every two months. These unique research summaries quickly gained popularity. CMCC’s library and faculty were a major resource for Chapman-Smith. In gratitude, he made annual donations to the library in the 1990s and still supplies copies of TRC for faculty and students. David Chapman-Smith was instrumental in the formation of the World Federation of Chiropractic (WFC) in 1988 and has served as its Secretary-General since its first Executive Meeting in Toronto, in 1989. The WFC’s first Congress was held at the Royal York Hotel, Toronto, in May 1991. “These years brought the beginning of a long and close partnership between the WFC and CMCC, which continues to this day. In terms of quality and quantity, no chiropractic educational institution has provided more original research for WFC Congresses and educational sessions.” [DCS interview by Brown, March 24, 2012]

Administration

Ian Coulter arrived at CMCC in 1981, as President Sutherland’s Executive Vice-President (Figure 6). Although Dr. Coulter’s PhD was in sociology, he had acquired intimate knowledge of the Canadian profession and the College from his two year stint as project director of a major federally funded study of chiropractic, conducted at the U of T.²² In 1983 Sutherland retired and was replaced by Coulter, our first non-chiropractic President. Coulter had already identified and corrected serious difficulties with CMCC’s central administration, financial office and clinics and initiated profound alterations to the College’s various divisions and its Board of Governors. These changes facilitated our achievement of accredited status with the Council on Chiropractic Education (Canada), in 1986.²³ Most of the faculty and students admired Coulter. “He was protective of academic integrity... his writings remain valuable ... he firmly believed in the College... he trusted his personnel and promoted leadership,” were among their comments. Dedicated to research and



Figure 6. *Ian Coulter.*

scholarship, Coulter’s mission was to make our profession more influential within the health care system, by preparing CMCC for university affiliation.²⁴

In 1984 Coulter reactivated our University Affairs Committee and started contacting institutions in Ontario. Getting no response, in 1988 he accepted an invitation to approach the University of Victoria (UVic), BC. “Ian poured his heart and soul into this process, even moving his family to Victoria for one summer.” Ultimately the push to unite with UVic, which began with high hopes, fizzled out, through circumstances beyond Ian’s control.

In 1991 Coulter left Canada, accepting positions with the Southern California University of Health Sciences, the RAND Corporation, the University of California and the Samuelli Foundation, where he was awarded the RAND/Samuelli Chair in Integrative Medicine, in 2008.²⁵ Dr. Coulter’s successor, Dr. Jean Moss, writes that at the time of his presidency, “He was one of my first and best role models... CMCC needed someone to establish guidelines for the operation of the institution and its relations to surrounding organizations... Ian made us proud, instilling a drive to succeed... and a desire to accept nothing but excellence. Much of CMCC’s subsequent development had its roots during Ian’s presidency.” [Unpublished article by Jean Moss, June 1, 2005]



Figure 7. Oswald Hall.



Figure 8. Leonard Goodman.

CMCC Public Board Members

Oswald Hall had been widely recognized as Canada's senior, pioneer sociologist long before he became a proponent of chiropractic (Figure 7).²⁶ Dr. Hall's office at the U of T was directly across the road from our Bloor Street campus in 1956 but it wasn't until 1973 that his influence emerged as Chair of the "Task Force on Education and Practice of Chiropractors" for the Ontario Council of Health. Hall was instrumental in guiding the Committee to make positive recommendations regarding our education and practice. In outlining a scope of practice, the committee assumed chiropractic was a prime contact health profession. Its objectives included maintaining CMCC as a distinctive, identifiable institution, funded as part of the public educational system and, if possible, joined to a university.²⁷ "These proposals flew in the face of a 1970 report by the Ontario Committee on the Healing Arts²⁸... which... if carried out... would have reduced us to the level of technicians, under direct supervision of the medical profession."²⁹

From 1976 to 1978 Hall collaborated with Drs. Coulter and Merrijoy Kelner in the previously mentioned investigative study of chiropractic and author the book, "Chiropractors, Do they Help?" Coulter found working with Hall "stimulating and educational" He was curious about people and able "to use sociological concepts to illuminate the findings... I recall how gentle and patient Oswald

was with me when I was learning to write." [Email Coulter to Brown, June 4, 2003]

Dr. Hall's most arduous initiative began when he became a Public Member of the CMCC Board (1982-1998). "His stamina and affability were tested during his 16 year tenure on the University Committee as the College endured protracted, failed attempts to unite with the University of Victoria, BC (1988-92) and York University, Toronto, ON (1995-2001)."³⁰

In March 2001, after seven years of harmonious negotiations, York University abruptly changed its mind and cancelled all future deliberations regarding affiliation with CMCC. The Faculty Council of Atkinson College voted against the affiliation proposal and that left no other open avenues. Following that shock, we discovered that the CNIB had severed 12 acres of its land and was preparing to restructure its remaining property. This included razing the I.V. Weir Building we were renting to house our library and administrative offices. The College was rapidly running out of space and time and would have to move quickly. But where and how?

In 2000, Allan Freedman persuaded one of his associates, *Leonard Goodman*, to let his name stand for the appointment as a public member to the CMCC Board of Governors by informing him, with his "usual sincerity," that he would only have to attend two meetings a year



Figure 9. *Brenda Smith*.



Figure 10. *Ron Robinson*.

(Figure 8). Mr. Goodman is an accomplished businessman and the Chief Executive Officer of the First Financial Group of Companies. Contrary to what he had been told, shortly after joining the Board Goodman found himself attending more than two meetings a week, as a member of its Executive Committee, Chair of the Development and Planned Giving Committee, the Corporate Division of the Capital Campaign, and the Construction and Finance Committee.

Easter weekend of April 2001, Goodman's broad influence in the corporate world made the College serious contenders to acquire property at 6100 Leslie Street, Toronto. From then on, Len Goodman, Allan Freedman and Jean Moss worked in concert for three strenuous years, to bring the concept of a substantially improved and enlarged facility for CMCC, from inception to fruition. Of course there were many players involved in the purchase and development of our new campus but without Len, it simply would not have happened. Len had the vision to see the potential for this real estate, the contacts to allow us to become the buyers and the expertise, energy and zeal to carry this complicated project through to completion.

Construction included renovation of 115,000 square feet of existing facilities plus the addition of another 35,000 square feet to the front of the building. Despite

myriad problems and 500 change orders, the project was finished on time and within budget. An undertaking which normally takes 18 to 24 months, reached substantial completion in less than one tumultuous year. With three perfectionists, Len, Allan and Jean Moss at the helm, the "Miracle on Leslie Street" became an institution of which every chiropractor can be proud.

As though the efforts of Mr. Goodman in the establishment of the new campus were not enough, his business acumen became integral to the disposition of the property on Bayview Avenue. CMCC owned two acres of land but the parking lot belonged to the original developer. For the purposes of marketing its portion, CMCC had received an indication of its value. By the end of negotiations, Goodman had obtained a sale price which far exceeded what was anticipated. Freedman is convinced that, "Without Mr. Goodman's involvement, CMCC would never have concluded the acquisition and sale of these properties at the price which was ultimately achieved." The College has paid tribute to Leonard Goodman, making him an Honourary Member of CMCC and installing a plaque on the wall as you enter the building, acknowledging Len Goodman as Chair of the Development Committee, along with his committee members, Jean Moss, Brenda Smith (Figure 9), Ron Robinson (Figure 10), Henry Graupner and Allan Freedman. Robinson, Smith and Graupner are

Figure 11. *Lesley Biggs.*³¹

three more non-chiropractors who willingly gave their all, to the development of a chiropractic edifice which is the envy of other educational institutions.

In addition to spending huge amounts of time supervising the development and construction of the Leslie Street campus and the disposition of the Bayview campus, Len is responsible for the success of the Corporate Division of the Capital Campaign, which added substantially to the College coffers. Len Goodman and his wife Alma lead by example, demonstrating their devotion to CMCC through generous personal donations to the Campaign and maintaining their production of innovative and entertaining fund raising events.³¹

Historians

Lesley Biggs states, that “the survival and ultimate acceptance of chiropractic into the health care system can only be explained by the balance of class forces; i.e. chiropractic has received strong support from working-class organizations (Figure 11).”³² Dr. Biggs’ thesis has provided this treatise with ample evidence to bolster her claim. She chose chiropractic for her PhD dissertation at the U of T because Kelner, Hall and Coulter were in her department “and had just finished the first major study of chiropractic in Canada, so there was a lot of interest in the subject.” In 1982, when Coulter was Acting President of

Figure 12. *Joseph Keating.*

CMCC, he gave Biggs “unlimited access to the College and its resources.” [Email, Biggs to Brown, Feb 2, 2012]

Biggs is now (2012) an Associate Professor in the Department of History and Acting Head, Women’s and Gender Studies, at the University of Saskatchewan (U of S). Her main areas of interest lie in the history and sociology of the professions with a particular focus on complementary and alternative healers such as midwives and chiropractors. In 2009 Dr. Biggs received the U of S “Master Teacher Award” and is described on their website as, “An award-winning researcher in alternative medicine, and a skilled and generous administrator... Always looking for creative ways to communicate complex ideas, Biggs revises her curricula and teaching methods as she learns more from classroom experiences... Her enthusiasm for the communication of knowledge, makes her the kind of teacher students remember gratefully, long after they have left the university.”

Joseph Keating modestly described himself as a researcher, faculty member, administrator and historian (Figure 12). Colleagues and former students remain awed by his superior intellect, prodigious publications and mentoring skills. Dr. Keating received his PhD from the University of New York in 1981 and quickly developed a fascination for chiropractic. In the mid 1980s he foraged into Canada, submitting dozens of articles to the JCCA.

His documentation of chiropractic history is legendary. In Canada, he unearthed our origins in Saskatchewan and Ontario and wrote definitive biographical studies of prominent chiropractors. And he had related interests: The development of practice standards; scientific substantiation of clinical procedures; improving the intellectual environment within the profession; and clarification of our philosophy.

Keating had a strong affinity for CMCC which he praised as “one of the two or three most important chiropractic schools, of its long-term commitment to scholarship and high academic standards... Schools such as CMCC are reaching a level of sophistication in science and scholarship that was just unimaginable two decades ago.”

Despite a hectic schedule, Keating always made time for the College. In February 1995, our Centennial Year, Keating spent nine days at CMCC: scouring the Library and Archives; presenting a seminar on “DD Palmer’s Forgotten Theories;” participating in a technique workshop; lecturing the students in all four years; and travelling to Port Perry to play the part of DD Palmer in the College’s 50th anniversary video. President Jean Moss recalls Dr. Keating “as someone from outside chiropractic who approached the subject from research and historical perspectives, providing important insights and meaningful input... He will be missed for his encyclopaedic knowledge and sense of humour.”³³

CMCC Update

September 18, 2004, our magnificent new College on Leslie Street opened on time, thanks to the tireless efforts of dozens of people who were inspired by the brilliant leadership of Jean Moss, Len Goodman and Allan Freedman. That glorious day, throngs of enthusiastic people from all walks of life were captivated by this remarkable expression of architectural and engineering ingenuity. One of the visiting dignitaries was Dr. Paul Carey, founding President of the Canadian Chiropractic Protective Association (CCPA) and a Council Member of the World Federation of Chiropractic. In 1996 the CCPA had pledged \$3 million to CMCC’s capital campaign, which was one of the largest single grants ever made to a chiropractic college. On that occasion Dr. Carey declared: “With this grant, chiropractors are investing in themselves and taking leadership for their own future.” At the grand opening

in 2004 Paul was asked if he was proud of the CCPA’s contribution. “There is no question. Yes, I was doubly surprised and pleased with CMCC’s new facilities. They are worthy of an institution teaching at the university level and certainly rival anything I’ve seen in my travels to chiropractic colleges around the world. The Library in particular is outstanding. It was money well invested.”³⁴

Since the auspicious opening, CMCC has enjoyed numerous other firsts. Some are listed below:

2005 – CMCC became the first private health sciences institution to be awarded degree granting privileges by the Ontario Ministry of Training, Colleges and Universities; the College launched a pilot project with the Department of Family and Community Medicine, at Toronto’s St. Michael’s Hospital; and Dr. Moss completed her two year term as President of the Association of Chiropractic Colleges (ACC).

2006 – CMCC completed the process, started in 1999, of implementing an integrated curriculum with a modular approach, allowing students to focus on specific regions of the body and providing an in-depth exploration of biological systems to ensure a comprehensive understanding of how chiropractic care benefits patients. The program combines lectures and labs with team-based learning and practice-based case studies, enhancing problem-solving and clinical skills. This year, 98% of CMCC graduates passed the written and 96% passed the clinical skills CCEB exams on the first attempt.

2007 – In June, 150 Doctors of Chiropractic, from every Canadian province and several European countries, crossed the stage at Convocation. Seventy-seven percent of these graduates entered year one with undergraduate degrees and half of them chose CMCC because of a chiropractor’s influence. During their internship, these students assumed patient care under the direct supervision of 20 highly trained clinicians, delivering 61,000 patient visits at eight community based clinics. CMCC is increasingly recognized as a valued government partner, participating in the public policy debate surrounding health care and education. In 2007 the College made a presentation to the provincial Standing Committee on Finance during their pre-budget consultations.

2008 – By now, CMCC’s mortgage had been reduced by one-third since moving to Leslie Street in 2004; re-branding of the College had taken place; and the first collective agreement with CUPE Local 4773, had been rati-

fied. In 2008 CMCC hosted its first Research Symposium, inviting speakers from Harvard University, the Mayo Clinic and the University of Vermont to discuss the latest developments in their areas of expertise. At Convocation the College conferred its first degrees under the authority of the Ministry of Training, Colleges and Universities and the second annual Student Satisfaction Survey revealed a 13 percent increase in overall student satisfaction.

2009 – The College began implementing an integrated software system; and received two Canadian Government capital funding grants, under the Knowledge and Infrastructure Program (KIP). CMCC initiated a Research Chair in Mechanobiology, to study spinal instability, degeneration and subluxation; the Library formed the first archival database devoted solely to the history of chiropractic; and Dr. Moss received the inaugural Award for Excellence in Women's Leadership, from the WFC.

2010 – In February, CMCC faculty and alumni were among the first chiropractors to become part of the Olympic Host Medical Services team within the polyclinics at the Vancouver Olympics. During the year, simulation labs were created containing: A computerized force-sensing table to measure the depth, direction and speed of an adjustment; a new Clinical Diagnostic Simulation Lab utilizing four Gaumard manikins; a new Treatment Development Lab, and a Biomechanics Lab with a GAITRite system for studying gait patterns.

2011 – In March, CMCC was the first privately funded school to receive continued permission to grant Doctor of Chiropractic degrees for an unprecedented 10 years, by the Ontario Ministry of Training, Colleges and Universities. In April, CMCC research efforts earned accolades at the ACC-RAC (Research Agenda Conference) in Las Vegas, and again at the WFC Congress, in Rio de Janeiro, in April. The same month, CMCC's Library became the first private institute to win membership in the Health Science Information Consortium of Toronto, increasing our voice within the academic and scientific communities.

2012 – January 11, St. Michael's Hospital (SMH), opened its new clinical facilities and CMCC's role (inaugurated in 2004), was expanded within the SMH's Academic Family Health Team. February 1, CMCC's President, Dr. Jean Moss, and Dr. Tim McTiernan, President of the University of Ontario Institute of Technology (UOIT) signed an articulation agreement between the two organizations, enabling qualified students to complete an

Honours Bachelor of Science degree in Kinesiology and a Doctor of Science degree in seven years instead of eight.

In March 2004, Dr. Gerry Clum, then President of Life Chiropractic College West, visited our Leslie Street site, while it was in the transformative stage and predicted that, "CMCC's new campus is the most exciting thing that has occurred in the Canadian chiropractic profession since the first college opened in 1945. It will establish CMCC as the preeminent chiropractic college in the world for years to come." So far, Dr. Clum's prophecies have been on the mark.

Acknowledgement

The author is grateful for Allan Freedman's assistance with the preparation of this historical paper.

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Urolithiasis presenting as right flank pain: a case report

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Background: *Urolithiasis refers to renal or ureteral calculi referred to in lay terminology as a kidney stone. Urolithiasis is a potential emergency often resulting in acute abdominal, low back, flank or groin pain. Chiropractors may encounter patients when they are in acute pain or after they have recovered from the acute phase and should be knowledgeable about the signs, symptoms, potential complications and appropriate recommendations for management.*

Case presentation: *A 52 year old male with acute right flank pain presented to the emergency department. A ureteric calculus with associated hydronephrosis was identified and he was prescribed pain medications and discharged to pass the stone naturally. One day later, he returned to the emergency department with severe pain and was referred to urology. He was managed with a temporary ureteric stent and antibiotics.*

Conclusion: *This case describes a patient with acute right flank and lower quadrant pain which was*

Contexte : *La lithiase urinaire se réfère à des calculs rénaux ou urétéraux connus plus communément comme des calculs rénaux. La lithiase urinaire présente une urgence potentielle qui entraîne souvent des douleurs aiguës à l'abdomen, au dos, à la colonne lombaire, au flanc ou à l'aîne. Les chiropraticiens peuvent rencontrer les patients quand ceux-ci éprouvent des douleurs aiguës ou après s'être remis de la phase aiguë et devraient donc connaître les signes, les symptômes, les complications possibles et les recommandations appropriées de gestion.*

Exposé de cas : *Un homme de 52 ans éprouvant des douleurs aiguës au flanc droit s'est présenté à l'urgence. Un calcul urétéral avec hydronéphrose associée a été décelé et on lui a prescrit des analgésiques et on l'a renvoyé chez lui pour passer les calculs rénaux sans intervention. Le lendemain il est retourné aux urgences avec une douleur intense et a été renvoyé à l'urologie, où on lui a posé une endoprothèse urétérale temporaire et prescrit des antibiotiques.*

Conclusion : *Ce cas décrit un patient souffrant d'une douleur aiguë au flanc et au quadrant inférieur droits. Le diagnostic posé indiquait des calculs urétéraux*

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diagnosed as an obstructing ureteric calculus. Acute management and preventive strategies in patients with visceral pathology such as renal calculi must be considered in patients with severe back and flank pain as it can progress to hydronephrosis and kidney failure.

KEY WORDS: urolithiasis, back pain, groin pain

Introduction

Back, flank and groin pain are common symptoms that often lead a patient to consult with a healthcare provider. Typically, chiropractors are consulted for mechanical back pain however a recent survey of American chiropractors indicated that 5.3% of chief complaints are non-musculoskeletal in origin.¹ Within this category was the inclusion of renal calculi which was reported to rarely present to a chiropractic clinic.¹ Although rarely encountered in a chiropractic practice, visceral pathology or injury should be of primary consideration for these practitioners as the clinical symptoms are often very similar and yet the management options are very different.

Urolithiasis often refers pain to the back, flank and groin regions depending on the location of the calculi. Most patients describe the pain as a downward-radiating flank pain that progresses anteriorly into the abdomen, pelvis and genitals as the calculus travels from the kidneys down the ureter and into the bladder.²

In some cases, occlusion of the renal system can follow resulting in nephrolithiasis and eventually kidney failure. The following case describes a patient in which urolithiasis resulted in occlusion of the renal system and nephrolithiasis. Practitioners with a focus on the musculoskeletal system such as chiropractors, physiotherapists and physiatrists need to be aware of alternate causes of back, flank and groin pain.

Case study

History

A 52 year old male presented to the emergency depart-

ment with severe right flank pain radiating to the right lower quadrant. His blood pressure was 154/96, pulse rate was 79 bpm, respiratory rate was 24 breaths per minute and temperature was 36.7° C. The pain was insidious in onset and had an intensity of 10/10 on verbal analog scale which decreased to 8/10 after administration of Toradol and Morphine medications provided in the emergency department. The pain was constant, lasting 3 hours in duration, and he had two episodes of emesis since its onset. He did not report experiencing any chest pain, dyspnea, fever or bowel and bladder dysfunction.

MOTS CLÉS : lithiase urinaire, douleur dorsale, douleur à l'aîne

ment with severe right flank pain radiating to the right lower quadrant. His blood pressure was 154/96, pulse rate was 79 bpm, respiratory rate was 24 breaths per minute and temperature was 36.7° C. The pain was insidious in onset and had an intensity of 10/10 on verbal analog scale which decreased to 8/10 after administration of Toradol and Morphine medications provided in the emergency department. The pain was constant, lasting 3 hours in duration, and he had two episodes of emesis since its onset. He did not report experiencing any chest pain, dyspnea, fever or bowel and bladder dysfunction.

His medical history included a similar pain in the left flank two years earlier which was diagnosed as kidney stones.

Physical Examination

His heart rate and respiration were within normal limits. He did not display any signs of edema or nausea, abdominal discomfort or indigestion. His abdomen was soft with diffuse tenderness which increased over the right lower quadrant. Urinalysis revealed a moderate increase in specific gravity (1.030), significant hematuria (3+) and a trace of protein.

Diagnostic Imaging

A right ureteric calculus was apparent on a conventional abdominal radiograph (Figure 3). He was discharged from the emergency department with the hope that he would then pass the stone naturally. Unfortunately, the following day, the patient returned reporting that the medications did not significantly affect his pain and his referral to the urology department was expedited. A computer-

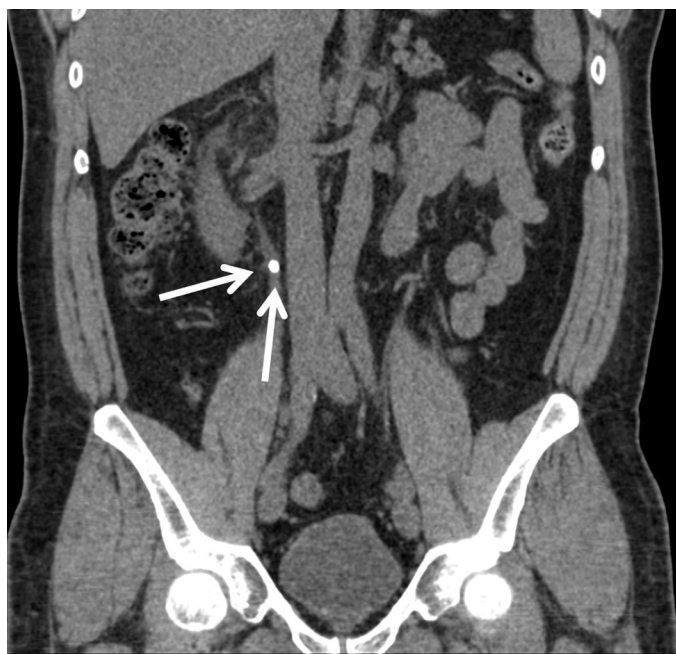


Figure 1. Coronal CT indicating a calcific density in the right proximal ureter.

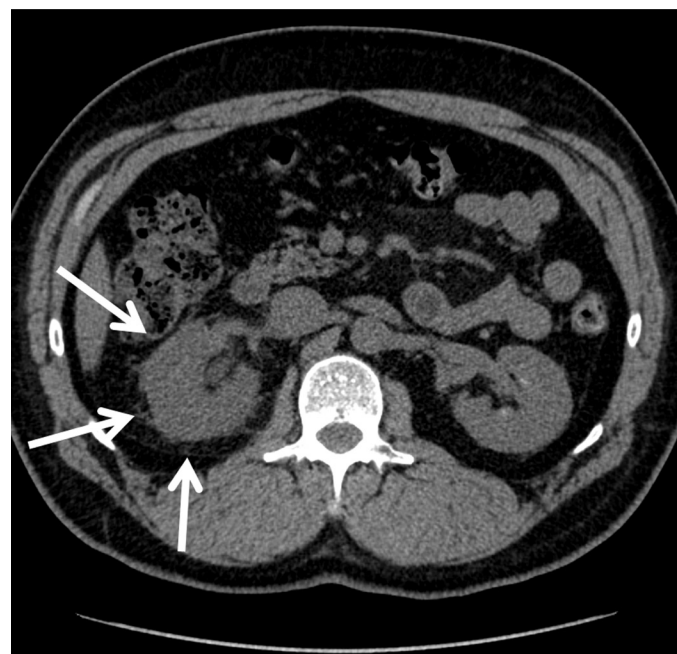


Figure 2. Axial CT indicating hydronephrosis and perinephric stranding in the right kidney.

ized tomography (CT) scan was subsequently obtained which revealed a 7mm calcific density in the right proximal ureter with associated moderate hydronephrosis and perinephric stranding (Figure 1 and 2). Multiple 1-2mm non-obstructing calculi were additionally noted in the left renal parenchyma. The patient was diagnosed with a right ureteric calculus and was managed further managed with pain (Ketorolac, Morphine and Naproxen) and antiemetic medications.

The consulting urologist concluded that because his symptoms were refractory to analgesics, and because the calculus was unlikely to pass on its own, emergency laser lithotripsy was indicated. At the time of this procedure, his urine appeared murky and was presumed to be infected and the lithotripsy was abandoned. As an alternative, a ureteric stent was placed to help drain the dilated and infected collecting system. Antibiotics and Tamsulosin were additionally prescribed. The patient was scheduled for stent and calculus removal two months later and instructed to attempt natural passage of the stone during this period.

Discussion

The prevalence of stones has been rising over the past 30 years and is of concern in an aging population. Several factors may contribute to this rise including improved diagnostic abilities, longer life spans, changes in health related behaviours (eg. consumption of soft drinks and animal proteins), environmental changes, or diuretic utilisation).³⁻⁶ By 70 years of age, 11% of men and 5.6% of women will have a symptomatic kidney stone.⁶ Calculi are typically diagnosed based on the presenting symptoms along with an imaging modality, however, classification of the calculus is based on its composition which requires analysis of the calculus after passage or removal. Conservative treatment options/recommendations are frequently determined and implemented at this point.

The underlying mechanism for calculus formation is that of supersaturation in the urine. Saturation is often described as the concentration ratios of calcium oxalate or calcium phosphate to its solubility. The majority of kidney stones contain calcium (approximately 90% in men and 70% in women) while the remainder consist of cystine

Table 1.
Common mechanical and visceral origins of abdominal, low back, flank, groin pain

Mechanical	Visceral
Sprain/Strain	Pelvic disease (prostatitis, endometriosis, inflammatory diseases, etc)
Discogenic	Renal disease (pyelonephritis, urolithiasis nephrolithiasis, perinephric abscess, etc)
Traumatic fracture	Aortic aneurysm
Compression/Insufficiency fracture	Gastrointestinal disease (cholecystitis, appendicitis, ulcers, etc)
Alignment disorders (scoliosis, kyphosis, spondylolisthesis, etc)	
Arthropathy	

(<1%), pure uric acid (10-15%) and struvite (10-15%).⁷ Calcium based stones are most commonly composed of calcium oxalate, calcium phosphate or both. Several factors can affect stone formation and each need to be addressed once they have been identified.

Various factors can increase an individual's risk of calculus development. Individuals with renal conditions such as polycystic kidney disease or renal tubular acidosis or metabolic syndromes are at increased risk.^{8,9} Additionally, lifestyle and dietary factors such as low urine volume, diets predominantly consisting of animal protein, oxalate or sodium, and abnormal body weight, sedentary activity and stressful life events may increase an individual's risk for calculus development.¹⁰

Urolithiasis is often easily identified due to its classic presentation as is demonstrated in this case. However in certain situations, it is possible that there is a mechanical pain experienced in conjunction with the visceral pain which can often confuse the treating clinician. Table 1 describes some common mechanical and visceral conditions which can present as abdominal, back, flank or groin pain. Deciphering the source of pain is essential to appropriate management as mechanical pain may be relieved temporarily with manual therapy, however the underlying visceral pain is usually persistent unless identified and further managed.¹¹

Diagnosis is usually suspected from a history and examination. Patients often complain of severe back,

flank or groin pain that is colicky in nature. Physical examination often reveals a restless patient with tenderness at the costovertebral angle which is reproduced with gentle tapping. Although a clinician's level of suspicion may be heightened following the history and physical examination, confirmation with diagnostic imaging is often required. Conventional radiographs have been utilised to identify the location and size of the calculus. Figure 3 demonstrates a conventional abdominal radiograph of the patient described in this case revealing a 6-7 mm radio-dense concretion in the right ureter (Arrow A). Incidental note is made of a probable pelvic phlebolith (Arrow B) that may be misinterpreted as a distal ureteric or bladder calculi. When circular concretions are located lower in the pelvis, they are more likely to be phleboliths than calculi.

More recently, computerized tomography (CT) has been recognized as the method of choice.^{12,13} Non-enhanced CT affords the ability to rapidly identify the presence of calculi in the urinary system, however, it is not possible to determine the composition of the calculi. Advances in technology have led to the utilisation of dual energy CT which does have added ability to differentiate the stone material by better characterizing the stone material.¹⁴ Although not widely used, the added benefit of dual energy CT can significantly affect the therapeutic options as a trial of urinary alkalinisation is warranted if the calculus is composed of uric acid.

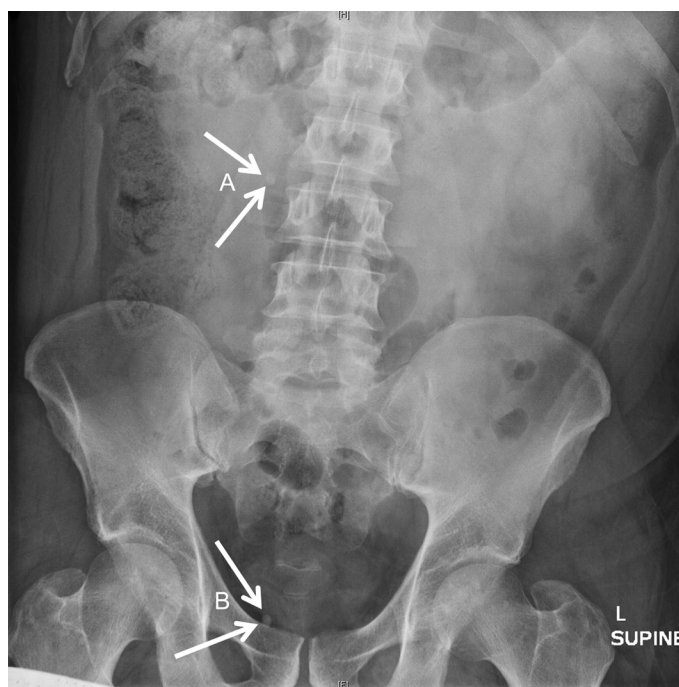


Figure 3. Abdominal radiograph indicating a ureteric calculi (A) and a pelvic phlebolith (B).

Management options follow two distinct routes. In the acute stage, unless there is obstruction, signs of infection, significant bleeding, or persistent pain, removal or fragmentation is not required.¹⁵ In the event that there is significant pain, opioids and nonsteroidal anti-inflammatories are often effective options.¹⁵ This was the initial choice of management for the patient described in this case. Alternatively, a randomized study by Mora et al., demonstrated that Trans Electrical Nerve Stimulation (TENS) was beneficial for decreasing pain, anxiety, nausea and heart rate while increasing satisfaction in acute renal colic episodes that were being transported to the hospital by paramedics.¹⁶ This form of intervention, although transient, may prove beneficial for chiropractors in situations where patients with acute renal pain present and require transportation to the emergency department.

In general, renal calculi that are >10mm in diameter will not pass on their own as compared to those that are <5mm. Calculi between 5-10 mm have variable outcomes and will either pass on their own or require further interventional management. Ureteral calculi are often man-

aged with interventions such as shockwave lithotripsy or laser lithotripsy.¹⁷⁻²⁰ In the context of infection, initial treatment with ureteric stenting and antibiotics is required. For calculi that are present in the kidneys, the intervention is often dependent on the composition of the calculus. Percutaneous nephrolithotomy may be utilised for calculi that are >20mm, staghorn calculi, or calculi that are not able to be removed cystoscopically.²¹ Alkalinisation is often selected to dissolve calculi composed of uric acid.¹⁴

Once the calculus has passed, management should focus on prevention. Healthcare practitioners should focus on educating patients about their future prognosis and risk for future calculus formation. Twenty-six percent of individuals with calculi have been shown to recur symptomatically, while 28% have been found in asymptomatic individuals.²² Hence, approximately 50% of individuals (symptomatic and asymptomatic) with a history of calculus formation may develop subsequent calculi over a 10 year period. Self care and lifestyle modifications are thought to help reduce the risk of recurrence.

Prevention of calculi development requires decreasing supersaturation by increasing the individuals' urine volume and lowering the solubility of calcium oxalate or phosphate. With respect to calculi composed of calcium oxalate, the goal is to raise urine volume while decreasing calcium and oxalate excretion. Increasing daily fluid intake to more than 2 liters has been shown to significantly reduce recurrent calculi formation.²³ Other strategies include dietary modifications such as adapting a low sodium, normal calcium, and restricting foods high in oxalate (spinach, rhubarb, wheat bran, chocolate, beets, miso, tahini and most nuts).²⁴

In situations of metabolic abnormalities such as citraturia, individuals are often instructed to follow a prophylactic therapeutic regimen of potassium citrate while others have suggested utilising alkalinizing substitutes while hydrating such as lemonade.²⁵ A recent trial by Tosukhowong et al has suggested that this may be beneficial as individuals utilising a lime powder mixed into their drinks had an increase in alkalinizing and citraturic actions as well as provided an antioxidant effect to attenuate renal tubular damage.²⁶ This may prove to be a viable alternative and a simple addition into the management of individuals susceptible to repeated calculus formation.

Much debate exists about the utilisation of probiotics in preventing oxalate supersaturation. The current belief

is that microorganisms such as *Oxalobacter formigenes* are important for metabolising oxalate.²⁷ However, Lieske et al reported that dietary restriction of oxalate resulted in decreased urinary oxalate levels; but, there were no effects of probiotic utilisation.²⁴ The current research in this area is lacking a standardised sample population to conduct trials. Several authors have suggested that probiotic utilisation is beneficial in moderate to high oxalate diets, whereas Lieske's study was performed on individuals with low-oxalate diets. To the authors' knowledge, there is insufficient evidence to support or refute the utilisation of probiotics in prevention of stone development.

Complications of renal and ureteric calculi include: hydronephrosis, renal damage, infection of the urinary tract and urosepsis. Hydronephrosis is a condition in which the urinary system is obstructed causing dilation and swelling of the kidney. Unilaterally, it occurs in 1 in 100 people and is often treated by removing the obstruction as well as undergoing a regimen of antibiotics for infections.¹⁴ If mismanaged or untreated, hydronephrosis can result in permanent kidney damage and potentially renal failure, particularly devastating in an individual with a solitary kidney.²⁸

Conclusion

Urolithiasis can result in severe pain, and emergent situations which require immediate management to ensure protection of the patients' urinary system. This case illustrates a situation in which temporary occlusion of the ureter resulted in moderate hydronephrosis. In the event of an underlying calculus, preservation of the urinary system is of most importance and clinicians need to be cognisant of renal or urterteric calculi when examining a patient with abdominal, back, flank or groin pain. Furthermore, clinicians should be equipped with the knowledge of preventive strategies to educate patients with previous calculi, or those that are susceptible to development. This case highlights the importance of considering visceral pathology in the presence of acute abdominal, low back, flank or groin pain.

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Anterior cruciate ligament laxity related to the menstrual cycle: an updated systematic review of the literature

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Sheena Clifton, BSc, DC
Brian J. Gleberzon, DC, MHSc*

Objectives: *The purpose of this study was to conduct a systematic review regarding the purported differences in anterior cruciate ligament (ACL) laxity throughout the course of the menstrual cycle.*

Methods: *A systematic review was performed by searching electronic databases, along with hand-searching of journals and reference tracking for any study that assessed ACL integrity throughout the menstrual cycle from 1998 until 2011. Studies that met the pre-defined inclusion criteria were evaluated using the Modified Sackett Score (MSS) instrument that assessed their methodological quality.*

Results: *Thirteen articles out of a possible 28 met the inclusion criteria.*

Conclusions: *This systematic review found 13 clinical trials investigating the effect of the menstrual cycle on ACL laxity. There is evidence to support the hypothesis that the ACL changes throughout the menstrual cycle, with it becoming more lax during the pre-ovulatory (luteal) phase. Overall, these reviews found statistically significant differences for variation in ACL laxity and injury throughout the menstrual cycle, especially during the pre-ovulatory phase. Female athletes may need to take precautions in order to reduce the likelihood of ACL injury. However, the quality of the assessments was low and the evidence is still very limited. More and better quality research is needed in this area.*

KEY WORDS: ligament, laxity, menstrual

Objectifs : *Le but de cette étude était de procéder à un examen systématique concernant les prétendues différences dans le laxisme du ligament croisé antérieur (LCA) tout au long du cycle menstruel.*

Méthodologie : *Un examen systématique a été effectué en recherchant des bases de données électroniques, ainsi qu'en effectuant une recherche manuelle des revues et un suivi de références pour toute étude de 1998 jusqu'en 2011 qui a évalué l'intégrité du ligament croisé antérieur LCA tout au long du cycle menstruel. Les études qui répondaient aux critères d'inclusion prédéfinis ont été évaluées en utilisant le score modifié de Sackett (MSS) qui a évalué la qualité de leur méthodologie.*

Résultats : *Treize articles, sur un total possible de 28, répondaient aux critères d'inclusion.*

Conclusions : *Cet examen systématique a découvert 13 essais cliniques portant sur l'effet du cycle menstruel sur le laxisme du LCA. Il existe des preuves pour étayer l'hypothèse que le LCA change tout au long du cycle menstruel, devenant plus relâché lors de la phase pré-ovulatoire (lutéale). Dans l'ensemble, ces examens ont montré des différences statistiquement significatives entre la variation de laxisme et de blessures du LCA tout au long du cycle menstruel, en particulier pendant la phase pré-ovulatoire. Les athlètes de sexe féminin devraient peut-être prendre des précautions pour réduire le risque de blessures du LCA. Cependant, les évaluations qualitatives étaient insuffisantes et les preuves sont encore très limitées. Donc, il faut effectuer plus de recherches, et de meilleure qualité, dans ce domaine.*

MOTS CLÉS : ligament, laxisme, menstruel

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Introduction

The physical disability and long rehabilitation process associated with anterior cruciate ligament (ACL) injury can be both psychologically and financially devastating to the individual, ultimately resulting in a decreased quality of life.¹ Female athletes have a higher rate of ACL injury than do men, and many of these injuries require extensive surgical and rehabilitative interventions, with a financial burden to the American healthcare system estimated to approach \$650 million annually.¹ Bearing that in mind, it is imperative to understand the mechanisms leading to such an injury in an effort to prevent its occurrence and its subsequent sequelae. Although both men and women are susceptible, the literature states that women have a 4 to 6 fold increased incidence of ACL injury.^{2,3} Notwithstanding the fact that a definitive etiology for this discrepancy between the sexes has not been established, proposed theories to account for it include: neuromuscular and biomechanical factors (differences in pelvis width/increased Q-angles in females, smaller femoral notch widths in females, increased female hamstring flexibility, and imbalanced hamstrings-to-quadriceps strength leading to differences in landing patterns); psychological factors (women may be more prone to maladaptive perfectionism leading to overtraining and burnout) and nutritional differences (higher frequency of food restriction and decreased calcium intake among females compared to males).^{1,3,4} An additional theory posits increased ligament laxity is related to hormonal fluctuations during the menstrual cycle.¹

The menstrual cycle is controlled by the pituitary-hypothalamic-ovarian axis and involves the complex interaction of estrogen, progesterone, relaxin and testosterone.¹ Typically, each menstrual cycle spans 28 days, beginning with the follicular phase from days 1-9 during which estrogen predominates, followed by the ovulatory phase spanning days 10-14, where estrogen continues to prevail and reaches its peak.¹ The cycle ends with the luteal phase extending from days 15-28 during which time progesterone levels surpass that of estrogen levels.¹ Relaxin is secreted during the follicular and luteal phases, reaching its peak during the luteal phase.⁵ Lastly, testosterone fluctuates throughout the cycle, and functions to contribute to the formation of estrogen.⁶ Although the hormones that predominate during each phase are consistent among all women with normal functioning cycles, the levels of each hormone varies among individuals.³

The hormones controlling the menstrual cycle are thought to affect the overall integrity of the ACL by altering its structure.⁷ In general, these hormones decrease the tensile properties of the ACL by binding to specific receptors on it.⁷ Specifically estrogen, when bound to receptors on the ACL, has been shown to decrease fibroblast proliferation, subsequently decreasing collagen production.⁷ This could theoretically result in a greater incidence of ACL injuries during the pre-ovulatory phase spanning days 1-14 of the menstrual cycle, when estrogen predominates. This theory has been supported by a case-control study in which female recreational skiers who sustained a non-contact ACL injury demonstrated a two-fold increase in injury rates during the pre-ovulatory phase compared to the uninjured controls.⁸ However, other studies have reported contradictory results that refute the theory that hormonal variations during the menstrual cycle contribute to ligament laxity. For example, Van Luren et al⁹ reported arthrometric analysis of ACL laxity that failed to demonstrate any variation in ACL laxity throughout the menstrual cycle. In addition, Belanger and colleagues¹⁰ examined 18 female subjects and were unable to establish an association between increased ACL laxity and the menstrual phase.

The objective of this article is to review the literature regarding changes to anterior cruciate ligament laxity during the menstrual cycle, building on previous reviews by Zazulac et al¹ and Hewett et al². A better understanding of the mechanism of injury may allow clinicians to identify females who are at greatest risk of ACL injury and subsequently contribute to injury prevention in female athletes.

Methods

A literature search was performed using the following electronic databases: Index to Chiropractic Literature, MEDLINE, CINAHL and Rehabilitation & Sports Medicine Source, through EBSCO Publishing. We combined controlled vocabulary terms with text words. In MEDLINE we exploded and searched the MeSH term menstrual cycle, which included fertile period, follicular phase, luteal phase and menstruation, and menstruation, and combined these terms with the MeSH term anterior cruciate ligament injury. Text words for these concepts included anterior cruciate ligament tear and anterior cruciate ligament injuries. This yielded 27 articles. Citations from specific articles (reference tracking) were then

Table 1:
Instrument Categories Used to Grade Articles for this Review

Grading Criteria:	
Baseline values of groups (/8)	No mention of baseline values score 0; baseline values mentioned but not statistically significant score 4; baseline values mentioned and not statistically significant..... score 8.
Relevance of outcomes and clinical significance (/7)	No mention of outcomes and clinical significance score 0; subjective outcome measures score 3; objective outcome measures score 5; both subjective and objective outcome measures score 7.
Prognostic stratification (comorbidity and risk factors) (/6)	No clear mention of study inclusion or exclusion criteria score 0; inadequate mention of inclusion or exclusion criteria score 3; complete mention and description of inclusion and exclusion criteria score 6.
Blinding strategies (/5)	No blinding strategies mentioned score 0; single blinded study without method described and appropriate score 2; single blinded study with method described and appropriate score 3; double blinded study without method described and appropriate score 4; double blinded study with method described and appropriate..... score 5.
Contamination/ co-intervention (/4)	No mention of ways to control for contamination or co-intervention score 0; some patients received some sort of contamination or co-intervention..... score 2; assumed that no contamination or co-intervention took place due to immediate follow-up score 3; contamination and co-intervention closely monitored and accounted for score 4.
Compliance of subjects to study procedures (/4)	No mention or detail given to compliance of study subjects score 0; compliance and co-intervention of patients monitored but not closely monitored..... score 1; some patients were compliant and did not receive co-interventions and was closely monitored and detailed score 2; compliance of subjects was assumed due to immediate follow-up score 3; all patients were compliant and closely monitored and detailed score 4.
Drop-out rates of subjects (/3)	No mention of drop-out rates score 0; drop-out rates mentioned score 1; no drop-out rates assumed due to immediate follow-up score 2; number and reason for drop-outs described..... score 3.
Publication date of research (/1)	Published prior to 2000 score 0; published after 2000 score 1.
Total Score: /38	

searched independently through selected databases followed by hand searching throughout the periodicals. Reference tracking yielded one article. Periodical searching yielded no eligible articles.

Inclusion/Exclusion Criteria

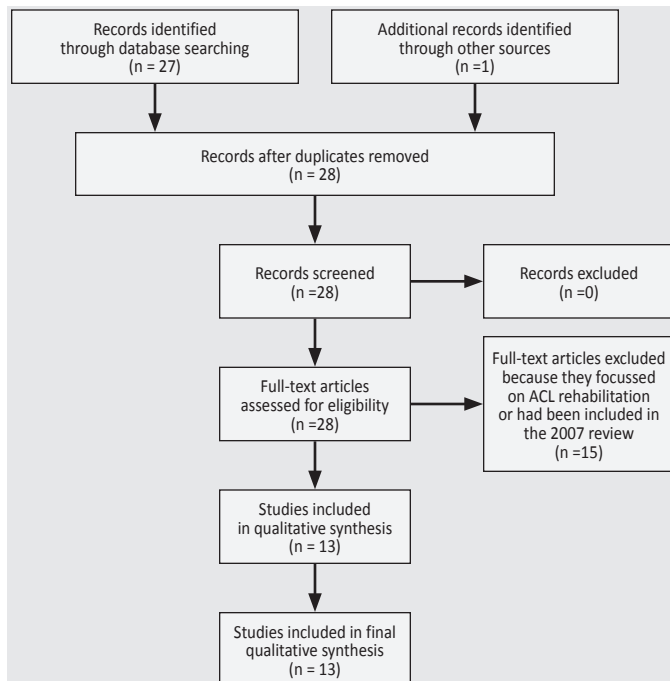
Inclusion criteria were as follows: female subjects of reproductive age; published between 1998 and August 2011; papers written in the English language and studies using human subjects only. Articles that focused on therapy for ACL injuries were excluded. Papers were also excluded

if they had been reviewed in the most recent literature review by Hewett et al in 2007.² Using these inclusion/exclusion criteria 13 articles were selected for review.

Quality Appraisal

The methodological quality of the studies that met the selection criteria was assessed using a modified version of an instrument developed by Sackett (see Table 1).¹¹ Since the majority of research on the topic of ACL laxity and menstrual hormonal fluctuations is limited to observational study designs rather than randomized clinical trials,

Table 2:
Flow chart of retrieved articles used in this Review.



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

the ‘assignment of patients’ and ‘follow-up levels’ criteria were not included in our grading as they were deemed incompatible with the majority of the research designs. As a result, the instrument was modified and scored out of 38 rather than 50.

The eligible articles were randomly assigned to four authors (LB, DB, JC, SC). Each accepted article was reviewed by two authors independently. The data from all accepted articles were recorded onto a data extraction sheet by the authors as part of their review. The authors checked and edited all entries for accuracy and consistency. Recorded data included study authors and quality score, details of the study design, sample, interventions, outcome measures, and main results/conclusions of the study. Any discrepancies of scores between the authors were settled via discussion until consensus was reached.

Results

Thirteen articles met the inclusion criteria (see Table 2).¹²⁻²⁴ After methodological quality assessment of each article using the modified Sackett grading instrument, papers were allocated scores out of a possible 38 points (Table 3). Of the 13 articles, 9 articles investigated ACL injuries throughout the menstrual cycle and 4 articles investigated the issue of ACL laxity throughout the menstrual cycle

Table 3:

	Beynon et al. 2006 AJSM	Eiling et al. 2007 KSSTA	Shultz et al. 2005 JOR	Park et al. 2009 AJSM 37(6)	Ruedl et al. 2009 KSSTA	Adachi et al. 2008 AOTS	Pollard et al. 2006 CB	Deie et al. 2002 IO	Hertel et al. 2006 KSSTA	Abt et al. 2007 KSSTA	Wojtys et al. 1998 AJSM	Park et al. 2009 AJSM	Park et al. 2008 BJSM
Baseline Values of Groups (/8)	8	8	4	8	8	4	4	8	4	4	4	4	4
Relevance of Outcomes & Clinical Significance (/7)	7	7	5	5	3	3	5	5	7	5	3	5	5
Prognostic Stratification (Comorbidity and Risk factors) (/6)	6	6	6	3	6	6	6	3	3	6	3	3	3
Blinding Strategies (/5)	0	3	3	0	0	0	0	0	0	0	0	0	0
Contamination/Co-Intervention (/4)	3	2	4	4	0	3	4	0	0	0	2	2	0
Compliance of Subjects to Study Procedures (/4)	3	0	1	1	3	3	0	0	1	0	3	0	0
Drop-out Rates of Subjects (/3)	2	0	1	1	2	2	0	3	3	3	2	0	0
Date of Publication (/1)	1	1	1	1	1	1	1	1	1	1	0	1	1
Total (/38)	30	27	25	23	23	22	20	20	19	19	17	15	13

- AJSM – American Journal of Sports Medicine
- KSSTA – Knee Surgery, Sports Traumatology, Arthroscopy
- AOTS – Archives of Orthopaedic and Trauma Surgery
- BJSM – British Journal of Sports Medicine

- CB – Clinical Biomechanics
- IO – International Orthopaedics
- JOR – Journal of Orthopedic Research

(see Tables 4a and 4b respectively). Articles are listed in descending order of their score. In the event two or more articles had the same score, they were arranged alphabetically. A brief summary of each of the 13 articles graded in this study is provided in Table 4a and 4b.

The accepted studies, determined by Sackett et al, scored between 30 and 13 out of a possible 38 points on the Modified Sackett Score (MSS) instrument (Table 2,3). Eight¹²⁻¹⁹ of the thirteen studies reported that knee ligament laxity changes throughout the menstrual cycle, although the phase during which this ligamentous laxity occurred varies throughout the cycle. Ruedl et al (MSS=23/39)¹², Adachi et al (MSS=22)¹³, Wojtys et al (MSS=17)¹⁴ and Park-b et al (MSS=13)¹⁵ all reported increased knee laxity during the ovulatory phase and Beynnon et al (MSS=30)¹⁶ reported increased knee laxity during the pre-ovulatory phase (compared to post-ovulatory phase). However, Schult et al (MSS=25)¹⁷ and Deie et al (MSS=20)¹⁸ reported increased knee laxity during the follicular phase and Parka (MSS=15)¹⁹ reported increases knee laxity during the luteal phase of the menstrual cycle.

On the other hand, five studies²⁰⁻²⁴ did not report any statistically significant changes in knee laxity during the menstrual cycle. Eiling et al (MSS=27)²⁰ reported that there was no statistically significant effect on anterior knee ligament laxity throughout the menstrual cycle and that 'musculoskeletal stiffness' was lower during the ovulatory phase of the menstrual cycle as compared to day one of menstruation and the mid-follicular phase. Two studies compared men to women with respect to knee laxity. The study by Deie et al¹⁸ reported there was no statistical difference in the anterior knee movement of 8 men assessed during the same three week period as 16 women and the study by Pollard et al²¹ that compared 12 men to 12 women reported that, while knee laxity increased following exercise, there was no difference across the sexes.

Discussions

Zazulak et al conducted a systematic review similar to ours in 2006.¹ Those researchers were able to retrieve nine studies. Subjects included collegiate athletes, high-school athletes, recreational athletes, non-athletes and 'unspecified' sport participants. Cohort sizes ranged from 7 to 41. Anterior tibiofemoral movement was measured in all studies using KT 1000 or KT 2000 arthrometers.¹

In that review, six of the nine reviewed studies re-

ported no statistically significant effect of the menstrual cycle on ACL laxity. However, the reviewers reminded the reader that the majority of these six studies based their observations on a single sampled day of the cycle, or randomly sampled across the cycle without hormonal or cycle landmark confirmation.¹ Of the three studies that did report increased laxity of ACL during the menstrual cycle, all three reported it occurred during the ovulatory or post-ovulatory (luteal) phase¹, a finding similar to what we found among the 13 articles we reviewed. Despite diversity in the literature, Zazulak et al¹ suggested that the three studies which found a positive association between the menstrual cycle and ligament laxity were superior in study design, methodology and consistency compared to the 6 studies which failed to show any association, thereby concluding that the menstrual cycle may have a significant effect on anterior knee laxity.

Hewett et al² performed a similar systematic review to the one by Zazulak et al¹, with the primary difference being that Hewett et al reviewed articles that investigated the effects of the menstrual cycle on anterior cruciate ligament injury risk among high-risk female athletes, whereas Zazulek et al investigated the effect of the menstrual cycle on anterior knee laxity. In the Hewett et al² review, seven studies met the study's inclusion criteria. Hewett et al² reported that all seven articles favoured an effect of the first half of the menstrual cycle for the increased ACL injuries, most commonly during the pre-ovulatory phase. These authors also reported that the use of oral contraceptives in combination with neuromuscular training may increase the stability of the knee joint and decrease the risk of injury to female athletes.² Hewett et al suggested that disproportionate or isolated quadriceps recruitment can create forces higher than those required for ACL failure.³ Therefore, neuromuscular training should focus on balancing hamstrings-to-quadriceps strength and recruitment in order to increase stability of the knee.

While Zazulak et al² focused on knee laxity and Hewett et al¹ focused on injury, this most recent review looked at a combination of both laxity and injury. The results of our review are in agreeance with Zazulak et al² and Hewett et al¹, supporting an effect of menstrual cycle on anterior cruciate ligament laxity. While the association between ligament laxity and hormonal fluctuations during the menstrual cycle has been suggested, there remains discrepancy concerning which phase of the menstrual cycle

Table 4a:
Studies Investigating ACL Laxity

Reference	Objective	Study Design	Score /38	Patients/Conditions	Methods	Main Outcome Measures	Main Results/Conclusions
Eiling et al 2007	1. To examine changes in lower limb musculo-tendinous stiffness (MTS) over the course of the menstrual cycle 2. Investigate the interaction of warm-up on MTS	Cross-sectional Study	27	11 adolescent females. Played netball for minimum 5 yrs. • eight A-grade players and state representatives • two B-grade players and two C-grade players The average age, height and weight of the subjects was: • 16.3 ± 0.65 years • 164.12 ± 6.2 cm and 60.72 ± 6.3 kg Trained min 2 hrs per week. Consistent menstrual cycles for 3 mths. Menarche >1 yr ago. No use of contraceptives or other hormones for 3 mths. No history of serious lower limb injury. Normal joint ROM.	Subjects documented menstrual history for 3 months prior and post testing. Each subject tested at each of the 4 phases of the cycle: – blood levels for LH, FSH, estradiol and progesterone. – ACL laxity using KT-2000. – MTS assessed before and after 5 min cycling warm up using unilateral hopping on force plate.	1. Blood levels LH, FSH, estradiol and progesterone. • The levels were analysed which allowed the levels to be matched with the testing date • If the values of the hormone analysis were not within the documented ranges for the specific phase, it was assumed that either the test date was miscalculated or that the cycle was anovulatory • In both cases, the subject was re-tested for that particular phase in the subsequent cycle. 2. KT-2000 • The knee was placed in 30 deg. of flexion as the subject lay supine on a bench 3. Force plate • Following a warm-up of 5 min of cycling at 50 W together with ten run-ups and netball landings subjects were instructed to perform a unilateral hop on a force plate in time with a metronome at a frequency of 2.2 Hz	No statistically significant effect of the menstrual cycle on anterior knee laxity. MTS significantly decreased following warm up. • Repeated measures ANOVA revealed significant (P < 0.05) main effects of test-session and warm-up on MTS for the dominant leg. • MTS was found to significantly decrease by 4.2% following the warm-up intervention It was significantly lower during the ovulatory phase compared to day one of menstruation and mid-follicular phase, 8.7 and 4.5%.
Schultz et al 2005	To investigate if hormone levels across the menstrual cycle can affect anterior knee laxity	Cross-sectional study	25	22 females with normal self-reported menstrual history in the previous 6 months Between the ages of 18 and 30, with a body mass index (BMI = weight/height ²) less than or equal to 30 Inclusion: • no history of pregnancy • no use of oral contraceptives or other hormone-stimulating medications for 6 months • non-smoking behavior • two healthy knees with no prior history of joint injury or surgery, no medical conditions affecting the connective tissue • physical activity limited to 7 h or less per week. Exclusion: • experienced an anovulatory cycle or missed three or more consecutive days of testing	Measured blood levels of estradiol, progesterone and testosterone. Then measured knee joint laxity with an arthrometer	Minimum and peak levels of blood estradiol, progesterone, and testosterone. Knee laxity using an arthrometer	The minimum concentrations of estradiol and progesterone in the early follicular phase are important factors in determining sensitivity of the knee joint's response to changing hormone levels. When minimum progesterone concentrations were higher and minimum estradiol concentrations were lower during the early follicular phase, females experienced greater increases in knee laxity across the menstrual cycle with attainment of peak estradiol and testosterone levels post ovulation.
Park et al 2009 (Alterations in knee joint...)	To investigate whether the hormonal cycle has an influence on knee joint mechanism and whether increased knee joint loading during the menstrual cycle affects knee joint mechanics.	Controlled laboratory study.	23	26 healthy women: • age 22.7 ± 3.3 years • height, 170.1 ± 7.1 cm • mass, 65.0 ± 9.3 kg • body mass index (BMI), 22.4 ± 2.5 • average menstrual cycle, 28.9 ± 2.7 days • activity level, 8.7 ± 4.4 h/wk Inclusion: • required that the subject have a normal menstrual cycle • no history of oral contraceptive use, and no previous knee injury Refrain from exercise 6 hrs prior to testing.	Blood samples drawn at 3 different phases of the menstrual cycle in each subject. Knee joint loading was then measured during each phase using the KT-2000 arthrometer. Motion analysis testing of the knee was then performed.	Blood serum estradiol and progesterone. KT-2000	No significant difference in knee joint mechanics between phases. However, increased knee joint laxity was associated with higher knee joint loads during movements.

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Table 4a:
Studies Investigating ACL Laxity (continued)

Reference	Objective	Study Design	Score /38	Patients/Conditions	Methods	Main Outcome Measures	Main Results/Conclusions
Pollard et al 2006	To investigate the collective effects of gender, estrogen and exercise on anterior knee laxity in active individuals	Observational Study	20	12 women: age 24.8 years 12 men: age 24.3 years – All 24 men and women had a history of participating in high school and/or recreational cutting and landing sports which included basketball, volleyball, field hockey and soccer. – Inclusion criteria: subjects had to have performed moderate exercise at least 4 times a week for at least 45 mins in duration for 2 months prior to participation in the study, had to have no history of significant lower extremity injury, were injury-free at the time of data collection, females had to have not taken oral contraceptives for the past 6 months and had experienced a normal 27-31 day cycle for the past 3 months. – Exclusion: if they had participated in collegiate level athletics at any time	All subjects came to the lab prior to data collection for a pre-collection session to familiarize them with the KT-1000. Female subjects were given ovulation kits that detect the surge of LH immediately preceding ovulation to determine the time of ovulation. Each completed an informed consent and was instructed to refrain from exercise prior to data collection on that day. Females assigned to start data collection at the onset of menses or the onset of ovulation and completed 5 day data collections following the same protocol each which occurred at a specific time to correlate with different phases of the menstrual cycle – onset menses, 10 and 12 days post onset, 7 and 9 days post ovulation. Male subjects started collection on a day of convenience and completed 3 data collections following the same protocol as females, 10-12 days apart	Exercise: • Subjects ran on a treadmill for 15 min at a self-selected pace. • The subject was asked to set the pace to correspond to what they would consider “moderately hard”. Once this pace was established, it was used throughout the rest of the data collections. • For each subsequent treadmill run, the subject was instructed to warm up during the first three minutes and to reach the predetermined pace by the end of 3 min. • immediately following the treadmill run, subjects were instructed to perform three dynamic lower extremity tasks consisting of the following: two minutes of weaving (grapevine) along a 20 m long runway; two minutes of left and right cutting along 2 m wide runway; and, 25 jump downs from a 46 cm step. KT-1000 arthrometer. Blood samples: looking at estrogen levels across the menstrual cycles	Knee laxity increased following exercise but did not differ across genders.
Deie et al 2002	To determine whether ACL laxity in women changes significantly during their menstrual cycles	Case-Control study.	20	16 women, aged 21-23 (average age of 21.6 years) 8 men No BCP Regular menses (28±4 days) No previous knee injury	Measurements of their knees using KT-2000 arthrometer were performed 2-3 times every week over 4 consecutive weeks. Women measured their basal body temp daily for 4 weeks and estradiol and progesterone levels in their blood weekly. From their BBT or estradiol and progesterone levels the follicular, ovulatory, and luteal phases were delineated. 342 measurements were made. 158 measurements= follicular phase, 56=ovulatory, 128=luteal phase – Men’s measurements of their knees using KT-2000 were performed 3 times a week over a 3 week period. 144 measurements were taken with 48 measurements in each of the first, second and third phases (based on when the measurement was taken in what week)	Arthrometer Basal body temp Blood samples	In men, no statistical significance with anterior movement through the 3 week period. In women, anterior or terminal stiffness was higher in the follicular phase than the ovulatory phase, which was in turn higher than the luteal phase.
Hertel et al 2006	To investigate changes in neuromuscular control and laxity at the knee across the menstrual cycle	Cross-sectional study.	19	– 14 female collegiate athletes • age 19.3 ± 1.3 years • height 163.6 ± 8.5 cm • mass 59.4 ± 6.8 kg. – normal ovulatory menstrual cycles (28-35 day cycles) with confirmed ovulation – not taking oral contraceptives – no history of serious knee injury – Subjects participated in either competitive soccer or stunt cheerleading	Urine hormone levels and ovulation measured. Neuromuscular performance and laxity of knee were measured in each phase of the cycle.	Hormone levels. Peak flexion and extension torque. Hamstring: quadriceps strength. Joint position sense. Centre of pressure velocity. Anterior knee laxity.	Neuromuscular control and knee joint laxity do not change substantially across the menstrual cycle despite varying estrogen and progesterone levels.

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Table 4a:
Studies Investigating ACL Laxity (continued)

Reference	Objective	Study Design	Score /38	Patients/Conditions	Methods	Main Outcome Measures	Main Results/Conclusions
Abt et al 2007	To determine if changes in the levels of estradiol and progesterone significantly alter fine motor coordination, postural stability, knee strength and knee joint kinematics and kinetics between the menses, post-ovulatory, and mid-luteal phases of the menstrual cycle.	Cross-sectional study.	19	10 physically active females were recruited from the local university <ul style="list-style-type: none"> Age: 21.4 ± 1.4 years Height: 1.67 ± 0.06 m Mass: 59.9 ± 7.4 kg who do not use oral contraceptives. <ul style="list-style-type: none"> – subjects were screened for: <ul style="list-style-type: none"> history of injury nutritional practices menstrual dysfunction thyroid dysfunction, and physical activity. Exclusion: <ul style="list-style-type: none"> mid-luteal progesterone level less than 10 ng/ml history of serious knee injury or other lower extremity injury within the prior 6 months previous or current eating disorder previous or current menstrual dysfunction 	Measured single leg postural stability, fine motor coordination, knee strength, knee biomechanics, and serum estradiol and progesterone.	Estradiol Progesterone Fine motor coordination Postural stability Hamstring: quad strength Knee flexion and valgus excursion Peak proximal ant tibial shear force Flexion and valgus moments at peak proximal ant tibial shear force	Neuromuscular and biomechanical characteristics are not influenced by estradiol and progesterone fluctuations
Park et al 2009	To determine whether changing hormone levels influence joint laxity and stiffness of a non-contractile knee joint and knee joint structures using a new analysis technique. To determine whether subsets of women exist who demonstrate or do not demonstrate changes in knee laxity in response to circulating hormone levels throughout their menstrual cycle.	Observational Study	15	26 women <ul style="list-style-type: none"> age, 22.7 ± 3.3 years height, 170.1 ± 7.1 cm mass, 65.0 ± 9.3 kg body mass index (BMI), 22.4 ± 2.5 average menstrual cycle, 28.9 ± 2.7 days and activity level, 8.7 ± 4.4 h/wk. Most subjects regularly participated in a sports activity at a recreational level. Inclusion: <ul style="list-style-type: none"> no previous knee injuries never been pregnant have regular menstrual cycles (approximately 28 days) with no missed cycles over the previous 24 months no oral contraceptive use for the previous 6 months 	Each completed a blood draw and laxity tests at 3 different times during her menstrual cycle. Blood samples were collected to determine the levels of estradiol and progesterone, indicating an appropriate phase of testing. Passive laxity and stiffness were measured using arthrometer	Self reported menstrual history Arthrometer Measured for estradiol and progesterone	Lowest hormones in follicular phase, highest in luteal phase Lowest estradiol and progesterone were in follicular and highest were in luteal phase – Greater knee laxity at 89N was recorded in ovulation compared to luteal phase – Max knee laxity during ovulation significantly exceeded max laxity during follicular phase
Park et al 2009 (Relationship between...)	To investigate whether changing knee laxity during the menstrual cycle correlates with changing knee joint loads in a cutting maneuver	Cross-sectional study	13	25 healthy women: <ul style="list-style-type: none"> mean age 22.7 years height 170.2 cm mass 64.7 kg body mass index 22.3 menstrual cycle 28.9 days activity levels 8.7 h/week The subjects regularly participated in sports activity at a recreational level. Inclusion: <ul style="list-style-type: none"> a normal menstrual cycle no history of oral contraceptive use no knee injury within the preceding 6 months 	Serum hormone concentrations were assessed and knee joint laxity was measured during the follicular, ovulation and luteal phases. Performed 10 trials of a cutting maneuver.	Knee joint laxity Peak knee angle Knee joint moment Knee joint impulse Blood hormone levels	Increased knee laxity was observed during ovulation compared with the luteal phase, but no significant changes in knee mechanics corresponding to menstrual phases were found.

Table 4b:
Studies Investigating ACL Injury

Reference	Objective	Study Design	Score /38	Patients/Conditions	Methods	Main Outcome Measures	Main Results/Conclusions
Beynnon et al 2006	To determine the relationship between the menstrual cycle and ACL injury	Case-control study	30	200 subjects, female only	Direct measurement of blood concentrations of progesterone and estradiol at time of injury. Self reported menstrual history.	Serum levels of progesterone and estradiol. Menstrual history.	The risk of sustaining an ACL tear increases during the pre-ovulatory phase of the menstrual cycle as compared to the post-ovulatory phase (3x)
Ruedl et al 2009	1. investigate a possible protective effect of oral contraceptive use against ACL injuries in rec. skiers 2. compare the frequencies of non-contact ACL injuries in the preovulatory phase with that in the postovulatory phase	Case-control Study	23	93 females With non-contact ACL injuries 93 female recreational skiers with a non-contact ACL injury and 93 age matched controls	MRI was used to diagnose ACL injury. Only non-contact ACL injuries were included. On and off pill users were included. Female recreational alpine skiers are treated in a ski clinic, which is located in close proximity to the ski resort.	Questionnaire, with information on: • Age • Height • Weight • Previous knee injuries of either leg A second questionnaire developed and validated by Wojtys et al. was used: • age at the start of menstruation • date of last menstruation • average length of menstruation • the use of oral contraceptives	ACL injury is greater in the pre-ovulatory phase. Use of oral contraceptives and previous knee injuries showed no association with ACL injury rate.
Adachi et al 2008	To determine if non-contact ACL injuries occurred randomly or correlate with a specific phase of the menstrual cycle in teenaged female athletes	Case-control Study	22	18 females aged 11-18 ACL injury (non-contact) confirmed by MRI. No history of pregnancy. No use of oral contraceptives or hormone stimulating meds. Consistent menstrual cycle last 6 months. Competitive or recreational athlete.	Subjects completed a questionnaire that documented injury history, menstrual history and activity level at each phase of the cycle to determine in which phase their injury occurred.	Questionnaire: • injury history • menstrual history • subjective activity levels on each phase of the menstrual cycle A second questionnaire developed by Wojtys et al. was used to document: • age • height • weight • detailed history of the menstrual cycle (including frequency and regularity, date of last menstrual period, average length of cycle, premenstrual and menstrual symptoms, and oral contraceptives)	Significant statistical association was found between the phase of the menstrual cycle and time of ACL injuries. More injuries occurred during the ovulation phase (72%). Few injuries in luteal and follicular phases.
Wojtys et al 1998	To investigate the variation in ACL injury rates during the female monthly cycle	Observational Study	17	28 women with ACL tears in the last 3 months.	Women with a history of either irregular or missed menstrual cycles were excluded and only patients with noncontact ACL injuries were included. – 28 met these criteria and were asked to fill out a questionnaire and provide their age, height, weight, level and freq. of sports participation, and previous knee injuries. Asked to document the date and mechanism of acute ACL injury, including the number of minutes played before the injury occurred, whether the injury occurred during a practice or game and the nature of the ACL injury. Each woman was asked to provide a detailed history of her menstrual cycle, frequency and regularity, date of last period and average length, premenstrual symptoms and oral contraceptive or hormone replacement use.	Questionnaire: • age • height • weight • level and frequency of sports participation • previous knee injuries • date and mechanism of the acute ACL injury (including the number of minutes played before the injury occurred, whether the injury occurred during a practice or game situation, and the nature of the ACL injury) • history of menstrual cycle (frequency, regularity, date of last menstrual period, average length of cycle, premenstrual symptoms, and oral contraceptive use	The association between the ovulatory phase and the rate of ACL injury is statistically significant. Further information needed.

is associated with greater ligament laxity. The current review found that the majority of studies (4 studies out of 8) that reported a positive association between increased laxity, injury and the menstrual cycle implicated the ovulatory phase as the most significant time for laxity to occur. These findings are somewhat in concordance with the conclusions of Zazulak et al², who identified the greatest laxity during the ovulatory and post-ovulatory phases. In contrast, Hewett et al¹ identified that the greatest injury risk occurred during the pre-ovulatory phase.

Overall, limited evidence from the three reviews supports the theory that ACL ligament laxity varies with the fluctuations of the hormonal cycle, thus predisposing female athletes to ACL injury. What remains to be clarified is what phase of the cycle females are most at risk. Future research should aim to clarify whether this fluctuation in ligament laxity is consistent amongst all women with hormonal fluctuations throughout their cycle, or whether ligament laxity is dependent on the absolute or relative hormonal level changes throughout a woman's cycle. Future studies can address this issue by focusing more stringently on measuring hormone levels and by examining women over a longer period of time (more than one cycle) to try and establish whether a trend in hormonal levels and ligament laxity can be established and a phase of increased risk identified.

Limitations

Many limitations were encountered throughout the review of the recent literature. Limitations included: the majority of the research was conducted during only one menstrual cycle per participant, which does not account for variation from cycle to cycle; there was no standardized definition of the phases of the menstrual cycle, resulting in variation of the phases from paper to paper; typically only one knee was assessed per participant and therefore the results cannot be confidently distinguished from conditions that may have been pre-existent in that knee; the majority of studies were conducted exclusively on women with normal 28-day cycles and; women who were on oral contraceptives were often excluded by design. The average woman, and the elite athlete, are not so easily categorized- especially since menstruation may cease among some high performance athletes with low body mass indexes, and thus the results reported in these studies may not be extrapolated to the female population most at-risk of ACL injury.

Other limitations of this review are that we only searched for articles in English and did not go further back than 1998, since that was where other similar reviewers ended. Another limitation was our use of an adapted Sacket instrument for the purposes of this review. Although it had face validity to do so, to the best of our knowledge there is no evidence that specifically supports the validity of the modifications we made to Sackett's original instrument. Furthermore, this tool does not assess important aspects including confounding factors, participation rates, study population consistency or selection bias. Lastly, 5 of the 13 studies accepted in this review are cross-sectional and therefore cannot be used to determine any cause and effect relationship between menstrual cycle and knee ligament laxity.

Conclusions

There is preliminary evidence to suggest that ligamentous laxity of the knee changes throughout the course of a women's menstrual cycle, with the majority of studies reporting the greatest change is during the ovulatory phase. However it is important to note that the evidence remains inconsistent and is based predominantly on studies of low methodological quality. Certainly better clinical trials need to be conducted that follow women over several menstrual cycles and that include women not on a standard 28-day cycle. Moreover, clinical trials investigating changes to ACL laxity should assess both knees. That said, this review, as well as the previously published study by Hewitt et al^{2,3}, suggest that healthcare professionals caution their female patients that injury may occur during different phases of their menstrual cycle- particularly the ovulatory phase. It may be prudent for female athletes to take the necessary precautions when exercising vigorously during certain stages of their menstrual cycle. Since it does appear that at least some women may experience ligament laxity during different phases of their menstrual cycle, patients can be encouraged to diarize any injuries they may sustain and monitor if they typically occur during a particular phase of their menstrual cycle. In addition, due to the lack of consensus on the phase at which increased laxity and injury occurs, healthcare professionals can provide greater benefit than a warning of the possibility of increased laxity with the implementation of a training program that focuses on balancing lower limb musculature strength as a preventative measure.

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Spontaneous resolution of symptoms associated with a facet synovial cyst in an adult female – a case report

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Background: *Facet cysts are implicated in neural compression in the lumbar spine. Surgery is the definitive treatment for symptomatic facet cysts since the failure rate for conservative treatment is quite high; however, the role of physical/manual medicine practitioners in the management of symptomatic facet cysts has not been well explored. This case report will add to the body of evidence of spontaneous resolution of symptoms associated with facet cysts in the chiropractic literature.*

Case: *A 58 year old female presented with acute low back and right leg pain which she attributed to a series of exercise classes that involved frequent foot stomping. Physical examination did not elicit any objective evidence of radiculopathy but MRI and CT scans revealed a facet cyst impinging on the right L5 nerve root. Injections and surgery were recommended; however, the patient's radicular symptoms completely resolved after three months without surgical intervention.*

Summary: *There is currently a paucity of data in the literature regarding the chiropractor's role in the*

Contexte : *Les kystes synoviaux lombaires sont impliqués dans la compression nerveuse au niveau du rachis lombaire. La chirurgie est le traitement définitif pour les kystes synoviaux lombaires symptomatiques puisque le taux d'échec du traitement conservateur est assez élevé, mais le rôle des médecins et des chiropraticiens dans la gestion de ces kystes n'a pas été suffisamment exploré. Cette étude de cas va enrichir l'ensemble de la preuve de la résolution spontanée des symptômes associés à des kystes synoviaux lombaires dans la documentation de la chiropratique.*

Cas : *Une femme de 58 ans souffrant d'une douleur aiguë au niveau lombaire et à la jambe droite attribue cette douleur à une série de cours de conditionnement physique qui comportaient des trépignements fréquents. L'examen physique n'a révélé aucune preuve objective de radiculopathie, mais l'IRM et la tomodensitométrie ont révélé un kyste synovial lombaire qui pressait la racine nerveuse L5 droite. On a recommandé des injections et la chirurgie, mais les symptômes radiculaires du patient ont complètement disparu après trois mois, sans intervention chirurgicale.*

Résumé : *Actuellement, il y a un manque de données dans la documentation concernant le rôle du chiropraticien dans la gestion des kystes synoviaux*

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management of symptomatic facet cysts. The case presented here has added to this literature and possible areas for future research have been explored.

KEY WORDS: facet, cyst, lumbar spine

lombaires symptomatiques. Le cas présenté ici a enrichi ce corpus et a permis d'explorer des domaines possibles de recherches futures.

MOTS CLÉS : facette, kyste, rachis lombaire

Introduction

Sciatica, defined as pain that radiates into the buttock, hip, and down one or both legs to the foot, affects only 10% of patients with low back pain¹ but is a significant cause of pain and suffering in patients and a diagnostic challenge for clinicians. Lesions that are associated with sciatica that are being reported in increasing numbers are facet cysts, although this increased frequency is likely attributed to advances in imaging rather than a reflection of prevalence.²

Surgical excision has been recognized as the definitive treatment for symptomatic facet cysts.^{2,3,4} Conservative forms of treatment have not been as widely documented and the reported success rates have been substantially lower than that of surgery.^{3,4,5} Furthermore, management of symptomatic facet cysts in the chiropractic literature has been reported in only three cases.^{6,7} In order to better explore the chiropractor's role in the management of facet cysts and to illuminate potential areas of research, more data must be documented regarding these lesions. This current paper will add to the body of evidence by presenting a case of spontaneously resolving symptoms associated with a facet cyst.

Case History

A 58 year old female presented to a private chiropractic clinic with a complaint of right sided lower back pain that began 5 days previously. The patient attributed the onset of her symptoms to a series of Qigong classes in which she was instructed to frequently stomp her feet. She had been taking these classes for one month prior to the onset of her symptoms. The pain was constant and described as

dull in character. It was rated as 2 out of 10 on a Numeric Rating Scale with 0 being "no pain" and 10 being "pain as bad as it could be". However, certain positions or movements (included sitting, standing, walking, twisting of the lumbar spine and transitioning between recumbent, sitting and standing positions) caused sharp radiating pain down the posterolateral aspect of her right leg to the plantar aspect of her right foot that was rated as 10/10 and would usually last for 15-20 minutes. None of these aggravating factors were consistent in causing the leg pain. Relief was obtained by lying down on her back; however the pain consistently caused her to wake up twice at night – once at approximately 2am and again at approximately 7am. She could not recall her sleeping position or any specific events that occur during these times. She denied any night sweats and did not report any recent weight loss, fever or trauma. Her medical history and systems review did not reveal any other past or present injuries or conditions and her family medical history was unremarkable.

The patient's history revealed that she was otherwise healthy and did not smoke or drink any alcohol and was not on any medications. Her diet was vegetarian although she does eat fish. She had three adult children and all three pregnancies and births were uneventful. She was a dentist but was only working part time. Prior to the chiropractic session, she did not seek any other forms of treatment. She denied seeing any other chiropractors but opted to see one due to her daughter's insistence.

Physical examination revealed a woman 5'1" tall weighing 110 lbs with anterior head carriage but otherwise no spinal antalgia. No muscle atrophy or trophic changes were observed in her lower limbs. Observation of

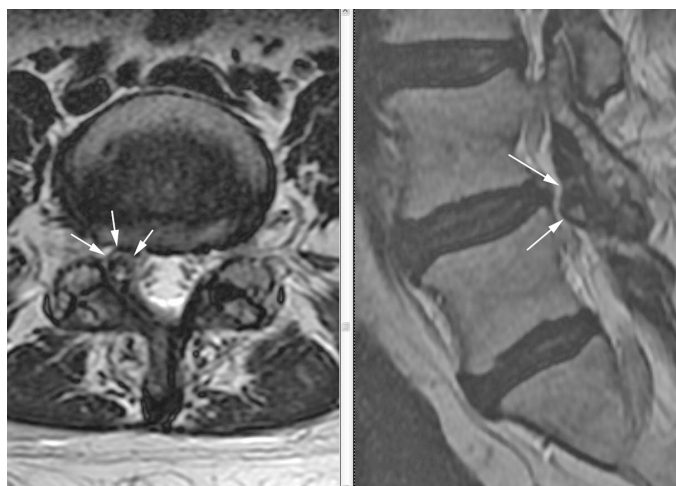


Figure 1. Axial and parasagittal FRFSE (fast relaxation fast spin echo) T2 sequences show a cystic structure with hypointense rim and hyperintense content projecting ventrally from the right L4-5 facet joint and into the right lateral recess (white arrows). There is a mild disc bulge at this level (not visualized in this image).

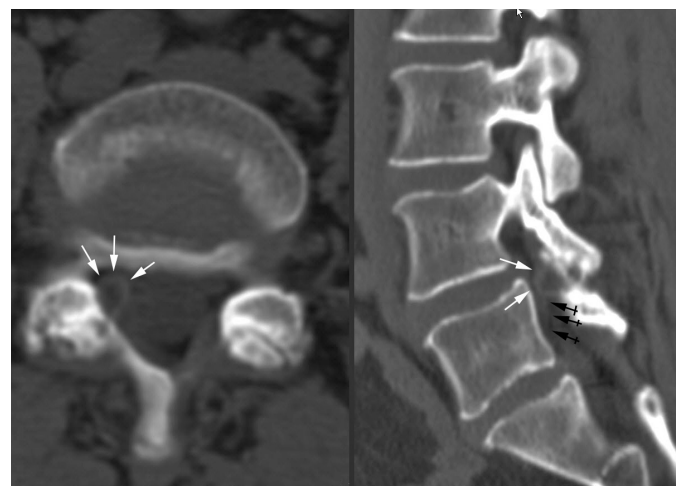


Figure 2. Axial and reformatted right parasagittal CT views in bone windows show a juxtaarticular cyst with a thin rim of attenuated density (white arrows), occluding the right L5 lateral recess and compressing the right L5 nerve root (black arrows) anterior to a hypertrophied and narrowed right L4/5 facet joint with subchondral cystic changes.

gait revealed that she walked with a slight limp favouring the right side. She was able to walk on her heels and toes but had mild unsteadiness on her heels. Active ranges of motion of the lumbar spine were full in extension and lateral flexion to either side. Forward flexion was reduced by 25% and reproduced her radicular symptoms. Neurological examination revealed normal and symmetrical sensation, 5/5 muscle strength and 2+ reflexes at all levels in the lower extremities. Straight leg raise was 90° on the left and 70° on the right due to hamstring muscle tightness. However, there were no signs of nerve root tension or exacerbation of her right leg symptoms. The Figure 4 manoeuvre produced local back pain bilaterally. Thomas' test (knee to chest manoeuvre) produced a pulling sensation in the lumbar spine. Posterior shear test⁸, Gaenslen's test⁸ and Yeoman's tests⁸ were non-provocative. Palpation of the right hamstring musculature revealed hypertonicity compared to the contralateral side. The lumbar paraspinal and gluteal muscles were normal in tone and bilaterally symmetrical.

Chiropractic care consisted of needle acupuncture, stretches for her hamstrings and gluteal muscles and a

neurogliding technique for her sciatic nerve as described by Butler⁹. Within a few days of the initial treatment, the patient experienced intolerable pain and went to the emergency department where she was prescribed pain medications. Due to the patient's symptoms of severe pain, her family physician requisitioned a CT scan and an MRI. The MRI revealed right L4-5 lateral recess narrowing secondary to facet changes, disc bulge and a small cystic lesion (Figure 1). A CT scan corroborated these findings and confirmed the presence of a 7mm synovial cyst impinging on the right L5 nerve root (Figure 2).

A course of cortisone injections were recommended followed by surgical removal if the injections proved to be ineffective. The patient's back pain was significantly exacerbated after the first injection however, so she refused any further medical interventions. She did not return to the initial chiropractor but sought acupuncture from a Traditional Chinese Medicine (TCM) provider for 6 sessions. In addition, she purchased an inversion table in order to self-administer gravity assisted traction. She did not find any of these treatment modalities helpful. The only relieving factor for her was Tai Chi. Three months

after initial presentation, the patient reported that the radicular symptoms had completely resolved. At 2 years follow-up, she continued to be symptom free.

Discussion

The etiology of facet cysts remains unclear. Synovial cysts were originally described by Baker as resulting from degenerative processes in a joint.¹⁰ The most common explanation for cysts is that they frequently occur as a result of lumbar spine stress (excessive loading) in addition to a degenerative lesion of the soft lumbar tissue.¹¹ It has been demonstrated that a statistically significant association exists between facet cysts and the frequency and severity of facet joint osteoarthritis and with spondylolisthesis.^{3,12} Increased mobility of the involved joint appears to be an important precursor to the formation of the cysts. This notion is supported by the statistic that the majority of synovial cysts are found at the L4–L5 level which is considered the most mobile lumbar level.^{3,4}

A literature search was conducted on MEDLINE using the search terms “synovial cyst” (MeSH and keyword) or “facet cyst” (keyword) combined with the following terms: “lumbosacral region” (MeSH); “spine” (MeSH and keyword); “lumbar” (keyword); “epidemiology” (MeSH and keyword); “therapeutics” (MeSH); “therapy” (keyword); “prognosis” (MeSH and keyword). The publication dates were from inception to 2011 with no limiters. Reference lists from articles were searched for additional pertinent studies.

Three articles were found in the literature pertaining to the epidemiology of facet cysts. One article retrospectively reviewed 303 consecutive MRI's of patients referred primarily for back pain or radiculopathy at a single facility and found the prevalence of anterior lumbar facet cysts projecting into the vertebral canal to be 2.3%.¹² A case series study reported that of 1800 CTs and MRIs of the lumbar spine, facet cysts were present in 0.6% of them.¹³ Another study identified 10 cysts in 2,000 reviews of CT lumbar spines.¹⁴ The majority of facet cysts occur in the lumbar spine, although rare cases of cervical and thoracic lesions have been reported.⁴

Patients with facet cysts are typically in their mid 60's.^{3,4,11} Aside from the commonality of onset at an older age, facet cysts do not seem to exhibit any clinical symptoms that are specific to them. Low back pain is usually the initial symptom followed by unilateral or bilateral

radicular pain. Neurogenic claudication is the next most common symptom. Sensory and motor deficits in a radicular distribution are found in less than half of patients^{3,4,11} whereas reflex changes are found in approximately 60% of patients¹⁵. Cauda equina syndrome may also occur; however, this is rare.^{3,4,11} If a cystic lesion is suspected, an MRI is considered the diagnostic imaging procedure of choice.³ On MRI, there is a well-defined rim that appears hypointense on all the MR sequences with contents that may be fluid, blood, air, calcification or fat.¹⁶

The most widely reported form of treatment for symptomatic facet cysts is surgery with the majority of the cases undergoing decompression (removing the thick, viscous contents of the cyst) or excision. Spinal fusion is sometimes performed but the value of this is still unclear.² Khan reviewed 9 case series with a total of 460 patients and Epstein reviewed 14 case series with a total of 410 cases of facet cysts that were treated with laminectomy and resection.^{3,4} Follow-up times for the cases varied considerably, ranging from 3 months to 10 years and averaging at 6 months. Outcome measures were defined as: excellent (no residual symptoms/signs); good (mild residual symptoms/signs); fair (minimal to no improvement); and poor (worse). “Good” to “Excellent” outcomes were reported in 65 to 100 % of the cases. Complications of cyst recurrence, cerebrospinal fluid fistula, discitis, epidural hematoma, seroma, deep vein thrombosis and death were reported in a small percentage of the cases.^{3,4}

Bydon reviewed 82 studies encompassing 966 patients who underwent surgery to determine postoperative symptomatic relief, recurrent back and leg pain and cyst recurrence after resection and decompression.² The percentages of patients experiencing complete resolution of their back or leg pain after surgery were 92.5% and 91.1%, respectively with recurrence rates of 21.9% and 12.7%, respectively at a mean follow-up of 25.4 months. Same-level synovial cyst recurrence occurred in 1.8% of patients after decompression alone but 0% in patients who had decompression and fusion. Approximately 6% of patients required reoperation for correction of spinal instability and mechanical back pain.

A relatively small number of cases have been published about conservative approaches to symptomatic facet cysts in comparison to operative approaches. Khan reported on 3 case series with a total of 59 patients³ and Epstein reviewed 2 case series including 34 cases⁴ treated with ster-

oid injections into the facet joints. Success rates ranged from approximately 33% to 43% after an average of 6 months of follow-up. Shah conducted a literature review of conservative treatments for facet cysts and found only 149 cases in total (this included 10 of the authors' own cases).⁵ Conservative measures that were reported included facet injections, epidural injections, bed rest, oral analgesics, physical therapy, bracing and chiropractic care. A success rate of 53% was reported for the combined 149 cases. The endpoint used to determine failure of treatment was the need for subsequent surgery.⁵

Although surgery is currently considered the most successful treatment for symptomatic facet cysts, evidence is based solely on case reports. Moreover published cases of symptomatic facet cysts in the physical/manual medicine literature are rare.^{6,7} In order to provide guidance for clinical decisions such as effective treatment approaches (ranging from exercises to watchful waiting) and recommended wait times before surgical referral, population based studies and randomized clinical trials need to be conducted.

In the present case, the patient's age of onset, non-specific clinical presentation, co-morbid imaging findings and location of the cyst at L4-L5 are consistent with previously published data. Although she had symptoms of pain radiating down her right leg, there were no objective findings in the physical examination to corroborate any radiculopathy. Previously published cases^{6,7,17,18,19} also lacked hard neurological findings. This could be indicative of a subgroup of patients with facet cysts that have a positive prognosis for symptom resolution. In addition, imaging studies revealed a facet cyst concomitant with facet degeneration and a disc bulge. Interestingly, lumbar disc lesions share a similar clinical presentation to facet cysts and the pathophysiology of both involve excessive mechanical loading of aberrant structures of the lumbar spine.¹⁵ It is therefore possible that rather than being discrete entities, disc herniations and facet cysts develop from a common underlying process. If this is the case, elucidating the process will help us to prevent or better manage these debilitating conditions.

After three months, the patient's symptoms spontaneously resolved. This timeframe approximates what was reported in previous cases of resolving symptoms of facet cysts^{6,7,17,18} and may be suggestive of an appropriate period of watchful waiting. Despite multiple treatment mo-

dalities being used, the patient only reported relief with gentle exercises. Similar observations were reported by Taylor in which various modalities were used but the patient only responded to lumbar stabilization exercises.⁶ Cox's multimodal treatment also included lumbar stabilization exercises but the effective/ineffective components of the treatment regimen were not delineated.⁷ Exercise therefore may be a key component of treating symptomatic facet cysts although there is insufficient information to specify what type of exercise.

This study has some limitations. Firstly, the patient sought multiple forms of treatment so it was difficult to determine which or if any of the modalities contributed to the resolution of her symptoms. Secondly, follow-up imaging was not performed to determine if the patient's facet cyst had disappeared or if her symptoms merely resolved without any structural change. This would have further illuminated the link between imaging findings and symptoms.

Summary

Facet cysts are implicated in causing symptoms of back pain and radiculopathy in patients in their mid sixties. The current literature indicates that surgery is the most successful form of treatment for symptomatic facet cysts; however, there is a paucity of data in the physical/manual medicine literature regarding these lesions. The case presented here has added to the body of evidence for symptomatic facet cysts. Possible areas for future research have been explored.

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Clinical and Radiological Anatomy of the Lumbar Spine
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Churchill Livingstone, 5th Edition, 2012

Softcover, 272 pages, \$80.95 CDN

Clinical and Radiological Anatomy of the Lumbar Spine written by Nikolai Bogduk is a valuable addition to the library of any practitioner involved in the treatment of back pain. The book is divided into twenty chapters that cover the basic anatomy of the spine, biomechanics, pathological conditions and radiological imaging of the spine. The book provides a deeper understanding of the clinical anatomy and biomechanics of the spine that aide in the treatment of low back disorders. The chapters on radiological anatomy provide the practitioner with a review in radiology that may aid in the interpretation of diagnostic images in practice. Included in these chapters are magnetic resonance images, which are often challenging to interpret in practice. The book is published in color providing informative diagrams of anatomy that aid in the understanding of key concepts.

A minor limitation of this book is the antiquated reference list that is provided at the end of each chapter. Though the author acknowledges that the principles of anatomy have not significantly changed, adding more current research would have further improved this edition. Adding cadaver images in future editions would also help practitioners to visualize the anatomy of the lumbar spine.

Overall, this book provides a detailed overview of relevant anatomy and radiology. I recommend it as reference for any practitioners looking for a concise guide on the lumbar spine.

Ismat Kanga, BSc, DC
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Managing Sports Injuries

Christopher M. Norris

Churchill Livingstone Elsevier 4th edition, 2011

Hardcover, 421 pages, \$ 141 CDN

Managing Sports Injuries is written as a guide for students and clinicians of physiotherapy and other manual therapies involved in the treatment of athletic injuries. The text contains 19 chapters, which are divided into two major sections. The first section outlines the principles of sport injuries including injuries, healing and training. The second section contains chapters related to injuries and conditions specific to regions of the body. Each chapter contains information on assessment, diagnosis and treatment including soft tissue therapy, mobilization and rehabilitative exercises. The chapters are well laid out with subheadings, diagrams and illustrations. Boxes for definitions and key points are present throughout the chapters that reiterate important concepts.

The strengths of this book are the helpful illustrations, rehabilitative exercises and clinical pearls that are provided. However, the book has some limitations, which cannot be disregarded. References are provided at the end of each chapter, however, the majority of references are not up to date. Furthermore, the author includes course notes as a reference, which may be unattainable for readers. The author also includes pre-manipulative testing of the cervical spine for which there are no reliable provocative tests to screen for vertebrobasilar insufficiency, according to the most recent literature.

An updated version of the book, which incorporates more current evidence and accessible references, has the potential to be a valuable reference for clinicians and students.

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Conditioning for Strength and Human Performance
2nd Ed. 2013

T. Jeff Chandler, Lee E. Brown

Wolters Kluwer/Lippincott Williams & Wilkins,
Philadelphia, PA

569 pp; \$84.95 CAD

ISBN: 978-1-4511-0084-6

The second edition of this book consists of 23 chapters divided into four sections focusing on Basic Sciences, Organization and Administration, Exercise Prescription and Special Topics. The main authors are Strength and Conditioning Specialists at US based Universities. Although each chapter in the book is independently written by various field experts, the book still maintains excellent flow and continuity. Improving on first edition, the authors have added new chapters on evidence based practice, training periodization, sports psychology, gender issues and implement training.

The chapters are well organized and are very “clinician friendly”. As the authors do an excellent job of breaking down each chapter into scientific content, real life case scenarios, content application, exercise examples, graphs, tables and highlighted take home points. The opening chapters of the book provide background information related to strength and conditioning science that is most suitable for the beginner or intermediate reader. An advanced reader may seek further performance enhancement or injury prevention knowledge as opposed to reviewing basic sciences principles.

This book is a suitable resource for any practitioner aiming to advance their knowledge in the strength and conditioning field. The book is clinically applicable for many health professionals and can assist in decision making for active care prescription for your patients or clients. With a price tag of \$84.95 CAD I would consider this book an excellent deal.

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Fascia: The Tensional Network of the Human Body

Robert Schleip, Thomas W. Findley, Leon Chaitow,
Peter A. Huijing

Churchill Livingstone, Elsevier, Toronto Ontario

566pp

\$65.95

ISBN: 978-0-7020-3425-1

The treatment and assessment of fascial tissue and fascial pathology has become increasingly popular over the past several years, particularly in the world of manual therapy. This has led to the publication of the first text dedicated to this tissue, entitled *Fascia: The Tensional Network of the Human Body*. A number of the world’s leading researchers and clinicians have been brought together to present the first comprehensive title on fascia. It has been written to address the needs of scientists and clinicians alike.

The first section of the text provides an in depth review of the scientific foundations regarding fascia including anatomy, communication, force transmission and physiology. The second section focuses on the clinical application of the basic sciences and covers the diagnosis and treatment of a number of fascia related disorders. Finally the third section discusses the challenges associated with researching fascial tissues as well as future directions that need to be taken in order to better understand this complex and vital tissue.

The information contained within this text provides the reader with the necessary scientific background to apply the proposed evidence based treatments for fascial disorders. The current trends within the scientific literature are pointing towards a need for a stronger understanding of this highly integrated tissue. The reader is provided with an up to date comprehensive review of fascial related research allowing them to address fascial disorders within their patients and to further improve the state of the literature regarding fascia.

Jason Porr, BSc (Hons) HK, DC

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Anatomy for Runners: Unlocking Your Athletic Potential for Health, Speed, and Injury Prevention

Jay Dicharry, MPT, SCS

Skyhorse Publishing, New York City, NY, 2012

309 pages, paperback, \$14.95 USD

ISBN: 978-1-62087-159-1

Anatomy for Runners consists of ten chapters progressing from anatomy and running biomechanics, to assessment and rehabilitation techniques. Jay Dicharry is a biomechanics researcher and therapist at SPEED Clinic and Motion Analysis Lab, and instructor at University of Virginia. As a competitive athlete, therapist, and coach; Dicharry integrates clinical and research experience for optimizing performance and combating injury.

Anatomy for Runners offers a broad understanding for the time-burdened clinician seeking basic principles of gait-analysis, footwear, and corrective exercises. Dicharry provides well-detailed appendices for those interested in further research on the anatomy and biomechanics of running related injuries and treatment approaches.

The chapters are logical and well organized, containing excellent use of real-life scenarios, analogies, pictures, and highlighted critical points. Particularly, Dicharry engages the reader using practical and understandable information on injury prevention and performance. Reader directed activities are integrated throughout the novel to encourage self-evaluation and self-care. However, Dicharry does not discount the importance of seeking professional opinion when deemed appropriate.

I would recommend this book to runners, coaches, and clinicians interested in an introduction to running injuries and assessment protocols. The book offers tremendous value, and can be placed in all sporting clinics waiting rooms across the country.

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Sports Nutrition for Endurance Athletes, 3rd Edition

Monique Ryan, MS, RD, CSSD, LDN

Velopress, Boulder Colorado, 2012

Soft cover, 432 pages

\$23.95 (CDN)

ISBN 978-1-934030-82-0

The 3rd edition of Sports Nutrition for Endurance Athletes is written by Monique Ryan, an internationally renowned sports nutritionist with over 25 years of professional experience. This text provides a comprehensive nutritional guide, aiding athletes to better optimize their performance in endurance sports (Triathlon, Cycling, Distance Running and Swimming).

The author explores the complicated topics of sports nutrition, and simplifies the ideas in a clear and concise format. The nutritional information is well organized and easy to comprehend. Nutritional guidelines are highlighted in tables and figures throughout the text for quick reference. Separate chapters provide in depth nutritional recommendations for each endurance sport (Triathlon, Cycling, Distance Running and Swimming), allowing athletes to form specific nutritional plans.

This text exceeded my expectation as a complete nutritional guide for a number of endurance sports. Sports Nutrition for Endurance Athletes is not only exclusive to high performance athletes, it can also be used by the “weekend warrior”, and anyone who is interested in maintaining a healthy lifestyle. This text is an excellent addition for coaches, sports chiropractors and those treating athletes and provides a comprehensive review of the literature to better aid endurance athletes through the training phase to competition day.

Sean Y. Abdulla, BKin (Hons), MSc, CK, DC

CMCC Sports Sciences Resident

Studying A Study & Testing A Test: Reading Evidence-Based Health Research 6th Ed.

Richard K. Riegelman

Wolters Kluwer/Lippincott Williams & Wilkins,
Philadelphia, PA

338 pp; \$71.95 CAD

ISBN: 978-0-7817-7426-0

Studying a Study and Testing a Test aims to educate readers on how to critically appraise health research. New additions within the sixth edition include “learn more boxes” which extrapolate on various topics and provide practical examples and “mini studies” which outline common errors that may occur when conducting research and how to avoid making these errors.

The text is designed around the “M.A.A.R.I.E Framework”, the author’s mnemonic device, used to critique research studies. Using this method reminds readers of the various components to be analyzed: Method, Assignment, Assessment, Results, Interpretation, and Extrapolation. This approach helps the reader develop a systematic method of evaluating research, highlights key components which go into a study and discusses ways of detecting potential study flaws.

The strengths of this text are its readability and providing clinical examples to aid in practical application. I recommend Studying a Study & Testing a Test for any student or health care professional looking to gain a better understanding on how to critically appraise research and put those results into practice.

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Evidence-Based Management of Low Back Pain

Dagenais S and Haldeman S

Elsevier Mosby, 2012, 560 pp.

Hard Cover

US \$115.00

ISBN: 9780323072939

Dagenais and Haldeman have edited a thorough and clinically relevant review of the current scientific evidence for the management of low back pain (LBP). With contributions from over 50 expert authors, this text consists of 30 chapters reviewing the entire spectrum of interventions for LBP, from least to most invasive. Each chapter describes the intervention, explains the theoretical rationale for its use, evaluates the evidence of efficacy, notes important considerations for patient safety, and finally, outlines the cost and cost-effectiveness of the treatment. This format is particularly helpful for clinicians to comparatively evaluate the appropriateness of an intervention for a given patient.

One of the greatest strengths of this text is the depth and quality of its references, which have been synthesized into an easily readable format. Although the references are extensive, readers must remember that research is constantly evolving, and always seek to incorporate the best available evidence into clinical decisions. Further, it is important to recognize this reference is not meant to dictate patient management, rather, to assist in the understanding of interventions that may be used.

Overall, this text is extremely enjoyable to read, and provides a strong foundation for the understanding of the management options for LBP. It is a thorough and well-written reference, and all providers of spine care would find this a valuable addition to their libraries!

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*Another version of this review was published in The Spine Journal, Vol 12, by Brynne Stainsby BA, DC, Book and Media Review: Evidence-based Management of Low Back Pain, Page 351, Copyright Elsevier (2012).

RE: Gleberzon BJ, Arts J, Mei A, McManus EL. The use of spinal manipulative therapy for pediatric health conditions: a systematic review of the literature. J Can Chiropr Assoc. 2012;56(2):128-41.

To the Editor:

We read with great interest the review article by Gleberzon et al.¹ on the use of spinal manipulative therapy (SMT) for pediatric health conditions. We also wish to add to the relevant literature characterizing the chiropractic care of children the manuscripts by Lee et al.² and Alcantara et al.³⁻⁴ and relevant articles as defined by their methodology. We offer the following articles on the chiropractic care of children with growing pains⁵, attention deficit hyperactivity disorder⁶, nocturnal enuresis⁷, developmental delay syndrome⁸ and pediatric low back pain⁹. Given the lack of completeness, their literature review must be examined with caution.

Recently, Alcantara and colleagues¹⁰ published a review of the literature on asthma. The salient features of their review revealed the pitfalls and challenges in designing a randomized controlled clinical trial (RCT) to examine the effectiveness of chiropractic SMT versus sham SMT. First, the validity of the sham SMT employed in the 3 clinical trials on asthma¹¹⁻¹³ are questionable since the respective investigators failed to validate their sham SMTs. Therefore, the interpretations of these studies and their conclusions are questionable. Consider the “simulated treatment” employed by Balon et al.¹² where the supposed differentiating factor for active versus sham SMT is the presence of cavitation. This assumption on the part of Balon et al.¹² is a fatal error in research design and places into question the conclusions their study may have offered. Secondly, the sham SMTs employed in the 3 clinical trials have semblance to SMTs employed in clinical practice by both chiropractors and osteopaths further placing into question the soundness of their study design.¹⁴ Similar to previous authors utilizing a checklist to examine the methodological quality of these asthma trials^{10,14}, Gleberzon et al.¹ failed to critically examine the particulars of their studies of interest and scored them without qualifying their questionable internal validity.

Recently, Alcantara and colleagues¹⁵ published their review of the literature on the chiropractic care of children

with infantile colic. Our issue with the Gleberzon review is their stated findings as comparable to the conclusions provided in the UK Evidence Report authored by Bronfort et al.¹⁶ that chiropractic SMT is not effective for infantile colic and asthma when compared to sham manipulation. To the best of our knowledge, no published clinical trial has compared active SMT versus sham SMT for infantile colic.¹⁵ It has been argued that the study by Olafsdottir et al.¹⁷ compared chiropractic SMT versus placebo.¹⁸ The Olafsdottir study compared SMT versus no treatment and therefore examined the effects of care to the natural history, the possibility of “spontaneous recovery”, the effects of time, the effects of repeated testing, and regression to the mean.¹⁹

Inherent in our role as clinicians, educators and patient advocates is the ability to critically appraise the literature to evaluate the strengths and limitations of our practice activities. In this era of evidence-informed practice and global competition for effective consumer healthcare services, we as a profession cannot afford to merely parrot the findings of other authors.

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To the Editor in reply:

Thank you for the opportunity to respond to the Letter to the Editor by Alcantara et al.¹ with respect to our study². Upon reading it closely, it seems their letter raised two issues of concern. These are: (i) that we did not capture a number of articles in our review and (ii) an on-going criticism of the study by Balon et al³.

With respect to their first concern, we have reviewed the articles that Alcantara et al.¹ believe we ought to have included in our review. We disagree with their assertion. In fact, it seems to us that Alcantara et al.¹ did not fully consider the inclusion criteria of our study; had they done so, they would have realized why the articles they cite were not eligible for inclusion.

The articles by Lee et al.⁴ and the two articles by Alcantara, Ohm and Kunz^{5,6} were cross-sectional descriptive surveys, and thus not eligible for assessment using the modified instrument by Sackett we used to assess a clinical trial's methodological quality. We also maintain these articles would not have substantially added any information of relevance to our discussion section. The article by Alcantara and Davis⁷ stated test subjects with attention-deficit/hyperactivity disorder were treated with both spinal manipulative therapy and nutritional supplementation; since the children were treated with two different modalities, it would have been impossible for us to determine which therapy resulted in the improvements reported by the authors, thus rendering it impossible for us to have assessed this study using our assessment instrument. As a personal observation, we find it puzzling that these studies were not published in the journals that focus on the chiropractic sciences, such as the *Journal of Canadian Chiropractic Association*, *Journal of Manipulative and Physiological Therapeutics*, *Journal of Chiropractic Medicine*, *Clinical Chiropractic* or *Chiropractic and Manual Therapy*.

The article by Hayden et al.⁸ was an overview that discussed a number of issues germane to the management of children, much of which was not relevant to our review. The case series and systematic review by Alcantara and Davis on 'growing pain'⁹, and the systematic review on the chiropractic care of asthma by Alcantara et al.¹⁰ were published in 2012 and thus were not available to us when we conducted our search in 2011.

We reviewed the article by van Poecke et al.¹¹ inves-

titigating the management of children with primary nocturnal enuresis. Upon review of the methods section, we read children in that study were treated using a chiropractic technique called “NeuroImpulse Protocol”, which the authors describe as a combination of toggle recoil and Logan Basic techniques. This made this study ineligible for review in our study since we limited our assessment to studies that only treated children using spinal manipulative therapy (SMT) [described as high-velocity, low amplitude (HVLA) thrusting procedures]. Likewise, the study by Cuthbert and Barras¹² treated children with Applied Kinesiology (AK). Of particular importance is the authors’ statement that: “Because AK diagnostic and treatment may consist of elements from different treatment modalities and are directed toward individual responses, there was a significant variation in the manipulative treatment received by each of the children in this study”^{12p662}. In other words, based on the use of AK diagnostic methods including Manual Muscle Testing and Therapy Localization, there was no way to know if each child received HVLA-SMT. In fact, nowhere in the ‘Interventions and Outcomes’ section do the authors mention the application of HVLA-SMT at all.

The balance of the letter to the editor by Alcantara et al.¹ claims we did not critically examine the methodology used by Balon et al.³ in their study published in the *New England Journal of Medicine* (NEJM). We have heard some members of the chiropractic community raise these concerns since the time the Balon et al.³ study was first published in 1998. It seems to us that the scientific community has determined that the methodology used by Balon et al.³ was appropriate, and certainly the study withstood the scrutiny of the peer-review process used by that high impact journal. We are familiar with the criticisms of the Balon et al.³ study and did not believe they represent a ‘fatal error’ as purported by Alcantara et al.¹.

Lastly, as Alcantara et al.¹ wrote, our study drew similar conclusions as the UK Evidence Report by Bronfort et al.¹³. Although we did not seek out to ‘parrot’ the conclusion reached by Bronfort et al.¹³ as asserted by Alcantara et al.¹, we were admittedly comforted by the fact that our study aligned itself with the Report, since the Report is widely heralded as the most extensive and appropriately conducted review on the effectiveness of manual therapy to date. It is also important to note that none of the additional references provided by Alcantara et al.¹ were cited

in the UK Evidence Report¹³, nor were they cited in two similar systematic reviews both conducted by Gotlib and Rupert^{14,15}.

In summary, we stand by the findings of our study as originally published and assert the articles referenced by Alcantara et al.¹ would not be eligible for inclusion in our study for the reasons described above and that they would have added little in the way of relevant information to our discussion section. More over, although mindful of their criticisms of the study by Balon et al.³, we reject the suggestion that such criticisms would have in any way altered our score of that study. That said, in the event we (or other authors) undertake a narrative or scoping review of the literature pertaining to the chiropractic management of children we are confident that the studies provided by Alcantara et al.¹ would be included.

Respectfully submitted

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