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Knowledge Transfer within the Canadian Chiropractic Community. Part 2: Narrowing the Evidence-Practice Gap

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Introduction

This two-part commentary aims to provide clinicians with a basic understanding of knowledge translation (KT), a term that is often used interchangeably with phrases such as knowledge transfer, translational research, knowledge mobilization, and knowledge exchange.¹ Knowledge translation, also known as the science of implementation, is increasingly recognized as a critical element in improving healthcare delivery and aligning the use of research knowledge with clinical practice.² The focus of our com-

mentary relates to how these KT processes link with evidence-based chiropractic care.

In Part 1 of this series,³ we presented an overview of the barriers that impede successful KT in the chiropractic profession. Now in Part 2, we provide an overview of KT strategies followed by a discussion of relevant KT efforts in the Canadian chiropractic community. This discussion will lead to a long-term vision of KT for Canadian chiropractic with suggestions to where KT can be applied or where current efforts can be augmented. The overall goal

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of this article is to present potential strategies for successful KT implementation in order to reduce the gap between current best evidence and its application in chiropractic practice.

KT Strategies

A broad lexicon of terminology is used to describe various strategies to KT application.¹ In this section, we will present the most commonly used designations which include active and passive strategies, push/pull strategies, and exchange strategies. As well, we will consider several targeted strategies aimed at improving clinical practice outcomes. In all instances, proposed KT activities should be consistent with ethical principles and norms, social values, as well as legal and other regulatory framework. (More at: <http://www.cihir-irsc.gc.ca/e/39033.html>.)

Passive and Active Strategies

Passive strategies are those that do not require personal interaction with the end user,⁴ and include publication of peer-reviewed articles and distribution of clinical practice guidelines (CPGs). Although there are several peer-reviewed journals that publish research evidence relevant to chiropractic, quality can be highly variable and publication in high impact journals does not guarantee high quality.⁵ One result of this circumstance is that clinicians can locate journal publications to support almost any type of practice or challenge evidence that conflicts with their personal beliefs. Also, depending on the journal, there may be a long period of time between when knowledge is submitted versus published. Similarly, textbook content can rapidly become out-dated. These points emphasize that passive strategies may be insufficient at creating effective transfer of appropriate knowledge.

In contrast to passive strategies, active strategies are those that involve personal interaction with the end user.⁴ Conferences and workshops are examples that can provide opportunities for personal interaction, although these opportunities may be limited and depend on the motivation of the participant. Other opportunities for face-to-face interactions include educational outreach visits, local working groups, and interventions that combine approaches such as audit and feedback.⁶ Active strategies that include interaction between researchers and the end users of knowledge are thought to be more likely to yield positive results than passive strategies.⁶

Push / Pull Strategies

Knowledge translation strategies can also be characterized by whether they ‘push’ or ‘pull’ knowledge in the direction of the end user and by whether there is an exchange of knowledge between the end user and the researcher. ‘Push’ strategies (also known as ‘research-push’) include those in which knowledge generation is driven by the researcher toward end users. In contrast, strategies that ‘pull’ research (also known as ‘user-pull’) include those in which end users plan and implement strategies to pull knowledge from sources they identify as helpful in making clinical decisions.⁷

Exchange Strategies

Exchange strategies are those in which the process of knowledge generation includes interaction between the researchers and end users.⁷ These strategies are most consistent with the knowledge-to-action cycle described by Graham and colleagues⁸ which was presented in Part 1 of this commentary. In the KT cycle, interactions are critical, particularly in the early stages of intervention design which should take into account barriers against adoption of knowledge.

Targeted Strategies

Strategies also vary in terms of their targeted end user. For example, some interventions are targeted at clinicians while others target patients or health organizations (e.g., professional associations). Here, we offer an overview of 12 strategies (or interventions) that target professionals with the aim of improving clinical practice outcomes. Definitions for these strategies were adapted from the Rx For Change database maintained by the Canadian Agency for Drugs and Technologies in Health.⁹

1. *Distribution of educational materials*: This passive form of disseminating information is well known to clinicians. It refers to published or printed evidence-based recommendations for Clinical Practice Guidelines (CPGs), audio-visual materials, and electronic publications. Given the high prevalence and significant costs associated with back and neck pain, evidence-based CPGs and best evidence synthesis CPGs can be particularly useful where overuse and/or misuse of services exist. These CPGs aim to direct appropriate care based on the best available scientific evidence and broad consensus while promoting efficient use of resources.^{10,11} Guideline dissemination and

implementation strategies can encourage practitioners to conform to best practices and lead to improvements in care,¹²⁻¹⁵ but their impact is generally small.¹⁶

Pros: Generally available; can be accessed electronically or be printed; systematic reviews and CPGs are regularly updated; generally affordable to end users.

Cons: High volume of information; identifying credible sources can be challenging; sometimes difficult to appraise quality; not always applicable to own practice setting; small impact on practice.

2. *Mass media:* Mass media is sometimes used by our national or provincial associations and by the Canadian Chiropractic Protective Association (CCPA) to communicate with their members through newspapers, posters, leaflets, booklets, and the internet via official websites and other online outlets. The goal of these efforts is to inform clinicians of best practice options. As this information tends to also be accessible to the general public, there is evidence that media campaigns can improve practice outcomes (e.g., patients who stand to benefit are more likely to pursue appropriate care).¹⁷ The chiropractic profession also uses mass media to target patients using strategies such as television advertisements and segments.

Pros: Possible to reach a large number of people at once; may send powerful target messages.

Cons: Audience is constantly solicited (information overload); can choose to ignore messages; very resource intensive/high cost strategy; variable effect on practice.

3. *Educational meetings:* Another frequently used strategy involves attending conferences or lectures. More active strategies however involve participating in workshops or traineeships. Many conferences, such as the semi-annual Congress of the World Federation of Chiropractic (WFC) combine both lectures and hands-on workshops. The annual Association of Chiropractic Colleges Research Agenda Conference (ACC/RAC) may be attended by practising clinicians. Clinicians can earn continuing education credits. Content is geared toward academic and research focused conference delegates through posters, presentations and didactic workshops. The effect of educational meetings with respect to improving practice outcomes or congruence between

practice and evidence is uncertain,¹⁸ but probably results in small improvements.

Pros: Commonly used; a form of social gathering; hands-on workshops can be fun for participants; can be a source of revenue for organizers.

Cons: Educational meetings alone are not likely to be effective for changing complex behaviours;¹⁹ direct costs such as airfare and accommodation, and indirect costs such as lost clinic revenue can limit the reach of this strategy.

4. *Audit and feedback:* Audits are summaries of the clinician's performance over a set period of time. The information can be obtained from clinical records, computerised databases, or observations from patients. Clinical performance or what one does in practice (e.g., number of imaging studies ordered for a particular problem) can be compared with that of other colleagues. Feedback consists of recommendations for clinical action. At present, this approach is being used in several jurisdictions to improve surgical performance and to reduce adverse events.

Pros: An audit and feedback approach can be effective in improving professional practice; when it is effective, the impact is generally small but potentially important; the absolute effects of audit and feedback are more likely to be larger when baseline adherence to recommended practice is low.²⁰

Cons: Resource intensive; clinical databases collecting the same good quality information across practices is not widely available; need reliable methods for providing timely feedback.

5. *Educational outreach visits:* Educational outreach visits focus on the use of a trained person who meets with clinicians in their own clinic to provide information with the intent of helping improve their practice. The information given may include feedback on the performance of the clinician. The impact of such visits on practice outcomes is small, but potentially important.²¹

Pros: Can provide/receive immediate feedback that can be readily applied in practice; can establish trusting relationship; high satisfaction.

Cons: Resource intensive (e.g., requires trained individuals, takes time).

6. *Local consensus processes*: Another active strategy involves participating in a group discussion where clinicians meet with the aim to discuss a particular clinical problem and determine solutions together.

Pros: Provides for a safe learning environment; topics are highly relevant to practitioners; engaging.

Cons: Group may seek to involve those who think alike to avoid conflicting views; may not have access to content expert.

7. *Local opinion leaders*: Opinion leaders (OLs) are people who are seen as likeable, trustworthy, and influential by their peers. Because of their influence, it is thought that they may be able to persuade clinicians to use up-to-date evidence when managing patients.^{22,23} Towards this, the current Guideline Initiative in Canada has launched a survey that asks decision-makers within Canadian chiropractic to identify OLs who could help deliver key messages on best practices and CPGs to their peers across Canada.

Pros: Gaining recognition as useful strategy; OLs may be nominated by peers who already trust this individual; possible to use the same OLs for a number of strategies over a long period of time.

Cons: Resource intensive (e.g., identifying and training opinion leaders).

8. *Multifaceted*: Multifaceted interventions are any combination of two or more professional, organisational, financial, or regulatory interventions designed to improve patient care. Several examples of this strategy, which aim to create multidisciplinary or interdisciplinary triage and care, are underway in many provinces.

Pros: Can target end users in multiple ways or several end users at once (e.g., practitioners, patients, decision-makers).

Cons: Unclear which combination of interventions (e.g. number, order, dosage) is most effective.

9. *Patient-mediated*: Patient-mediated strategies involve collecting new clinical information (not previously available) directly from patients and providing these data to clinicians (e.g. Oswestry Disability Index). It also includes strategies aimed at favouring a shared decision making process.

Pros: Patient feedback can positively influence clinician decisions; engaging patients in their care aligns with the 'patient-centred' model of care; this strategy is useful when grey zones exist in the clinical decision making process as it is often the case for musculoskeletal conditions.

Cons: Clinicians with a paternalistic approach may feel threatened by patient knowledge; acquiring additional information from patients requires more time.

10. *Reminders*: This strategy aims to prompt clinicians to recall information, ideally at the time they make a decision about patient care. There is moderate quality evidence that computer generated printed reminders result in significant improvement to professional practices, with a median improvement of processes of care of 7.0% (inter-quartile range = 3.9% to 16.4%).²⁴

Pros: Provides timely information to clinicians during clinical care (i.e., helps one reflect on habitual practice).

Cons: Requires electronic patient health records programmed to deliver timely reminders; resource intensive.

11. *Tailored interventions*: Interventions are developed (tailored) based on previously identified barriers and facilitators toward adopting best practices. Interventions are guided by the findings from interviews or surveys conducted among clinicians (sometime patients or decision-makers as well).

Pros: Chances of overcoming important barriers are increased (e.g., practitioner, patient, practice, system level); better rationale for the recommended strategy; theory-based interventions help understand why the strategy worked (or not) in a particular context.

Cons: Time intensive to develop; resource intensive.

12. *Knowledge brokering*: A knowledge broker is an individual whose job is to mobilize relevant knowledge to the appropriate users and to facilitate the translation of that knowledge into practice.²⁵ According to a paper in the journal *Science*,²⁶ knowledge brokering is an emerging career option with a knowledge broker described as some-

one who “...sits in between those who create knowledge (i.e. the researchers) and those who use knowledge, such as policy-makers, the general public, or people working in the health domain”. Knowledge brokers try to bridge the gap that can exist between those two worlds and build connections.²⁶ Although there are no knowledge brokers currently in chiropractic, they are becoming increasingly prevalent in the rehabilitation sciences. For example, at the University of British Columbia, there is a knowledge broker in the Department of Physical Therapy, whose job is to promote and facilitate evidence-based practice, to increase awareness of activities and opportunities in physical therapy, to communicate with relevant stakeholders, and to bridge the gap between research and practice (<http://physicaltherapy.med.ubc.ca/physical-therapy-knowledge-broker/>).

Pros: Content expert can coordinate a range of relevant KT strategies, create learning opportunities, and help narrow the gap between researchers, practitioners and stakeholders.

Cons: Requires individuals with specialized training who are cognizant of the particularities of the health discipline; type of training is currently ill-defined; costly.

Evaluating the success of KT Strategies

While choosing the correct KT strategy is important, equally critical is measuring its effect. Early steps to evaluating any KT strategy include identifying stakeholders in the process and determining specific objectives and appropriate outcome measures. In evaluating any KT strategy, the following questions should be asked and answered:

- 1) Can the KT interventions be delivered as planned?
- 2) Do the proposed interventions change clinical practice (e.g., increase compliance with recommended care)?
- 3) Do the interventions improve outcomes important to patients' health (e.g., level of pain, mobility, disability)?
- 4) Do the interventions result in cost saving?

These outcomes should be closely aligned with the objectives of the KT strategy. For example, increased implementation of clinical care pathways can be measured by

reviewing patient charts or a quality assurance database. Similarly, substitute measures may also be used but are limited by their association with the actual outcome(s) of interest such as behavioural simulation (e.g., solving clinical vignettes), a change in process of care (e.g., improved level of knowledge, capability or intention to perform the desired behaviour), tracking the number of attendees at conferences or quantifying the number of professional development courses held and attendees. In addition, it may be relevant to focus on economic outcomes such as tracking income relating to patents, technology transfer (licenses) and/or commercialization of chiropractic initiatives in industry. These and other unique metrics could be devised to directly reflect the priorities of the profession and the nature of the information/knowledge being translated. Stakeholders within the profession have an important role in determining the most appropriate metrics that best reflect these goals.

Current KT efforts and opportunities in Canada

There are currently several ongoing KT efforts within the chiropractic profession at various stages of implementation. Most of these efforts focus on advancing best practices within the profession. Like any KT effort, the success of translating new knowledge into practice not only depends on choosing the correct KT strategy, but also on ‘buy in’ from all levels of the chiropractic profession, including clinicians, researchers, policy-makers, educational institutions, and professional associations. With that in mind, the following examples of KT efforts need your help and are ready for your involvement.

1. *The E-BASE study:* Launched in late 2013, over 7000 Canadian chiropractors have received an invitation from the Canadian Chiropractic Association (CCA) and the Canadian Federation of Chiropractic Regulatory and Educational Accrediting Boards (CFCREAB) to complete an online survey regarding their knowledge and beliefs towards evidence-based clinical practice (EBCP). This survey of Canadian chiropractors aims to: 1) assess current level of knowledge and attitudes toward evidence-based clinical practice, and 2) assess the ‘impact’ of previous CPGs created by the CCA and CFCREAB. This survey is important for helping members of the profession better understand what clinicians think of EBCP in general and if they are familiar with existing CPGs. Ultimately, information gathered regarding attitudes towards evidence

based chiropractic practice and familiarity with existing CCA guidelines will help determine how best to convey information on best practices to clinicians.

2. *The CCA-CFCREAB Guideline on Adult Neck Pain:* An update of the CCA Guideline for management of Adult Neck Pain was recently published.²⁷ The Guideline Initiative (see below) interviewed chiropractors and decision makers in the profession to help understand barriers and facilitators to adopting this new guideline. A number of KT strategies are being developed to help clinicians make informed decisions regarding the management of patients with neck pain.

3. *The Guideline Initiative:* The new website of the CCA Guideline Initiative, housed under the CCA, will be up and running in August 2014. Please visit: <http://chiropractic.ca/guidelines-best-practice/>. This website is an important tool to bridge the gap between knowledge and practice. Target audiences are clinicians, their patients, and leaders/decision-makers in the chiropractic profession. Each section will include up-to-date information to help make informed decisions about patient care. Types of information and activities being considered for the new website include:

- a repository of evidence-based chiropractic CPGs, associated tools, job aids, and shared decision making tools.
- links to credible sources of information on topics of interest to practitioners, patients, and leaders/decision-makers.
- a ‘virtual clinic’ (i.e., case-based learning online) and webinars to ease understanding of new CPGs and related tools.
- short videos on new and existing research conducted by chiropractic researchers; these will be delivered in a format and in a style that is accessible to the target audience.

4. *University-Based Working Groups:* University-based chiropractic working groups involve scientists, graduate students, clinicians, and representatives from provincial and national chiropractic organizations. The mandate of such groups is to promote awareness of each other’s activities and maximize collaborative potential for chiropractors with university affiliations. The first group began meeting quarterly at McMaster University in 2009, and is supported by the CCA and Ontario Chiropractic Association.²⁸ Since the inception of the initial group,

new groups have formed with the support of the CCA that are affiliated with the University of Manitoba, the University of Regina, and universities in the Toronto region. Group meetings facilitate the assessment of the general capacity for chiropractic research at specific institutions. The diverse backgrounds of working group members also allow meetings to serve as KT forums, and opportunities to brainstorm future collaborative initiatives. For institutions with a limited chiropractic faculty presence, these groups also serve as a vehicle to engage with local and regional chiropractors with no direct institutional affiliation and perhaps a limited research background. Such “grassroots” participation is vital to the development of clinically-driven research questions that are of particular importance and relevance to everyday practice. Including representatives from provincial and national chiropractic organizations in group meetings and activities also facilitates activities aimed at disseminating the research knowledge to organizational members, as well as local and regional policy-makers. Employing common video conferencing tools can provide access to a broader scope of members to increase the impact of this initiative. For a list of existing working groups and their respective contact information, please contact Dr. Frances LeBlanc: fleblanc@chiropracticcanada.ca.

5. *The Practice-based Research Network:* The Practice-Based Research Network (PBRN) evolved from the efforts of members of the Guideline Initiative to help bridge the gap between practicing chiropractors, consumers, researchers, and decision-makers. The aim of the PBRN is to engage these groups to improve the uptake of best practices to improve the quality and safety of patient care, primarily in the management of musculoskeletal conditions, and to standardize reporting of patient outcomes in Canada.²⁹ A planning meeting will be held at the end of 2014 to facilitate a partnership between practicing chiropractors, patient representatives, researchers, and decision-makers to discuss the formation and development of the first Canadian chiropractic PBRN. The aim of this meeting is to provide expertise and strategies that can be applied in the creation of an organizational infrastructure to facilitate the conduct of practice-based research within a network of clinics. Practicing chiropractors are encouraged to contact Heather Owens at howens@chiropractic.ca.

6. *Regional Chiropractic Groups:* There are groups

of chiropractors from specific geographic regions across Canada that host regular or semi-regular meetings. The meetings may feature a guest speaker or have a theme to guide discussions. Meetings frequently occur over meals creating an informal environment and increased sense of camaraderie. Some of the groups have an informal invitation or announcement of meetings through an e-mail list. Other groups have a formal hierarchy with executive, clearly defined member lists, websites, newsletters, membership dues, and mission statements. Examples of components from mission statements include: serve as a representative membership organization to the chiropractic profession in the region; provide local leadership within the profession; create local educational opportunities for the region's chiropractors; facilitate fellowship within the local profession. Regardless of how or when they formed, these groups are an opportunity for chiropractors who may feel isolated in private outpatient clinical practice to engage with other members of the profession.

For a list of regional chiropractic groups known to exist and their respective contact information, or if your region has a local chiropractic society or group that you would like others to be made aware of to engage fellow chiropractors in informal or formal KT experiences, please contact Dr. Frances LeBlanc: fleblanc@chiropracticcanada.ca. You may also use this contact information if your region does not have a group and you wish to retrieve a template for how to create a group.

7. Local Opinion Leaders: The Guideline Initiative has recently surveyed chiropractic organizations in Canada and members of the chiropractic specialty colleges to recommend up to three OLs. From time to time, OLs may be asked to present material developed by the Guideline Initiative in continuing education activities within respective jurisdictions (e.g., conferences, workshops, seminars, webinars, online educational modules) to promote evidence based practice. OLs may be used along with other strategies, such as reminders, audit and feedback, and distributing educational materials. A 10-member selection committee will recommend a small group of individuals from the list of potential OLs who will be invited to participate in a training session to help them become more effective communicators and leaders when interacting with colleagues and other healthcare professionals. Readers of this journal may contact Heather Owens to inquire about OLs in their province: howens@chiropractic.ca.

Long-term KT vision for the Canadian Chiropractic community

In this section, we present some specific suggestions for new initiatives that may help to enhance evidence-based chiropractic care through the mobilization of relevant knowledge.

1. *Continuing Education:* Continuing Education (CE) intends to update knowledge and help maintain/develop professional competencies of clinicians. While attendance of educational meetings such as conferences, workshops, and interactive meetings is generally effective for improving both appropriateness of care and patient-important health outcomes, its effect size tends to be small.³⁰ As previously discussed, this may be due in part to the fact that educational strategies are often limited by a unidirectional flow of knowledge. We suggest that CE should not be simply a transfer of information; it should aim to improve overall management of chronic conditions and increase focus on health care outcomes and performance.³¹ Long-term goals should involve the maintenance of licensure/certification by focusing on demonstration of improved practice; multiple media, multiple techniques of instruction, and multiple exposures to content are suggested to meet instructional objectives intended to improve clinical outcomes.^{32,33}

To help address the clinical care gap, we propose the creation of a national CE program. We suggest establishing a working group composed of representatives from academic institutions (e.g., CMCC, UQTR), the CF-CREAB, the Education Council (CCEC), the Education Board (CCEB), the CCA, the CCPA, Chiropractic Specialties, and the Canadian Chiropractic Research Foundation (CCRF). The aim of this working group would be to explore challenges related to the delivery and the quality of CE in chiropractic in Canada. Developing consistency in CE standards could be eased by the adoption of a common framework similar to the one used by the Federation of Chiropractic Licensing Boards in the US (i.e., PACE: Providers of Approved Continuing Education). A centralized CE approval process exists in many other health professions. Ultimately, this could lead to the creation of a National CE program whereby jurisdictions and teaching institutions would collaborate to provide high quality postgraduate CE training. Such a strategy aligns with recent recommendations to create a supportive environment, redesign educational delivery systems, provide a

robust body of evidence-based knowledge, and engage clinician-learners.³⁴

2. *Knowledge Brokering*: To facilitate interactions between researchers and clinicians and other relevant stakeholders (leaders, opinion-makers, policy-makers), we propose that a knowledge broker position be established. The knowledge broker would be involved with ongoing KT efforts in Canada and would help in the organization and implementation of additional efforts. As well, they would evaluate and synthesize knowledge related to evidence-based practice and ensure open and effective two-way communication of knowledge with end users. At present, these activities are currently dispersed among many parties. While a network of people with related interests is critical to KT success, a dedicated knowledge broker would undoubtedly improve co-ordination of these activities.

Final thoughts

The increased adoption of EBCP by the chiropractic profession is foundational to the goal of mainstream integration of chiropractic services into Canada's health delivery system.³⁵ This is reflected by the vision of the CCA: '*Chiropractors will be an integral part of every Canadian's healthcare team by 2023.*' In order to realize this goal, the chiropractic profession must demonstrate its unwavering commitment to leadership within the evolving Canadian health care system by fostering a strong knowledge creation initiative.

One of the greatest challenges to improving health care is the translation of high quality evidence into clinical practice.³⁶ Without strategies in place to facilitate this goal, the chiropractic profession will be challenged to become further integrated into the Canadian healthcare system.

The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn and relearn.

Alvin Toffler

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The Canadian Chiropractic Guideline Initiative: progress to date

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Background

The Canadian Chiropractic Guideline Initiative (CCGI) is operating at full speed. On behalf of the dedicated clin-

icians, researchers, academics, and leaders in the chiropractic profession contributing to the success of the CCGI, it gives me great pleasure to share our progress to date.

Achieving our long term goal to improve on the delivery of chiropractic care and patient health requires a wide range of expertise and commitment by all levels of health care. It is important to acknowledge the work of a large number of dedicated people involved in the Committees and Working Groups of the CCGI (see details below).

The Clinical Practice Guideline Initiative was launched by the Canadian Chiropractic Association (CCA) and the Canadian Federation of Chiropractic Regulatory and Education Accrediting Boards (CFCREAB or Federation) over a decade ago to develop clinical practice guidelines (CPGs) to improve delivery of chiropractic care in Canada. CPGs aim to describe appropriate care based on the best available scientific evidence and broad consensus while promoting efficient use of resources. For details, see: *Bussi eres A, Stuber K. The Clinical Practice Guideline Initiative: A joint collaboration designed to improve the quality of care delivered by doctors of chiropractic. J Can Chiropr Assoc. 2013; 57(4):219-84.*

To accomplish its complex tasks, the Guideline Initiative is made up of a Guideline Steering Committee, a Guideline Advisory Committee, a Guideline Development Group, an External Review Group, a Guideline Implementation Group, an International Scientific Advis-

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 JCCA 2014

ory Committee, research associates and graduate students (Appendix 1). Committee members originate from several countries and represent a range of clinical and scientific disciplines or specialties. The first annual report dated December 2nd 2013 described the structure, methods and procedures of the Guideline Initiative. The following presents the key elements contained in the semi-annual report dated June 2014.

On March 29-30th 2014, the Guideline Steering Committee along with 5 key members representing each guideline working group (Guideline Advisory Committee, Implementation Group and Development Group) gathered in Toronto for a strategic planning session. Each representative contributed valuable insight from different vantage points which helped the group accomplish its target goal of creating a robust new vision, mission and strategies for the project.

The new statements and strategies are as follows:

Vision

Enhance the health of Canadians by fostering excellence in chiropractic care.

Mission

Develop evidence-based clinical practice guidelines and best practice recommendations, and facilitate their dissemination and implementation within the chiropractic profession.

Strategies

- 1) Transform the culture of the profession to one that is guided by evidence-informed practice.
- 2) Engage stakeholders to sustain the Canadian Chiropractic Guideline Initiative.
- 3) Produce, adapt or endorse recommendations relevant to chiropractic practice to enhance patient care, based on the best available evidence.
- 4) Create and apply innovative knowledge translation strategies to influence chiropractic practice.

A motion to pass the newly created vision, mission and strategies was unanimously adopted and passed at the end of the meeting. A small sub-group from the GSC met on April 17th to develop the tactics (activities) and metrics

(evaluation measurements) that will be prioritized to accomplish the vision and mission. Tactics and metrics were approved by the GSC in May 2014.

Overview of the Roles and Responsibilities of Committees and Working Groups of the CCGI:

The various committees and working groups regularly meet online to discuss tasks related to the respective mandates. Face-to-face meetings occurs once or twice a year as needed.

- **Guideline Steering Committee (GSC)**
The 6 member-committee established governance policies. The GSC provides overall direction, approves the budget and monitors progress of the CCGI.
- **Guideline Advisory Committee (GAC)**
The 9-member committee provides guidance on the overall direction and monitors progress made by the CCGI. In addition, GAC members may advise on individual projects undertaken by working groups.
- **Guideline Development Group (GDG)**
The 15-member committee held its first face-to-face meeting in Toronto on January 10-11, 2014. The scope, key questions (Analytical Framework and systematic review/best evidence synthesis) and timeline for the low back pain (LBP) Assessment guideline were determined during a series of calls after the meeting. Considering ongoing work in this field, the GDG will appraise, and adapt and/or adopt upcoming recommendations on the management of LBP and other musculoskeletal conditions. Details are provided below.
- **Guideline Dissemination/Implementation Group (GIG)**
The 17-member committee regularly meets to advance a series of projects to support specific dissemination activities. To ease its work, four subgroups were created: practitioner; patients; schools; leader/decision makers. Each subgroup is developing strategies to help disseminate key findings of the updated CCA-CFCRE-AB Neck Pain guideline (*Bryans R, Decina P, Descarreaux M, Duranleau M, Marcoux H, Potter B, et al. Evidence-based guidelines for the chiropractic treatment of adults with neck pain. J Manip Physiol Therap. 2014;37(1):42-63*).
- **External Review Group**
Composition of the External Review Group will include members of the recognized chiropractic specialties.

- **North-Atlantic Research Consortium (NARC)**

A collaborative agreement between the CCA (Canada), and chiropractic professional organisations in Denmark, Norway, Switzerland and the UK was signed in 2011. This agreement aims to facilitate collaborations between involved countries on education, research and clinical practice guidelines. Two researchers from Denmark are members of one of the working groups of the Guideline Initiative and a researcher from Norway assists with another project. NARC members met at the 2014 ECU conference. Additional representatives were invited to participate. Graduate students may participate in specific research projects of the Guideline Initiative. This has the advantage of helping build research capacity within respective countries while provide the CCGI with additional resources and expertise.

Achievements since October 2012

(aligned with the four new strategies outlined above)

Strategy 1: Transform the culture of the profession to one that is guided by evidence-based practice.

a) Identifying Opinion Leaders:

Stakeholders of the CCGI received an invitation to complete a survey to identify potential opinion leaders (OLs) to help disseminate key messages from guideline recommendations. A committee met in June 2014 to select over twenty OLs who will receive training in the fall 2014 and the winter of 2015. OLs will help disseminate key messages to practitioners and stakeholders.

b) Medium and long term plans:

Harmonization of Continuing Education (CE) across jurisdictions in Canada and establishing partnerships with teaching institutions is deemed important to take advantage of existing strategies and programs and to create opportunities for sharing and disseminating best practices and guideline recommendations. Development of a national continuing education program will be recommended to help standardize accreditation of quality CE activities. Furthermore, routine data collection to inform practice patterns and variations, identify evidence-practice gaps, and help determine if and how best practice influence patient care and patient health is recognized as important. This may be accomplished

using available/tailored electronic health technologies to provide quality objective data on day-to-day chiropractic patient encounters.

While these two projects are necessary for the wellbeing of the profession and patient, and serve to help integrate the profession into the health care system, their accomplishment largely depends on the commitment of stakeholders, including regulatory boards, professional associations, and academic institutions.

Strategy 2: Engage stakeholders to sustain the Canadian Chiropractic Guideline Initiative.

a) Develop a sustainability plan:

The Guideline Steering Committee will aim to stabilize and diversify funding of the CGI. Multiyear funding from stakeholders will be sought.

b) Ensure stakeholders have opportunities to engage:

Semi-annual reports tied back to strategy are provided to stakeholders in June and December. Engagement at national meetings will create the appropriate structures to ensure transparency.

Strategy 3: Produce, adapt or endorse recommendations relevant to chiropractic practice to enhance patient care, based on the best available evidence.

a) Gap analysis on content areas:

The Guideline Development Group (GDG) will help identify gaps in the current availability of clinical practice guidelines and best practice. Specifically, GDG members will compare findings with a list of ongoing systematic reviews, best evidence synthesis and clinical practice guidelines. A priority list will be developed and circulated among stakeholders. The GDG will then adapt/endorse/develop key recommendations based on this prioritization.

b) Assessment of LBP:

The Bone and Joint Canada initiative aims to recommend a model of care for the management of LBP within the next 3-6 months. In addition, national LBP guidelines are currently being updated (e.g., NICE in the UK and TOP in Canada). The CCGI is closely monitoring work undertaken by the different groups. Results will be considered by members of the GDG prior to disseminating to Canadian chiropractors.

Strategy 4: Create and apply innovative knowledge translation (KT) strategies to influence chiropractic practice.

Specific knowledge translation interventions of the CCGI are further described in a Commentary in the current issue (see page 206).

a) National E-BASE-survey:

An IRB approval was received by McGill for a survey aimed at identifying Canadian chiropractor's attitudes and skills toward evidence-based practice. Similar studies were conducted by Dr. Mike Schneider DC, PhD amongst US chiropractors (phase 1 of an R21 grant study) and by Dr. Matthew Leach in Australia amongst Complementary and Alternative Medicine (CAM) providers. The study was launched in December 2013. Over 7000 invitations were sent out across the country through the CCA, the provincial chiropractic jurisdictions and the JCCA. Return rate was less than 10% despite three reminders. Significant technical challenges were encountered (password to register received in junk mail for a number of participants). Data analysis will be conducted in summer of 2014.

b) Ontario Chiropractic Observational and Analysis Study (O-COAST): improving quality of care through better understanding of current chiropractic practice.

Principal investigators, Sil Mior DC, PhD, André Bussières DC, PhD and Simon French BAppSc(Chiropractic), MPH, PhD obtained funding from the Ontario Chiropractic Association (OCA) and from Queen's University in early 2014 to document the reasons people seek care from Ontario chiropractors, the problems/diagnoses identified by chiropractors and the treatment they provide. The results of this project will be used to leverage further funding to undertake a national Canadian study in the future. We believe the proposed research will be the first in Canada to document what happens in chiropractic practice, providing the foundation for ensuring that people who seek the care of a chiropractor are provided with the most effective and safest approach. A meeting of the steering committee occurred with representatives of the OCA and CCA in March 2014. The study was launched in June 2014.

c) Scoping review on Research utilization, evidence-based practice, and knowledge translation in chiropractic:

Over 3618 citations were retrieved from the search, of which 53 matched the eligibility criteria. Descriptive and content analysis were completed in June 2014. Findings will inform on what has been done thus far on these topics (research utilization, evidence-based practice, and KT in chiropractic). A manuscript will be submitted for publication in the fall.

d) Information hub on best practices:

The new responsive website of the CCGI is hosted under the CCA while remaining independent (<http://chiropractic.ca/guidelines-best-practice/>). The Website was developed in collaboration with members of the Guideline Dissemination/Implementation Group (GIG) and the CCA. Material and tools to accompany guidelines are being developed for three target audiences: 1) practitioners (guidelines and tools, methods to help implement CPGs, useful links to high quality information); 2) patients (shared decision making tools, self-care, and key recommendations to stimulate discussion with clinicians), and 3) decision makers (to help identify important issues to consider for implementing guidelines within respective jurisdictions).

e) Neck Pain guideline implementation study:

Members of the GIG are developing a proposal to test the implementation of a theory-based tailored KT intervention. The feasibility study is expected to begin in the fall of 2014.

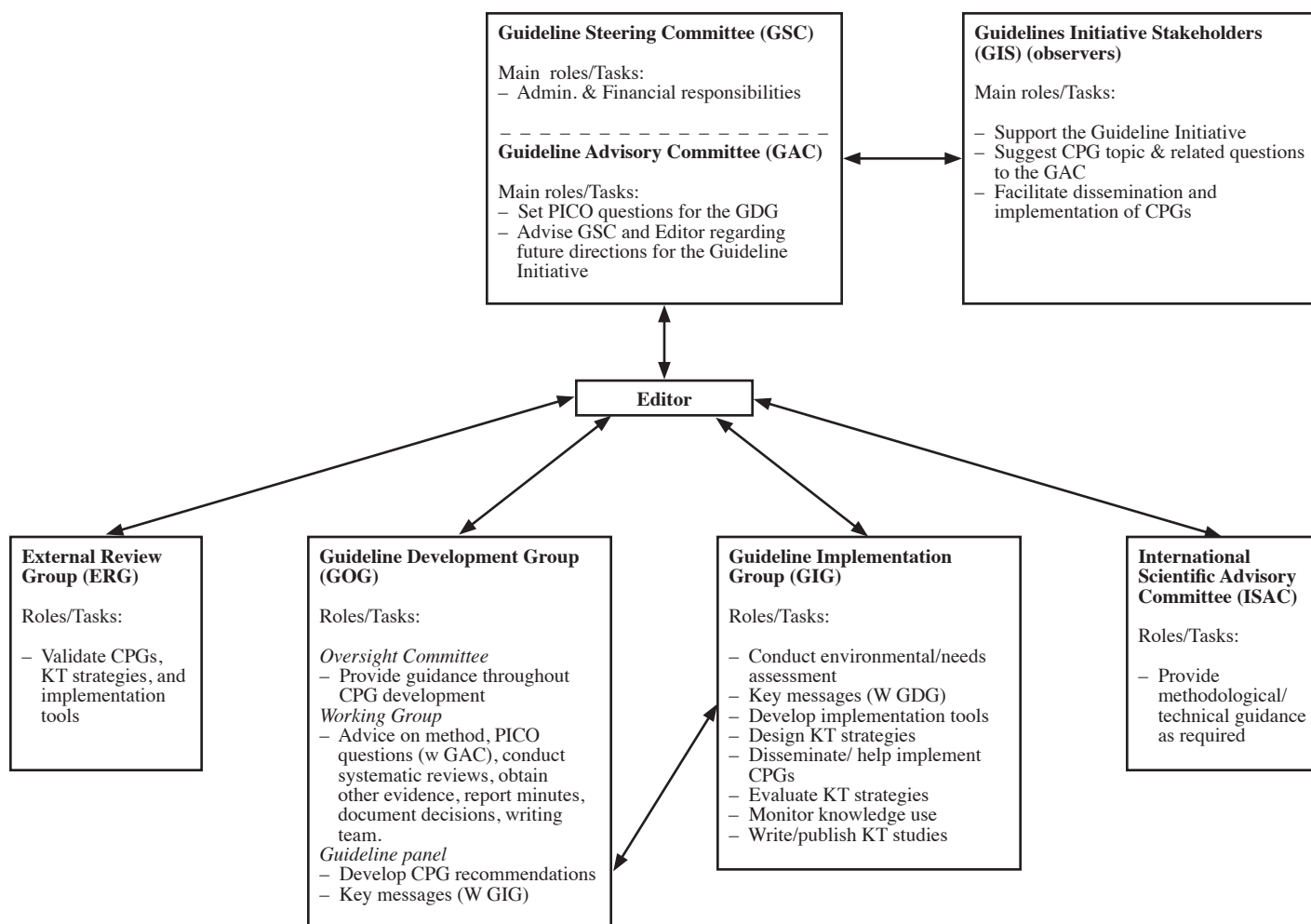
f) Chiropractic Practice-Based Research Network (PBRN):

A CIHR planning grant was submitted by Dr Bussières along with 10 co-investigators (a national and international multidisciplinary research team) in October 2013. The aim of this project is to bring together clinicians, patients, decision-makers and researchers to recommend strategies for the creation of a PBRN infrastructure so that research can be conducted to improve the delivery of appropriate, high quality chiropractic care to Canadians with musculoskeletal complaints. A first meeting is planned for the end of 2014. Details of the proposed PBRN may be found in a commentary published in the JCCA (Bussières A, Côté P, French S, Godwin M, Gotlib A, Graham ID, Grondin D, Hawk C, Leboeuf-Yde C, Mior S, Stuber S. *Creating a Chiropractic Practice-Based Research Network (PBRN): Enhancing the management of musculoskeletal care. J Can Chiropr Assoc. 2014; 58(1):8-15.*

We hope that you will be as excited as we are by the rich potential of the Canadian Chiropractic Guideline Initiative and look forward to hearing from you about ideas for col-

laboration and other activity in this critical area for the future of the chiropractic profession. Please visit our website at (<http://chiropractic.ca/guidelines-best-practice/>).

Appendix 1 Clinical Practice Guidelines Initiative (2013-2017)



Adherence to clinical practice guidelines among three primary contact professions: a best evidence synthesis of the literature for the management of acute and subacute low back pain

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Aim: To determine adherence to clinical practice guidelines in the medical, physiotherapy and chiropractic professions for acute and subacute mechanical low back pain through best-evidence synthesis of the healthcare literature.

Objectif : Évaluer la conformité, dans les professions médicale, de physiothérapie et de chiropratique, avec les directives de pratique clinique en ce qui concerne la lombalgie mécanique aiguë et subaiguë par une synthèse des données probantes de la documentation sur les soins de santé.

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Methods: A structured best-evidence synthesis of the relevant literature through a literature search of relevant databases for peer-reviewed papers on adherence to clinical practice guidelines from 1995 to 2013. Inclusion of papers was based on selection criteria and appraisal by two reviewers who independently applied a modified Downs & Black appraisal tool. The appraised papers were summarized in tabular form and analysed by the authors.

Results: The literature search retrieved 23 potentially relevant papers that were evaluated for methodological quality, of which 11 studies met the inclusion criteria. The main finding was that no profession in the study consistently attained an overall high concordance rating. Of the three professions examined, 73% of chiropractors adhered to current clinical practice guidelines, followed by physiotherapists (62%) and then medical practitioners (52%).

Conclusions: This review showed that quality papers in this area of research are very limited. Notwithstanding, chiropractors appear to adhere to clinical practice guidelines more so than physiotherapists and medical practitioners, although there is scope for improvement across all three professions.

(JCCA 2014; 58(3):220-237)

KEY WORDS: evidence based guidelines, chiropractic, low back pain, medicine, physiotherapy

Introduction

Mechanical low back pain (LBP) is a common condition, which until recently has been depicted as self-resolving and transient. Emerging evidence contradicts the traditional assumption that spontaneous recovery occurs in the majority of patients, with back pain being neither insignificant nor self-limiting.^{1,2} While the majority of people with an episode of acute LBP improve enough to return to work within the first two weeks, the probability of recurrence within the first year ranges from 30

Méthodologie : Une synthèse structurée des données probantes provenant de la documentation pertinente, par une recherche des bases de données des publications examinées par les pairs sur le respect des directives de pratique clinique entre 1995 et 2013. Le choix des publications a été fait selon des critères de sélection et des évaluations distinctes par deux examinateurs qui ont utilisé l'outil d'évaluation Downs & Black modifié. Les documents d'évaluation ont été résumés en tableaux et ont été analysés par les auteurs.

Résultats : La recherche des documents a extrait 23 publications potentiellement pertinentes qui ont été examinées pour leur qualité méthodologique, et dont 11 satisfaisaient les critères de sélection. La principale conclusion était qu'aucune des professions à l'étude n'a atteint de façon consistante un taux global élevé de concordance. Parmi les trois professions à l'étude, 73 % des chiropraticiens respectaient les directives de pratique clinique, suivis par les physiothérapeutes (62 %), et les médecins (52 %).

Conclusions : Cette étude a démontré la rareté des publications de qualité dans ce domaine de recherche. Cela dit, les chiropraticiens semblent respecter les directives de pratique clinique plus que les physiothérapeutes et les médecins, bien qu'il y ait des possibilités d'amélioration dans les trois professions.

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MOTS CLÉS : directives basées sur des données probantes, chiropratique, lombalgie, médecine, physiothérapie

to 60%.^{3,4} In as many as one-third of people, the initial episode of LBP persists for a year.⁵ Should the pain be present in multiple spinal regions, the prognosis is much worse.⁶ A recent Scandinavian study found only 19% of people could report a single day of the year without back pain.⁷

After respiratory conditions, the majority of conditions managed by medical practitioners are musculoskeletal, despite 39% of sufferers choosing not to seek the care of any health professional, and of these musculoskeletal con-

ditions, back pain is the most common.⁸⁻¹⁰ Patients with back pain spend about 75% more annually on health care than people without back pain and this does not include costs for lost work time or diminished productivity.¹¹ Indeed, productivity loss and directly related health care expenditure continue to escalate along with prevalence. Between 1997 and 2005 in the US, expenditures for back and neck pain rose 65%, adjusted for inflation.¹² Spinal disorders are consistently within the top ten of the most expensive health care presentations.^{9,13} Health system administrators clearly have a powerful incentive to ensure concordance with guidelines to encourage management that demonstrates positive treatment outcomes, cost efficiency and is patient-centred. Currently, fewer than 10% of Australians with low back pain get access to evidence-informed management.¹⁴

Guidelines

Formulation of guidelines is the natural sequitur to the goal of implementation of evidence-based practice. Thus nations including Canada, USA, UK and Australia have set about standardizing practice and publishing guidelines for virtually all aspects of health care; there exists even a formal Guidelines International Network.¹⁵⁻¹⁸ Compliance with guidelines however seems to be as problematic as developing them in the first place, evidence-based guidelines and systematic reviews have flourished, but seem to have had little impact on actual primary care practices.^{19,20}

Guideline concordance (“practising in agreement with or in a way that is consistent with guidelines”) can be broadly considered within two contexts: 1) clinical decision-making, and 2) clinical intervention or management. In turn, management includes passive (clinician-centric) and active (patient-centric) aspects. Clinical decision-making relates to the utilisation of health history taking, physical examination and the use of diagnostic tests. Evaluation of guideline concordance (adherence) can thus take the form of ‘triage concordance’ and/or ‘management concordance’. This paper is concerned with the latter.

Recommendations in guidelines are made on the basis of being: 1) effective, 2) benefits outweighing risks, 3) costs being reasonable compared to expected benefits, and 4) the recommended actions being practical and feasible.²¹

Guideline panels usually have letters and numbers to

indicate the strength of the recommendations, however they use them differently. This is potentially confusing, thus a binary system is now preferred; for example as employed by the GRADE panel.^{22,23} In this system, the strength of a recommendation reflects the extent of confidence that desirable effects of an intervention outweigh undesirable effects. Strong recommendations mean that *most* informed patients would choose the recommended management and that clinicians can structure their interactions with patients accordingly (i.e. *most* people in the same situation would want the recommended course of action and only a *small* proportion would not). Weak recommendations mean that patients’ choices will vary according to their values and preferences, and clinicians must ensure that patients’ care is in keeping with their values and preferences (i.e. *most* people in the same situation would want the recommended course of action, but *many* would not).

Guidelines are sometimes embedded within ‘*models of care*’, ‘*codes of conduct*’ and ‘*clinical frameworks*’ which contain expectations of practitioners *regardless of profession*; i.e., manual care practitioners should perform a comprehensive health history and appropriate physical examination; form a clinical impression and/or diagnosis; develop an individual plan of management; provide patient feedback in a timely manner; obtain informed consent; initiate appropriate care in a timely manner within scope of practice; manage the patient according to best available evidence; provide management within a biopsychosocial/holistic model; empower the patient; and measure response to management.²⁴⁻²⁷

Methods

Contemporary evidence-based guidelines for the management of non-specific acute and subacute LBP are broadly homogenous.^{5,15,16,18,28-32} We developed a composite list of recommendations drawn from three representative EBG examples: the first, Western Australian Government Department of Health ‘*Spinal Pain Model of Care*’, from the jurisdiction where the authors reside; and the other two, recently published guidelines at the time of the study from the state of Oregon (USA) and the Institute for Clinical Systems Improvement (USA).^{5,25,28}

For the management of acute and/or subacute mechanical LBP, the following evidence-based treatment and “core” recommendations are offered:

- Identify potentially serious causes, ‘red flags’ and neural compression syndromes as well as non-spine pain origins
 - Provide patient advice and education, using *The Back Book*.³³ Included in advice is:
 - Reassure the patient: “*Recovery is to be expected*”
 - Manage fear avoidance and psychosomatic issues: “*Hurt does not equal harm*”
 - Promote effective self-management of symptoms through appropriate advice
 - Discourage bed rest
 - Encourage the patient to stay active and continue ordinary activities (including work)
 - Do not advise back-specific exercises (‘general’ exercise should be recommended to reduce recurrence, however, no specific exercise is preferred)
 - May recommend appropriate medication within scope of practice*
 - The use of spinal manipulation (grade V; manual, high-velocity, low-amplitude, thrust-type manipulation) as a first-line or adjunctive treatment.
 - Exercise therapy, back school, joint mobilization (with therapeutic intent), massage (with therapeutic intent), electrotherapy/physical agents (heat, cold), and traction/lumbar supports were considered, but excluded from the protocol because the evidence for their use is either insufficient, equivocal, or negative. Although clinical guidelines offer mixed support for spinal manipulation, a recent practice guideline recommends its use, and specific trials support the effectiveness of spinal manipulation in the subgroup of patients with acute LBP of short duration.²⁷
- * Only guideline adherence scores from medical practitioners were collected with respect to medication and injection therapy as they are the only health care professionals legally able to utilise such methods in most jurisdictions.

To obtain concordance data with guideline recommendations, six databases and search engines were searched

for articles published between January 1995 and July 2013 [JL&RB]. These databases were Medline, Web of Science, EMBASE, SportDiscus, Google Scholar and The Cochrane Library. The search strategy is tabulated in Appendix 1. The abstracts of all papers returned by the search were assessed, and papers not directly relevant to Guideline Adherence for acute and/or subacute LBP were excluded. Inclusion of papers was based on selection criteria and appraised by two reviewers independently using a modified Downs & Black appraisal tool. Reference lists of included papers were examined and appropriate papers identified and reviewed. Any new papers in turn had their reference lists examined until no new papers were identified. Only papers written or transcribed in English were included, and papers were evaluated for methodological quality before inclusion in this study.

Measuring Methodological Quality

Each paper identified in the initial search was evaluated for methodological quality using a modified version of the system described by Downs and Black.³⁴ Inclusion of papers were based on selection criteria and appraised by two independent reviewers. Scoring on the modified version could range between 0 and 20, with a higher score indicating higher methodological quality. Papers that scored below 12/20 (i.e. <60%) were deemed poor quality and excluded. This standard scoring methodology and inclusion criteria is considered valid and reliable for assessing randomized and nonrandomized studies and thus readily adapted for use in this context.³⁵ This tool was chosen and adapted as there exists no “gold standard” critical appraisal or widely accepted generic tool that can be applied equally well across study types and specifically not for allied health research requirements.^{36,37} Scoring was performed independently by two researchers [JL&RB], and although a third researcher [LA-W] was available in the event of disagreement, he was not required.

Concordance Evaluation Protocol

Evaluation was conducted using the following protocol:

1. When evidence was reported in the form of a statement but no figures were reported, the concordance score was not used in this study;
2. When numeric data were present, a fraction equal to the concordance to a particular recommendation was given, the denominator representing the total number of

practitioners studied and the numerator representing the number of these practitioners that followed the recommendation. In some studies, numerators were determined from percentages, e.g., 50% concordance of 70 practitioners yielded a value of 35/70 and 25% concordance yielded 17.5/70 (numerators were not rounded to the nearest integer to avoid introducing further rounding errors);

3. When concordance scores for a particular recommendation were sourced from more than one study, a combined (pooled) score was calculated by adding both

the numerators and denominators of the scores given, e.g., a concordance score of 35.5/70 and another of 40/60 yielded a value of 75.5/130 (58%).

Results

Of 23 studies initially identified, 6 did not contain numeric data related to treatment recommendations of LBP, and 6 did not have a methodological quality of at least 12/20 so were not included in this study. Thus, 11 studies met the inclusion criteria outlined above, were relevant

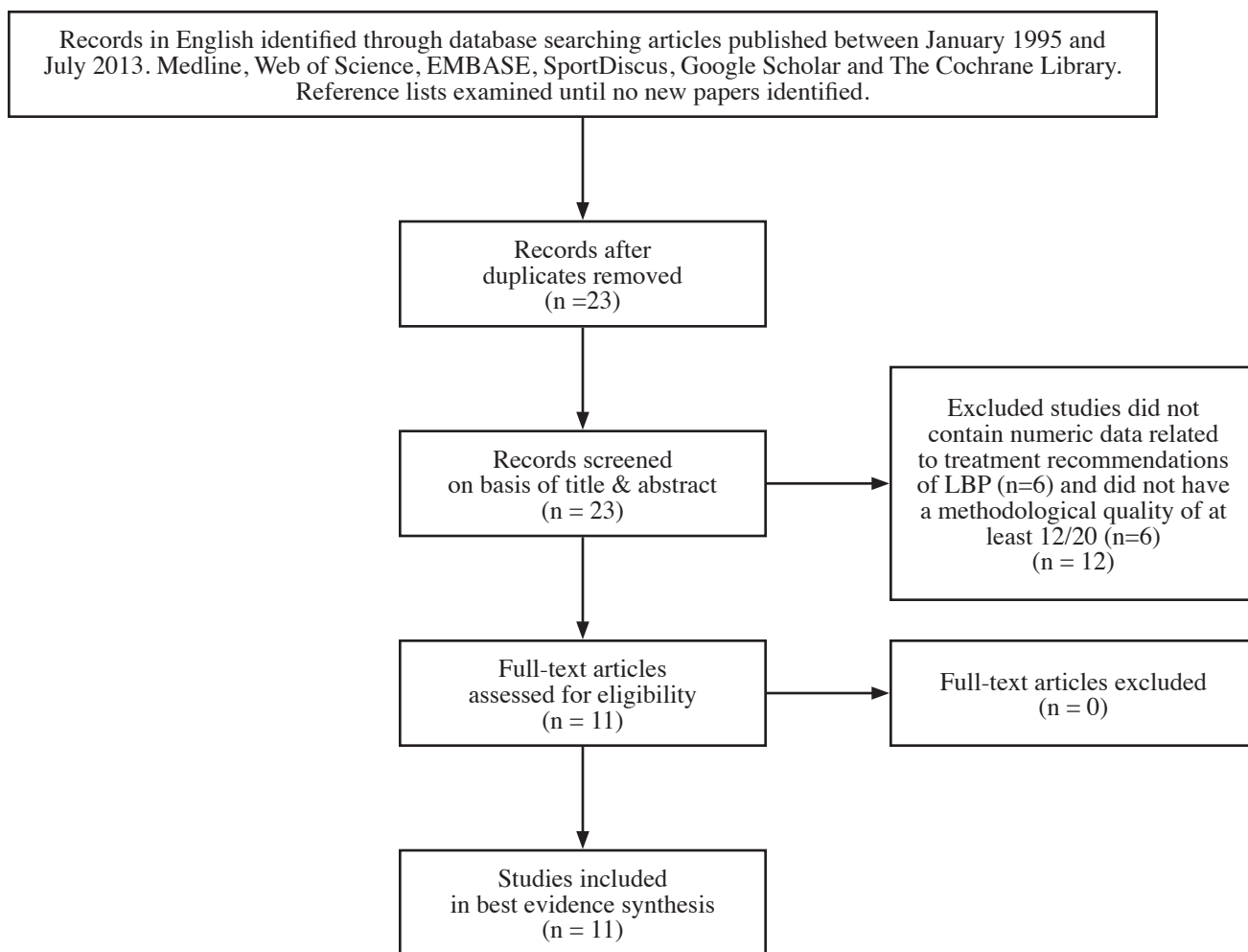


Figure 1:
Flow Chart of Study

within the framework of this study, and contained data that provided insight into guideline adherence. Methodological quality scores of the 11 studies included in this

review ranged from 12 to 19, with a mean of 16.4 (Table I), and data from these studies were used to estimate concordance scores for the EBG recommendations (Table II).

Table I
Methodological Quality Findings for Included Studies

Question	Bishop and Wing (118)	Bishop et al (119)	Briggs et al (115)	Buchbinder and Jolley (120)	Coudeyre et al (121)	Harte et al (122)	Li & Bombardier (123)	Linton et al (124)	Little et al (125)	Pollentier & Langworthy (126)	Walker et al (127)
1. Is the hypothesis/aim/objective of the study clearly described?	1	1	1	1	1	1	1	1	1	1	1
2. Are the main outcomes to be measured clearly described in the <i>Introduction</i> or <i>Methods</i> section?	1	1	1	1	1	1	1	1	1	0	1
3. Are the characteristics of the participants included in the study clearly described?	0	1	1	1	1	1	1	0	0	1	1
4. Are the distributions of principal confounders in each group of subjects to be compared clearly described?	1	1	1	0	2	1	2	1	0	1	1
5. Are the main findings of the study clearly described?	1	1	1	1	1	1	1	1	1	1	1
6. Does the study provide estimates of the random variability in the data for the main outcomes?	0	1	1	1	1	1	1	1	1	1	1
7. Have actual probability values been reported (e.g., 0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?	0	0	1	0	1	1	0	1	0	1	0
8. Were the subjects asked to participate in the study representative of the entire population from which they were recruited?	1	1	1	0	1	1	1	1	0	1	1
9. Were those subjects who were prepared to participate representative of the entire population from which they were recruited?	0	0	1	0	0	1	1	0	0	0	0
10. Were the staff, places, and facilities representative of the treatment the majority of patients would receive?	1	1	0	1	1	1	1	1	0	1	1
11. If any of the results of the study were based on 'data dredging', was this made clear?	1	1	1	1	1	1	1	1	1	1	1
12. Were the statistical tests used to assess the main outcomes appropriate?	1	1	1	1	1	1	1	1	1	1	1
13. Were the main outcome measures used accurate (valid and reliable)?	1	1	1	1	1	1	1	1	1	1	1
14. Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?	0	1	1	0	1	0	1	0	0	0	1
15. Did the study have sufficient power to detect clinically important effects?	5	5	5	5	5	5	5	5	5	5	5
Total methodological quality points	14	17	18	14	19	18	19	16	12	16	17

Included studies

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Table II
GLC According to EBG Recommendation [Blank fields indicate no data]

Recommendation topic	Study	Chiropractors		Physiotherapists		Medical Practitioners	
		Fraction	Percent	Fraction	Percent	Fraction	Percent
Self-management and appropriate advice	Briggs et al	41.7/46	91%	105.2/171	80%	80.3/176	52%
	Li and Bombardier			255.6/274			
	Linton et al			54.0/71		34.2/60	
	Little et al					94.5/163	
Bed rest	Briggs et al	39.0/46	97%	127.4/171	87%	114.6/176	86%
	Buchbinder and Jolley					413.9/511	
	Coudeyre et al					785.9/845	
	Li and Bombardier			259.1/274			
Physical Activity (including work)	Walker et al	270.4/274					
	Bishop and Wing		55%		87%	30.6/139	71%
	Briggs et al	35.5/46		117.4/171		91.7/176	
	Buchbinder and Jolley					467.6/511	
Spinal manipulation	Li and Bombardier			267.7/274			
	Walker et al	139.7/274					
	Bishop and Wing		76%		18%	70.2/139	34%
	Buchbinder and Jolley					143.1/511	
Acupuncture	Li and Bombardier			48.6/274			
	Little et al					33.2/66	
	Walker et al	208/274					
	Buchbinder and Jolley		93%		82%	107.3/511	38%
Traction and short-wave diathermy	Li and Bombardier			223.8/274			
	Little et al					149.5/159	
	Walker et al	254.1/274					
	Buchbinder and Jolley		95%		54%	281.1/511	55%
Recommends or uses physiotherapy	Harte et al			644.3/1239			
	Li and Bombardier			175.4/274			
	Walker et al	260.2/274					
	Bishop and Wing		23%		50%	77.8/139	41%
Recommends or uses chiropractic	Briggs et al	10.6/46		85.3/171		40.3/176	
	Buchbinder and Jolley					219.7/511	
	Briggs et al	45.0/46	99%	17.4/171	10%	12.7/176	7%
Appropriate use of diagnostic imaging	Pollentier and Langworthy	247.8/249					
	Bishop and Wing		32%		88%	132.1/139	81%
	Bishop et al			507.5/580		402.2/442	
	Buchbinder and Jolley					393.5/511	
Medication	Walker et al	87.7/274					
	Bishop and Wing		N/A		N/A	95.2/139	46%
	Briggs et al					50.9/176	
Trigger point injection therapy	Buchbinder and Jolley					224.8/511	
			N/A		N/A		
Lumbar support	Li and Bombardier		91%	258.6/274	94%		
	Walker et al	250.7/274					
Heat	Li and Bombardier		42%	139.9/274	51%		
	Walker et al	116.3/274					
Spinal mobilisation	Li and Bombardier		69%	90.3/274	33%		
	Walker et al	189.2/274					
Red flags" and neural compression syndromes	Bishop and Wing				60%	7.0/139	5%
	Li and Bombardier			164.4/274			
Back-specific exercises	Li and Bombardier			209.3/274	76%		
	Buchbinder and Jolley				47%	132.9/511	49%
TENS	Li and Bombardier			128.8/274			
	Li and Bombardier			267.2/274	98%		
LASER	Li and Bombardier			155.4/274	57%		
	Li and Bombardier						
Ultrasound	Walker et al	134.8/274	49%				
	Walker et al						
Massage	Walker et al						
	Walker et al						
Reassurance	Walker et al						
	Walker et al						
Fear avoidance and psychosomatic issues	Walker et al						
	Walker et al						
Total: Average for recommendations where all professions had data			73.44%		61.78%		51.67%
Total: Overall for recommendations common to all three professions			70.15%		63.06%		47.08%
Fraction = concordance to a particular recommendation where the denominator represents the total number of practitioners studied and the numerator represents the number of practitioners who followed the recommendation.							

Concordance Data

The numbers of EBG recommendations with concordance scores were 13 for chiropractors, 12 for medical practitioners and 17 for physiotherapists, and average concordance percentages over these recommendations were 70.2, 63.1 and 47.1 for each profession, respectively.

There were recommendations with concordance scores available for all three professions related to providing advice on self-management, bed rest and physical activity including work. Recommendations concerning the use of medications only had concordance scores for medical practitioners due to the inability of chiropractors and physiotherapists to prescribe medication. Only physiotherapists had concordance scores for guidelines pertaining to back exercises and use of LASER, and only chiropractors had a score for the use of massage therapy.

Of the recommendations common to all three professions, chiropractors had the highest concordance scores for six, but the lowest concordance scores for three, and their average concordance was 73.4%. Average concordance was 61.8% for physiotherapists and 51.7% for medical practitioners. The score for chiropractors was notably negatively affected by imaging use which may technically be considered a 'triage guideline'.³⁸

In regard to recommending their own therapy, chiropractors scored 99% for recommending or using their treatment, while physiotherapists only scored 50% for recommending or using physiotherapy. In regard to recommending each other's discipline, chiropractors were more than twice as likely to recommend or use physiotherapy (23%) than physiotherapists were to recommend or use chiropractic (10%). Medical practitioners claim to recommend or use chiropractic and physiotherapy at very different rates: 41% for physiotherapy and 7% for chiropractic.

Although TENS and traction are considered ineffective or possibly harmful²⁵, their dissuasion received a low concordance score of around 50% by physiotherapists. The use of spinal manipulation, received low recommendations from both medical practitioners and physiotherapists with 33% and 17%, respectively. Likewise, medical practitioners and physiotherapists were not overly concordant with identifying red flags (5% and 60% respectively). Furthermore, medical practitioners had a lower rating for promoting self-management through advice than the other two professions (52% versus 80% and 91%).

Discussion

We examined the guideline adherence for the management of non-specific acute and subacute LBP reported in the literature relating to the professions of medicine, physiotherapy and chiropractic. These three professions were chosen because, between them, they deliver the vast majority of management of these conditions in Western societies. It is an important consideration that guidelines are intended to enable, guide, motivate, or sometimes 'cajole' physicians and health care providers to deliver certain types of care. However, they do not directly determine the care provided to a particular patient.²¹ Although research is conducted and guidelines formulated for populations, their application in a specific case is still the domain of the individual practitioner. Our results, which demonstrated that no profession in the study consistently attained an overall high concordance rating (according to the Downs & Black scoring system), are consistent with other studies that demonstrate that many primary care physicians continue to be non-concordant.³⁹⁻⁴⁴

Utilisation

According to the Canadian Institute of Health Economics study by Scott et al. (2010), up to 25% of patients with back pain seek help from a health care provider, with 75% of these patients presenting to either a physician or a chiropractor.^{45,46} Primary care physicians undertake the initial evaluation in 65% of LBP cases and often ultimately become the sole provider for these patients.⁴⁷ Most patients tend to visit more than one provider, and between 10% and 50% of patients receive physiotherapy.⁴⁸⁻⁵⁰ In Canada, chiropractic services have remained relatively stable over the last decade at about 11%. Utilization is higher in provinces where public funding was or continues to be available.⁵¹ North American and UK demographics are reflected in Australia where Sibbritt and Adams (2010) also found Australians with longer-term back pain tended to consult more with chiropractors, and Walker, Muller and Grant (2004) noted that chiropractors were the second-most utilised practitioners sought for care (19.1%) after medical care (22.4%) for back pain.^{52,53} In Australia, although the number of physiotherapists working in the private sector is 2.9 times larger than that of chiropractic, chiropractors provide approximately two and a half times more services than physiotherapists.⁵⁴

Medicine

Medical practitioners are the health professionals most likely to be consulted for spinal pain in developed countries.^{46,53} Non-steroidal anti-inflammatory drugs and acetaminophen are popular treatments among medical practitioners and some studies find they are generally prescribed according to guidelines for acute LBP, and guideline recommendations against the use of antidepressants are followed. However, recent data from the USA demonstrate the opposite; 'simple analgesia' prescription rates are falling and inappropriate opioid prescription rates are rising, along with referral for surgical consultation for non-specific back pain.⁵⁵ Up to 45% of medical practitioners do not follow guidelines and prescribe oral steroids for acute LBP.³⁹ A recent Australian study found guideline adherence for opioid prescription was poor; in fact, no medical practitioner in the study was always compliant with all guideline items, and only 31% usually followed most items.⁵⁶ Given the pathway to misuse and abuse and the known illicit market for this class of drug, this is of significant concern. The rise in use of opioids for pain relief has in fact become a major issue for health care, placing a significant economic strain on developed economies.^{55,57}

Scott et al. found that the majority of Canadian medical practitioners correctly recommended the use of heat or ice and discouraged prolonged bed rest for patients with acute LBP, although some studies still recorded high rates of discordance regarding the prescription of bed rest.⁴⁶ Medical practitioners are more likely to be receptive to a guideline when they are aware of shortcomings in the care that they provide, however, somewhat ironically, those with a special interest in LBP are probably the group in greatest need of guidance⁵⁸⁻⁶⁰ For example, Di Iorio et al (2000) measured overall concordance in a sample of 87 family medical practitioners and found that 68% adhered to guidelines on LBP, but only 6% achieved a concordance level greater than 90%.³⁹ Overmeer et al (2005) found no significant difference in practice behaviour between Swedish medical practitioners who were familiar with guidelines and those who were not.⁶¹

Physiotherapy

Physiotherapists occupy a wide variety of roles in health care. These roles include working in hospitals, workplaces, sports and community centres, women's health

centres, rehabilitation centres, aged care facilities, mental health centres, chronic disease management centres, the private sector, schools, education and research facilities, and even with animals.⁶²

Multiple studies indicate that passive interventions, such as electrotherapies, remain popular with physiotherapists, notwithstanding their lack of evidence.^{61,63-69} Treatments supported by guidelines, such as spinal manipulation, are underused, whereas ineffective treatments are overused: specifically, contrary to guideline recommendations, transcutaneous electrical nerve stimulation (TENS) and ultrasound are still considered to be effective treatments for acute LBP by many physiotherapists (and medical practitioners).^{46,68} Contrary to the prevailing perception of the profession being strongly evidence-based, studies consistently demonstrate resistance to adoption of evidence-based practice among physiotherapists, even when specific education and post-graduate and professional development training is undertaken.^{70,71}

Chiropractic

The demographics of chiropractic are much easier to quantify than either physiotherapy or medicine due to its relatively homogenous nature. Of approximately 82,000 chiropractors worldwide, the vast majority are in private practice and provide care directly to the public. Their care is usually funded by direct payment 'out of pocket' from their patients.⁷² About 1% are in academia and a tiny fraction are in full-time research.⁷³ There are approximately 4,300 registered chiropractors in Australia, and each year it is estimated that over three million people (~16% of the Australian population) consult a chiropractor at least once.^{25,74-76} A wide variety of manual and mechanically assisted spinal manipulative techniques are employed by chiropractors; however, chiropractic is still generically identified by its hallmark description of providing '*non-pharmaceutical, non-surgical spinal care*'.⁷⁷⁻⁷⁹ This is accomplished primarily by manual methods of spinal manipulation therapy (adjustment) (SMT) and active care and lifestyle advice.⁸⁰ Wenban (2003) reported that, when compared to the many other studies of similar design that have evaluated the extent to which different medical specialties are evidence based, chiropractic practice was found to have the highest proportion of care (68.3%) supported by good-quality experimental (RCT) evidence.⁸¹ This compares favourably to mainstream medicine where,

for example, Imrie and Ramney (2003) found an average of 37.0% of medical practice to be based on RCTs (notably excluding spinal care).⁸²

General

Scott, Moga and Harstall use the term “*Know-Do Gap*” (2010) in their robust work and concluded that “*Guidelines are often used to establish standards of care and provide a benchmark for evidence-based practice, but their directives are not always heeded*”.⁴⁶

Several studies have investigated possible explanations for the high levels of non-concordance with guidelines demonstrated by health professionals. Li and Bombardier (2001) concluded that only half of the (physical) therapists in their study confirmed the usefulness of practice guidelines in managing any clinical conditions, including LBP.⁶³ This finding may indicate some reluctance to embrace guidelines, especially for managing acute lumbar impairment. Other studies included patients’ demands⁸³, excessive commitment to particular modes of therapy, lack of awareness or outcome expectancy, inertia of previous practice⁴³, and the health care practitioners’ own perceptions of treatment effectiveness⁸⁴ as reasons for discordance with guidelines.

Education

Suboptimal guideline adherence by medical practitioners in the management of spinal pain may be related to deficiency of musculoskeletal medicine in undergraduate medical education, a phenomenon not lost on the World Health Organization.⁸⁵⁻⁸⁷ This observation has resulted in a number of follow-up studies highlighting the deficiencies of medical management of spinal pain compared to physiotherapists and chiropractors^{88,89} and medicine in general^{46,90}. Our study is consistent with this phenomenon with medical practitioners scoring lowest of the three.

Red Flags

Of some concern is the lack of concordance in identifying ‘red flags’. Red flags are features of the patient’s medical history and clinical examination that may suggest a higher risk of serious disorders, such as infection, inflammatory disease, cancer or fracture.⁹¹⁻⁹³ The exclusion of specific pathologies is step one of the clinical assessment, and clinical guidelines recommend that the identification of ‘red flags’ as the ideal method to accomplish this.^{94,95}

Approximately 10% of all malignancies have symptomatic spine involvement as the initial manifestation of the disease, including multiple myeloma, non-Hodgkin’s lymphoma, and carcinoma of the lung, breast and prostate.⁹⁶ Early detection and treatment of spinal malignancies are important to prevent further spread of metastatic disease and the development of complications such as vertebral fracture and spinal cord compression.⁹⁷ One reason put forward for the low rate of concordance in the red flag category is that, despite their inclusion in the guidelines and their apparent clinical importance, the usefulness of screening using ‘red flags’ in patients with LBP continues to be robustly debated, and there remains very little information on their diagnostic accuracy and how best to use them in clinical practice.^{91,93,98}

Medications

Our findings in regard to the administration of medications are also consistent with a number of recent studies that have examined comparative competence and attitudes toward evidence-based practice among primary spinal care practitioners. Di Iorio (2000) found many medical practitioners recommend drugs discouraged by the applicable guideline.³⁹ Although we did not categorise the types of medications, this trend is consistent with other studies that show that, despite there being no clear evidence supporting the prescription of, for example; antidepressants in the treatment of LBP, up to 23% of general practice physicians prescribe antidepressants.^{39,99-102}

Referral Patterns

The referral patterns in this study followed the trends set by other studies that demonstrated a significant difference between medical referrals to physiotherapists and to chiropractors. In our study overall 41% of medical practitioners would refer to physiotherapists while only 7% would refer to chiropractors. These data are an interesting paradox; considering about 38% of physicians admit using CAM treatments themselves for medical conditions, most notably acupuncture, chiropractic and osteopathy.¹⁰³ Only 30% of medical practitioners in a study by Greene et al. (2006)¹⁰⁴ and between 29–50% in various other studies¹⁰⁵⁻¹⁰⁷ have ever made a formal referral to a chiropractor. Several possible explanations for medical practitioners’ unwillingness to ‘formalise’ their relationships with chiropractors have been suggested and include

the perception that alternative care providers could be a threat to their practices. Some of the medical practitioners also mentioned that they do not know enough about chiropractic to have an opinion or do not view chiropractic as a legitimate health profession; they thereby fear malpractice litigation¹⁰⁸, or it may simply be a manifest lack of inter-professional trust¹⁰⁹. Traditionally, medical practitioners receive little training in common musculoskeletal problems in undergraduate medical school, during medical internship, and in post-graduate education and often have limited knowledge about the suite of non-pharmacological treatments available to patients. Surveys and interviews indicate that medical practitioners have a lack of confidence in examining and providing treatment to patients with back pain, and many medical practitioners feel ill-equipped, often relying on pharmacological management instead of referring to those musculoskeletal practitioners such as musculoskeletal physiotherapists, chiropractors and osteopaths that are specifically equipped to deliver manual therapy.^{58,110} The impact of low referral rates to chiropractors and other manual therapists is not benign but manifests in greater suffering and expense to the patients who present with LBP. Cost-effectiveness data from randomised clinical trials indicate that primary care for patients with LBP is not cost-effective unless it also involves one or more added components such as exercise, spinal manipulation or behavioural counselling.^{111,112} Indeed the North American Spine Society recommends spinal manipulation—5 to 10 sessions over 2 to 4 weeks—should be considered before surgery or narcotics.¹¹³

Another finding of this study was that 99% of chiropractors would recommend or use chiropractic care for treatment of LBP, but only 50% of physiotherapists would recommend or use physiotherapy. One reason for this trend may be that some physiotherapists still use modalities that have questionable effectiveness and result in unfavourable patient outcomes. For example, Li and Bombardier (2001) found mechanical spinal traction, which has consistently been shown to be of little benefit for acute and subacute lumbar impairment and is not recommended by the guidelines, was preferred by about 30% of the physical therapists in their study for acute sciatica. In the same study, Li and Bombardier also found that, despite the reported success of spinal manipulation in the treatment of LBP, only 5% of the physical therapists re-

ported that they would use spinal manipulation to treat patients with acute lumbar impairment, as compared with more than a third of the therapists who indicated that they would use mobilisation, which may not be as effective.⁶³ This discrepancy could be explained by the small number of therapists in the study who were trained to perform spinal manipulation. Although most of the respondents in the study had received postgraduate training in manual therapy, only 8.8% completed courses that included joint manipulation.

Beliefs

Another explanation may suggest a difference in belief systems that each profession holds with respect to treatment of LBP and the confidence level they hold for the desired patient outcomes. While some chiropractors may hold unorthodox views which are in contrast to current scientific paradigms, at least in Canada they are definitely a minority.¹¹⁴ In a study that looked specifically at beliefs held by 600 university undergraduate students in the health care professions, Briggs et al. (2012) found chiropractic, and to a lesser extent physiotherapy students, reported significantly more helpful beliefs for management of spinal pain compared with the other disciplines, while medical and pharmacy students reported the least helpful beliefs. Although this study did not look specifically at the interventions of practicing health professionals, one could predict that beliefs, at least to a certain degree, may influence actions. If this is true, the high levels of concordance with recommendations for physical activity, work and bed rest across disciplines may reflect practitioners' beliefs.¹¹⁵ One is left to wonder what is worse, to know and not do, or not know in the first place?⁴⁶

Given the substantial financial and other resources devoted to formulating guidelines, the question could be reasonably asked; “*who cares, since so many practitioners don't follow them?*” Health authorities clearly care and at least in the third party payer context, are beginning to actually *require* practitioners to practice within clinical frameworks regardless of their profession.²⁶ Efforts are underway to look at questions like this, from a quality perspective, not just a compliance one. For example in the USA, the National Center for Quality Assurance has best practices by which it judges physician behaviours, such as relates to both diagnosis and treatment and may reward practitioners for “best practices”.¹¹⁶ Our work may serve

to corroborate existing evidence of the comparative cost-effectiveness of chiropractic.¹¹⁷

Limitations of the Study

The authors recognize the methodological study limitations with respect to adapting the appraisal tool to assess concordance and when comparing results from different studies that used various designs. In addition, while assessment of LBP can include ordering of imaging studies for some patients, concordance was not assessed in great detail in our study.

Lack of data in several categories for all professions limited our comparisons, although this seems to be minimal since averages of the guidelines where all professions had data (medicine 51.7%; physiotherapy 61.8%; chiropractic 73.4%) and the overall averages (medicine 47.1%; physiotherapy 63.1%; chiropractic 70.2%) were relatively unchanged.

This study was not designed as a systematic review, rather a best evidence synthesis so it was thorough but not exhaustive. Papers prior to 1995 were excluded; as there was less homogeneity of guidelines prior to that time, it would not be relevant to evaluate concordance to guidelines that did not exist at the time. While our study was 'systematic', it was not a systematic review (according to all the PRISMA protocols), due to the constraints of human and financial resources available.

Despite the limitations, we believe that the findings from this work are important. To our knowledge, this is the first in-depth study comparing the practice behaviors of medical practitioners, physiotherapists and chiropractors with respect to guideline adherence for acute and sub-acute non-malignant mechanical LBP.

The authors caution that this study should not be considered an end, but a beginning. Although the chiropractic profession in our study fared the best of the three, this is by no means a cause for complacency, rather it highlights the need for further research, especially within the chiropractic sector.

Conclusion

Adoption of evidence-based practice continues to be a challenge for chiropractors, physiotherapists and medical practitioners as no profession attained satisfactorily high guideline adherence in our view.

We found chiropractors have the highest levels of

guideline adherence, and chiropractors and physiotherapists are both significantly more guideline concordant than medical practitioners with respect to management of acute and subacute low back pain. It seems clear that medical practitioners often rely on pharmacological management instead of referring to musculoskeletal practitioners, who are specifically equipped to deliver manual care and other appropriate management that has a robust evidence basis. The impact of low referral rates to chiropractors and other manual therapists is not benign but manifests in greater suffering and more expense to the patients who present with acute and subacute low back pain.

More quality research is urgently needed in order to accurately determine levels of guideline adherence and just as importantly identify the reasons that practitioners are not concordant with guidelines. Wider concordance with guidelines for management of spinal pain has the potential to result in significant savings in health care expenditure and a significant reduction in disability and morbidity.

Abbreviations

EBG:	Evidence-Based Guideline
GP:	General Practitioner (Australia)
LASER:	Light Amplification by Stimulated Emission of Radiation Therapy
LBP:	Low Back Pain
SMT:	Spinal Manipulative Therapy
TENS:	Transcutaneous Electrical Nerve Stimulation

Competing interests

- The authors declare they have no competing interests beyond LA-W, RB and GP-S being registered chiropractors.
- JL was supported with a stipend as a research assistant.

Authors' contributions

- LW conceived the work, conducted literature searches, drafted and reviewed the text.
- RB conducted literature searches, cross-checked and analysed results, drafted and reviewed the text.
- GPS reviewed and edited the text.
- JL compiled and analysed data and reviewed the text.
- AB drafted and reviewed the text, conducted statistical analysis.

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Appendix 1: Search Terms

Main search terms	Relevant associated words
Clinical Guidelines	Guideline AND/OR Protocol AND/OR Clinical guideline AND/OR Model of Care AND/OR evidence based guideline
Low Back Pain	Back pain AND/OR Low back pain AND/OR Non-malignant low back pain AND/OR Mechanical low back pain AND/OR Non-specific low back pain AND/OR Subacute low back pain
Facilitators	Enable* AND/OR support* AND/OR Adherence AND/OR Compliance AND/OR Concordance AND/OR Observance

Prevalence of cardiac arrhythmias in a community based chiropractic practice

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Introduction: The prevalence of arrhythmias in chiropractic practice (the proportion of current patients who currently have arrhythmias) is unknown, but thought to be increasing. As arrhythmias influence management of chiropractic patients, the objective of this study was to determine the feasibility of screening for cardiac arrhythmias in a chiropractic clinic.

Methods: With a convenience sample from one clinic, ECG data were recorded and analyzed to identify arrhythmias.

Results: Seventy-six of ninety contacted patients participated in this study. Only 8 (~26%) of 31 patients with known or suspected cardiovascular abnormalities demonstrated arrhythmias versus 7 (~16%) of 45 subjects who were not previously aware of having an arrhythmia.

Introduction : La prévalence d'arythmie en chiropratique (la proportion de patients actuels qui ont actuellement des arythmies) n'est pas connue, mais on pense qu'elle est en augmentation. Étant donné l'influence de l'arythmie sur la gestion des patients en chiropratique, l'objectif de cette étude a été de déterminer la faisabilité de dépistage de l'arythmie cardiaque dans une clinique de chiropratique.

Méthodologie : Avec un échantillonnage pratique provenant d'une seule clinique, des données d'ECG ont été enregistrées et analysées afin de déceler les arythmies.

Résultats : Soixante-seize des quatre-vingt-dix patients sollicités ont participé à cette étude. Seulement 8 des 31 patients (~26 %) ayant des anomalies cardiovasculaires connues ou soupçonnées ont révélé une arythmie, contrairement à 7 des 45 (~16 %) patients qui n'avaient pas présenté auparavant des risques d'arythmie.

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Conclusion: *The screening of patients for cardiac arrhythmias in a community based chiropractic clinic is feasible. A 3-minute recording of ECG activity at rest is not a highly sensitive method of identifying patients with previously recognized arrhythmias, but is capable of identifying previously undiagnosed arrhythmias.*

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KEY WORDS: screening; prevalence; arrhythmia

Introduction

The term “arrhythmia” refers to an abnormality of cardiac rhythm resulting in heart beats which occur too quickly, too slowly, or unevenly. This irregularity in heart beat can result in inefficient pumping of blood and may damage the lungs, brain and other organs. There are various types of arrhythmias, including atrial fibrillation, conduction disorders, bradycardia, premature contraction, tachycardia, and ventricular fibrillation or fluttering.¹ Arrhythmias appear to be reasonably common in the general population and some types of arrhythmias have important health implications. As early intervention can prevent or forestall negative outcomes such as stroke², it would be useful to have reliable data on prevalence, including the prevalence in asymptomatic subjects in the general population. At present, data on the prevalence of arrhythmias are incomplete. Such research as exists confirms that prevalence rises with age. A Japanese study found that the prevalence of arrhythmias increased from 1.25% among elementary school students to 2.32% among junior high students.³ An American study⁴ of healthy subjects aged 60 to 85 years demonstrated that a large proportion (in fact, the majority) of subjects had complex arrhythmias, both supraventricular (24% of the sample) and ventricular (49% of the sample). Nearly all subjects with arrhythmias were asymptomatic. Another study⁵ found that in 5,201 adults, aged 65 and older, “serious arrhythmias such as sustained ventricular tachycardia and complete atrioventricular block were uncommon, but brief episodes of ventricular tachycardia (greater than or equal to three depolarizations) were detected in 4.3% of women and 10.3% of men.”

Conclusion : *Le dépistage de l'arythmie cardiaque chez les patients dans une clinique communautaire de chiropratique est faisable. Un enregistrement à repos d'ECG de 3 minutes n'est pas une méthode très précise pour déceler des patients déjà connus pour avoir des arythmies, mais peut révéler des arythmies non diagnostiquées jusqu'alors.*

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MOTS CLÉS : dépistage; prévalence; arythmie

As chiropractors increasingly serve older populations, it is likely that many of their patients have previously undetected arrhythmias and would benefit from secondary preventative measures. For example, anticoagulant therapy greatly reduces the incidence of stroke in patients with atrial fibrillation.² A survey by the National Board of Chiropractic Examiners showed that chiropractors rarely recognize cardiac disorders in their clinics.⁶ However, the actual prevalence of arrhythmias in chiropractic practice remains unknown. Given that approximately 12% of the Canadian population makes use of chiropractic care⁷, community based chiropractic clinics may present an opportunity to screen for important and previously unrecognized cardiac disease. As Canadian chiropractors achieve increasing integration into the larger health care system⁸, the added value of the chiropractic clinic as a screening facility for both musculoskeletal and non-musculoskeletal conditions may provide a further argument on behalf of interprofessional cooperation.

Thus, the objective of this project was to determine the feasibility of screening for cardiac arrhythmias in a chiropractic patient population.

Methods

Study Design

This was a prevalence study with a convenience sample of patients recruited from a single community based clinic in southern Ontario, Canada. The study was approved by the research ethics board (REB) of Canadian Memorial Chiropractic College.

Sample Specification

The target population consisted of patients receiving treatment at a clinic in the Niagara region of Ontario. Patients were either asked to participate as they presented for care, or were called by the clinic receptionist if they had presented for care within the previous six months. There were no exclusion criteria based on demographics or age, although 75% of the sample comprised individuals aged 40 and older. There was no predetermined sample size. However, ECG recordings were reviewed as collected to determine whether or not the study was actually capturing cases of arrhythmia. In this context, Minami et al had previously reported that a similar screening methodology, on which ours was modelled, recorded arrhythmias in approximately 10% of subjects with a prior history versus 1.7% of subjects with no prior history of arrhythmia.⁹

Recruitment Process

The study commenced on February 17, 2012 and ended on March 27, 2012. Of 90 recruited patients, 14 were unable to keep their appointments for various reasons, and so recordings were obtained from 76 subjects.

The subjects were directly recruited by the receptionist or the chiropractor, and informed of the nature of the study. These patients already had a scheduled appointment on the selected study day, or were called and asked to come in to specifically participate in the study. Prior to the recording of ECG data, patients provided written informed consent and answered a short set of questions (supplementary file 1) to identify patients who had or were likely at risk of arrhythmia.

Supplementary File 1

Prevalence of Arrhythmia in Chiropractic Practice	
File ID:	Date:
Examination:	
Age (in years):	Blood Pressure (mm Hg):
Height (include units):	Weight (include units):
Patient Questionnaire:	
Do you have or have you ever been told that you have an irregular heart beat?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you have or have you ever been told that you have a cardiovascular disease – a disease affecting your heart or blood vessels?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you have or have you ever been told that you have high blood pressure?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have you recently had dizzy spells or fainting?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No
Have you recently had a sense of your heart racing or beating in your chest – so called palpitations?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you have or have you ever been told that you have diabetes?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No
Do you smoke cigarettes?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

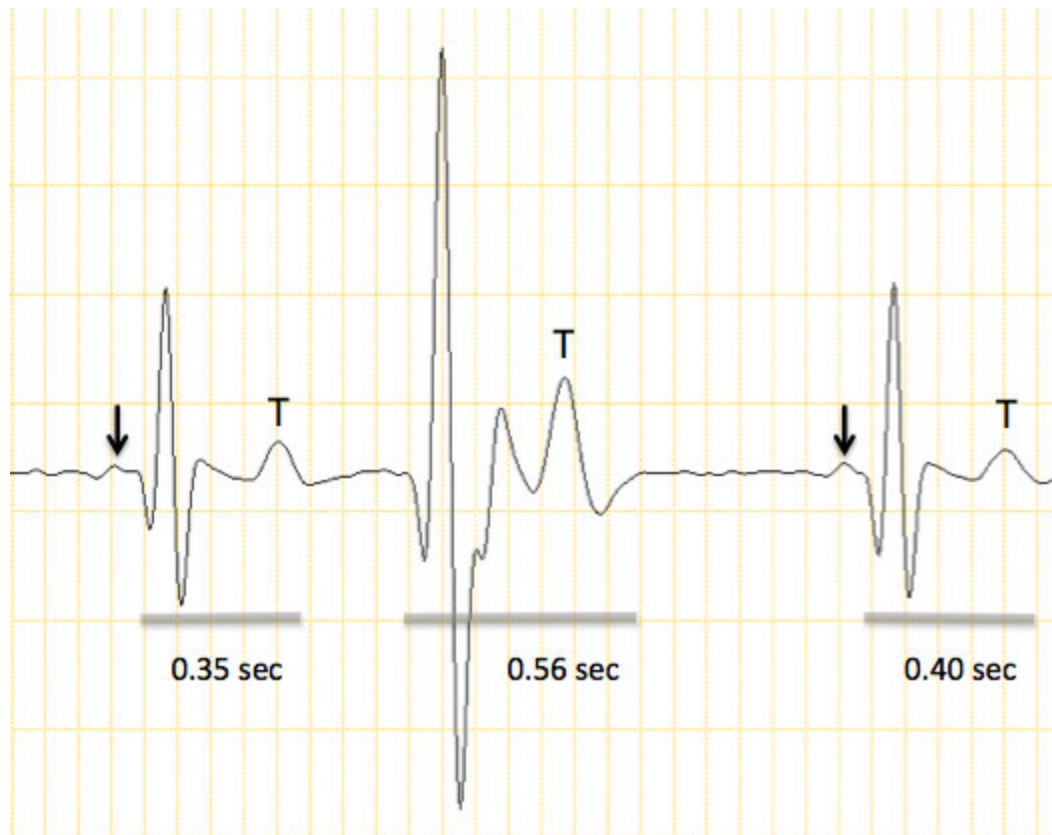


Figure 1:

ECG recording of a premature ventricular contraction

Representative ECG data from one patient who displayed multiple premature ventricular contractions. Vertical arrows indicate P-waves preceding normal QRS complexes. T's denote T-waves following QRS complexes. The horizontal bars indicate the durations of Q-T intervals. The central recording has no apparent P-wave, an abnormal QRS complex and a much prolonged Q-T interval, as is characteristic of premature ventricular contractions.

Description of Equipment, Data Collection and Data Analysis

Subjects completed health surveys and consent forms prior to data collection. Height, weight and blood pressure were measured just prior to ECG recording. ECGs were collected using a Zephyr BioHarness (ADInstruments, Boulder, Colorado) which is a 2-lead portable single chest-strap, dry harness that logs, monitors, and analyzes biological data. Data were recorded automatically via a wireless connection to a USB radio receiver, and analysis was performed using the Zephyr Bioharness software as

well as LabChart 6.0 software (ADInstruments, Boulder, Colorado). Data were recorded for three consecutive minutes while the patient sat comfortably. R-waves and ectopic beats were automatically tagged using the LabChart 6.0 software. Then, the ECGs were reviewed visually to identify anomalies such as missed beats, premature beats, and changes in wave form, as for example the prolonged QRS complex typical of premature ventricular contractions (see figure 1).

In this study, the treating chiropractor was informed of which patients appeared to have arrhythmias. These

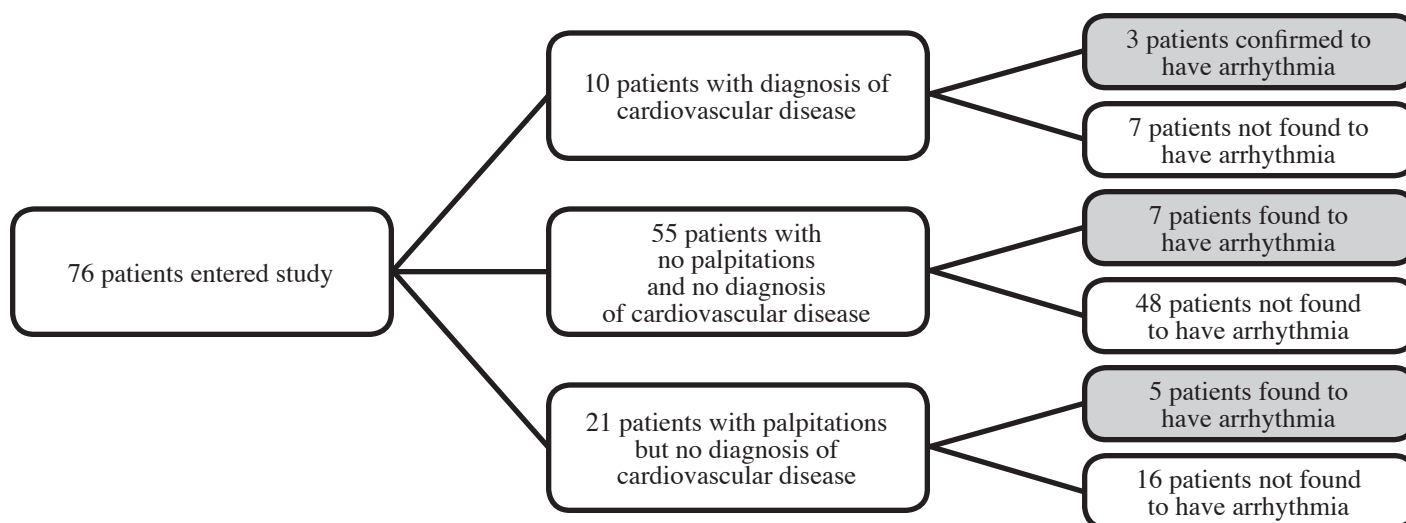


Figure 2:
Medical histories and screening results of patients

The 76 patients recruited into the study could be classified into 3 cohorts based on their histories: previously diagnosed with cardiovascular disease; no previous diagnosis of cardiovascular disease or history of palpitations; history of palpitations but no diagnosis of palpitations. In each of these three cohorts, there were patients who were and were not found to have arrhythmias during a 3-minute screening ECG.

patients were then advised by the chiropractor to consult with their family physician for follow-up and a letter with a representative tracing was provided for the physician.

Results

ECGs were obtained from a total of 76 patients (45 females, 31 males, mean age 51 ± 14 years, mean body-mass index 29.0 ± 6.6). In more detail, the age distributions were: 2 subjects, aged 13 and 17 years, respectively; 2 subjects aged 20 and 29 years, respectively, 11 subjects aged 30 to 39 years; 16 subjects aged 40 to 49 years, 27 subjects aged 50 to 59 years; 14 subjects aged 60 to 69 years; 2 subjects aged 72 years and 2 subjects aged 86 years. Nineteen subjects (25%) had body mass indices (BMIs) of between 25.0 and 29.9, conventionally regarded as overweight, and 38 (50%) had BMIs of 30.0 or greater, conventionally regarded as obese.

As shown in figure 2, of the 76 patients, 10 (13%) reported having cardiovascular disease (2 of these patients also reported palpitations). Additionally, 21 (28%) reported experiencing palpitations or a 'racing heart' in the absence

of a medical diagnosis of frank cardiovascular disease and did not equate their experience of palpitations with 'cardiovascular disease.' Of the 10 patients reporting cardiovascular disease, 3 were found to have an arrhythmia. Of the 21 patients in total who reported experiencing palpitations or racing of the heart in the absence of frank disease, 5 were found to have an arrhythmia. Further, of the 19 (25%) patients who were told, as part of a previous medical diagnosis, that they had an arrhythmia (regardless of whether they had a subjective sense of palpitations), 4 displayed arrhythmias during their 3-minute ECGs. Thus, of the 31 patients in total who either had a diagnosis of cardiovascular disease or symptoms suggestive of arrhythmia, 8 displayed arrhythmia during the 3-minute screening.

Of the 15 patients whose ECGs showed arrhythmias (9 of whom were not aware that they had arrhythmias), 8 displayed premature ventricular contractions (PVCs), 3 had premature atrial contractions (PACs), 2 had atrial fibrillation, 1 had missed beats and 1 had a bundle branch block. All 15 of the patients with ECG abnormalities had BMIs above 25.0 (mean BMI: 31.6).

Discussion

Fifteen of 76 patients (~20%) in this study displayed cardiac arrhythmias. This prevalence of arrhythmias is consistent with the findings of other epidemiological studies. A previous study⁴ found that 49% of subjects aged 60 years or older had arrhythmias of ventricular origin, such as PVCs, and 24% of subjects had supraventricular arrhythmias. Among the factors influencing prevalence of arrhythmias are age (prevalence increases in essentially a linear fashion between ages 45 and 95), gender (prevalence is greater in males than females) and ethnicity (prevalence is greater in African Americans than in American Caucasians).^{10,11} In this regard, a recent study found that 38% of patients visiting chiropractors in the United States of America were over 50 years old.⁶ In our sample, 45 of 75 patients (~59%) were over 50 years of age.

Of the 76 subjects that participated in the study, 31 had indicated that either they had been told they had a cardiovascular disease and/or an arrhythmia, or that they had experienced subjective palpitations/racing of the heart. From this group of 31 individuals, only 8 had ECG readings displaying an arrhythmia, the other 23 individuals had normal readings. In this regard, it is to be noted that arrhythmias may be transient or episodic so that a 3-minute recording is likely to have an imperfect sensitivity, but is more sensitive than the common 20 second screening ECG.⁹ There was also a group of 9 subjects (~12% of our sample) who were not aware of having an arrhythmia (regardless of whether they had a history of cardiovascular disease) and yet their 3-minute ECG recordings did display arrhythmias.

These observed irregularities in the cardiac rhythm took various forms: 8 ECGs displayed PVCs, 3 had PACs, 2 had atrial fibrillation, 1 had missed beats and 1 had a bundle branch block. A PVC results from ectopic foci in the ventricles leading to premature depolarization that therefore propagates along an abnormal and often lengthened pathway. On ECG, this appears as a widened QRS complex, measuring greater than 0.12 seconds, with no visible P wave (figure 1). Isolated PVCs are of little clinical consequence, but when they occur in series they may represent a risk of serious cardiac dysfunction including ventricular fibrillation.¹² With a PAC, an ectopic focus within the atria initiates a depolarization with an irregular P wave.¹³ Individual PACs present little

risk, but trains of PACs inducing tachycardia may be distressing and predispose to more serious consequences. Atrial fibrillation is a relatively common arrhythmia. From the point of view of cardiac function, it may seem relatively inconsequential, as the atria make a relatively minor contribution to ventricular filling. However, atrial fibrillation is, by virtue of clot generation, an important risk factor for ischemic stroke.¹³ A missed beat likely originates from an intrinsic dysfunction of the sinoatrial node. Bundle branch block is due to damage which impairs conduction in one bundle branch. This may produce a delayed or prolonged depolarization of the ventricles, which represents a risk for more serious arrhythmia such as fibrillation.¹⁴

Arrhythmias may manifest as chest pain, dizziness, palpitations, dyspnea, or weakness. The frequency, duration, and severity of symptoms can differ greatly, with some patients being totally asymptomatic while others experience debilitating symptoms.¹⁵ In this regard, asymptomatic arrhythmias may be as clinically important as symptomatic arrhythmias, and are associated with such complications as stroke and heart failure.^{14,16} Furthermore, secondary prevention (identification and early intervention) are important in mitigating negative outcomes.¹⁷ Implementation of anticoagulant therapy in patients with atrial fibrillation has been associated with substantial reduction in the incidence of stroke and reduction in mortality.² Hence, the community-based chiropractic clinic may provide an important opportunity to contribute to public health through screening for cardiac arrhythmias.

Study Limitations:

The true prevalence of arrhythmias in our sample is likely higher than our data suggest. To identify possible abnormalities in rhythm, a simple 2-lead ECG screening tool was used for this study, whereas the hospital standard is a 12-lead ECG. Nonetheless, for the purpose of screening only for common arrhythmias (bradycardia, tachycardia, missed and extra beats) a 2-lead device is adequate as long as R-waves can be reliably identified.^{18,19} Nonetheless, certain diagnostic features might have been missed. Thus, the identification of, for example, a bundle branch block in one subject, would require confirmation. Additionally, with convenience samples there must always be caution in extrapolating to the greater patient population. Patients who knew or suspected that they had a cardiac

abnormality might have been more or less inclined to participate in this study, and the recruiters may have been more or less inclined to recruit such patients.

In this study, it was not possible to calculate the sensitivity or specificity of the screening process, as it is not possible to identify 'true positives' and 'true negatives.' Given that arrhythmias are often intermittent complaints, it would be necessary to monitor patients over much longer periods of time and during normal activities in order to approach perfect diagnostic accuracy. Twenty-four or even 48-hour recordings are now used in advanced screenings, although a parsimonious interpretation of the technology might conclude that there is no 'gold standard' by which to judge whether patients truly ever or never have an arrhythmia. Thus, a pragmatic evaluation might ask whether a given screening process leads to an improved outcome for patients.

Conclusions

This study found a high point prevalence of arrhythmias in a cohort of chiropractic patients, consistent with the previously reported high prevalence in older adults. Screening for arrhythmias in this cohort identified patients who had previously-undetected arrhythmias and who might well benefit from early detection and intervention. The screening process was not disruptive of the clinic routine, and the high rate of compliance suggests that this sort of screening is well-accepted by patients. All patients who had, but were not previously aware of having, arrhythmias with potentially serious consequences were referred for further medical investigation.

This feasibility study suggests that chiropractic patient pools are worthwhile targets for screening for arrhythmias. This is not to imply that there should be a stream of chiropractic care for cardiovascular disease which is separate from the current medical system. Within the context of the jurisdiction where this study was conducted, there is a trend towards integration of chiropractic services into not only private, but also publically funded hospitals and health centers. That chiropractic practices provide an opportunity for screening for cardiovascular disorders may speak to their value as components of a system of integrated health care.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

All authors contributed to the conception of this study. SP and NP performed data collection. SP, NP and BB performed data analysis. All authors contributed to and approved the final manuscript.

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The cellular and molecular biology of the intervertebral disc: A clinician's primer

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Clinicians routinely encounter patients suffering from both degenerative and acute spinal pain, often as a consequence of pathology affecting the intervertebral disc (IVD). The IVD is a complex structure essential to spinal function and is subject to degenerative disease and injury. However, due to the complexity of spinal pain syndromes it is often difficult to determine the extent of the IVD's contribution to the genesis of spinal pain. The location of the IVD is within close proximity to vital neural elements and may in the event of pathological change or injury compromise those structures. It is therefore important that clinicians performing manual therapy understand the cellular and molecular biology of the IVD as well as its clinical manifestation of degeneration/injury in order to safely manage and

Les cliniciens voient régulièrement des patients souffrant de douleurs vertébrales à la fois dégénératives et aiguës, souvent une conséquence d'une pathologie affectant le disque intervertébral (DIV). Le DIV est une structure complexe essentielle à la fonction rachidienne et peut être touché par des maladies dégénératives et des blessures. Toutefois, en raison de la complexité des syndromes de douleurs vertébrales, il est souvent difficile de déterminer la part de contribution du DIV à la genèse de cette douleur. L'emplacement du DIV est à proximité d'éléments neuronaux vitaux et peut, en cas de changement pathologique ou d'une blessure, compromettre ces structures. Il est donc important que les cliniciens administrant une thérapie manuelle comprennent la biologie cellulaire et moléculaire du DIV ainsi que la manifestation clinique de la dégénérescence et des blessures de celui-ci, afin de gérer en toute sécurité et d'apprécier le rôle joué par le disque dans le

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appreciate the role played by the disc in the development of mechanical spinal pain syndromes.

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développement des syndromes de douleurs vertébrales mécaniques.

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MOTS CLÉS : colonne vertébrale, dégénératif, douleur, disque, intervertébral

Introduction:

The intervertebral disc (IVD) is a complex structure positioned between two adjacent vertebrae where in addition to protecting the spinal cord and segmental spinal nerves it confers flexibility, multi-axial spinal motion and load transmission to the spine. The IVD is vulnerable to injury and degeneration often leading to pain syndromes however much remains to be discovered concerning the development of axial and radicular pain syndromes, the biology of the disc and the capacity of the IVD to repair itself after injury.¹ From the clinician's perspective, familiarity with the biology of the IVD is vital in order to understand the natural history of disc-related injury/illness and to develop appropriate therapeutic strategies. The purpose of this review is to provide an overview of the salient characteristics of IVD pathology with a particular emphasis upon degenerative disease and its role in the generation of clinical spinal pain syndromes.

The disc as an organ:

Capping the IVD superiorly and inferiorly, the cartilaginous vertebral end plates (VEP) are thinnest in the central region contiguous with the NP and may be up to 1mm thick at their outer edge. Much like hyaline cartilage found within appendicular joints, VEPs are typically without vasculature or neural elements and although a minute arrangement of vessels exists at early stages, these will fade as skeletal maturity is reached and undergo calcification and significant loss of function with degenerative disease.^{2,3,4} Although the VEPs are without direct vascular supply, there are capillary networks abutting the central portion of the VEP that are directly connected with the vasculature of the vertebral body. Interestingly the capillary density is 4 times denser at the centre of the VEP (over the nucleus pulposus or 'NP') than the periphery;

suggesting the importance of diffusion from these networks into and out of the NP.⁵

Encircling the NP and located between the superior and inferior VEPs, the annulus fibrosus (AF) confers ligament-like restraint properties to the IVD and thereby essential biomechanical support to the disc when subjected to loading.⁶ The AF adheres strongly to the periphery of the vertebral body in a symphysis type of attachment where many small diameter sensory nerve fibers surround the AF, normally penetrating only the outer few millimeters of the lamellae.^{7,8} These small diameter sensory fibers contribute to mechanotransduction properties and in the case of injury, also nociception.^{7,8} In addition to peripheral innervation, the AF also receives a meager vascular supply from the encircling veins and capillary networks.⁸ Although far removed from the outer AF fibers, the NP is in intimate proximity with the inner AF, forming the "transition zone". In youth the "transition zone" boundary between the AF and NP is well defined, but with degenerative change and aging this distinction becomes blurred and loses its clear anatomical border.

It is important to consider that the IVD NP is an avascular, immune privileged and unique niche unlike any other tissue compartment in the body with unique cellular properties. The specific types of cells within the NP continue to be incompletely characterized resulting in the use of non-specific terms such as "NP cells" to define them. At present at least 3 different NP cell types: "chondrocyte-like" cells (NP), notochordal cells (NCs) and NP stem/progenitor cells (NPPCs), have been identified within the NP.^{9,10} NP cells have evolved to tolerate the otherwise hostile conditions present within the NP where they extracellular matrix (ECM) that is a product of their synthesis. The ECM within the NP contains abundant collagen type II and to a lesser extent collagen I plus a rich amount of proteoglycans, specifically aggrecan. In particular the

presence of aggrecan confers tremendous water-binding capacity to the NP with vital ECM-maintenance conferred by a number of other smaller single leucine-rich proteoglycans or "SLRPs".¹¹

Development and Cellular Configuration:

Development of the IVD involves both the embryonic mesenchyme and the NCs. During embryogenesis the NP consists predominantly of NC cells; a configuration that markedly changes with growth and development such that NCs are replaced by chondrocyte-like 'NP cells' by late adolescence.⁸ In some animal species such as non-chondrodystrophic dogs (mongrels), rats, rabbits and mice, NCs remain present in aging IVDs. An emerging hypothesis is that animals that retain NCs appear to be protected from the development of DDD due at least in part due to soluble factors secreted by NCs that contribute to IVD homeostasis.¹²⁻¹⁶ It has been reported that progenitor/stem cells are present in a number of human and non-human NPs and it is likely that these stem/progenitor cells migrate to the NP during development.¹⁷ One of the authors of this paper (WME) recently reported that NPPCs have multipotent differential potential including *in vivo* neuro-differentiation.¹⁰ Even in degenerative human IVDs, progenitor cells exist and have been shown to undergo chondrogenic, osteogenic and adipogenic differentiation.^{10,18} An important consideration concerning the presence of NPPCs within the NP is the capacity (or failure) of these stem/progenitor cells to assist with renewal of the NP, and the nature of their interaction with other cells within the NP.

Molecular biology of the IVD:

Nucleus Pulposus: In youth the NP is a highly hydrated gelatinous structure composed of between 1-3% cells, with the remainder made up of ECM and water.¹⁹ With age the configuration of the NP changes such that with increasing degeneration the NP is subjected to diminished water content, declining numbers of viable cells and a significant change in the expression of many ECM molecules.²⁰⁻²³

Annulus Fibrosus: The peripheral fibers of the AF are mainly comprised of collagen type I, however more centrally the NP strongly expresses collagen type II.²⁴ Due to a gradual advancement of AF fibers on the NP and a change in NP cell collagen biosynthesis, the proportion of type II is eventually supplanted by type I.²³ The import-

ance of collagen type II to normal function of the IVD NP is due to its complex structure and ability to interact with the high water content of the NP ECM in a manner analogous to hyaline cartilage.

Vertebral Endplates: Ongoing cellular turnover acts in concert with nutrient diffusion through the IVD and the VEP's, whereby the balance between anabolic and catabolic activity is maintained and controlled by complex growth factor and cytokine interaction.^{26,27} The hypoxic (2-5% O₂), avascular, low pH and decreased levels of glucose combine to comprise the metabolic 'niche' unique to the NP where the energy source required by resident cells is provided via anaerobic glycolysis and ATP.^{25,26} When a decrease in anabolic activity is superseded by an increase in catabolic activity, the net result is a deterioration of the ECM and progressive cell death.²⁷ Such an alteration may be associated with a decrease in cross linked collagen, which coupled with macroscopic changes such as cracks and fibrillations within the disc, may ultimately lead to a reduction in the NP's overall biomechanical sufficiency.^{28,29}

Extra-Cellular Matrix: When compressed under load, the primary purpose of the NP is to balance forces throughout the IVD structure, afford stability to the spine, and act as a conduit through which nutrient and wastes can diffuse into and out of the IVD.^{30,31} A family of molecules critical to the function of the IVD and the NP in particular, the proteoglycans (PGs) have evolved in order to provide such essential load-bearing characteristics. There are numerous species of PG, with the large aggregating species 'aggrecan' acting as the primary molecule responsible for the IVDs viscoelastic properties.

Proteoglycans: The glycosaminoglycan side chains (GAGs) are an essential component of the proteoglycan molecules and to the PG aggrecan in particular in that aggrecan substantially assists the IVD NP in load-bearing. The ability of the GAG side chains to strongly bind water molecules and thereby maintain a well-hydrated NP is due to the highly negative charges of the GAGs that in turn electrostatically bind polar water molecules. The GAGs are capable of functioning as water-binding molecules only when they are intact and bound to the PG core protein. The most abundant GAGs found within the disc (in particular with respect to aggrecan) are chondroitin sulfate (CS) and to a lesser degree, keratan sulfate (KS).³² In addition to their mechanical function PGs (notably the SLRPs) also have a play pivotal signal transduction roles

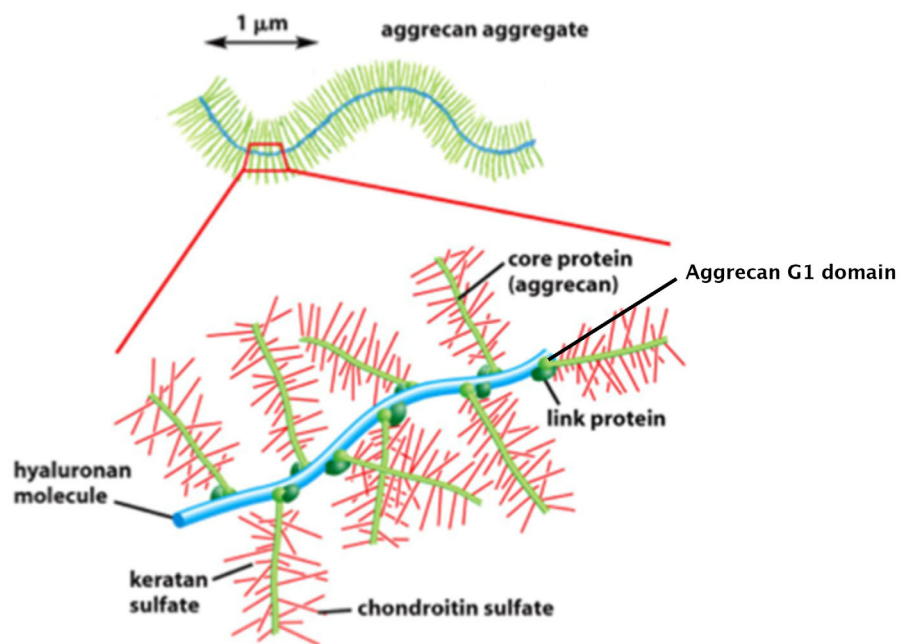


Figure 1:

Schematic of aggrecan aggregate. Arrow indicates large aggrecan aggregate with an enlarged area depicting aggrecan molecules consisting of a core protein, keratan and chondroitin sulfate GAGs linked via the G1 globular domain to the hyaluronic acid monomer. Modified from Fox AJS, Bedi A, Rodeo SA. The basic science of human knee menisci: structure, composition, and function. Sports Health: A Multidisciplinary Approach. 2012; 4: 340. DOI: 10.1177/1941738111429419

since they are capable of binding and sequestering growth factors within the ECM.¹¹ These biological/signaling properties assist with ECM maintenance in that the bio-availability of growth factors and other cytokines mediated by SLRPs are important for sustained cell survival (see review by Brown et al).^{11,33}

The CD44 cell surface receptor secretes long chains of hyaluronic acid to which the GAG side chains are covalently attached via their G1 globular domains and stabilized by link proteins (Figure 1).³⁴ As discussed above, GAGs and their rich sulfate residues attach to the aggrecan core protein, thereby conveying a high net negative charge to the molecule that electrostatically binds water. This charge contributes to the tremendous net swelling pressure of the IVD NP, resulting in its profound capacity to bear load.^{2,9,29,35,36} Since the cells of the fully developed disc rely on diffusion for their metabolic needs, a decrease in PGs (particularly aggrecan) can affect the

flow of molecules in and out of the disc and in the case of SLRPs diminish the growth factor binding ability and contribute to ECM degradation. Therefore a depletion of aggrecan and fragmentation of SLRP core proteins such as through injury or degeneration can allow the migration of important ECM molecules out of the disc and a breakdown in vital cell-ECM communication.^{2,11,32} PGs and collagen molecules are degraded through the actions of a variety of proteases that serve to cleave the binding sites of PGs to hyaluronic acid or by degrading the collagen type II molecules.^{23,24,27} This loss of GAGS secondary to degeneration is of critical importance since when loaded, degenerated discs lose fluid more quickly due to a loss of GAGs, an overall reduction in net swelling pressure and therefore a loss of water, disc height and their ability to bear load. These cellular and molecular changes are often exhibited using sophisticated imaging such as MRI as a flattened or bulging discs.^{2,5,6,24,25,37,38,39,40}

Pathobiology of IVD degeneration:

Aging and degenerative disc disease (DDD) are classifications of the disordered IVD that have been used interchangeably for many years however recently it has become increasingly accepted that they do not reflect the same biological events.^{1,24,31} DDD appears to include significant underlying patho-biological changes of the VEPs, such that the normal diffusion of essential molecules and gases are sufficiently altered contributing to cell death, degeneration of the IVD and endplates as well as subchondral bone (classified on MRI as modic changes).³¹ Conversely, normal aging does not result in a collapsed IVD with disorganized appearance, rather the associated changes are typified by darkening of the height of the NP on T2 MRI and degeneration of the IVD components but with good preservation of disc height.^{24,31}

The degenerative process weakens the disc reducing its tolerance to load-bearing, which in turn increases aberrant forces along the end plate and through the encircling AF. Such impaired loadbearing results in remodeling of the disc/vertebral interface manifesting as zygapophyseal osteoarthritis and ligament hypertrophy such as is typical with osteoarthritic changes of appendicular joints.^{2,7,41,42} Eventual fissuring and tears within the annulus may enable the ingrowth of nerves and blood vessels, both of which represent important biological occurrences since discs which may become pain generators must first exhibit structural disruption.^{24,43} At present apart from the use of provocative discography, such pathological changes are undetectable. Perhaps someday more sophisticated imaging will be able to detect such adaptations, potentially serving a diagnostic role in the identification of painful disc syndromes however at the present such changes are not clinically detectable.^{2,5,24,37,44,45,46}

The disc as a source of pain:

The annular fissures and tears that develop in degenerative discs often exhibit granulation tissue that develops as part of the body's attempt to heal.^{23,30,42} The presence of such tears and the resultant inflammatory tissue can lead to the attraction and ingrowth of nerves capable of expressing nociceptive information.^{24,43} This process involves the secretion of inflammatory pain-related mediators as well as an augmented expression of pain-related molecules such as nerve growth factor and its receptor (TrkA).^{20,30} This increased nociceptive capacity can lead to an ampli-

fied response or 'peripheral sensitization'.²⁰ This peripheral sensitization results in the activation of mechanically sensitive afferents mediated by the local secretion of inflammatory molecules which in the event of injury, may account for the disparity of painful degenerative discs as compared to degenerative discs that are not painful.⁴⁷

In an elegant study involving the rabbit lumbar spine, Yamashita et al, reported that the annulus conveys both mechanosensitive as well as nociceptive input to the nervous system, suggesting the IVD is capable of mediating pain.⁴⁸ They further indicated that the IVD annulus is likely sensitive to stronger more injurious stimuli as opposed to the lower thresholds of injury that may exist for muscle and facet joints.⁴⁸ Given the pivotal role of the disc during weight bearing it makes biological sense that under normal conditions the tissues would have higher nociceptive activation thresholds that would not convey pain under normal loading conditions. These thresholds may well be lowered in the event of disease or injury and become pain sensitive under normal loadbearing; a common clinical observation of the back pain patient. A recent comprehensive review of the innervation of the lumbar IVD by Edgar hypothesized that the IVD could, unlike other joints have a unique visceral-type of nerve supply as opposed to the somatic innervation more typically exhibited by joints.⁴⁷ Edgar also demonstrated that stimulation of the AF in the lower lumbar spine of rats resulted in a nociceptive afferent discharge to the L2 dorsal roots. These findings further support the increasing evidence that lumbar discogenic pain shares similarities with visceral pain. It follows that the innervation of the IVD annulus (and facet joints) serves to function as a proprioceptive network capable of activating paraspinal muscles for locomotion and stabilization of motion segments. When activated by injury/inflammation an up-regulation of muscle activation leads to the increased motor activity seen in most patients suffering from mechanical spinal pain (muscle spasm and local, segmental pain); this aberrant motor activity and the biomechanical/neuromuscular effects associated therewith may represent at least to some degree what is referred to in the manual therapy realm as a 'subluxation'.^{21,22}

Impact of cellular and molecular biology to the clinician:

Spinal pain reportedly affects up to 80% of the population with most people improving to varying degrees with or

without treatment. However, although many patients “improve”, in the presence of significant injury/degeneration the disc should not be considered as fully healed. In fact, due to associated pathobiological changes many may not adequately recover and will continue to display recurrent and intermittent symptoms.^{2,22,41} Sources of spinal pain include the posterior zygapophyseal or facet joints, spinal and capsular ligaments, spinal musculature and other connective tissues. Although a number of approaches to treatment exist, there continues to be difficulty reaching a consensus regarding the most appropriate for spinal pain of mechanical nature.^{49,50} Chiropractors, physical therapists and other practitioners treat spinal pain primarily with mechanical approaches such as exercise, mobilization and manipulation of spinal joints and tissues. It is therefore imperative that clinicians be aware of the role these tissues play in the development of spinal pain as well as the ability of conservative therapies to affect these pain-related tissues. This review is based upon the important role played by the IVD in the genesis of mechanical spinal pain syndromes.⁵⁰⁻⁵³

Biochemical determinants of IVD-sourced pain:

Tissue samples taken from patients with low back pain have demonstrated the presence of associated degenerative disease in terms of increased expression of inflammatory cytokines and degradative enzymes.⁵⁴ Furthermore, Burke et al., (2002) have demonstrated the expression of significantly higher levels of the inflammatory and pain-related cytokines interleukin-6 (IL-6) and interleukin-8 (IL-8) in surgical samples obtained from patients undergoing spinal fusion for discogenic pain, as compared to tissue from patients with sciatica.⁵⁵ Also, in a recent study Shamji et al demonstrated increased amounts of IL-4, IL-6 and IL-12 present in surgical samples from patients with degenerative disc disease and disc herniation, versus non degenerate discs samples procured from autopsy. These findings strongly implicate the role played by inflammatory mediators in the biology of the internally disrupted disc and the likely development of disc related back pain secondary to such disruption.^{55,56}

ECM Pathobiology:

The amount of collagen cross-linking within the IVD NP ECM increases with aging, as does non-enzymatic glycosylation that can result in impaired viscoelastic proper-

ties of the disc.²³ Molecular degradation coupled with the variable depth and size of annular fissures and tears as well as progressive cell death render the disc more vulnerable to mechanical injury.^{2,23,37,41} As a consequence of this degradation the annulus forms one of three broad categories of tear: *circumferential* or *delaminations* due to the effects of shearing stress between the laminae of the AF; *peripheral rim* tears, frequently presenting in the anterior fibers of the AF; or *radial fissures*, which extend to the periphery of the AF in a posterior or posterolateral orientation.²⁴ Despite a correlation between radial fissures and NP degeneration, the manner in which these events occur remains unknown and probably occurs within a continuum. In fact, most evidence suggests that disc prolapse is preceded by both radial fissures and tissue fragmentation, supporting the notion that prolapse is likely a late event in a cumulative, degenerative process as opposed to a purely traumatic occurrence.^{24,36,43,57}

Due to cellular and molecular changes within the NP and degradation of the annulus the IVD becomes less hydrated and in fact loses its ability to bind water-in large part due to fragmentation of SLRPs, degraded aggrecan and progressive cell death. Therefore any therapy that could rejuvenate the IVD would be seen to as the “holy grail” of disc biological research and there are many laboratories worldwide actively seeking precisely this goal. Given the biology of IVD degeneration, it is difficult to imagine that any externally applied therapy could heal/regenerate or ‘rehydrate’ the IVD that does not provide cellular replacement, regeneration of the proteoglycan networks and/or the VEPs. However treatments have been proposed over the past years including “non-surgical spinal decompression” that claim to re-hydrate the IVD by drawing water into the disc with claims to “heal from the inside out”. There is no doubt that traction helps some patients and this mode of therapy has been used since the time of Hippocrates for the treatment of spinal pain patients. However to date, there are no published studies detailing the cellular/molecular mechanisms whereby axial traction (with or without topically applied laser light, oxygen therapy or supplementation with chondroitin sulfate and other nutraceuticals) could re-hydrate the degenerative disc apart from poorly controlled case reports and testimonials. It is difficult to reconcile how an incompetent IVD NP with diminished water binding capacity could upon exposure to traction somehow heal from “the inside out”. It is left

to the reader to reconcile the science of disc degeneration with such treatments that at this point must be considered to be at best unproven.

Spinal Manipulation and the IVD:

Bronfort et al., define spinal manipulative therapy (SMT), as “the application of high-velocity, low-amplitude manual thrusts to the spinal joints slightly beyond the passive range of joint motion” and spinal mobilization (MOB) as “the application of manual force to the spinal joints within the passive range of joint motion that does not involve a thrust.”⁵⁸ During SMT and MOB, the effects of the externally applied force upon the spine have been shown to result in considerable load conveyed through the IVD.⁵⁹

Most disc injuries occur spontaneously although a history of otherwise normal activity such as bending/lifting or coughing/sneezing prior to the onset of the patient's symptoms is common.²⁷ Suri et al confirmed that even though patients identified specific events with respect to the genesis of their lumbar disc herniation (LDH), the majority of LDH occurred without specific provocation.^{27,38} Furthermore, when the identification of possible inciting events was made they were more likely to be benign tasks of daily living rather than traumatic occurrences. In particular neither Suri et al, nor Brinckmann and Porter demonstrated that specific provocative events were significantly linked with severe clinical presentations.^{38,57} Structural and biochemical failure of the disc should therefore be considered to follow a continuum whereby degenerative changes predispose the structure to weaken such that further loading could result in incremental or acute failure. Depending upon the circumstances, a given patient presenting with a first episode of disc injury may have a good chance of recovery or yet another incident in a series of recurrent episodes. It must be considered likely that the disc is in some cases existing in a critically delicate condition and that only trivial trauma may be required to result in disc failure; otherwise simple activities of daily living such as bending could not result in the full-blown onset of acute symptoms. Under these circumstances it is inconsistent with biology to consider that manual therapy could “cause” an injury that is already underway.⁶⁰ For example, the natural history of lumbar acute disc herniation often begins with acute back pain, followed by the development of radiculopathy hours, days, weeks or months later as the sequelae of the disc herniation proceed. In the more se-

vere situation such as cauda equina, the symptoms follow a similar course depending upon the location and extent of the disc injury. Such progression may be deleteriously affected by activities of daily living such as lifting, bending, sitting and coughing therefore the possibility that the situation could be exacerbated by the application of external forces should not be discounted. Therefore the clinician ought to be vigilant for signs and symptoms suggestive of disc disorders given the commonplace occurrence of acute neck and or back pain and the potential ramifications of applied forces to the spine. The following clinical vignette represents an example of the IVD existing within such a delicate balance.

Clinical Vignette:

A 32 yr-old female presented with chief complaint of left neck, shoulder and arm pain and variable numbness extending to the thumb and forefinger of approximately one month duration. There was no history of recent trauma. The patient had been involved in a motor vehicle accident 11 years prior when the bicycle she was riding was struck head-on by an oncoming vehicle. At the time she was diagnosed with a closed-head injury, WAD II mechanical neck pain, fractured maxilla, two dislodged lower teeth and a chin laceration. Subsequently the patient's neck pain was treated with non-operative methods including physical therapy/exercise, massage and activity modification. During the 12-year interval between the MVA until presentation, the patient suffered multiple exacerbations of neck and upper back pain that were primarily treated with physical therapies as above. Swimming offered relief as did occasional use of over the counter analgesics and anti-inflammatory medication. The patient complained of both legs ‘falling asleep’ easily after the accident as well as a rapid onset of bilateral numbness in the arms when they resting overhead on a pillow at night. Desk work also aggravated both the neck and arm pain.

Physical examination revealed a moderate loss of left lateral bending of the cervical spine that caused an increase in left upper back, shoulder and arm pain (positive Spurling sign) and cradling the affected arm across the chest was relieving. Biceps and brachioradialis reflexes were diminished and there was a moderate reduction in wrist extension and triceps power graded as 4+ on the left. Furthermore, a mild, intermittently positive Hoffman sign affected the left hand that was not present on the right.

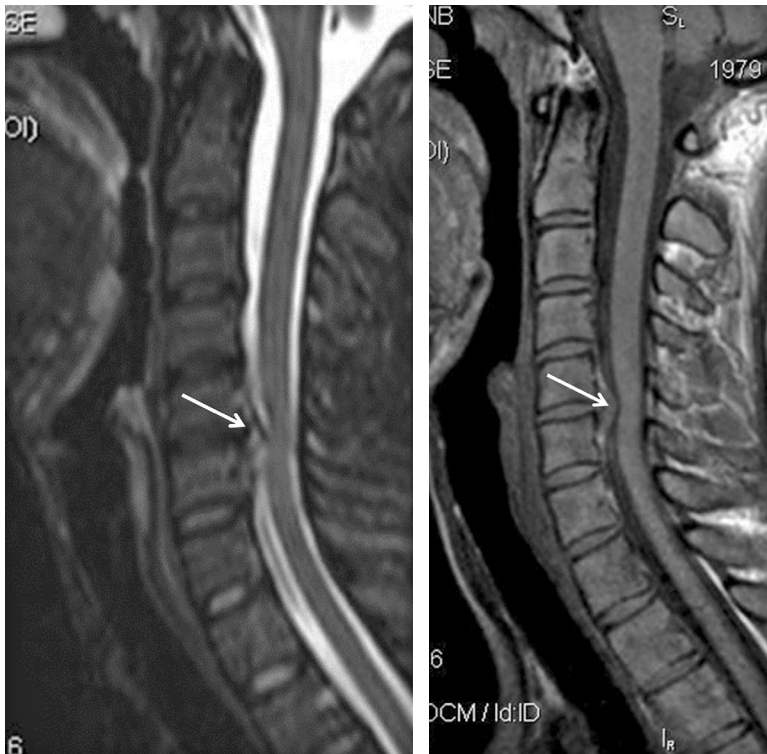


Figure 2a

Figure 2b

Figure 2:
 (a) T2-weighted sagittal MRI scan of patient's cervical spine (2011) demonstrating significant right paracentral herniated nucleus pulposus of the C5-6 intervertebral disc (white arrows in all figures). (b) Sagittal T1 MRI of cervical spine depicting large C5-6 disc herniation and elevation of posterior longitudinal ligament, (c) Axial image of the same C5-6 disc as in (b), (d) Plain film radiographs of patient's cervical spine post C5-6 anterior cervical decompression and fusion. Note interbody bone graft and plate affixed to the anterior aspect of the cervical spine (white arrow).

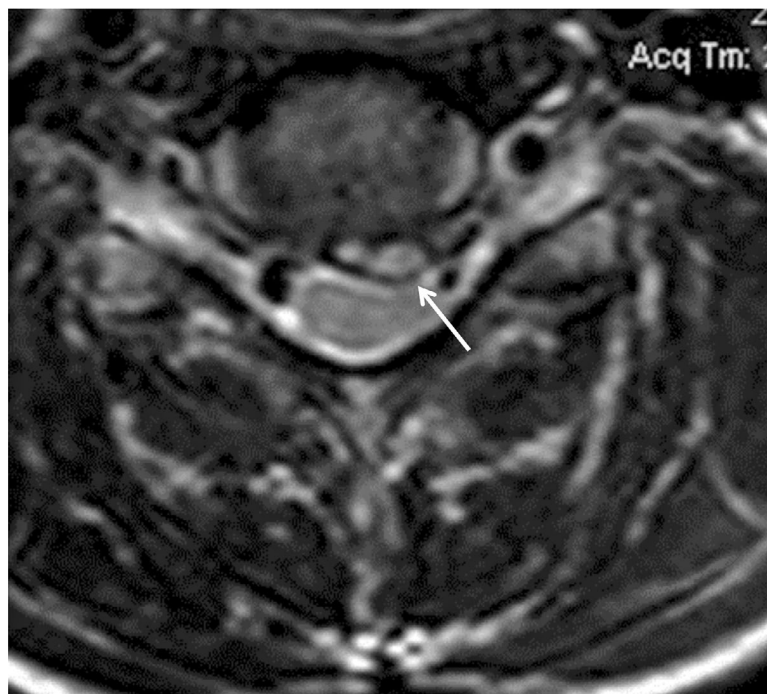


Figure 2c

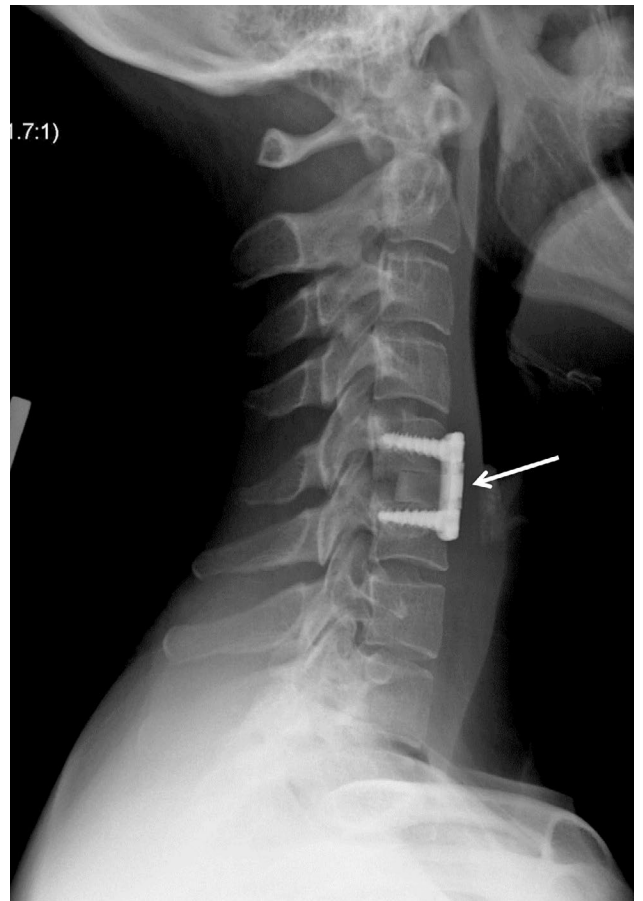


Figure 2d



Figure 3:
T2-weighted sagittal MRI scan of patient's cervical spine (2006) revealing minor bulging of the C5-6 intervertebral disc.

There was a disturbance of tandem gait with the patient experiencing a modest but reproducible loss of balance. The plantar reflex was flexor with no clonus affecting either lower limb and there was no atrophy affecting either of upper or lower extremities. A recent MRI examination revealed a large C5-6 posterior/left disc herniation significantly impinging on the spinal cord (Figure 2 a-c).

The patient was fitted with a rigid collar and monitored weekly for three weeks. Over the following three-week period the patient exhibited mild difficulty with balance and coordination, especially demonstrated when walking around corners and desks. Within the initial, few weeks after presentation and after repeated questioning regarding signs of long tract pathology, the patient related intermittent episodes when areas of the buttocks felt wet after sitting—even though none was palpable. Although subtle, signs of neural compromise were sufficient to warrant neurosurgical consultation ultimately resulting in an anterior cervical decompression and fusion of the C5-6 interspace (Figure 2d). Post operatively the patient recovered exceptionally well and following a course of

strengthening and range of motion exercises, made a full recovery.

It is likely this patient actually suffered a spinal cord injury at the time of MVA including injury to the C5-6 IVD. It is also probable that injury to the spinal cord was responsible for many of the neurological symptoms of which the patient complained since these neurological symptoms have largely resolved following surgery. Important lessons learned from this case include the spontaneous development of symptoms of disc herniation, the onset of 'hard' neurological signs (demonstrative of spinal cord compression), and the likelihood that the large C5-6 cervical disc herniation occurred at some point many years after the MVA; without any further trauma and in the absence of any particular event. A previous cervical spine MRI performed in 2006 revealed mild bulging and loss of hydration of the C4-5 and C5-6 IVD as revealed by the T2-weighted MRI (Figure 3). Therefore, the development of the acute disc herniation in the absence of any further trauma occurred gradually, probably over many years and then manifested spontaneously. In this

situation, an innocuous event such as a slip on the sidewalk or violent sneeze could have led to a worsening of the symptoms. Clearly in this case pathological changes affecting the disc were well underway and neurological compromise (although subtle), had already declared itself by the time of presentation. Providers of rehabilitation therapy need to bear extremely close attention to patients exhibiting signs and symptoms similar to those in this clinical vignette in order to obtain the best possible clinical outcome for their patients.

Conclusion:

By adulthood, the IVD is a largely fibrocartilaginous structure that permits limited motion while offering resistance against compressive loading. With degenerative change, there is a disruption in homeostatic regulation of the degenerative/damaged IVD leading to increased levels of catabolic and pain-causing cytokines in addition to granular or scar tissue formation rendering it vulnerable to further injury. With respect to non-operative treatment of spinal pain, numerous studies support the use of SMT and MOB; however, this remains controversial and lumbar disc herniation (LDH) remains the number one malpractice claim made against chiropractors⁶¹. Another non-operative treatment for DDD is non-surgical spinal decompression however; there is no mechanistic, biological evidence to support the notion that this form of treatment can re-hydrate a degenerative disc. Therefore, prior to selecting a form of treatment, the clinician should be aware of the biological model of IVD and apply an evidence-based, judicious approach to the management of patients afflicted with these disorders.

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The diagnostic accuracy of the Kemp's test: a systematic review

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Background: *The objective of this review was to evaluate the existing literature regarding the accuracy of the Kemp's test in the diagnosis of facet joint pain compared to a reference standard.*

Methods: *Several databases were searched. All diagnostic accuracy studies comparing the Kemp's test with an acceptable reference standard were included. Included studies were scored for quality and internal validity.*

Results: *Five articles met the inclusion criteria of this review. Two studies had a low risk of bias, and three had a low concern regarding applicability. Pooling of data from studies using similar methods revealed that the test's negative predictive value was the only diagnostic accuracy measure above 50% (56.8%, 59.9%).*

Contexte : *L'objectif de cette étude était d'évaluer la documentation scientifique publiée traitant de l'exactitude du test de Kemp dans le diagnostic de la douleur des facettes articulaires par rapport à une référence normative.*

Méthodologie : *Des recherches ont été faites dans plusieurs bases de données. Toutes les études sur l'exactitude des diagnostics comparant le test de Kemp à une référence normative acceptable ont été incluses. Les études retenues ont été notées sur une échelle de qualité et de validité interne.*

Résultats : *Cinq articles ont satisfait les critères d'inclusion dans cette étude. Deux études présentaient un faible risque de biais, alors que trois autres avaient un manque d'intérêt quant à l'applicabilité. Les données recueillies d'études utilisant des méthodologies semblables ont révélé que la valeur négative prédictive du test présentait l'unique mesure de l'exactitude de diagnostic supérieure à 50 % (56,8 % ; 59,9 %).*

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Conclusions: Currently, the literature supporting the use of the Kemp's test is limited and indicates that it has poor diagnostic accuracy. It is debatable whether clinicians should continue to use this test to diagnose facet joint pain.

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KEY WORDS: Kemp test, joint, facet, pain, diagnosis, chiropractic

Introduction

Zygapophyseal (facet) joint pain has been defined as pain originating from any structure related to the facet joints, including the fibrous capsule, synovial membrane, hyaline cartilage, and bone.^{1,2} Facet joint pain may be localized to its associated spinal region or referred to distant sources, and multiple studies have demonstrated characteristic pain referral patterns for the cervical, thoracic, and lumbar facet joints.^{1,3-6} Reports of facet joint pain prevalence rates vary widely in the literature, due in part to the variety of methods used to confirm the diagnosis.¹ It is generally accepted that the most reliable and valid method of diagnosing facet joint pain is through the use of anesthetic injections to the facet joints (intra-articular) or their nerve supply (medial branch blocks).^{1,4-6} Due to the moderately high false-positive rates of single block studies, double block studies using comparative or control injections are recommended to achieve a definitive diagnosis.^{1,3-6} Studies using double diagnostic blocks have demonstrated facet joint pain prevalence rates of 36-67% in chronic neck pain patients, 34-48% in chronic thoracic pain patients, and 15-45% in chronic low back pain patients.³⁻⁶

Due to the cost and risk of complications associated with diagnostic blocks, it would be beneficial to establish clinical screening procedures that can reliably and validly diagnose facet joint pain.⁷⁻⁹ Some studies¹⁰⁻¹³ have shown a possible association between certain clinical features and a positive response to facet joint anesthesia. However, the collective literature in this area generally suggests that there are no historic or physical examination findings that

Conclusions : À l'heure actuelle, il n'y a pas suffisamment de documents scientifiques appuyant l'utilisation du test de Kemp, ce qui laisse prévoir une faible précision diagnostique du test. Il y a lieu de se demander si les cliniciens devraient poursuivre l'utilisation de ce test par le diagnostic des douleurs de facettes articulaires.

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MOTS CLÉS : test de Kemp, articulation, facette, douleur, diagnostic, chiropratique

can reliably predict this response and therefore accurately diagnose facet joint pain.^{1,6,7}

One clinical test that has been described in the literature as being potentially useful in diagnosing facet joint pain (or "facet syndrome") is the Kemp's test¹⁴ (also referred to as the Quadrant test¹⁵ and Extension-Rotation test⁹). The testing procedure is typically described as having a patient perform extension combined with rotation of the spinal region of interest, with a positive test defined as a reproduction of the patient's pain, as depicted in Figures 1 and 2 for the cervical and lumbar spine respectively.^{9,14,15} In a recent survey of Ontario chiropractors,¹⁶ 82.4%, 69.8%, and 82.2% of respondents stated that they "often/almost always" use the Kemp's test as a diagnostic procedure for the cervical spine, thoracic spine, and lumbar spine, respectively. Interestingly, the perceived importance of this test seems to vary amongst health care practitioners. When a multidisciplinary panel of experts consisting of physicians, surgeons, and physical therapists based in Australia and New Zealand was asked to identify indicators of facet joint pain, one of the items that achieved consensus was "pain in extension, lateral flexion, or rotation to the ipsilateral side".¹⁷ At a workshop held in conjunction with the 2008 annual congress of The European Chiropractors Union, a majority of the European chiropractors in attendance suggested that a positive Kemp's test would aid in diagnosing facet syndrome.¹⁸ Conversely, in a recent survey of faculty members of an American chiropractic college,¹⁹ nearly half of the respondents disagreed with the statements: "A positive Kemp's test is a strong indicator that facet syndrome



Figure 1a:
Cervical Kemp's test – start position.



Figure 1b:
Cervical Kemp's test – finishing position.



Figure 2a:
Lumbar Kemp's test – start position.

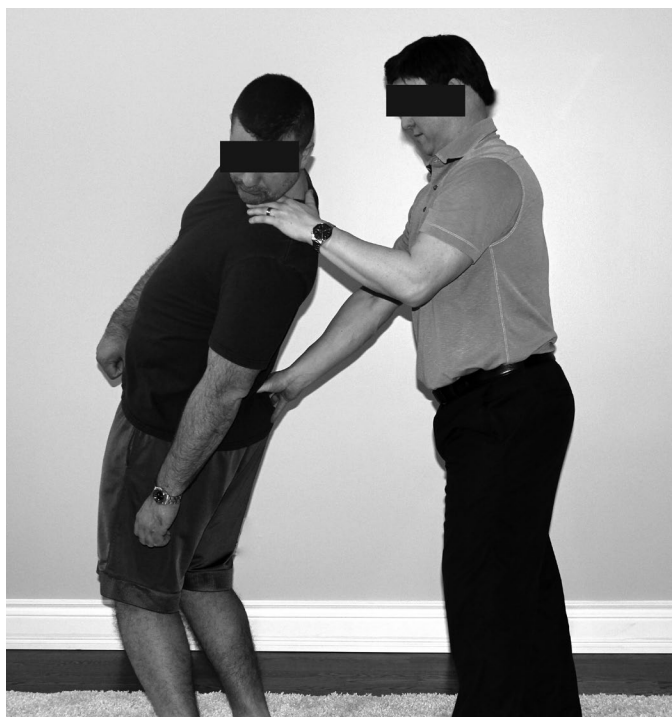


Figure 2b:
Lumbar Kemp's test – finishing position.

is present” and “A negative Kemp’s test is a strong indicator that facet syndrome is not present”. Interestingly, 41.5% of respondents considered a positive Kemp’s test to be a strong indicator of the presence of a lateral disc lesion, compared to 26.8% who considered it to be a strong indicator of facet syndrome.

As with any clinical test, the accuracy of Kemp’s test in diagnosing its target condition (in this case facet joint pain) needs to be considered by clinicians in order for the test to be applied most appropriately in practice. This seems particularly pertinent considering the test’s apparently high usage rate and perceived usefulness in diagnosing facet joint pain amongst chiropractors. Therefore, the purpose of the current study was to systematically review the evidence related to the diagnostic accuracy of the Kemp’s test in the diagnosis of facet joint pain compared to a reference standard (i.e. diagnostic block).

Methods

Study design

The methods of this systematic review were decided *a priori* and adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.²⁰ The PRISMA statement includes a 27-item checklist designed to improve reporting of systematic reviews and meta-analyses.

Box 1. Search strategy

1. (facet OR zygapophyseal) AND diagnosis AND pain
2. (Kemp’s OR Quadrant OR extension rotation) AND (spine OR back OR neck)

Search strategy

Several online databases (EMBASE, PubMed, MEDLINE, CINAHL, PEDro, Index to Chiropractic Literature) were searched in all languages from their date of commencement to October 2013. Reference searching of any retrieved articles was also employed. The search strategy employed in EMBASE, PubMed, MEDLINE, and CINAHL can be seen in Box 1. A further keyword search was conducted in PEDro and the Index to Chiropractic Literature databases and included the terms *facet syndrome* AND *diagnostic accuracy*, as well as *Kemp’s OR Quadrant OR extension rotation* AND *diagnostic accuracy*. Individual searches for Kemp’s OR Quadrant OR extension rotation were also undertaken.

Study selection

Two authors (CL and KS) independently reviewed the electronic database search results (title and abstract) independently. Any titles and abstracts that appeared to meet inclusion criteria were selected for full text review. The inclusion and exclusion criteria for this review can

Box 2. Inclusion and Exclusion Criteria

Inclusion Criteria

1. Any article published in English.
2. Articles published in a peer reviewed journal or abstracts from scientific conference.
3. Diagnostic accuracy study comparing the Kemp’s test (or Quadrant test or extension-rotation test) with an acceptable reference standard, preferably facet joint injections.
4. Any setting.
5. Adult participants with cervical or lumbar facet joint pain of any duration (acute, subacute, chronic, recurrent) and any intensity (no minimum or maximum score on a pain scale).
6. The outcomes in the comparison studies include those that either require complete relief of facet joint pain symptoms after injection or a minimum subjective numerical decrease (such as a percentage) in pain upon injection.

Exclusion Criteria

1. Articles not published in English.
2. Articles not published in a peer-reviewed journal.
3. Studies that did not employ a comparison or reference standard test.
4. Studies that reported on patients with a condition other than facet joint pain, including but not limited to degenerative joint disease, degenerative disc disease, malignancies, infections, pregnancy, or neurological conditions.

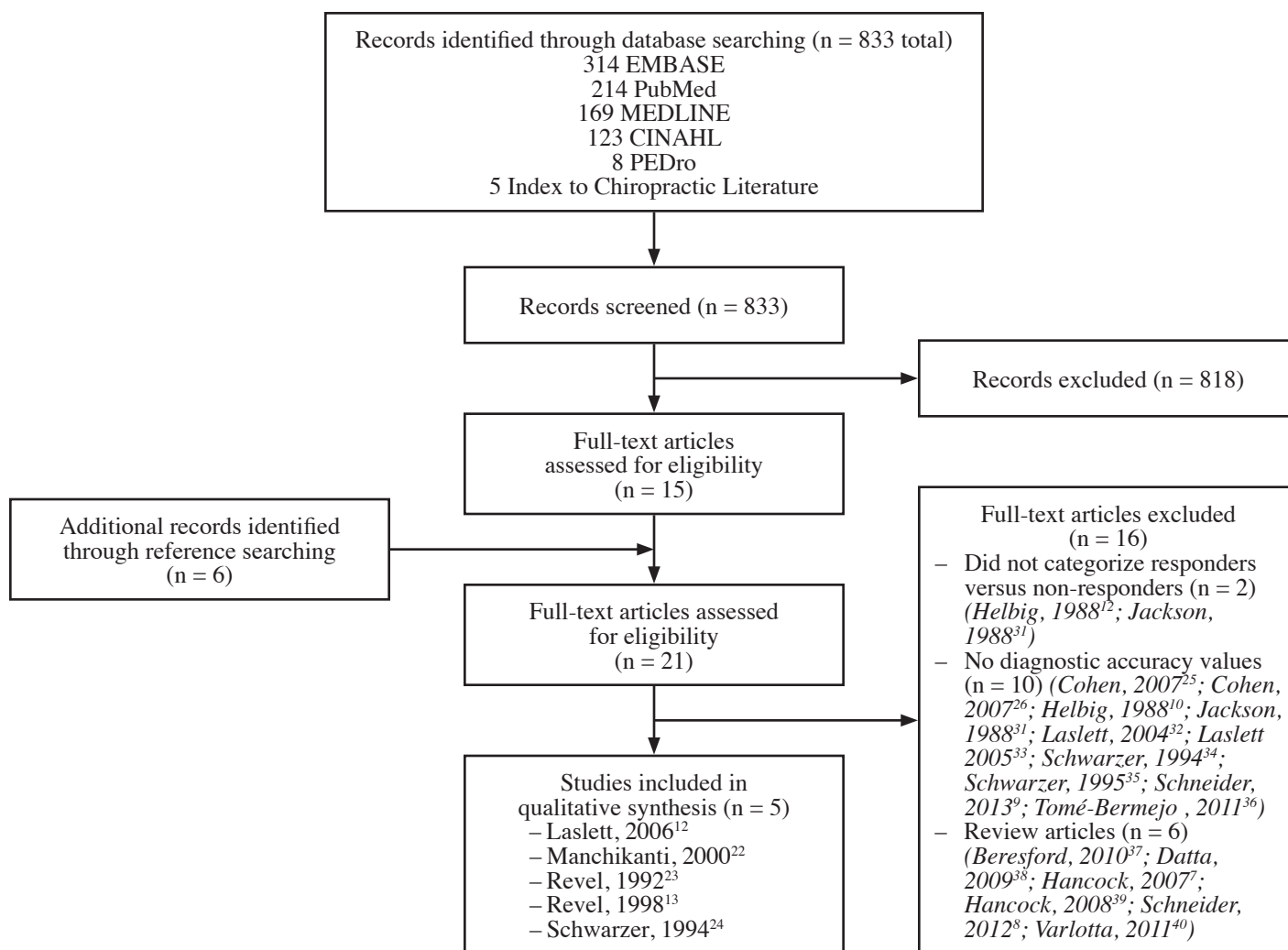


Figure 3. Selection process of included articles

be seen in Box 2. Any disagreements were resolved by discussion between the two authors. The same two authors independently conducted the full text review of the retrieved articles comparing them with the inclusion and exclusion criteria. Any disagreements were resolved by discussion, with a third author (PB) consulted if resolution was not achieved, to produce the final articles for inclusion. A data extraction form was prepared with one author (CL) independently extracting data from the selected studies. A second author (KS) reviewed the completed form for accuracy, with any disagreements resolved by a third author (PB).

Quality assessment

All full text journal articles that met the inclusion criteria of the review were independently scored for quality and internal validity by two authors (SS and KS) using the Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS 2).²¹ Any disagreements were resolved by discussion.

Diagnostic accuracy measures

For the quantitative assessment, statistical measures of diagnostic accuracy (sensitivity, specificity, positive and negative likelihood ratios, and positive and negative pre-

Table 1.
Included Study Characteristics

Author, year of publication	Participants	Reference Standard
Laslett, 2006 ¹²	n=120 54% male, 46% female Average age: 43 years	Fluoroscopic-guided 2% lidocaine injections with confirmatory (double) blocks with 0.75% bupivacaine in positive responders. A positive response was based on 75–95% pain reduction in increments of 5% and was used in separate analyses.
Manchikanti, 2000 ²²	n=200 patients 80 male, 120 female Average age: 47.3 years (range 14-87 years)	Fluoroscopic-guided 1% lidocaine injections with confirmatory (double) blocks 0.25% bupivacaine in positive responders. A positive response was based on a minimum of 75% pain relief.
Revel, 1992 ²³	n=40 patients, 14 males, 26 females Median age: 59 years (range 30-82 years)	Fluoroscopic-guided facet joint injection with 2% lidocaine. A positive response was based on a minimum of 75% pain relief.
Revel, 1998 ¹³	n=80 25 male, 54 female Average age: 58 years (range 34-87 years) 42 received lidocaine injection	Fluoroscopic-guided facet joint injection with either 2% lidocaine or saline. A positive response was based on a minimum of 75% pain relief.
Schwarzer, 1994 ²⁴	n=176 106 males, 70 females Median age: 38.4 years (inter-quartile range 31.2-46.1 years)	Fluoroscopic-guided 2% lignocaine, injections with confirmatory (double) blocks with 0.5% bupivacaine in positive responders (definite or complete relief from the lignocaine injection). A positive was based on a minimum of 50% pain relief on the confirmatory block.

dictive values) from each included study were calculated from two by two (2 × 2) tables completed by one of the authors (KS) and confirmed by another author (PB), and further confirmed with direct reporting from each included study where applicable. Data was pooled from studies deemed to be sufficiently similar (in terms of methods and minimum pain relief values), and the same statistical measures were calculated from cumulative 2 × 2 tables.

Results

Study selection

Figure 3 depicts the flow of articles through the review process. Five articles, evaluating a total of 616 patients, met the inclusion criteria for this review. Of these articles, two were identified through the electronic database search,^{12,22} while the remaining three articles^{13,23,24} were identified by reference searching. All five included studies specifically assessed lumbar facet joint pain; none evaluated cervical facet joint pain. None of the included studies specifically named the test as “Kemp’s” or “Quadrant”; rather, they all referred to the test as the extension-rotation test.

Study descriptions

Table 1 presents the characteristics of the studies included in the review. Three studies^{12,22,24} employed double block injections as the reference standard, while the remaining two studies employed single block injections as the reference standard.^{13,23} Interestingly, in two of the studies^{13,22} the authors considered the *absence* of pain exacerbation on extension-rotation to be a positive result.

Diagnostic accuracy measures

Table 2 presents the statistical measures of diagnostic accuracy in the included studies as calculated from 2 × 2 tables. None of the included studies had both sensitivity and specificity measures of at least 50% for the extension-rotation test. Sensitivity was found to be 100% in two studies (Laslett, 2006¹² using a 95% pain relief standard; Schwarzer, 1994²⁴) and 85.7% (Laslett, 2006¹² using a 75% pain relief standard). The highest specificity was 67.3% by Manchikanti et al.²² The highest positive likelihood ratio was 1.29 (Laslett, 2006¹² using a 95% pain relief standard), while the lowest negative likelihood ratio was 0.00 (Laslett, 2006¹² 95% pain relief standard; Schwarzer, 1994²⁴). The highest positive predictive value was 43.5%

Table 2.
Diagnostic Accuracy Measures of Included Studies

Author, year of publication	Sensitivity	Specificity	LR+	LR-	PPV	NPV
Laslett, 2006 ¹² – 95% pain relief standard	100%	22.3%	1.29	0.00	13.0%	100%
Laslett, 2006 ¹² – 75% pain relief standard	85.7%	21.8%	1.10	0.66	26.1%	82.6%
Manchikanti, 2000 ²²	32.1%	67.3%	0.98	1.01	43.5%	55.8%
Revel, 1992 ²³	31.8%	22.2%	0.41	3.07	33.3%	21.1%
Revel, 1998 ¹³	23%	51.7%	0.48	1.49	17.7%	60%
Schwarzer, 1994 ²⁴	100%	11.6%	1.13	0.00	17.6%	100%

Legend: LR+ = Positive likelihood ratio; LR- = Negative likelihood ratio; PPV = Positive Predictive Value; NPV = Negative Predictive Value

Table 3.
Pooled Study Diagnostic Accuracy Measures

Study parameters	Single block injections with minimum 75% improvement in symptoms (Revel, 1998 ¹³ ; Revel, 1992 ²³)	Double block injections with minimum 75% improvement in symptoms (Laslett, 2006 ¹² ; Manchikanti, 2000 ²²)
Sensitivity	34.5%	45.5%
Specificity	47.2%	46.9%
LR+	0.65	0.86
LR-	1.39	1.16
PPV	26.3%	33.2%
NPV	56.8%	59.9%

Legend: LR+ = Positive likelihood ratio; LR- = Negative likelihood ratio; PPV = Positive Predictive Value; NPV = Negative Predictive Value.

Table 4.
QUADAS 2 Methodological Quality Data for the Included Studies

Study	Risk of Bias				Applicability Concerns		
	Patient Selection	Index Test	Reference Standard	Flow & Timing	Patient Selection	Index Test	Reference Standard
Laslett, 2006 ¹²	Y	Y	Y	Y	Y	Y	Y
Manchikanti, 2000 ²²	Y	?	?	Y	Y	Y	Y
Revel, 1992 ²³	Y	Y	?	Y	N	Y	Y
Revel, 1998 ¹³	Y	Y	Y	N	Y	Y	Y
Schwarzer, 1994 ²⁴	N	Y	N	Y	N	?	Y

Legend: Y = low risk; N = high risk; ? = Unsure.

(Manchikanti, 2000²²), while the highest negative predictive value was 100%, found in two studies (Laslett, 2006¹² using the 95% pain relief standard; Schwarzer, 1994²⁴).

Results from two studies (Revel, 1998¹³; Revel, 1992²³) employing single block injections and requiring at least 75% improvement in pain symptoms were pooled and statistical measures of diagnostic accuracy were calculated in 2 x 2 tables and are reported in Table 3. Similarly, two studies (Laslett, 2006¹²; Manchikanti, 2000²²) that employed double block injections and requiring at least 75% improvement in pain symptoms were pooled and statistical measures of diagnostic accuracy were calculated in 2 x 2 tables and are reported in Table 3. These pooled results revealed that only negative predictive value produced results above 50%.

Methodological quality

Table 4 presents the QUADAS 2 assessment results for each included study. Two studies were found to have low risk of bias (Laslett, 2006¹²; Revel, 1998¹³), while three studies were deemed to be at risk of bias (Manchikanti, 2000²²; Revel, 1992²³; Schwarzer, 1994²⁴). Three studies were deemed to have low concern regarding applicability (Laslett, 2006¹²; Revel, 1998¹³; Manchikanti, 2000²²), whereas two studies had concerns regarding applicability (Revel, 1992²³; Schwarzer, 1994²⁴).

Discussion

Interpretation of results and clinical relevance of the findings

The evidence supporting the diagnostic accuracy of the Kemp's test in the diagnosis of facet joint pain is limited. Only two studies met the inclusion criteria for this review and were judged to have a low risk of bias and low concern regarding applicability (Table 4).^{12,13} Of these, only the study by Laslett et al¹² employed double diagnostic block injections and required at least 75% improvement in pain symptoms after the confirmatory block. With these considerations in mind, we synthesized the data from those studies whose methods were suitably similar (Table 3). The calculated specificity and positive predictive values were generally quite low, indicating that the value of a positive Kemp's test result in diagnosing facet joint pain is highly dubious. This suggestion is supported by two studies in which patients underwent radio-

frequency denervation treatment following a positive response to a single diagnostic block injection; the results demonstrated that pain exacerbation by extension-rotation was significantly correlated with treatment failure.^{25,26} Although the calculated sensitivity values were also <50%, the negative predictive values were ~60%, suggesting that a negative Kemp's test result may have moderate clinical value in eliminating the facet joint as a source of pain.

Although the Kemp's test in isolation appears to be of limited usefulness in the diagnosis of facet joint pain, a positive or negative test result may have value as part of a prediction rule or serial approach to diagnosis that incorporates other clinical variables to establish a diagnosis. Laslett et al¹² described five "optimal" clinical prediction rules created from a multitude of clinical variables, four of which included "positive extension/rotation test" as one of the rule variables. Mirroring the results of our review, these four rules generally demonstrated poor to moderate specificity and positive predictive values, and very high sensitivity and negative predictive values. These results also support the potential usefulness of a negative Kemp's test result.

An important point to consider is that all of these studies only consider the ability of the Kemp's test to discriminate between individuals who respond to diagnostic joint blocks from those who do not. Such procedures can be used therapeutically to reduce or eliminate an individual's back pain; however, the ability of the Kemp's test to discriminate between individuals who would respond to other forms of treatment (e.g. spinal manipulation) is unknown. Clinical prediction rules to indicate back pain patients who are more or less likely to respond to spinal manipulation have been proposed.²⁷⁻³⁰ Although these prediction rules do not include a positive or negative Kemp's test result as a predictor variable, the authors of these studies do not specifically describe the Kemp's tests as being one of the potential variables that was considered for inclusion in any of the prediction rules.

Limitations

Our literature search only yielded five studies that met the *a priori* inclusion criteria. Since these studies varied in terms of several important aspects of the methods used (e.g. single vs. double joint blocks, differences in the minimum pain reduction required to be considered a "posi-

tive" response to joint block), conclusions drawn from pooling of the data must be tempered. In addition, the general quality of the included articles was moderate with three studies deemed to be a risk of bias and two studies had concerns regarding applicability.

Our database search only revealed two of the studies included in our review. The remaining three were only identified by reference searching of the included studies and other reviews elicited by our search. Combined with the fact that non-English articles were excluded from our review, it is possible that additional studies investigating the diagnostic accuracy of the Kemp's test have not been included herein.

Finally, the current accepted "gold standard" for diagnosing facet joint pain is through the use of anesthetic injections to the facet joints (intra-articular) or their nerve supply (medial branch blocks). As such, this was used as the reference standard by which the accuracy of the Kemp's test was evaluated in our review. However, the limitations of the current "gold standard" as being definitive evidence of facet joint pain would potentially affect the diagnostic accuracy values reported herein.

Suggestions for future research

It is vital that any studies investigating the diagnostic accuracy of the "Kemp's test" or its potential inclusion in a clinical prediction rule related to the categorization of treatment responders/non-responders use a consistent terminology to describe the procedure. Since "extension-rotation test" seems to be the most common term that has been used in the literature to date, we propose that future researchers (and clinicians) adopt this term when referring to this procedure. Future studies investigating the diagnostic accuracy of this (or any) clinical test at diagnosing facet joint pain should use double joint injections and require a consistent level of improvement (we suggest 75%) in pain symptoms as the reference standard.

Conclusions

The literature supporting the use of the Kemp's test to diagnose facet joint pain is limited and generally indicates that the test has poor diagnostic accuracy. There is preliminary evidence that a negative test result, either in isolation or as part of a clinical prediction rule, may have some clinical value in eliminating the facet joint as a source of pain. Until more evidence is established regarding this

test, however, it is debatable whether clinicians should continue to use it to diagnose facet joint pain.

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Varied clinical presentation of os odontoideum: a case report

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Objective: *To present a case of an os odontoideum and to provide insight into the varied clinical presentations.*

Clinical Features: *A 54 year old man presented with chronic neck pain without headache. A clinical examination was performed and the chiropractor viewed his AP and lateral radiographs. Previous flexion/extension radiographs and MRI imaging from 2009 were requested for review. The patient was diagnosed with grade II mechanical neck pain. Treatment was rendered that day which included spinal manipulation/mobilization. Several days later the requested imaging reports were received and described the presence of an os odontoideum.*

Conclusion: *In the presence of os odontoideum, familiarity with the signs and symptoms of potential cervical instability is imperative. Health care providers*

Objectif : *Présenter un cas d'os odontoïde, et donner un aperçu des différents tableaux cliniques.*

Caractéristiques cliniques : *Un homme de 54 ans qui souffre de douleurs cervicales chroniques, sans maux de tête. Un examen clinique a eu lieu et le chiropraticien a vérifié sa pression artérielle et ses radiographies latérales. Des radiographies et images IRM antérieures de la flexion et l'extension, datant de 2009, ont aussi été requises pour examen. On avait diagnostiqué sur ce patient une cervicalgie mécanique de stade II. Un traitement avait été administré ce même jour, dont une manipulation / mobilisation vertébrale. Quelques jours plus tard, les rapports demandés d'imagerie sont reçus, qui font état d'un os odontoïde.*

Conclusion : *Il est impératif de reconnaître les signes et les symptômes d'une instabilité cervicale potentielle, en la présence d'un os odontoïde. Les fournisseurs de soins de santé doivent faire preuve de vigilance à l'égard des antécédents de leurs patients, des examens*

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must remain diligent in their patient histories, physical exams, and imaging. This case highlights the importance of following up on imaging studies to rule out diagnoses that would involve treatment contraindications thus ensuring safe and effective treatment.

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KEY WORDS: os odontoideum, neck pain, cervical anomaly, instability, chiropractic

physiques, et de l'imagerie médicale. Ce cas souligne l'importance de faire le suivi des examens d'imagerie pour écarter tout mauvais diagnostic qui engendrerait un traitement contre-indiqué, pour assurer une prise en charge sûre et efficace du patient.

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MOTS CLÉS : os odontoïde, douleur cervicale, anomalie cervicale, instabilité, chiropratique

Introduction

Os odontoideum is the most common anomaly of the odontoid process.¹ The term os odontoideum was first coined by Giacomini in 1886 and is defined as "...an ossicle with smooth circumferential cortical margins and no osseous continuity with the body of C2".² Debate within the literature continues regarding the congenital or traumatic etiology of os odontoideum. Regardless of etiology, both types of os odontoideum can lead to instability of C1 on C2, placing the spinal cord at significant risk of injury.³ This paper presents a case of os odontoideum in a fifty-four year old male presenting to a chiropractic clinic with longstanding neck pain. Clinical presentations, diagnosis and management are discussed. Manual therapists treating neck complaints need to be aware of this anomaly considering that instability of the atlanto-axial joint secondary to an os odontoideum can have serious consequences.

Case Presentation

A fifty-four year old male presented to a chiropractic clinic with a longstanding complaint of a stiff and achy neck and upper back without headache. The neck pain was focused primarily on the left and the patient reported significant right rotational restriction, especially with shoulder checking. The patient reported one previous episode of neck pain in 2009 and two previous motor vehicle accidents; a roll-over accident in the 1970s and a minor accident in the 1980s. No medical attention was sought following either accident.

On examination, an alordotic cervical curve was present with mild anterior head carriage. Upper limb neurological screening was unremarkable bilaterally (upper deep ten-

don reflexes, muscle testing and sensory examination). Active and passive cervical range of motion was globally limited with pain whereas resisted cervical spine range of motion was unremarkable and graded 5/5. Static and motion palpation demonstrated bilateral paraspinal muscle tension and tenderness as well as global segmental restrictions from C3-7. The differential diagnoses after the history and physical exam included Grade II mechanical neck pain, cervical spine degenerative disc disease and cervical spondylosis.

The patient brought his cervical radiographs (AP, lateral) which showed moderate degenerative disc disease at the C5-C7 segments. The patient had additional radiographic views ordered in 2009 by his previous chiropractor along with a MRI ordered by his medical doctor for his prior neck complaint. A request was sent to obtain the cervical spine radiographs and the MRI report. That day cervical long axis distraction mobilizations and cervical spine manipulation were administered with consent and no adverse effects were reported.

Several days later the requested radiographic and MRI reports were received by the treating chiropractor. The radiographic report, read by a chiropractic radiologist, gave the following information: "Dystopic os odontoidium with dynamic stenosis at C1-C2 and lateral hypermobility with secondary degenerative joint disease of the left lateral atlanto-axial joint. Dynamic narrowing of the spinal cord space: from 16.8 mm in extension to 15.3 mm in flexion". (See figure 1) The MRI report stated the following: "There is a remote fracture noted at the dens of C2. There is still some edema within this area. Suggest clinical correlation. If the fracture is recent then a CT scan

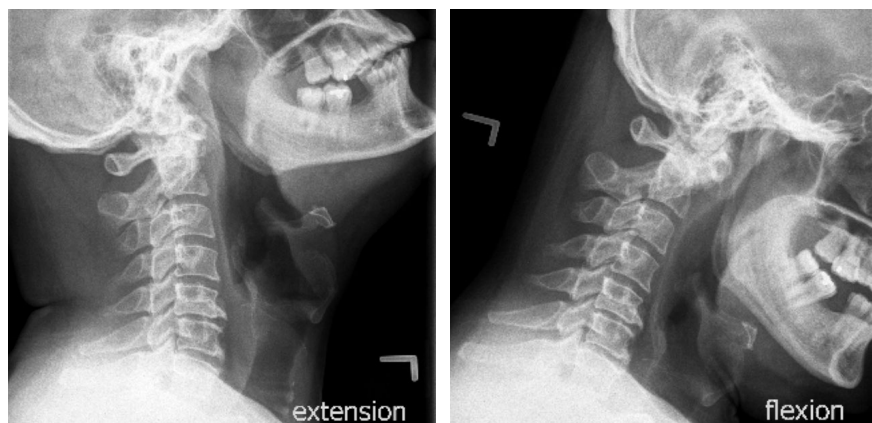


Figure 1.

Previous flexion and extension views showing a dynamic narrowing of the spinal cord space (from C1 spinolaminar line to the posterior border of C2 vertebral body) from 16.8mm in extension to 15.3 mm in flexion.

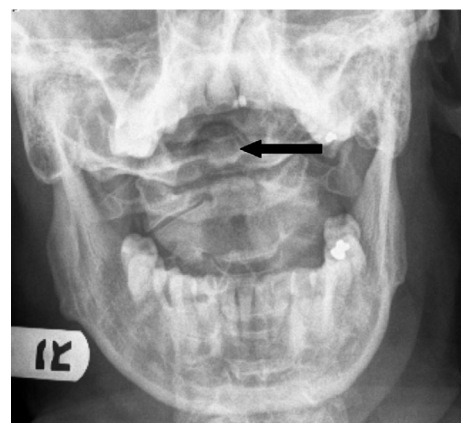


Figure 2.

APOM view showing an ossicle above a stump projection from the C2 centrum. This is associated with moderate narrowing of the left lateral atlantoaxial joint with medial displacement and right lateral offset of the right C1 lateral mass.

of this area will be helpful to further assess the extent of healing at the fracture line”.

The patient returned to the chiropractic office a few days later and the results of the imaging reports were reviewed. The patient mentioned that the results of the 2009 imaging studies were never discussed with him. The patient was educated on the os odontoideum condition, advised that cervical spine manipulation was no longer a treatment option, and referred back to his medical doctor for further evaluation and surgical considerations. The patient was not seen by an orthopaedic specialist as he was not interested in surgical intervention.

Discussion

The exact incidence and prevalence of os odontoideum is unclear within the literature as many cases remain clinically silent. Considering the issues with instability and the risk of morbidity which arise in patients with os odontoideum, it is imperative that manual therapists are aware of potential clinical indicators of the condition. The clinical presentation of os odontoideum is quite varied within the literature and can differ significantly between patients. Although os odontoideum cannot be diagnosed without

the use of imaging, the following clinical presentations have been noted:

Asymptomatic

Many patients with os odontoideum are often delayed in their diagnosis or the os odontoideum is found as an incidental finding on radiographs because patients are often asymptomatic.³ The majority of asymptomatic individuals are neurologically intact and only some present with incidentally discovered atlanto-axial instability.⁴

Neck Pain

Neck pain is one of the most common symptoms in patients with a diagnosed os odontoideum. In a review of seventy eight patients identified with an os odontoideum, neck pain was the most commonly reported symptom in 64% of patients.² It has also been reported that in some cases, pain in the occipital or cervical region may be the only symptom.⁴ However, with an already high prevalence of neck pain in the general population and a lack of prospective studies, the link between neck pain and the presence of os odontoideum is a difficult association to make.

Headaches

Headaches, a common condition treated by manual therapists, have been reported as a symptom of os odontoideum in the literature however not to a great extent and mostly within case reports. In a 2011 review of seventy eight patients with os odontoideum, only 2 patients presented with headaches.² The estimated lifetime prevalence of headache (including all headache types) has been reported to be between 93% and 98%.⁵ Given such a high prevalence of headache in the general population, the association between os odontoideum and headache is unclear.

History of Trauma

The association between os odontoideum and previous history of trauma is debated within the literature. However, a large portion of evidence currently points towards a traumatic etiology in the majority of reported cases.⁴ There is a proposed theory that trauma may be an instigating event for the development of symptoms from a pre-existing os odontoideum. In a case series by Spierings and Braakman, approximately 43% of patients presented with a history of trauma.⁶ Other authors maintain that previous traumatic events may not be responsible for an os odontoideum. These authors have proposed that a traumatic event could result in a soft tissue injury that may increase the degree of instability and thus cause a pre-existing os odontoideum to become symptomatic.⁷ The effect trauma has on developing or exasperating a pre-existing os odontoideum is still unknown. However, given the amount of evidence pointing towards a traumatic etiology, inquiring about previous trauma during a patient history may offer valuable information to warrant further investigation.

Congenital Syndromes

Os odontoideum are commonly associated with a number of congenital syndromes. It is important to keep this differential in mind in patients presenting with Down syndrome, Klippel-Feil syndrome, Morquio's disease, multiple epiphyseal dysplasia, pseudoachondroplasia, achondroplasia, Larson syndrome, and chondrodystrophia calcificans.⁴ It is proposed that ligament hyperlaxity and incomplete ossification of the odontoid process in these syndromes may predispose individuals to the development of a traumatic os odontoideum.⁴

Neurological Signs and Symptoms

Patients with os odontoideum can be asymptomatic however, many have also presented with a wide array of neurological symptoms. In a review of seventy eight patients with os odontoideum, eighteen patients (23%) had neurological signs or symptoms at presentation and an additional fifteen (19%) had a history of intermittent or prior neurological symptoms.^{2,8} Patients with an os odontoideum may have abnormal atlanto-axial motion anteriorly, posteriorly or in both directions. Flexion of the cervical spine can cause anterior translation of C-1 leading to impingement on the dorsal aspect of the spinal cord whereas extension can cause the anterior ring of C1 and ossicle to impinge on the ventral aspect of the cord.⁸ Therefore, a wide variety of neurological signs and symptoms may present in patients with os odontoideum ranging from subtle transient myelopathy to more explicit signs such as tetraplegia, paresis, bulbar sign and central cord syndrome.⁴

Recommendations

The proper management of os odontoideum still remains uncertain due to the fact that it is a rare condition. The majority of the literature consists of case reports and case series making it difficult to offer evidence-based guidelines and practice recommendations. Also, there remains a gap in knowledge of the long term natural history of untreated os odontoideum. The majority of reports indicate that patients tend to remain asymptomatic after a follow-up between one and seven years.² However, one study reported that symptomatic atlanto-axial instability can develop over time, even after a diagnosis of a 'stable' os odontoideum is made.⁹

The following recommendation has been given for patients with incidental os odontoideum: "Patients with os odontoideum, either with or without C1–2 instability, who have neither symptoms nor neurological signs may be managed with clinical and radiographic surveillance."¹⁰ However, other authors have advocated for surgical intervention for all patients with radiographically unstable os odontoideum, whether symptomatic or not.² Although there are inconsistencies within the literature and a lack of high quality evidence, Table 1 lists recommendations that have been noted within the literature.

Table 1.
Recommendations for os odontoideum

- A detailed history, physical exam and neurological exam should be completed on all neck pain patients to look for clinical indicators of instability and detect subtle myelopathies.³
- If instability is suspected, initial imaging should include cervical radiographs consisting of an open-mouth odontoid view, a lateral cervical view and flexion/extension views.^{3,4}
- An unstable os odontoideum is an absolute contraindication to cervical spine manipulation and possibly cervical spine mobilization.¹¹
- Atlanto-axial instability has been defined as greater than three millimeters of motion at C1-C2 on flexion/extension films.¹²
- A MRI and surgical consultation is indicated if significant instability is seen on flexion/extension radiographs or if myelopathy is detected on clinical examination.^{3,4,13}
- All patients with an os odontoideum should be educated on potential instability.²
- Patients deemed 'stable' upon surgical consult or who choose not to undergo surgery are encouraged to have flexion-extension radiographs taken every year and a MRI of the cranio-cervical junction every five years. These patients should also be educated regarding the risks of participation in contact sports.⁴

Conclusion

There remains a lack of consensus within the literature regarding best practices for os odontoideum and the long term prognosis is unknown. With this uncertainty and the risk of cervical instability, it is imperative that health care professionals, particularly manual therapists who treat neck pain patients, become familiar with the signs and symptoms of potential cervical instability. These health care providers must also remain diligent in their patient histories, physical exams, and imaging studies. This case highlights the importance of following up on imaging studies to rule out diagnoses and not simply relying on the fact that they were performed. Whether or not surgical fixation is warranted is outside the scope of practice for manual therapists. However, the role of manual therapists should be to recognize signs and symptoms of os odontoideum, refer patients for a medical opinion and surgical consultation, and properly educate their patients on the nature and potential risks of their condition.

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Subtle radiographic presentation of a pleural effusion secondary to a cancer of unknown primary: a case study

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Carcinoma of unknown primary sites is a clinical syndrome that represents many types of cancer. The mortality rate associated to this type of cancer is elevated and a rapid medical referral is required for patients presenting this condition. Pleural effusion may be the only visible sign. We report a case of pleural effusion secondary to a cancer of unknown primary site in a 60-year-old man that sought chiropractic care for radiating low back pain. The radiographic studies revealed a pleural effusion as one of the only significant findings. This article will address the clinical presentation, radiographic studies and a discussion on the radiographic detection of pleural effusion.

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KEY WORDS: cancer of unknown primary, metastasis, pleural effusion

Les cancers de sites primaires inconnus représentent un syndrome clinique englobant de nombreux types de néoplasie. Le taux de mortalité associé à ce type de cancer est élevé et une consultation médicale rapide est nécessaire chez les patients présentant cette affection. Un épanchement pleural peut être le seul signe radiographique visible. Nous rapportons un cas d'épanchement pleural secondaire à un cancer de sites primaires inconnus chez un homme de 60 ans qui consultait en chiropratique pour une lombalgie irradiante. Les études radiographiques ont révélé un épanchement pleural comme une trouvaille fortuite. Nous avons inclus la présentation clinique, les examens radiographiques et une discussion sur la détection d'un épanchement pleural.

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MOTS-CLÉS: cancer d'origine inconnue, métastase, épanchement pleural

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Introduction

Cancer of unknown primary origin (CUP), or occult primary malignancy, is not a single entity, but rather a complex clinical syndrome that represents many types of cancer. Patients with CUP presents with histologically confirmed metastatic cancer for which the primary site cannot be identified, even following a sophisticated work-up.¹ CUP is not rare, it is the seventh to eighth most frequent cancer in the world^{1,2} and represents 2% of all malignancies diagnosed in the United-States³. CUP represents the fourth leading cause of cancer deaths in both sexes.⁴ The overall age-standardised incidence per 100,000 people per year is 7-12 cases in the USA, 18-19 in Australia, 5-7 in the Netherlands, and 4-6 in Switzerland.¹ The median age at presentation is 59-66 years.^{4,5} CUP is slightly more common in men than in women and predominantly affects adults (less than 1% of patient with non-hematologic CUP are children).⁴ Patients may demonstrate a wide variety of clinical presentations such as palpable masses, pain or dyspnea, as well as abnormal radiographic findings such as multiple lung nodules and destructive bone lesions.⁶

The natural history of patients with CUP differs considerably from patients with known primary tumours. CUP shows several fundamental characteristics: short history with symptoms and signs associated with metastatic sites, early dissemination in the absence of primary tumour, aggressive clinical course, and occasionally unpredictable metastatic pattern (frequency and location of metastases different from those of known primary tumours).⁷ Early dissemination is responsible for the lack of primary tumour-related clinical signs.⁴ Additionally, more than 50% of CUP patients have metastatic lesions in more than one location at the time of diagnosis.⁴ Optimal therapy for patients with CUP is still under debate and may depend on the histological type of the lesions found: adenomatous, squamous, neuroendocrine or poorly differentiated cell types.⁸ The prognosis is poor with an approximate median survival following the diagnosis of 6-9 months.⁴ Post-mortem studies have been able to establish that the primary tumours in 73% of patients, the most common primary sites includes lungs (27%), pancreas (24%), liver or bile duct (8%), colo-rectal (7%), genital system (7%) and stomach (6%).⁹

CUP exceeds the scope of practice of chiropractors, however, it is important for clinicians to be mindful that this condition as well as many other cancers initially

present with non-specific and vague symptoms. Recognition and quick referrals are key to an appropriate management. This case illustrates this situation well. A review of the history eliciting important details such as dyspnea, loss of appetite; an appropriate examination revealing among other findings, hepatomegaly and a careful observation of important radiographic findings of pleural effusion allowed for a quick referral. Even if the findings of pleural effusion are not specific to CUP, they are serious enough to refer the patient for rapid medical care in order to identify and treat the underlying condition.

Case presentation

A 60 year-old man sought chiropractic care after suffering from episodes of low back pain extending down the left leg for approximately 6 weeks. He described the pain as stiffness that prevented him from walking comfortably or crossing his legs while in a seated position. Initially, the pain was sporadic, but for the last week, it had been rather constant, prompting him to seek care.

Upon further questioning, the patient reported a loss of appetite resulting in a loss of approximately 20 pounds in the last 6 months. He also suffered from insomnia, fatigue and dyspnea. The patient was a long-time smoker. His past medical history included hyperlipidemia, chronic renal failure, myocardial infarction (at age 46). He had been hospitalised for pleural effusion in the past few months. The patient was treated with medication for high blood pressure, anemia, hyperlipidemia, gastric ulcer and prevention of angina.

The orthopaedic and neurological assessment findings were consistent with left sacroiliac joint dysfunction. Nearly all the ranges of motion for the lumbar, hip and knee joints were decreased but none were painful. The vascular examination of the lower limbs was unremarkable.

During part of the examination, the patient was placed in a prone position and signs of facial plethora were noticed. The discoloration faded while the patient was in an upright position and returned each time with a recumbent position. Abdominal and pulmonary examinations were then performed. The liver was found to be enlarged but not tender and the pulmonary examination was within normal limits.

Chest and lumbar radiographs were obtained motivated mainly by the history of unexpected weight loss and

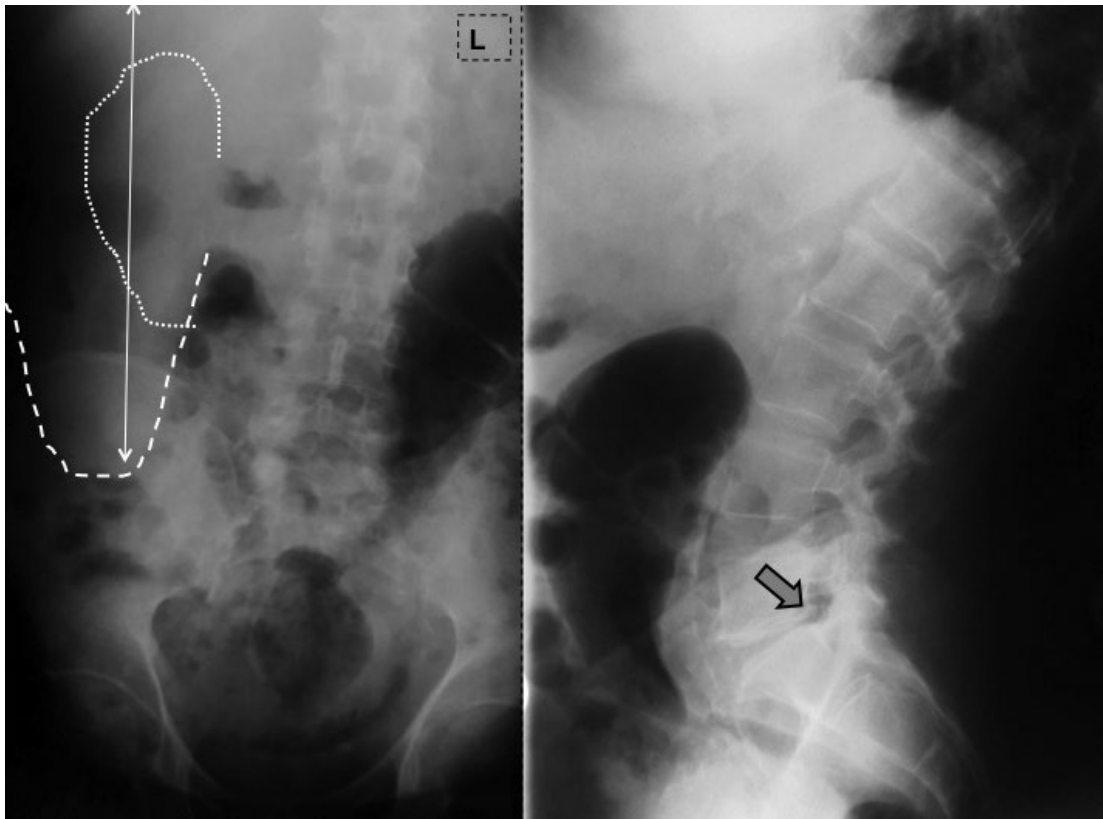


Figure 1:

AP and lateral lumbar radiographs showing degenerative disc disease with posterior osteophytosis at L5 (solid arrow). Hepatomegaly was also observed, especially on the frontal radiograph. The liver measured more than 16 cm at the midclavicular line. Its medial border extended beyond the right kidney (dotted line) and the inferior lobe extended passed the iliac crest (dashed line).

anorexia combined with the presence of dyspnea, insomnia, malaise and facial plethora.

Radiological findings

Bone density appeared decreased, especially considering the age and body habitus of the patient. Atherosclerotic plaque was visible in the abdominal aorta and the common iliac arteries. Mild degenerative disc disease was present throughout the lumbar spine, but especially involving L5-S1, where a posterior osteophyte was present. Hepatomegaly was also observed, in concordance with the clinical examination. Hepatomegaly is not easily determined on radiographs. Generally, it can be suspected if the liver measures more than 16 cm in length at the mid-clavicular line on the AP lumbar radiograph and extends

below the level of the iliac crest.^{10,11} (Figure 1) The liver could not be measured precisely on the radiographs since the superior border could not be seen but its measurement was more than 20 cm. The medial border of the liver as outlined by the air-filled colon also extended past the level of the right kidney, another sign of hepatomegaly.¹²

The chest radiographs (with incomplete field of view due to technical processing damage) demonstrated important blunting of the costophrenic sulci on the right. This is seen on the lateral view with rounding of the costovertebral angle as well as on the frontal view with the disappearance of the right costophrenic angle. The right hemidiaphragm appeared elevated partly because of the accumulation of fluid in the pleural space. This could also be accentuated by the hepatomegaly. (Figure 2) Mild

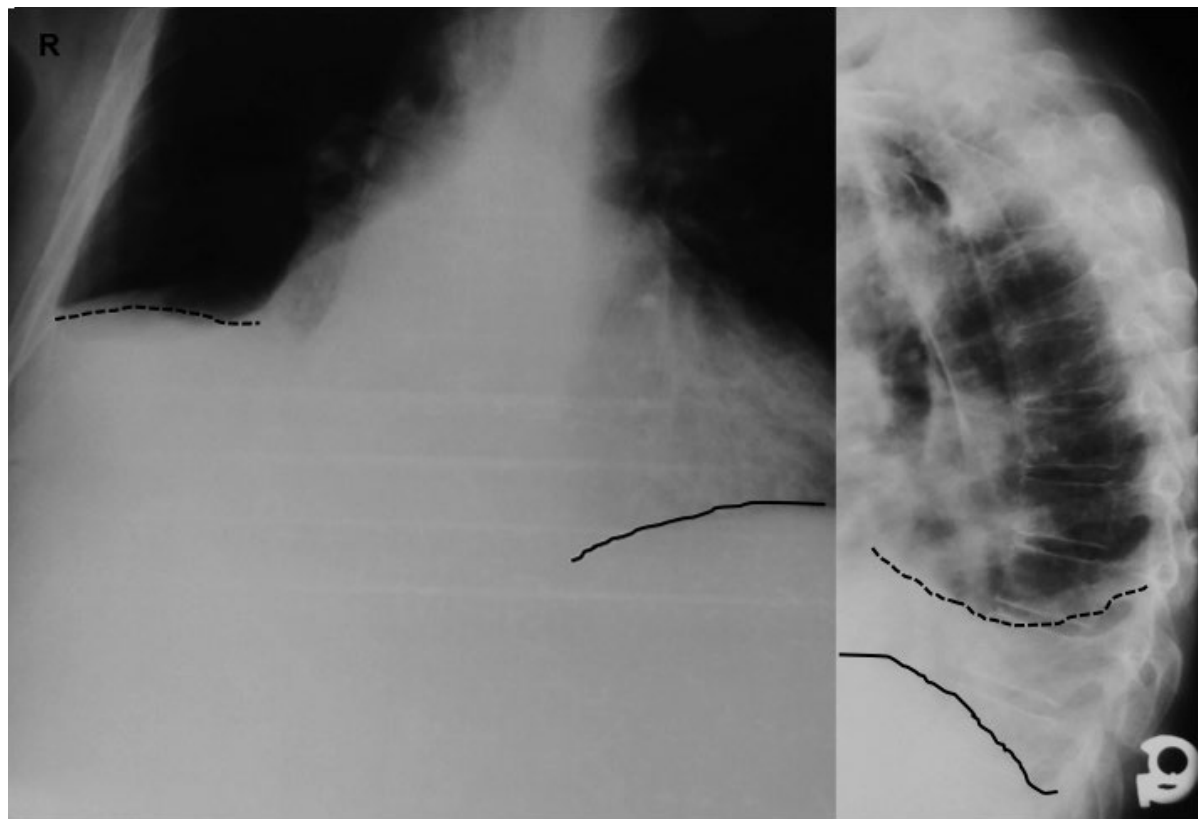


Figure 2:

PA and lateral chest radiographs with incomplete field of view due to technical processing damage.

*The right diaphragm (dashed line) appeared elevated on both views.
The posterior and lateral costophrenic angles are rounded on the right side.*

blunting of the costophrenic sulci (posterior and lateral) is also noted on the left. The cardiac silhouette also appeared enlarged, when grossly assessed with the cardiothoracic ratio.¹³

The combination of hepatomegaly, mild cardiomegaly and recurrent pleural effusion, along with the past history raised serious concerns about this patient's health status. The patient was referred to the hospital for more assessment and testing.

The patient was hospitalized and underwent a full work-up. The diagnosis of carcinoma with unknown primary source was communicated by the patient's wife to one of the authors during a phone conversation, approximately two weeks after the initial visit. Metastatic lesions had been found in the lungs, brain and bones. The patient

was given a grim prognosis: less than one year to live. He passed away two months later.

Discussion

This case highlights the importance of adequately correlating examination with radiological findings. Although the clinical presentation raised serious «red flags» for the presence of disease, the radiological signs were subtle and could have been easily missed, especially if the clinician had omitted to assess the soft tissues. Although the assessment of hepatomegaly on radiograph is imprecise at best, the findings of pleural effusions are relatively easy to visualize if one knows where to look. Chiropractors do not have the necessary resources to diagnose a CUP, but they can recognise a pleural effusion. Pleural effusion is

Table 1:
Causes of pleural effusion^{14,17,19}

Transudates	Congestive heart failure Cirrhosis with ascites Nephrotic syndrome Hypoalbuminemia Myxedema Peritoneal dialysis Glomerulonephritis Superior vena cava obstruction Pulmonary embolism
Exudates	<u>Malignant</u> Primary lung Mesothelioma Pulmonary/pleural metastases Lymphoma <u>Infections</u> Bacterial pneumonia Bronchiectasis Lung abscess Tuberculosis Viral illness <u>Connective Tissue Disease</u> Rheumatoid arthritis Systemic lupus erythematosus <u>Abdominal/Gastrointestinal Disorders</u> Pancreatitis Subphrenic abscess Esophageal rupture Abdominal surgery <u>Miscellaneous</u> Pulmonary infarction Uremia Drug reaction Postpartum Chylothorax

not uncommon in patients with CUP, it might be the only visible sign in many patients (as in this case study).⁴

Pathophysiology

The leading aetiologies of pleural effusion are cancer (27%), heart failure (20%), pneumonia (18%), tuberculosis (9%), pericardial diseases (3.5%) and cirrhosis (3%).¹⁴(table1) The normal pleural space contains a small amount of liquids, which allows the lungs to expand and deflate with minimal friction during respiratory movements.^{15,16} Pleural fluid is normally produced by the systemic capillaries of the parietal pleural surface and absorbed into pulmonary capillaries at the visceral pleural surface.¹⁷ Lymphatic vessels also play an important role

in removing pleural liquids.^{14,15,17-19} There is pleural fluid accumulation whenever the rate of pleural fluid formation exceeds that of its reabsorption. Pleural effusion associated with bacterial pneumonia, bronchiectasis or lung abscess is called parapneumonic effusion, while the presence of pus in the pleural space is named empyema.¹⁷

According to the composition of the pleural fluid, pleural effusions are classically divided in two type: transudates and exudates.²⁰ Transudates (low level of protein) occur when there is:

- Increased hydrostatic pressure (e.g.: congestive heart problems),
- Decrease oncotic forces (e.g.: hypoproteinemia),
- Increase negative intrapleural pressure (e.g.: atelectasis),
- Movement of ascitic fluid through the diaphragm (e.g.: hepatic hydrothorax).^{14,18,19}

Exudates (high amount of protein) results of:

- Increase in the permeability of the capillary secondary to infection or neoplastic process and/or
- Reduction of lymphatic drainage resulting from obstruction of the latter caused by proliferative (e.g.: malignancy) or inflammatory (e.g.: parapneumonic effusions) process.^{14,18,19}

Clinical approach to pleural effusion

The patient history may be very helpful to recognize the signs of pleural effusion and guide the investigation of its potential causes. For example, a typical viral prodrome (low-grade fever, sore throat, upper respiratory symptoms) might indicate a viral pleuritis. A history of congestive heart failure, liver disease, uremia, or malignancy will direct the etiologic investigation of the effusion. Symptoms are often caused by an underlying disease and not the effusion itself.¹⁷ Small pleural effusion can be entirely asymptomatic.^{14,17} Large effusions will cause dyspnea, orthopnea, with or without chest pain (shooting, dull aching) or dry cough. The chest pain is usually exacerbated by deep inspiration or coughing and may refer to the abdomen or the ipsilateral shoulder.^{14,17,21} Orthopnea is a positional dyspnea where the patient has less symptoms when lying on the affected side.¹⁴

Classic signs during physical examination are: diminished breath sounds, dullness to the percussion, decrease tactile fremitus, and localized pleural friction rub.^{16,17} Auscultatory percussion (method of Guarino) might also

Table 2:
*Differential diagnosis aids with pleural effusion*¹⁴

Radiological characteristics	Potential Diagnoses
Massive pleural effusion	Malignancy, parapneumonic/empyema, tuberculosis, hepatic hydrothorax
Massive effusion without contralateral mediastinal deviation	Lung cancer, mesothelioma
Bilateral pleural effusion	Heart failure, malignancy, lupus pleuritis and other systemic inflammatory conditions
Located effusion	Parapneumonic/empyema, tuberculosis, hemothorax, malignancy, pleurodesis, pulmonary embolism, heart failure
Air-fluid level in the pleural space	Bronchopleural fistula, gas-forming pleuropulmonary infection, spontaneous pneumothorax, trauma, oesophageal rupture
Focal consolidation	Pneumonia, lung contusion, Lung cancer
Apical Infiltrate	Tuberculosis or loculated fluid
Interstitial infiltrates	Heart failure, viral pneumonia, lymphangitic carcinomatosis, rheumatoid arthritis
Lung nodules or masses	Malignancy, multifocal infection, rheumatoid arthritis
Pleural calcification	Tuberculous, empyema, asbestos-related pleural disease, trauma
Pericardial calcification	Constrictive pericarditis
Rib fissure or fracture	Trauma

Adapted with permission from Porcel 2013¹⁴

have some value for detecting small effusion.²² Many of the patient's medical conditions might have been responsible of the previous hospitalisation for pleural effusion. Among the conditions listed in table 1, the patient had heart and renal failure.

The presence of facial plethora, as demonstrated by this patient is not a classic sign of pleural effusion. It may be a manifestation of retrosternal goiter but may also occur with lung carcinoma, lymphoma, thymoma, or aortic aneurysms.²³ By having the patient in a prone position with both arm elevated on the arm rest, we may accidentally have reproduce elements of the Pemberton's manoeuvre.²⁴ During this classic manoeuvre, the patient raises both arms above his head as high as possible for one minute. The manoeuvre is positive if the patient experience facial plethora (Pemberton's sign). Pemberton sign occurs when the thoracic inlet becomes obstructed during positional changes, resulting in compression of the jugular veins.

Radiography

Radiographs are the easiest and least expensive way to confirm a clinical suspicion of pleural effusion.²⁵ Chest radiography may also reveal pleural effusion as an incidental finding. Blunting of a costophrenic angle is the classic sign for pleural effusion. It is important to note that minor blunting may be caused by scarring or chronic atelectasis. Effusions first become apparent on lateral upright radiographs with blunting of the posterior costophrenic angle.^{17,19} An accumulation of 200 ml of fluid is necessary for the effusion to affect the lateral angles of frontal standing radiographs.^{19,25} Lateral decubitus radiograph with the affected side down is the more sensible view to identify an effusion of 5 to 15 ml.²⁶ It is possible that effusion unnoticed if the radiograph is taken in the supine position. The fluid then layers superiorly and posteriorly. In this case, an effusion should be considered when there is an opacification of the apical portion of the lung.¹⁹ Other imaging techniques such as ultrasound, CT and MRI may

be helpful in localising effusions and distinguishing transudate from exudates. Table 2 summarizes useful radiographic signs that can guide the investigation for potential diagnosis.

Even if radiography is an effective way to identify a pleural effusion, advance imaging, pleural fluid analysis and when applicable pleural biopsy are key elements to uncover the aetiology of the underlying disease. The role of the chiropractor is to detect the effusion and quickly refer the patient for further investigation. Patients with identified pleural effusion should be referred for medical investigations and treatment since the majority of the underlying condition requires rapid medical attention.

Conclusion

The confluence of findings including pleural effusion led to appropriate referral and diagnosis of CUP. Pleural effusion may be caused by a variety of serious underlying conditions and should be considered in the differential diagnosis of patients presenting with dyspnea, dry cough or trepopnea, with or without chest pain. Pleural effusion might also be an incidental finding on thoracic or lumbar radiography. Chiropractors should look for an asymmetry of the hemi diaphragm, or a blunting of the costophrenic angle on every film where the diaphragm can be visualised. In order to identify and treat the underlying condition, patients should be referred for rapid medical care.

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Commentary on a framework for multicultural education

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Today's changing demographics require that multicultural factors be considered in the delivery of quality patient-centred health care in chiropractic. Yet minimal training in cultural competency in chiropractic education leaves graduates ill-equipped to treat a diverse population. This commentary examines cultural competency training in current literature, demonstrates frameworks for curriculum integration, and suggests how cultural competency might be included in a chiropractic college curriculum. A database search yielded little evidence that cultural competency is integrated into curricula of chiropractic schools. Some journal articles note that promoting multicultural education and cultural sensitivity is an important goal. However, they provide no mechanisms as to how this can be achieved within training programs. Thus, although an undeniable need exists for all healthcare practitioners to develop cultural competency in the face of an increasingly diverse population, cultural competency education has not kept pace. Chiropractic schools

Les changements démographiques de nos jours exigent la prise en considération de facteurs multiculturels dans l'administration de soins chiropratiques de qualité axés sur les patients. Pourtant, la formation minimale en compétences culturelles que les diplômés reçoivent pendant leurs études en chiropratique les laisse mal préparés pour soigner une population culturellement diverse. Cet article examine la formation en compétences culturelles dans la documentation spécialisée, indique des structures pour son intégration dans les programmes d'études, et propose les étapes d'intégrer les compétences culturelles dans un cursus de collège de chiropratique. Une recherche des bases de données a révélé peu de preuves indiquant que les compétences culturelles fassent partie du programme des écoles de chiropratique. Certains articles de journaux font remarquer que la promotion d'une éducation multiculturelle et d'une sensibilité culturelle est un objectif important. Cependant, ils ne mentionnent aucun mécanisme pour réaliser cet objectif dans les programmes de formation. Donc, malgré le besoin incontestable de développement de compétences multiculturelles chez les praticiens de soins de santé devant la diversité croissante de la population, la formation en compétences culturelles n'a pas suivi. Les écoles de chiropratique doivent revoir leurs programmes

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must review their curricula to develop the cultural competencies of their graduates and a basic framework is suggested.

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KEY WORDS: cultural competency, cultural diversity, multicultural education, curriculum, multiculturalism, chiropractic

Introduction

The demographics of both healthcare providers and their patients have been affected by the increasingly multicultural nature of North American society. Chiropractic presently enjoys dual status as an acknowledged primary healthcare profession with competence in the area of the spine and locomotor systems, and as an alternative healthcare discipline with holistic connotations incorporating many aspects of general wellness and operating on a biopsychosocial model of health care. Consumers of health care can become patients under one or both of these aforementioned categories, therefore allowing chiropractic professionals to practice according to evidence-based principles and a philosophy of holism. The changing multicultural demographic suggests that factors such as race, ethnicity, culture, language, and religion may modify how patient-centred care is received and how it ought to be delivered. The chiropractic literature is found to contain some articles on the underrepresentation of minorities in the student bodies of North American chiropractic colleges and on the lack of a diverse practitioner workforce. With patient demographic percentages expected to change drastically by 2050 in North America, the profession is ill-equipped to provide culturally competent care.¹ However, the virtual absence of multicultural education as a standalone course in chiropractic colleges suggests that graduates are ill-equipped in cultural competency to treat a diverse population.

The purpose of this commentary is to discuss whether a framework for multicultural education in chiropractic exists in the literature and what research has been done on cultural competency training in chiropractic. It further outlines suggestions on how to integrate it into a chiropractic college curriculum.

d'études afin de développer les compétences culturelles de leurs étudiants. Pour accomplir ceci, un système élémentaire est proposé.

(JCCA. 2014;58(3):280-285)

MOTS CLÉS : compétence culturelle, diversité culturelle, éducation multiculturelle, curriculum, multiculturalisme, chiropratique

Methods

A literature review was conducted using three databases: the Index to Chiropractic Literature (ICL), Medline, and CINAHL. The only limiter was the English language. No limit was put on the date. MeSH terms included cultural competency, cultural diversity, education, curriculum, and multiculturalism. Text words chiroprac*, and ethnic or ethnicity, or cultural or culture* were used to capture any other relevant information. Newspaper and magazine articles were also explored for material relevant to teaching cultural competency in chiropractic, but they offered only comment, not authentic research on the subject.

Results

The search demonstrated that no framework had been proposed in chiropractic education and furthermore, it revealed that health care providers are generally inadequately trained to deal with patients of diverse backgrounds.

The most recent paper addressing diversity issues published in the Journal of Chiropractic Humanities² has a section on “Overcoming Barriers of Diversity: Chiropractic Education”, but provides no specific outline for how that could be accomplished. It offers two suggestions: (1) students, as stakeholders in the curriculum, should be allowed the opportunity for input; and (2) “faculty development should be focused on promoting diversity and cultural sensitivity discourse.” The authors note that the effectiveness should be studied, but provide no mechanism as to how that should be implemented.

Johnson and Green, in their challenge to the chiropractic profession to meet the necessity of the demographics of 2050, suggest that planning must occur in education, research, practice and community, and leadership and policy.¹ Their suggestions are well-intended, but do not

provide a framework for student education at the grassroots level.

Khauv and Alcantara provide a retrospective analysis of the effects of a six-hour cultural competency training course adapted from the University of California, Los Angeles School of Public Health program.³ They conclude that the “program improved chiropractic students’ knowledge in cultural competency”, but they could not confirm that patient care improved. They also found that no standard curriculum for cultural competency exists in chiropractic.

In 2006, Callender determined that there were insufficient number of chiropractic role models amongst minority populations.⁴ She suggested that programs should be created to encourage underrepresented minorities to become students of chiropractic; however, without an appropriate infrastructure to train future role models, a self-perpetuating cycle of lack of a framework will continue the dialogue of need versus implementation.

A number of studies have examined cultural competency training in medical and nursing schools. Lee, Anderson, and Hill concluded from a small pilot study that an education program was an effective cross-cultural knowledge tool among nurses.⁵ Yet Flores, Gee, and Kastner found that “most U.S. and Canadian schools provide inadequate instruction about cultural issues, especially the cultural aspects of large minority groups”.⁶ Other studies found that students of health care, especially Caucasian students, have seldom had to deal with many of the issues faced by their ethnically diverse counterparts. White-Means, Dong, Hufstader, and Brown examined cultural competency among students in medicine, nursing, and pharmacy with the intent of comparing objective and subjective cognitive approaches to detect the possible implications for health inequalities.⁷ Cultural competency scores were higher for Hispanics and non-Hispanic blacks than for non-Hispanic whites among medicine and pharmacy students, and multi-racial nursing students scored significantly higher in cultural competency than non-Hispanic whites.

A further study by Musolino et al. found that Asians, Hispanics, and other non-whites in medicine, nursing, physical therapy, pharmacy, and other health care fields outpaced their Caucasian peers in cultural competency.⁸ Their study indicated that there were several variables including race, degree in health education, contact with

a diverse population, health education setting, and participation in a cultural or diversity educational program that influenced the level of cultural competency among the participants.

A 2006 study by Ruddock and Turner looked at another, more radical way to potentially increase cultural competency using the educational setting. The authors took seven nursing students and immersed them in a culture different from their own with the aim of exploring whether having international learning experience as part of the education program promoted cultural sensitivity in participants.⁹ The findings, illustrating how students began developing cultural sensitivity and experiencing personal growth, suggested that attitudes such as openness, respect, and flexibility enabled participants to better appreciate their own culture, as well as adapt to a new one.

Using both qualitative and quantitative methods, Hilliard, Rathsack, Brannigan, and Sander explored the development of cultural competency among doctoral students of physical therapy during their final weeks of clinical education experiences.¹⁰ The qualitative methods allowed them to reflect upon difficult cultural encounters that challenged their beliefs and assumptions during this period and to understand how they related to people whose attitudes, beliefs, values, and language skills differed from their own. The authors concluded that changes in attitude were the key to effective encounters, as students learn to communicate and connect with those perceived to be different from themselves. Effecting the curricular change necessary to ensure that graduates have the requisite cultural competency and sensitivity presents challenges to chiropractic educators, but strategies found in contemporary educational models can be adapted to encourage students to think critically, communicate appropriately, and meet changing health care needs. The process of acquiring intercultural competence is founded in adult education theory.

A Framework for Multicultural Education

James Banks, a pioneer of multicultural education, defines it as a process that “... seeks to create equal educational opportunities for all students by changing the total school environment so that it will reflect the diverse cultures and groups within a society.” Banks’ intent is to ensure academic achievement for all. He proposes five steps for

the implementation of multicultural education: content integration, knowledge construction, prejudice reduction, equitable pedagogy, and empowerment of school culture.¹¹ Examples and content in teaching concepts drawn from other cultures and groups constitute content integration. The presentation of assumptions that are accepted as understood in other cultures, and examples of situations where these might be questioned or put to a test permits content integration. Students' supervised investigation of the cultural assumptions, biases, and perspectives influencing a discipline of study is a means for constructing knowledge. Helping the student to develop positive attitudes toward other cultures should reduce prejudice. By adjusting their teaching styles to different learning styles, faculty can achieve greater equity in pedagogy and advance the empowerment of students from minority cultures within the school culture.

The Curriculum

In order to enhance students' awareness and appreciation of diversity in any population, such as the school itself or the culture at large, curriculum change must move beyond the lecture. Such change requires a range of methodologies and approaches. Perspectives on a variety of ethnic cultures should be structured in such a way as to maximize critical thinking and productive learning. Since much course learning may otherwise appear disconnected to students, Meacham suggests that multicultural learning should ideally be integrated into as many academic disciplines as possible across all four years of chiropractic education.¹² For example, first year studies should include exposure to the premises of cultural competency and samples of cultural norms, health beliefs, and health practices. Reflection should continue in second year with the examination of language and communication patterns, family relationships, religion, and ethnicities. Small group discussion may be used to encourage engagement and critical thinking. Finally, immersion into another culture, either just before or during clinic internship, would challenge students to examine their own belief system and reflect on their response to that culture and the knowledge acquired. Billings and Halstead confirm that a variety of activity in instructional strategies consolidates experiential knowledge acquisition.¹³

Developing Cultural Competency

Theoretical framework

Nunez, cited in Billings & Halstead, defines cultural competency as "the skill of using multiple cultural lenses and the capacity to function effectively as an individual and an organization within the context of the cultural beliefs, behaviours, and needs presented by consumers in their communities".¹³ Alternatively, in health care, Betancourt in Khauv and Alcantara, defines cultural competence as "...understanding the importance of social and cultural influences on patients' health beliefs and behaviors; considering how these factors interact at multiple levels of the health care delivery system."³

In order to develop a course reflective of this definition, Campinha-Bacote proposes five components of the process of developing cultural competence: cultural awareness, cultural knowledge, cultural skill, cultural encounters, and cultural desire.¹⁴ The student is expected to progress from a lack of or limited notion of cultural competence to cultural knowledge and awareness and how this will impact the clinical encounter. This process includes progressing from the cognitive to the affective domain with changes in attitude and behaviour. This is of importance for the healthcare professions, including chiropractic. In fact, "one might propose that cultural competence is to quality care what multicultural education is to quality education".¹⁴ This would suggest that it is an added dimension intended to be formative of and integral to the learner as future healthcare provider. Bringing students of chiropractic to this level of care is the mission of faculty and the vision of the teaching institution.

As stated earlier, students come from diverse backgrounds and will practice in ethnically diverse settings. This necessitates sociocultural contextualization. Constructivist learning theory acknowledges that new knowledge is built on students' existing knowledge.¹⁴ The teacher-facilitator's role is to lead students to inquire into their previous experiences, to appreciate multiple perspectives, to become aware of possible differences between learners' and instructors' goals, and to embed their learning in the social context.¹⁵ Educational theories suggest that learning can best be accomplished in small groups and by being self-directed.¹⁶ This philosophical base for the framework is befitting of students from different backgrounds and life experiences.

It is not yet known to what extent cultural competency improves health outcomes in medicine, let alone in chiropractic. But it is acknowledged that a lack of it contributes to health disparities.¹⁷ In order to develop an integrated approach to multicultural education and cultural competency, knowledge, skills and attitude must be co-constructed. This community-based learning will capitalize on Campinha-Bacote's five components to develop cultural competence.¹⁸

Cultural awareness. Students must examine their own culture and life experiences, as some may be bicultural, born of one culture and living in another. They need to explore the implications of their background culture for health care, and be aware of their prejudices and biases towards other cultures.¹⁵ Exposure to other cultures may help them to realize their own ethnocentricity. One project might be participation in an activity in a different culture.

Cultural knowledge. "Cultural knowledge is the attainment of factual information about different cultural groups".¹³ This includes worldviews of different cultures and knowledge regarding specific physical, biological, and physiological variations among ethnic groups. Not only is the student expected to accumulate information, but also to reflect critically on this knowledge according to what has been learned about awareness.

Cultural skills. Students are expected to communicate with individuals of different cultures, conduct a cultural assessment, and learn how to conduct a culturally based physical assessment.¹⁹ Verbal and non-verbal (body) language, eye contact, and silence, for example, may have different meanings in different cultures. Practising with standardized patients in a clinical examination setting would provide that practical experience.

Cultural encounters. "Multiple face-to-face experiential encounters deepen exposure to diversity within cultural groups and prevent stereotyping that may develop when obtaining academic knowledge".¹⁵ By means of multiple encounters, cultural sensitivity is developed. Internship in culturally diverse outpatient clinics would enhance this sensitivity.

Cultural desires. The culmination of all this "is motivation to want to engage in the process of becoming culturally aware, knowledgeable, and skilful and seeking cultural encounters"¹⁹ As constructivist theory suggests, building one component upon another creates multi-di-

mensional knowledge that is more easily transferable to a clinical setting because of its methodology. Activity and experience confirm deeper learning which will enhance the clinical encounter later in practice.

Students trained in the five competencies in four years of a transformed curriculum will be able to be appraised not only for their learning, but also for the success of a multicultural education.

Course outlines should clearly identify the competency to be acquired in each course, based on Campinha-Bacote's five models.¹⁴ Each competency will dictate the type of teaching method to be used. Lectures, small group discussions, and assignments will determine the type of appropriate testing.

Conclusion

This paper has presented an analysis of the need for multicultural education and cultural competency and a critique of the knowledge gap in chiropractic education regarding this need. It has demonstrated the lack of a framework on how best to achieve a learner-centred syllabus in chiropractic education using guidelines grounded in sound education theory. In the current social context in which diverse demographics necessitate an educational response to ensure best practices in patient care, this paper is a preliminary response to the need to address cultural competency education. This review advances the theoretical background to develop the learning process for acquiring cultural competency. It suggests ways to incorporate the stages of learning and activities into a four-year chiropractic curriculum. Research criteria on multicultural education in chiropractic would depend on student outcomes and what areas require further investigation. This article may have future implications that could affect how chiropractic schools develop their curricula and the competencies of the students they graduate.

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Fracture of the lateral tubercle of the posterior talar process caused by a rock-climbing fall: a case report

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The purpose of this case report is to describe the clinical presentation of a patient who suffered from a fracture of the lateral tubercle of the posterior talar process caused by a fall while rock-climbing. The initial evaluation revealed diffuse ankle swelling, tenderness, and pain at the distal aspect of both malleoli. Plain film radiography revealed a fracture of the posterior process of the talus. Computed tomography (CT) outlined the extension of the fracture line in the postero-lateral aspect of the body of the talus with minimal displacement. The patient was treated conservatively with an Aircast© walking boot for 6 weeks (non-weight-bearing) followed by a 2-week period of partial weight bearing. At the 8 week follow-up, he reported minimal tenderness and normal ankle function. Clinicians should be aware that talar fracture identification on plain films is difficult and computed tomography or magnetic resonance imaging may be required.

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KEY WORDS: talus, athletic injuries, diagnostic imaging, radiology, rock-climbing

L'objectif de ce rapport de cas est de décrire la présentation clinique d'un patient qui a subi une fracture du tubercule latéral du processus talaire postérieur suite à une chute d'escalade. L'évaluation initiale a révélé un œdème diffus de la cheville et de la douleur sur l'aspect distal des deux malléoles. Les radiographies ont révélé une fracture de l'apophyse postérieure du talus. La tomodensitométrie a démontré que la ligne de fracture atteignait l'aspect postéro-latérale du corps du talus avec déplacement minimal. Le patient a été traité avec une botte Aircast© pour 6 semaines (sans mise en charge) suivie d'une période de 2 semaines de mise en charge partielle. Après 8 semaines, il rapporte un inconfort minimal ainsi qu'une fonction normale de sa cheville. Les cliniciens doivent être conscient que ce type de fracture requiert une évaluation minutieuse des radiographies. La tomodensitométrie ou l'imagerie par résonance magnétique sont parfois nécessaires.

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MOTS-CLÉS: talus, blessures sportives, imagerie diagnostique, radiologie, escalade

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Introduction

Fractures and dislocations of the talus are considered rare, accounting for 0.1% to 0.85% of all fractures.^{1,2} Nevertheless, the talus is the second most frequent tarsal bone fracture after the calcaneus.^{2,3} Talar fractures have been described by Fortin and are classified according to their anatomical location: head, body, or neck.²

Fractures of the talar body can be further subdivided into three groups: 1) cleavage fractures (horizontal, sagittal, shear, or coronal); 2) talar process or tubercle fractures; and 3) compression fractures.² Fractures of the tubercles of the posterior talar process are considered rare. Since, they have mainly been reported as case study or case series it is impossible to appreciate their incidence.⁴⁻¹⁰ Despite the relative rarity of this injury, it is often misdiagnosed (or underdiagnosed) as an ankle sprain.^{10,11} The purpose of this paper is to present a retrospective case study of a lateral tubercle of the posterior talar process fracture sustained by a young adult rock climber.

Case presentation

A 29-year-old male patient sustained a right ankle injury during a fall. His foot somehow collided with the rock wall while trying to stop the fall. The patient had to walk approximately 500 meters in order to seek help. The initial evaluation revealed diffuse ankle swelling, tenderness, and pain at the distal aspect of both malleoli. The patient presentation satisfied the criteria of the Ottawa ankle rules¹², and AP, medial oblique and lateral radiographs of the ankle were obtained. A mildly posteriorly displaced fracture of the posterior process of the talus was seen (figure 1). Due to the unusual presentation of the fracture, computed tomography (CT) was then ordered. The CT outlined the extension of the fracture line through the postero-lateral aspect of the body of the talus with minimal displacement (figure 2).

The patient was referred to a hospital-based orthopaedic clinic. He was treated conservatively with an Aircast® walking boot for 6 weeks (non-weight-bearing) followed



Figure 1:
Lateral ankle radiographs showing a fracture of the lateral tubercle of the posterior talar process.

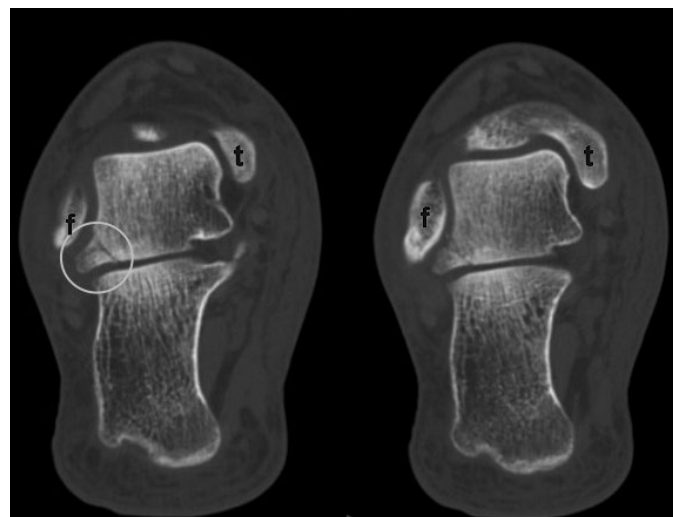


Figure 2:
Computed tomography images through the talocalcaneal joint. The images were obtained on the day of the injury. A comminuted fracture line is seen through the lateral tubercle of the posterior talar process and extending into the body of the bone. The fibula is depicted by the letter « f » and the medial malleolus of the tibia is shown by the letter « t ».

by a 2-week period of partial weight bearing. At 6 weeks following the injury, a repeated radiographic examination demonstrated a non-union of the tubercle fragment with minimal displacement (figure 3). The patient gradually resumed all his occupational and sports activities and reported minimal tenderness and normal ankle function. Further follow-up was not needed.

Discussion

The posterior process of the talar body is formed by the lateral and medial tubercles.¹³ The tubercles are separated by a groove in which courses the flexor hallucis longus tendon. The lateral tubercle is larger and serves as the attachment site for the posterior talofibular and the posterior talocalcaneal ligaments.^{10,13} The medial tubercle serves as the attachment of the deltoid ligament.^{10,13} The os trigonum is an accessory ossicle commonly located posteriorly



Figure 3:

Lateral radiograph of the ankle obtained 6 weeks after the injury. Union of the fragment with the talus is very unlikely at this stage. Since the patient's condition was improving steadily, surgical removal of the fragment was not considered.

to the lateral tubercle and should not be mistaken for a fracture of the posterior process of the talus.¹⁴

Fractures of the posterior talar process have been only described as case reports or case series, making it difficult to generalize the usual presentation, cause and associated symptoms. It has been suggested that fracture of the lateral tubercle may be caused by excessive plantar flexion (compression fracture) or inversion (avulsion fracture), while fractures of the medial tubercle would be the result of dorsiflexion with pronation (avulsion fracture).^{10,11} Like other talar fractures, they occur when a person falls from a certain height or during sports who require kicking such as football.^{2,11}

The clinical presentation of a patient with fracture of the lateral tubercle usually includes pain and swelling in the posterolateral area of the ankle.^{10,11} Deep palpation of that area should reveal tenderness and reproduce pain as well as plantar flexion or dorsiflexion of the great toe.¹¹ Patients with fractures of the medial tubercle may only suffer from mild pain, especially while walking.¹⁵ Typically, pain and swelling will be localized posterior to the medial malleolus.^{11,15} Fractures of both tubercles are commonly misdiagnosed as ankle sprains.^{10,11} Paulos has reported that 85% of his cases were not initially adequately diagnosed.¹⁰

Fractures of the lateral tubercle are usually best visualized on lateral radiograph of the foot. It is important not to dismiss a fracture fragment located at the posterosuperior aspect of the talus as a normal variant: an accessory ossicle called the os trigonum.¹⁴ Accessory ossicles tend to be rounded with a well corticated margin, while fracture fragments may be irregular and demonstrate jagged edges. Fractures of the medial tubercle are generally not well seen on the standard 3 view ankle series. To visualize this injury, an external oblique view with approximately 40 degrees of external rotation may be required.^{8,11,16}

The Ottawa ankle rules (figure 4) are now generally used to determine the indication of ankle radiograph because it has demonstrated a very high sensitivity, moderate specificity, therefore, a very low rate of false negatives.¹² The implementation of the Ottawa ankle rules contributed to reducing the number of unnecessary investigations. Unfortunately, fractures of the talus were rarely encountered in the Ottawa ankle trials and some authors have suggested that talus fracture might fall in a "blind spot".¹⁷ Judd suggested that: "the Ottawa ankle rules is likely to

allow detection of talus and calcaneus fracture because patients will not often be able to bear weight".¹¹ In this case study, the patient could bear weight, but had pain in both the lateral and medial malleolus areas. Radiographic analysis might be considered, according to clinical judgement and experience, when the mechanism of injury suggests a fracture or when a suspected ankle sprain does not improve over time. When suspicion is present, CT or MRI will better demonstrate this type of fracture.¹⁶

Fractures of both tubercles will usually be treated conservatively if there is minimal displacement.^{2,10,11} Non weight-bearing and short leg casts are recommended for 4 to 6 weeks followed by 2 weeks of weight bearing to tolerance. If the symptoms persist; an additional period of immobilization (4 to 6 weeks) might be required. Surgical excision of the fragment might be considered if the pain persists more than 6 months.^{2,11} Displaced fracture or larger fracture might require reduction and surgical fixation.^{2,7,8}

Conclusion

This report demonstrates a case of fracture of the lateral tubercle of the posterior talar process caused by a rock-climbing fall. Clinicians should be aware that a fracture of posterior talar process may mimic the signs and symptoms of ankle sprains.

Acknowledgment

The patient would like to thank his climbing partner.

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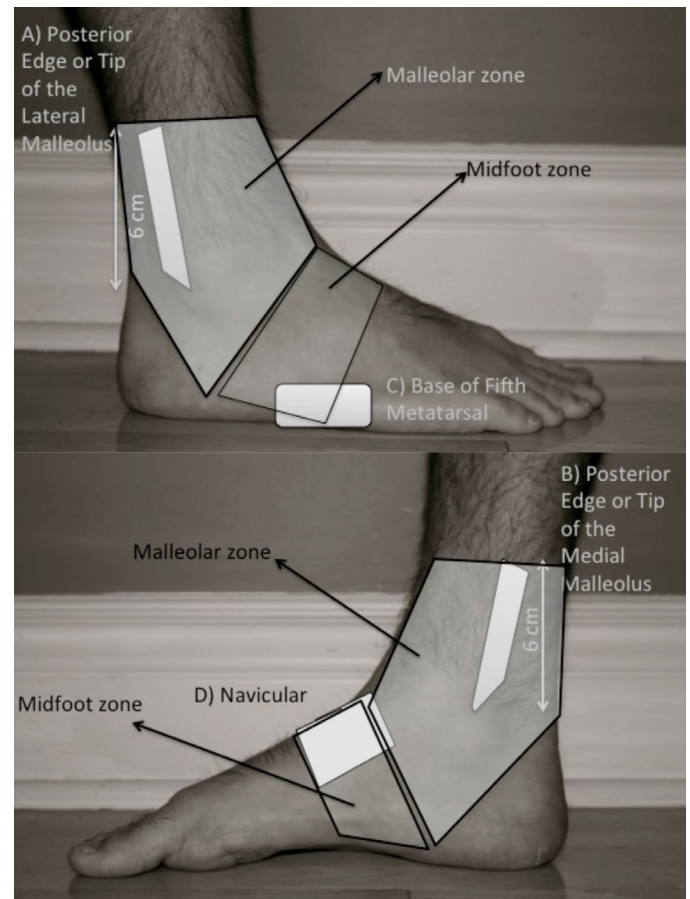


Figure 4:

Ottawa Ankle Rules: An ankle radiographic series is only required if there is pain in the malleolar zone and any of these findings: – Bone tenderness at A – Bone tenderness at B – Inability to bear weight.

A foot radiographic series is only required if there is pain in the midfoot zone and any of these findings: – Bone tenderness at C – Bone tenderness at D – Inability to bear weight.

(Adapted with permission from http://www.ohri.ca/emerg/cdr/docs/cdr_ankle_poster.pdf)

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Congenital scoliosis in non-identical twins: case reports and literature review

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Congenital scoliosis due to vertebral anomalies may occur in less than 0.1% of the population. Several different theories have been put forth in the literature to account for the etiology of congenital scoliosis and the vertebral anomalies which contribute to its development. The study of scoliosis in twins has contributed to the understanding of causative factors including genetics, environment and in utero events during embryologic development. Case reports of fraternal (non-identical) juvenile male twins with congenital scoliosis associated with differing congenital vertebral anomalies are presented. Both children were asymptomatic at the time of the initial consultation and showed no signs of neurologic compromise. Rapidly progressive, severe genetic scoliosis requires prudent observation and referral to a pediatric orthopedic surgeon to determine appropriate options for care and to screen for potentially life threatening disorders. Chiropractors may be seen as

La scoliose congénitale due à des anomalies vertébrales peut se produire chez moins de 0,1 % de la population. Plusieurs théories différentes ont été avancées dans la recherche scientifique pour expliquer l'étiologie de la scoliose congénitale et les anomalies vertébrales qui contribuent à son développement. L'étude de la scoliose chez les jumeaux a contribué à la compréhension des facteurs étiologiques, dont la génétique, l'environnement, et les événements in utero au cours du développement embryonnaire. On présente des rapports de cas de frères jumeaux (non identiques) mineurs atteints de scoliose congénitale associée à différentes anomalies vertébrales congénitales. Les deux enfants étaient asymptomatiques au moment de la consultation initiale et n'ont montré aucun signe d'atteinte neurologique. Susceptible de progresser rapidement, la scoliose génétique grave nécessite une observation attentive, et le renvoi à un chirurgien orthopédiste pédiatrique pour déterminer les options appropriées des soins et pour le dépistage de maladies potentiellement mortelles. Les chiropraticiens peuvent être considérés comme des remparts contre la scoliose. Ceci étant dit,

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gatekeepers for scoliosis and a thorough understanding of appropriate standards of care is required.

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KEY WORDS: scoliosis, twins, congenital, hemivertebra, chiropractic

Introduction

Scoliosis is a lateral curvature and twisting of the spine measuring 10 degrees or more. The Cobb method of measurement determines the degree of scoliotic curvature by the angle created between lines drawn on endplates of the end vertebrae (superior endplate of upper end vertebra; inferior end plate of lower end vertebra). (Figure 1) This method has been adopted and standardized by the Scoliosis Research Society, which also classifies the severity of scoliosis. (Table 1) The Nash and Moe method measures vertebral rotation on a frontal radiograph using the dis-

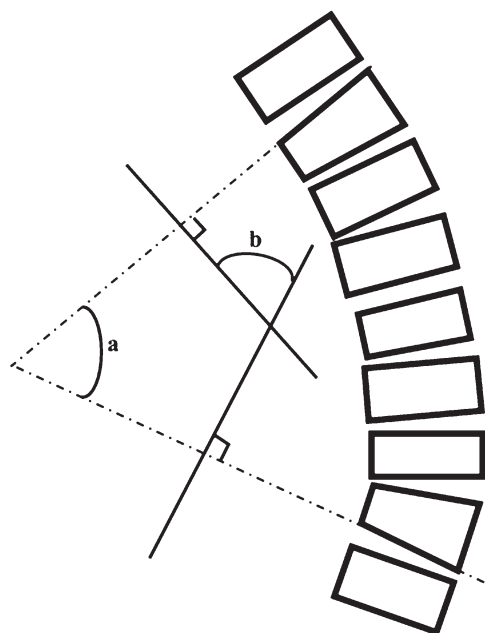


Figure 1. Cobb method of scoliosis mensuration (Reproduced with permission of the Radiological Society of North America (RSNA). Kim H, Kim HS, Moon ES et al. *Scoliosis imaging: What radiologists should know. RadioGraphics. 2010;30:1823-1842*)

une connaissance approfondie des normes appropriées de soins est nécessaire.

(JCCA. 2014;58(3):291-299)

MOTS CLÉS : scoliose, jumeaux, congénital, hémivertèbre, chiropratique

placement of the pedicle on the vertebral body. (Figure 2) Juvenile idiopathic scoliosis is defined as a spinal curvature diagnosed between 3 years and 9 years 11 months of age, whereas congenital scoliosis is associated with bony abnormalities of the spine present at birth.¹ Juvenile onset scoliosis has been reported to account for 8% to 21% of patients with scoliosis, although these numbers are based on studies with small numbers of participants and may not be statistically accurate.^{2,3} The incidence of congenital scoliosis in the juvenile population is unknown since many spinal anomalies go undetected due to the presence

Table 1.

Lippman-Cobb Classification of Scoliotic Curvature

Group	Angle of Curvature in Degrees
I	<20
II	21-30
III	31-50
IV	51-75
V	76-100
VI	101-125
VII	>125

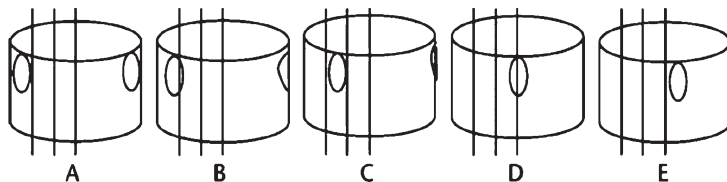


Figure 2. Nash and Moe pedicle method for determining vertebral rotation

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Figure 3A.
Photograph of Twin A at 5 years 9 months

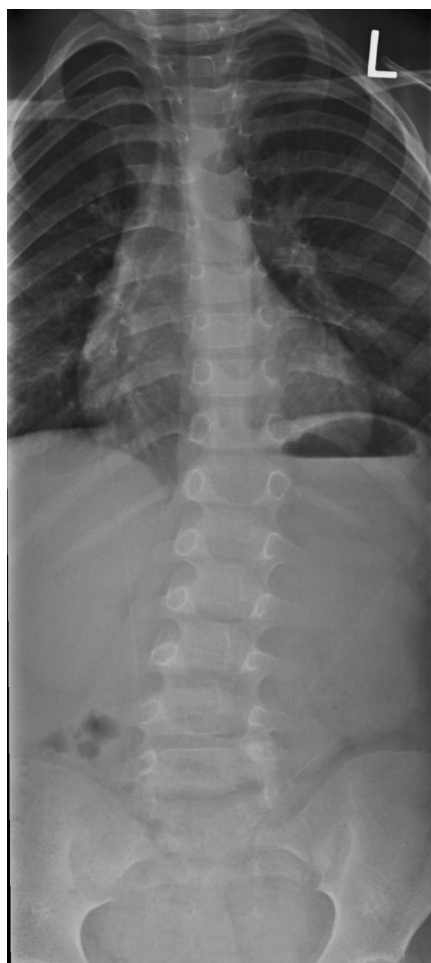


Figure 3B.
Twin A-AP standing radiograph at 4 years 11 months. 10 degree right lumbar scoliosis with mild compensatory left thoracic curve associated with decreased vertical interpediculate distance between the left L4 and left L5 pedicles as compared to the corresponding pedicles on the right, and low right hemipelvis



Figure 3C.
Twin A Lateral standing lumbar spine radiograph showing L4 facet hypoplasia and L4 anterolisthesis

of minimal spinal deformity. The incidence of vertebral anomalies has been estimated to be 0.05-0.1% of live births.⁴ Several theories exist as to the etiology of congenital scoliosis. The overall impression among researchers is that the cause is multifactorial.⁵⁻⁷

These case reports detail the presentation of a pair of fraternal juvenile twins with dissimilar scoliotic curve characteristics in a private chiropractic practice. A literature review was conducted to appreciate the etiology of congenital and juvenile onset scoliosis particularly in twins, as well as to briefly outline current standards of care.

Case Report

Twin males aged 5 years 9 months presented to a private chiropractic office on referral from the family medical physician for evaluation of juvenile scoliosis. They were escorted by their birth mother who was interviewed with respect to family history, birth history and the twin's history to date. At the time of this presentation the twins were asymptomatic, apart from visible signs of truncal asymmetry and postural imbalance. Twin A was 119.5 cm tall and weighed 24.5 kg, while twin B measured 115.5 cm in height and weighed 21.8 kg. Both boys were of nor-



Figure 4A.
Photograph of Twin B at 5 years 9 months



Figure 4B.
*Twin B AP standing radiograph at 22 months
Hemivertebra at T10 with a 30 degree right thoraco-lumbar scoliosis*

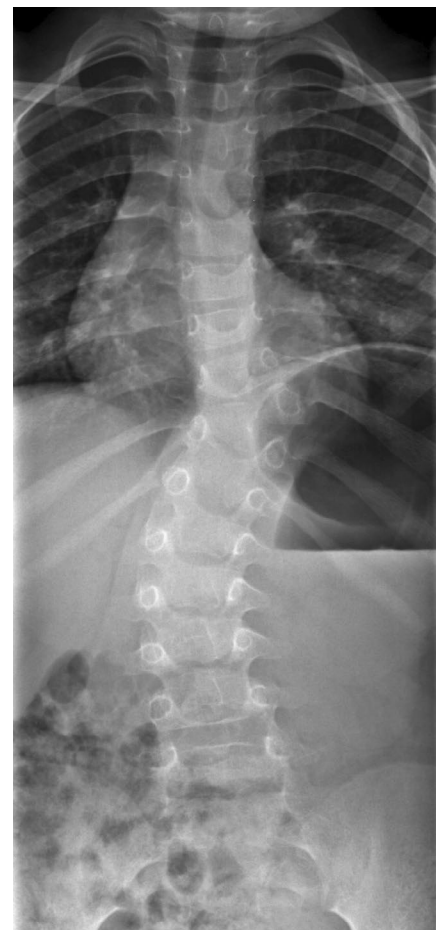


Figure 4C.
*Twin B Twin B AP standing radiograph 4 years 11 months
Hemivertebra at T10 with a 35 degree right thoraco-lumbar scoliosis*

mal intellectual development for age and were able to follow directions when asked. They were active throughout the interview and examination and appeared to possess equal strength, co-ordination and physical ability. During standing postural assessment, twin A demonstrated pelvic and shoulder unlevelling, lower on the right side, with left head tilt. (Figure 3A) No rib humping was observed during forward trunk flexion (Adam's test). Twin B demonstrated trunk rotation left posterior and right head tilt (Figure 4A). Slight left lower rib humping was evident on forward trunk flexion. Lateral bending and extension

ranges were tested in twin A and were found to be within normal limits, while twin B exhibited mild segmental restriction in left lateral bending at the thoraco-lumbar junction. No pain was elicited during examination in either twin. Babinski sign was absent when tested, and gait and balance was normal in both twins.

The mother's family history is unremarkable for scoliosis, congenital spinal anomaly or other serious disease. She has two other older female children, neither having any evidence of scoliosis. She denies smoking, drug use, or illness prior to conception or during pregnancy. The

father's family history is also negative for scoliosis or spinal anomaly, and there is no consanguinity with the twin's mother. The boys were full term at delivery and were determined to be fraternal, not identical twins. At birth, twin A was 4.2 kg and 52.5 cm in length while twin B was 3.7 kg and 54 cm in length. They were considered to be very large babies at birth for twins, and gestational diabetes was ruled out as a contributing factor to their size. The twin's siblings were also born with similarly high birth weights.

The mother was questioned about her health and lifestyle during the early stages of pregnancy with the twins. She recalled that she had been breast feeding her second child and had been menstruating for one year following a one year absence of her monthly cycle following the delivery of this child. She normally has a 6-8 week menstrual cycle and was unaware that she was pregnant until approximately 6 weeks of gestation. She had been exercising regularly and enjoyed very good health during this time. She was not aware that she was carrying twins until 5 months of gestation.

Radiographs of the twins were provided and reviewed during consultation. Twin A had a single AP standing radiograph taken at 4 years 11 months of age which demonstrated a 10 degree right lumbar scoliosis measured using the Cobb method between L2 and L5. There was also a mild compensatory left thoracic curve present. (Figure 3B) This view also demonstrated pelvic unleveling, lower on the right which was possibly associated with a lower limb discrepancy due to a shorter right leg. A decreased vertical interpedicular distance was noted at L4-5 suggestive of a failure of segmentation. A lateral lumbar film was recommended and taken at a later time to confirm this anomaly. (Figure 3C) An independent chiropractic radiologist was consulted to review these films. The anomaly was reported as "L4 hypoplastic facet development with anterolisthesis of L4 on L5". "The findings suggest congenital etiology scoliosis". (Addendum)

Twin B had serial AP standing radiographs taken at 22 months and again at 4 years 11 months. The initial view demonstrated a hemivertebra at T-10 with incomplete development of the right side of this anomalous segment. This was associated with a 30 degree right thoraco-lumbar scoliosis measured using the Cobb method between T12 and L4 which had developed below the anomaly. (Figure 4B) The second radiograph demonstrated progression

of the thoraco-lumbar scoliosis to 35 degrees associated with the hemivertebra. (Figure 4C)

Discussion

The study of scoliosis in twins, particularly adolescent idiopathic scoliosis is well documented.⁸⁻²¹ Grauers et al published their findings on "Heritability of Scoliosis" following a survey of 64,578 twins in the Swedish twin registry and concluded that genetic factors were responsible for 38% of scoliosis cases as compared to 62% environmental association with the development of scoliosis. This study also concluded that in monozygotic twins, concordance for idiopathic scoliosis is much higher than in same sex dizygotic twins.²² There were three studies published regarding juvenile scoliosis in twins.²³⁻²⁵

Congenital scoliosis is a lateral curvature of the spine associated with vertebral anomalies such as block vertebra, wedge vertebra, single hemivertebra, two unilateral hemivertebrae, a unilateral unsegmented bar, or a unilateral unsegmented bar with contralateral hemivertebrae at the same level. These represent the five classifications of vertebral anomaly as described by McMaster and Ohtsuka.²⁶ A single hemivertebra, which is classified as a failure of formation is a common vertebral anomaly found in congenital scoliosis and depending on the location, will contribute to scoliotic progression in the growing child. A fully segmented hemivertebra may be associated with rapid scoliotic progression and may be resistant to conservative management.²⁷⁻³¹ Genetic signaling in the embryological development stage of somitogenesis, as well as temporary vascular insufficiency of the growing fetus may contribute to failure of ossification of a vertebra or vertebrae, osseous metaplasia of the annulus fibrosus or persistent notochord. These proposed theories in the formation of vertebral anomalies, such as hemivertebrae and other structural malformations suggest a role for environmental and genetic contributors.³²⁻³⁷

Juvenile scoliosis is unique in that progression may occur during a period of time where growth is dormant.^{2,36,37} Progression of the spinal curvature may initially be so subtle that clinical observation without serial radiographs will not demonstrate the rate of progression. Curve patterns in juvenile scoliosis tend to be similar to those in adolescent idiopathic scoliosis. Studies which follow cases of juvenile scoliosis report that progression is more likely to be aggressive in younger patients.^{2,38,39}

However some patients within these studies showed gradual regression of their curves with time as they approached puberty, further confounding the theories of the natural course of scoliotic progression and complicating clinical decision making with respect to treatment.^{40,41} Unrecognized physical activity, particularly in male patients may lead to curve regression. Symmetric loading of vertebral structures during weight bearing exercise may be a contributing factor in gradual regression. Prepubescent curve regression is not a guarantee that a scoliotic curve will not progress rapidly during adolescence.^{42,43}

Congenital scoliosis due to hemivertebra is more likely to show rapid progression at a younger age than juvenile idiopathic scoliosis and a referral for a surgical opinion at an early age is necessary.^{30,31,42} Anomalies of the neurologic or visceral structures, especially of the genitourinary system, may also occur when errors of formation or segmentation of the spine exist. During the fifth week of embryonic development, the vertebral column and the genitourinary system may be subject to embryonic insult which could lead to abnormalities.^{44,45} This may present challenges when considering surgical intervention to minimize the progression of scoliosis. A complete evaluation of the surgical candidate with vertebral anomalies, including spinal and abdominal MRI, as well as diagnostic ultrasound and occasionally voiding cystourethrograms may be necessary to minimize surgical risk as well as to diagnose and treat potentially life threatening disorders.⁴⁶⁻⁴⁹ Neither Twin A or Twin B has yet been assessed for other developmental anomalies.

Winter and Lonstein published a retrospective case series of 1250 patients with congenital spinal deformities and found that only seven patients with scoliosis secondary to a hemivertebra showed gradual improvement without treatment. This is not a favorable prognosis for children with congenital scoliosis due to a vertebral anomaly and points to the importance of identifying and determining the classification of the anomaly at the earliest possible age. One of the children in Winter and Lonstein's study was a twin with a hemivertebra at L1 while his twin brother had no vertebral anomaly. The child with hemivertebra was followed from age 15 months to age 16 years and showed a reduction of the spinal curvature from 42 degrees to 31 degrees without intervention, and was asymptomatic at all times.⁵⁰

Non-identical twins are dichorionic, diamniotic twins

and the differences in their genetic makeup would be similar to siblings born as a result of pregnancies separated by time. However, the twins in these case studies offer a unique opportunity to observe the progression of this challenging clinical condition for the practicing chiropractor. These case studies and review of the literature suggest that while there is an understanding of the etiology of scoliosis, accurate prognosis cannot be made on a case by case basis as to the likelihood of progression or regression of scoliosis. There are many and varied contributing factors during fetal development and during childhood which affect the progression of scoliosis. It is incumbent on the practitioner monitoring patients with scoliosis to diligently follow and to carefully observe subtle changes that may foretell progression and to make clinical decisions regarding appropriate standards of care. Examinations should be conducted at 2-3 to 36-60 months intervals according to the specific clinical situation, and standing frontal full spine radiographs including the occiput and pelvis should be obtained when progression is apparent.⁵¹ A scoliometer, which is a variant of a carpenter's level, can be incorporated in the examination process to measure the severity of the rib hump and lumbar bulge. Raster stereography may also be considered to document the shape of the spine using reflected light beams without the use of ionizing radiation.⁵²

Pediatric orthopedic referral would be the most prudent course of action for twin B with congenital scoliosis. Hemivertebra resection and transpedicular instrumentation or contralateral hemiepiphysiodesis are options for surgical intervention in young children and should be performed early to prevent severe local deformities and secondary structural changes. Adequate post surgical bracing is essential to prevent failure of instrumentation, which has been reported as a frequent occurrence.^{28,29,31,40,43-47}

Twin A shows signs of a mild congenital scoliosis associated with a subtle vertebral anomaly. Some evidence in the literature supports the use of chiropractic spinal manipulation and rehabilitative exercises for the management of scoliosis, although long term trials have not yet been conducted.⁵³⁻⁵⁶ None of the studies cited were conducted on juvenile patients. Brace management has been shown to be a recognized and beneficial form of conservative care in some cases and may be indicated if idiopathic scoliosis progresses at any time prior to skeletal maturity.^{51,57-59}

Limitations

These case studies represent one pair of non-identical twins.

Conclusion

The twins in these case studies were both born with congenital vertebral anomalies which contribute to dissimilar scoliotic characteristics. Referral and screening for potentially life threatening disorders including other CNS or genitourinary anomalies as well as potential referral for surgical intervention is important. By gaining a better understanding of the etiology and time of onset of scoliosis, improved screening methods and standards of care may be developed in the management of this enigmatic childhood disorder, particularly in twins. These cases demonstrate the importance of the role of the chiropractor in examination, monitoring, discussing risks of progression, and in making an appropriate referral to a pediatric orthopedic surgeon for follow up care in severe cases of congenital scoliosis. Educational resources should be provided to parents of twins for the purpose of monitoring scoliosis progression, especially in families where scoliosis or congenital structural anomalies are present. Funding for long term studies of conservative management of juvenile idiopathic scoliosis and congenital scoliosis including spinal manipulation should be considered to determine effectiveness.

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Addendum

Independent Chiropractic Radiologist's report for Twin A radiographs

11-28-1013

This is review of a two view series of a five year old twin for scoliosis

Anteroposterior upright thoracic, lumbar spine and pelvic and lateral lumbar spine views reveal Lovett positive dextroscoliosis of the lumbar spine, apex at the L3-L4 level measuring less than ten degree Cobb angle. The right hemipelvis is inferior to the left as seen at the iliac crest and femoral head levels. No compensatory levoscoliosis of the thoracic spine is noted. On the anteroposterior view the left sided disc space is unilaterally less than the right and the pedicle length development at this site is noted on lateral projection to be mildly decreased compared to the superior adjacent L3-L4 level. The L5 pedicle formation is less in sagittal measurement than the L4 or L3 levels. The inferior facet development is hypoplastic at the L4 level and the McNabb line drawn under the L5 inferior vertebral body shows the first sacral facet to fall markedly superior to it. There is hyperextension of L5 on the sacrum. This creates a facet syndrome of imbrication of the first sacral facet into the upper intervertebral foramen of L4-L5. The L4-L5 osseoligamentous canal area is also diminished in comparison to the superior L3-L4 level. The L4 vertebral body is anterior on the fifth lumbar body as seen both at the anterior and posterior vertebral body alignment. No pars interarticulares deformity is detected on this two film study.

Impression:

1. Dextroscoliosis of the lumbar spine
2. L4 hypoplastic facet development with anterolisthesis of L4 on L5 and intervertebral foraminal narrowing at the L4-L5 level
3. L5 hyperextension and facet syndrome of L5-S1 resulting in imbrication of the first sacral facet into the L5-S1 intervertebral foramen
4. Low right hemipelvis as noted above

Comment:

The findings suggest congenital etiology scoliosis. Oblique views with CT scanning would render further detailed anatomical structural confirmation of the impressions given in this report.

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Community-based falls prevention: lessons from an Interprofessional Mobility Clinic

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Falls are a common and serious risk with an aging population. Chiropractors commonly see firsthand the effects of falls and resulting injuries in their senior patients and they can reduce falls risk through active screening. Ongoing research has provided proven approaches for making falls less likely. Screening for falls should be done yearly for all patients 65 years and older or in those with a predisposing medical condition. Additional specific falls prevention professional education would enable the chiropractor to best assist these patients. Collaboration and communication with the patient's family physician

Les chutes présentent un risque commun et grave chez une population vieillissante. Les chiropraticiens constatent habituellement directement les effets des chutes et les blessures conséquentes chez leurs patients âgés; et ils peuvent en réduire les risques grâce à un dépistage actif. Des recherches continues fournissent des méthodes vérifiées de réduction de la probabilité de chutes. Un dépistage des risques de chute doit être effectué chaque année pour tous les patients de 65 ans et plus, ou pour ceux dont l'état de santé les prédispose. Une formation professionnelle supplémentaire spécifique dans la prévention des chutes permettrait au chiropraticien de mieux aider ces patients. La collaboration et la communication avec le médecin de famille du patient offrent une occasion d'améliorer le

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offers an opportunity for improved interprofessional dialogue to enhance patient care related to falls risk. Frequently falls prevention strategies are implemented by an interprofessional team. Chiropractors increasingly contribute within multidisciplinary teams. Collaboration by the chiropractor requires both simple screening and knowledge of health care system navigation. Such awareness can permit optimal participation in the care of their patient and the best outcome.

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KEY WORDS: falls, elderly, injury, prevention, chiropractic

dialogue interprofessionnel au profit de meilleurs soins prodigués au patient sur les risques de chute. Souvent les stratégies en matière de prévention des chutes sont mises en place par une équipe interprofessionnelle. Les chiropraticiens œuvrent de plus en plus au sein d'équipes multidisciplinaires. La collaboration des chiropraticiens nécessite des compétences pour de simples dépistages, ainsi que des connaissances pour s'orienter dans le système des soins de santé. De telles connaissances permettront au chiropraticien une participation optimale aux soins de son patient et l'obtention des meilleurs résultats.

(JCCA. 2014;58(3):300-311)

MOTS CLÉS : chutes, personnes âgées, blessures, prévention, chiropratique

Introduction

Falls often have devastating consequences for the elderly.¹ Chiropractors commonly see firsthand the effects of falls and resulting injuries in their senior patients. Ongoing research has provided proven approaches for making falls less likely.¹ The reduction of falls risk may need to be managed by a referral for a multifactorial fall assessment, through the patient's family physician.² Frequently falls prevention strategies are implemented by an interprofessional team. Chiropractors increasingly contribute within multidisciplinary teams.³ Collaboration by the chiropractor requires both simple screening and knowledge of health care system navigation. Such awareness can permit optimal participation in the care of their patient and the best outcome.

"A fall is an unexpected event in which the participant comes to rest on the ground, floor, or lower level".⁴ Each year, one in three community living adults aged 65 and older incur a fall.^{5,6} Falls by seniors are expected to increase in the coming years due to an escalating prevalence of chronic disease.^{7,8} The cause of falling is multi-factorial.⁴ In community-based populations, almost half of all falls happen in the home.⁹ The subsequent effects can lead to distress, disability, fracture, long-term care admission, and mortality.^{6,9}

In 30-73% of those who have fallen, a fear of falling

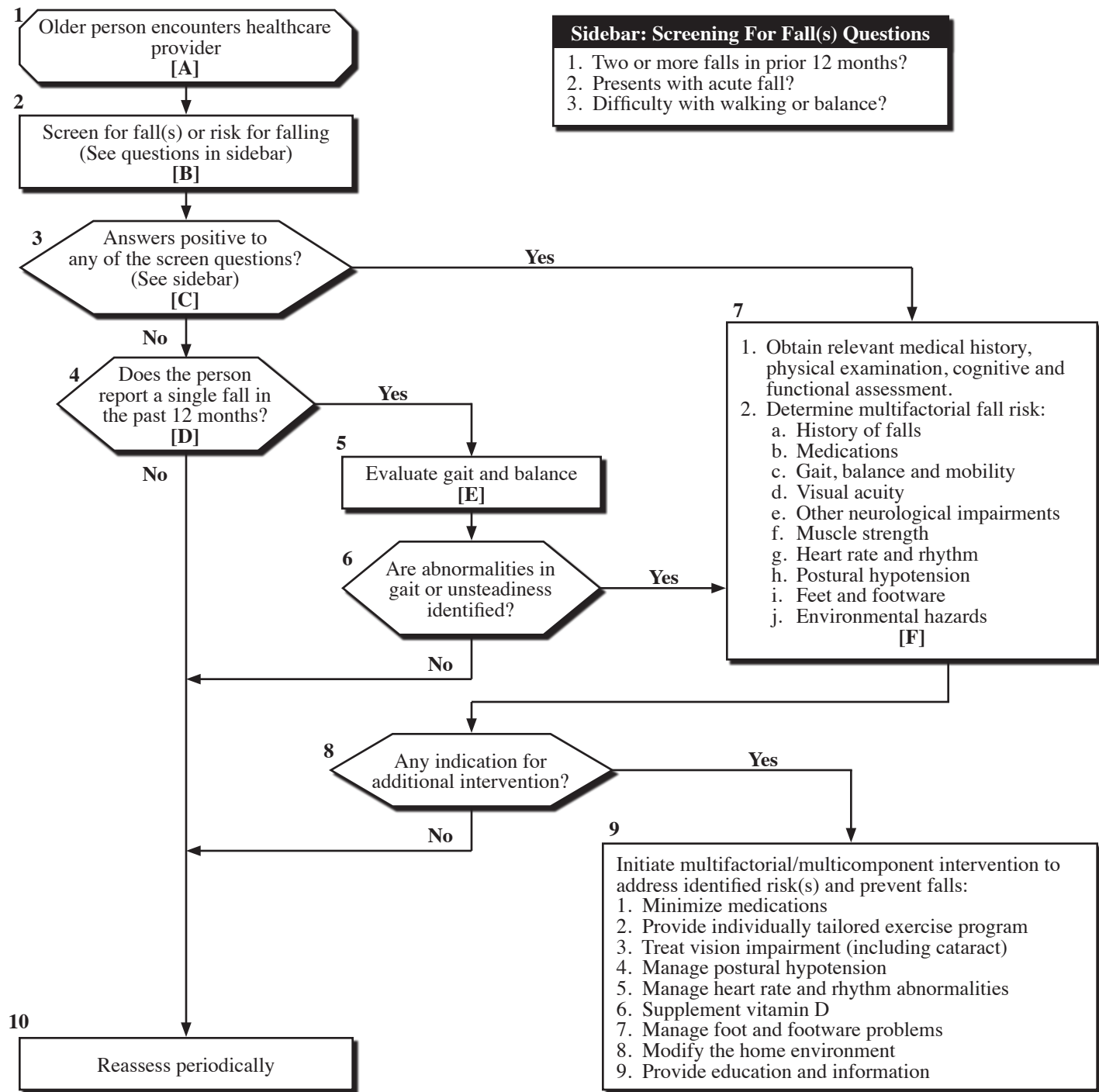
develops which is known as post-fall anxiety syndrome.¹⁰ This apprehension can lead to activity restriction, loss of confidence, depression, functional decline, and social isolation.¹⁰ Falls represent a significant burden for seniors, their families, and the health care system.^{11,12} For example, falls are the second most common cause of spinal cord injury and following a fall, a fractured hip has a 1-year mortality rate of over 20% in seniors.^{13,14} Fortunately, there are community-based methods for chiropractors to help reduce this ever increasing problem.^{2,6,15}

The Centre for Family Medicine Family Health Team in Kitchener, Ontario has developed an interprofessional Mobility Clinic, which provides primary care to patients with physical disabilities. This team includes family physicians, an occupational therapist (OT), nurses, a social worker, a clinical pharmacist, an optometrist, a physiotherapist (PT), and a chiropractor. At the Mobility Clinic, the primary reason for referral is mobility concerns and falls.¹⁶ Preventing falls can be challenging because of multifactorial short and long-term causes.^{17,18} Based on our team's four years of Mobility Clinic experience and available evidence, we provide an overview of a falls risk assessment, falls prevention measures, and offer steps to tailor our interprofessional approach to a chiropractic office setting. The hope of this paper is to raise awareness among chiropractors to better assist their patients in iden-

Figure 1:

Prevention of Falls in Older Persons Living in the Community

With permission from the American Geriatrics Society: "The AGS/BGS Clinical Practice Guideline: Prevention of Falls in Older Persons" (http://www.americangeriatrics.org/health_care_professionals/clinical_practice/clinical_guidelines_recommendations/2010/) from the American Geriatrics Society, www.americangeriatrics.org.



tifying those at risk of falls and highlight an opportunity to collaborate with other health professionals in limiting this risk.

Screening

While the topic of falls may come up during a typical patient encounter, screening all chiropractic patients over the age of 65 or those at risk for falling should be done yearly.^{2,6} Screening can be done by asking if two or more falls have occurred in the last 12 months, in concordance with the American Geriatrics Society, British Geriatrics Society, and NICE clinical practice guidelines.^{2,6} If there is an affirmation, check their gait and balance (see Physical Examination section) along with frequency and circumstances around the falls.¹⁴ Patients positively identified by this screening should be referred to their family physician for consideration of a multifactorial falls risk assessment (figure 1).^{2,4,6,19,20}

Any patients reporting a single fall should also be evaluated for gait and balance and if significant deficits are detected (see Physical Examination section), they should be referred to their family physician for a multifactorial fall risk assessment.^{2,6,19} Some family physicians may not feel they have the expertise to perform a com-

prehensive falls assessment and may subsequently refer to organizations like the Mobility Clinic or a community-based falls clinic; but these types of resources vary between communities. One might assume that the family physician may be aware of the patient's falls or risk of falls; however the literature shows that falls are under-reported.²¹ The chiropractor, as a member of the patient's health care team, has an important role in identifying an individual's risk of falls and collaborating with the patient's family physician to manage it.

History

The following patient questioning is for clinicians who want to have a more detailed history to consider beyond the basic screening information provided above. This would be especially important when access to a multifactorial falls assessment is not possible. The information gathered will facilitate greater collaboration with other health professionals, and with the patient's permission, should be brought to the family physician's attention. This is especially true for the Red and Yellow flags (see Table 1 and Table 2). The 2010 clinical practice guideline of the American Geriatrics Society suggests that if falls have occurred, ask what were the circumstances and frequency?²²

Table 1:
Red Flags Requiring Family Physician Notification (with patient permission)

	Additional Symptom Information
• Cardiac symptoms	This includes shortness of breath, chest pain/pressure, and/or palpitations ¹⁴ A past medical history of heart disease is an independent predictor of cardiac syncope. Absence of cardiac disease excludes cardiac cause ²⁴
• Dizziness	If light headed this is possibly caused by reduced blood flow to the brain ²⁵ If the entire room sensed as spinning this is possibly caused by benign paroxysmal positional vertigo ²⁶
• Turning head brings on symptoms	Possibly vertebrobasilar insufficiency, syncope, or cervicogenic dizziness ^{27,28,29}
• Loss of consciousness/seizure	
• Amnesia related to circumstances of fall	30% of patients with witnessed loss of consciousness have amnesia ²⁴
• Head injury	
• Unreported injuries from past falls	
• Substance abuse	This can increase the risk of falls ^{30,31} Does the patient misuse/abuse alcohol, prescription drugs, and/or use illicit drugs ^{32,33}

Falls related questions for patients include those covered by the acronym “SPLAT”:

- (S) ymptoms prior to and at the time of the falls²
- (P) revious falls, near falls, and/or fear of falling^{6,22,23}
- (L) ocation to identify contributing environmental factors (for example, was there poor lighting, was footing poor, did they trip, or were they in a crowd)
- (A) ctivity the person was participating in when they fell (for example, were they turning, changing position, or transferring?)
- (T) ime of day the falls occurred (for example, falls in the morning could be due to orthostatic hypotension and later in the day could be due to fatigue)

Other falls questions considered at the Mobility Clinic include:

- Was the cause unexplained?
- Was the fall witnessed?
- What kind of shoes was the patient wearing?

This will give you a sense if the fall was a one-time case or a pattern indicating predisposition or an underlying issue.

A systems review should be done to get the patient’s entire medical health history.² Any number of illnesses can put the patient at greater risk for falls.¹⁷ The patient’s current medications and supplements should be recorded.² There may be a history of previous injuries from one or many falls.² This may have involved the family physician, ambulance, and hospital emergency room (ER). Determine what injuries were sustained in the fall and their status. Document any other consequences of the falls. Also, be aware that the presence of cognitive impairment may make the patient a poor historian regarding their falls.⁴⁰

Other questions considered at the Mobility Clinic include:

- Is the patient under a specialist’s care for a medical condition?
- Does the patient have pain anywhere?
- Was there previous rehabilitation/therapy?
- What previous imaging was performed?
- Has the patient had any fractures and do they have osteoporosis?²
- Was the patient able to get up from their fall on

Table 2:
Yellow Flags Requiring Family Physician Notification (with patient permission)

	Additional Symptom Information
• Fear of falling	Ask “Are you are afraid of falling again?” There are validated questionnaires available such as the Activities-specific Balance Confidence Scale and Falls Efficacy Scale to measure this fear ³⁴ This fear is a significant contributor to the risk of falls and can result in functional decline, decreased quality of life, and institutionalization ^{6,23}
• Dementia	This is an independent risk factor for falls ⁶ Cognitive impairment/dementia can be screened for using the Mini-Cog tool ³⁵
• Depression	This is also associated with falls and can be screened for with the PHQ-2 questionnaire ^{36,37}
• Sleep disturbance	This includes sleep apnea which can be tested for with a sleep study by the family physician Poor quality sleep is a risk for falls ³⁸
• Incontinence	This may cause urgent trips to bathroom, often at night, and lead to a fall ⁶
• Taking 4 or more medications ³⁹	

their own (this gives a variety of information including if any injuries occurred and possibly whether the patient is deconditioned)?

- Does the patient furniture or wall walk (uses furniture and the walls for support when walking in the home as this suggests risk of falls)?
- Has the patient ever had hearing difficulty or tinnitus/Meniere’s disease (this could indicate inner ear trouble causing reduced balance)?^{41,42}
- When was the patient’s last optometry consult and is their prescription up to date (visual impairment is a falls risk)?⁶
- Do they have cataracts?²
- Can the patient feel the ground under their feet when they are standing or walking (this could indicate a peripheral neuropathy, possibly from diabetes)?

Standard chiropractic history taking can gather more information on the presence of pain.⁴³ Pain can cause a fall.⁴⁴ Possible underlying mechanisms for the pain-falls relationship can be grouped into three categories:

- 1) local joint pathology⁴⁴
- 2) neuromuscular effects of pain (including reflex muscle inhibition)⁴⁴
- 3) central mechanisms whereby pain interferes with cognition or executive function⁴⁴

Physical Examination

No gold standard in testing exists for falls risk assessment (Table 3 includes some common tests used at the

Mobility Clinic). The chiropractor’s physical exam starts with observing the patient as they walk into the treatment area. Observing the patient’s gait can be extremely informative.⁴⁵ Increased stride-to-stride variability in stride length, speed, and double-support are independently associated with falling.⁴⁵ One does not necessarily have to be an expert at gait analysis; but rather be able to identify obvious balance and gait issues (e.g. reaches for furniture/walls, nearly falls in the office, limps, and/or may use a gait aid). Compare, if safe and possible, between when they do not use and use their walking aid to evaluate the benefit to gait. The Timed Up and Go test is a standardized test for assessing falls risk that may be done in the chiropractor’s office with little equipment or time and may give additional information.⁴⁶ The patient sits in a chair with armrests and is timed how long it takes them to get up, walk to a line 3 metres away, turn around, walk back, and sit down. They may use their gait, if required, to perform safely. There is one practice trial and then an average of three trials. The literature shows cut-off values distinguishing potential non-fallers and fallers varying from 10 to 32.6 seconds (some suggest 13.5 seconds).⁴⁷ There is no definitive time for completion and as much of the information may be gained by how the patient performs the test.⁴⁶

The following is for practitioners with an interest in a more detailed assessment. The Mobility Clinic has used the University of Utah’s resource for common abnormal gait patterns which can be found at http://library.med.utah.edu/neurologicexam/html/gait_abnormal.html.⁴⁹ We

Table 3:
Key Testing To Consider

	Resources (none of the tests are considered the gold standard)
Gait Assessment	Observation ⁴⁸ The University of Utah ⁴⁹ http://library.med.utah.edu/neurologicexam/html/gait_abnormal.html Tinetti test (Performance-Oriented Mobility Assessment) ⁵⁰
Balance Assessment	Tinetti test (Performance-Oriented Mobility Assessment) ⁵⁰ Berg Balance Scale ⁵¹
Falls Risk Assessment	Timed Up and Go test ⁴⁶ Grip Strength ⁵² Tandem Gait ⁵³

also use the Tinetti test (Performance-Oriented Mobility Assessment) to determine falls risk and this can be done in 5 minutes with practice.⁵⁰ The test has a gait component and a balance component. What makes the Tinetti test unique is the inclusion of a perturbation to the patient (a push) to determine how well the patient can react and recover balance. You have to be prepared to catch the patient if they start to fall. The Otago exercise program assessment will help determine which Otago exercises to prescribe.^{54,55} Others use the Berg Balance Scale.⁵¹ Grip strength measures risk of mobility limitation and risk of falls.^{52,53} Testing tandem gait (heel-to-toe walking) is also useful to assess balance and falls risk.⁵³

Another falls risk the Mobility Clinic tests for is orthostatic hypotension (OH).² This occurs when blood pressure (BP) is reduced and/or pulse rate changes with the patient going from lying supine to standing and may result in loss of consciousness.⁵⁶ This OH can be tested with your sphygmomanometer and stethoscope with the patient tested first supine, then standing at one minute, and then three minutes.⁵⁶ A drop of systolic BP of 20 mmHg, diastolic BP of 10 mmHg, or an increased pulse of 20 beats per minute (bpm) (possibly caused by volume depletion/dehydration) or reduced pulse of 10 bpm (possibly caused by baroreceptor altered function) is considered significant and should be followed up with the patient's family physician.⁵⁶

A history-focused physical examination, aimed at detecting any physical causes of falls, should include the following: spinal alignment, spinal and lower extremity active/passive ranges of motion, thorough neurological exam (myotomes, reflexes, clonus, plantar reflex, and dermatomes for sharp, dull, vibration and tone sensations) and special orthopedic tests.^{2,48,57} At the Mobility Clinic, we also consider testing the cranial nerves, gross vision, cerebellar testing (Romberg, finger-to-nose, heel-to-shin, and hand flip), proprioception, monofilament, graphesthesia, and stereognosis.^{2,48,49} The Trendelenburg and side-lying resisted hip abduction tests are quite useful for assessing pelvic stability.⁴⁸ Checking lower extremity peripheral pulses should also be considered.⁴⁸

Examination and assessment of the feet is required. Issues with the feet are common in older people and are connected with reduced balance and function.² Falls are more likely when bunions, deformed nails, ulcers, toe deformities, and other conditions are present.² Older adults

may also have difficulties with foot position awareness.² Footwear condition and type may put the patient at risk of falls.² Therefore, footwear needs to be inspected.²

At the Mobility Clinic, the patient's weight and height are taken to insure a healthy body mass index and proper medication dosing. Waist circumference is used by others to assess health.⁵⁸ At the Mobility Clinic, the family physician will perform a medical assessment of the patient where indicated by information gathered in the history. They will listen to the chest for any cardiac irregularities, arrhythmia, palpitations, and lung function.²

At the Mobility Clinic, we screen for osteoporosis to determine fragility fracture risk.⁶ Densitometry testing through the family physician may be performed along with using the CAROC or FRAX tools.⁵⁹ Spinal compression fractures due to osteoporosis can be screened for using the wall-occiput, rib-pelvis, historical height loss and prospective height loss measures to determine if an osteoporosis protocol x-ray is required of the spine.⁵⁹⁻⁶² Postural changes with osteoporosis, such as thoracic kyphosis, increase the risk of falls.⁶³

Management

Communicating with the patient's family physician is essential if you have concerns about a patient's balance or falls risk. For patients without a family physician, community services can be accessed through a walk-in-clinic or the hospital ER. The chiropractor may be helpful in managing some of the physical deficits found during the assessment; most often this may involve treating abnormalities found in the spine and/or lower kinetic chain. The risk of falling increases in proportion to the severity of chronic musculoskeletal pain, the number of joint groups affected, and the amount of interference with daily activities.⁶⁴ Specific exercises can be given to the patient where deficits in strength, gait, and balance are noted along with safe manual therapy. Be certain there are no cardiac or other risk factors when prescribing an exercise program (to insure safety, communicate with the patient's family physician if recommending exercise). Postural retraining may also be considered if there are any concerning discoveries.

The following are part of a multifactorial falls intervention:

Specific balance, strengthening, gait, and coordination exercises are recommended by systematic reviews and

clinical practice guidelines.^{2,4,6,19} For example, the Otago exercise program is validated to help prevent falls.^{54,55,65} For patients with limited mobility not accustomed to exercising, caution is required when starting an exercise program as this may initially increase their risk of falling.² To improve patient safety with exercises, an individualized exercise program should be prescribed, and regular monitoring and progression of exercises should occur. Other options for improving patient strength and balance include participating in a community-based group exercise programs designed for seniors to reduce the risk of falls.^{2,66} Tai chi classes or a referral to a physiotherapist for a home exercise regimen are other considerations.^{4,66} In addition, flexibility and endurance training could be offered; but not as sole components of a program.² Not only can exercise be part of a multifactorial intervention; but it can also be considered a single intervention as well.² It is important to note that exercise programs require monitoring by qualified professionals (such as a chiropractor, kinesiologist, physiotherapist, occupational therapist, athletic therapist, or fitness instructor).²

A home falls risk assessment is helpful to prevent falls.^{6,66} The Canadian Chiropractic Association (“Best Foot Forward” program. <http://www.chiropracticcanada.ca/en-us/members/practice-building/Best-Foot-Forward.aspx>) has available resources.⁶⁷ Also, the HOME FAST screening tool has been shown to predict falls in older people and is responsive to change.^{68,69} Common areas identified in both initiatives include inspecting the patient’s home inside and outside for slipping and tripping hazards and poor lighting.^{67,68} Grab bars in the bathroom, a shower chair, raised toilet seat, commode, and bed rail are ideally recommended though an occupational therapist (OT) home assessment.⁶⁶ The OT is trained in home safety, activities of daily living skills assessment, and functional performance. They can address risks and help implement risk reduction strategies through educating the patient.⁶⁶ This includes teaching the patient how to get up safely from a fall when alone and how to perform safe transfers. In most provinces, an OT working with a home-care agency will provide a home assessment if referred by a physician. Where OT access is not available, the chiropractor or physiotherapist might provide this assistance. Patients should be given advice in how to summon help and how to avoid lying in a position for a prolonged period of time, which can have serious health consequences.⁶

Personal emergency response systems (such as Life-line™) or a special senior’s Alert 911 device are an option if the patient is at risk for falls and often alone. This can allow a person to call for help if they are unable to get up. The risk for falls may be reduced with issuing a disabled parking pass. This can be authorized by chiropractors and other professionals in the province of Ontario.

Walking aids, such as a cane or wheeled walker, can help prevent falls.⁶⁶ A simple test to determine if your patient requires a gait aid is to offer your hand for support while they walk.⁶⁴ If this is of benefit, it may indicate a cane would be helpful.⁷⁰ If they prefer using two of your hands or a grocery cart while shopping, this may indicate that a wheeled walker would be more suitable.⁷⁰ A simple sizing guide is to have the top of the handle of the cane or wheeled walker at their wrist crease with arms at their sides, the patient having good posture, and looking straight ahead.⁷⁰ If they tend to fall backwards, you could reduce the device height a little till they feel more secure. Walking aids improve posture and reduce any secondary musculoskeletal pain. To ensure patients have the appropriate device, a consultation with an OT or PT is recommended. It is important for patients to be properly fit for these aids and be provided with education about how to safely use the device. Improper use can lead to a fall. An OT or PT can also facilitate funding through government sources. (e.g. in Ontario, the Assistive Devices Program (ADP) may cover up to 75% of the cost of a walker).

The family physician will order any special testing required to optimally medically manage the patient. This would include lab work, diagnostic testing, and imaging. Before any test is ordered, consideration as to whether the results would change treatment should occur. Medical management, possibly involving specialist referral, would be discussed with the patient. If present, heart rate and rhythm abnormalities and orthostatic hypotension treatment may be recommended.² In some cases, heart conditions require cardiac surgery and/or dual-chamber cardiac pacing (in the case of cardioinhibitory carotid sinus hypersensitivity).^{2,6,66}

Many studies have shown that a medication and supplement review by a clinical pharmacist can be effective in reducing falls risk. Comorbidities increase the pill burden resulting adverse drug events, and drug interactions, which may further increase the risk of falls. Furthermore, changes in renal function, liver function, body mass, and

adipose result in changes in the pharmacokinetic parameters of medications, which in turn, affect the pharmacological effect of medications. Taking 4 or more prescription medications increases the risk of falls.³⁹ Finally, medications or classes of medications are known to increase the risk of falls in the elderly.^{66,71} Agents most frequently associated with increasing the risk of falls include antihypertensive and cardiovascular agents, diuretics, beta-blockers, psychotropics, antidepressants, benzodiazepines, antipsychotics, sedative/hypnotics, hypoglycemics, opioids, and non-steroidal anti-inflammatory drugs (NSAIDs).⁷¹

Sudden discontinuation of any of the medications listed is not prudent without a thorough review, and patients taking any of the listed medications should be referred to either their physician or pharmacist so that appropriate reduction in dose, slow discontinuation, or replacement with safer alternative agents may be attempted. In Ontario, if a patient is on three or more medications they can have a medication review with their pharmacist paid for by government health insurance (OHIP). Unless indicated otherwise by their physician, total dietary intake of elemental calcium from all sources (diet and/or supplementation) for patients age 50 years and over should be 1200 mg/day to reduce osteoporosis fragility fracture risk.^{6,59} In addition to the above advised calcium, supplementation of 800-2000 iu/day of vitamin D for patients age 50 years and older is recommended for optimum bone health.^{59,72} New research shows that such vitamin D intake doesn't prevent falls, as was previously thought.⁷³

A full oculo-visual assessment and intervention may be required.^{2,6} An eye exam is recommended when a patient reports that they have not had one recently (within a year) or if any reduction in visual function is described. An older patient is advised not to wear multifocal lens while walking, especially on stairs.² Single-lens distance-vision glasses are suggested for outdoor use in multifocal-lens users who participate in regular outdoor activities.⁷⁴ In addition, cataract surgery has been shown to be effective for reducing falls.²

Problems noted with the feet should be referred to an appropriate professional, such as a chiropodist, for treatment.² Footwear should be laced or buckled, have a low heel, a non-slip high surface contact area sole, and be inspected for wear.² Closed heel footwear that fits properly should be considered. Anti-slip footwear devices worn

in slippery conditions were noted to reduced outside falls.^{70,75} Custom foot orthotics, if indicated by the examination, may be prescribed.⁷⁰

Educational and information programs should be contemplated for community-based patients.^{2,6} Topics discussed include falls prevention and where to get further assistance and advice.⁶ Regional health units or community agencies may have such evidenced-informed programs.

Conclusion

With the increase in physical, emotional and economic costs associated in the aging population, it is important that chiropractors are aware of and evaluate for falls risks. This overview intended to offer clinicians a greater appreciation of the prevalence, complexity, and importance of fall prevention in the community. Chiropractors are well positioned to fill healthcare gaps in this area. Knowledge on falls prevention has the potential to improve the quality of life for patients and may also be a source of improved professional satisfaction.

Key Points

- Falls are a common and serious risk with an aging population.
- Chiropractors can reduce falls risk through active screening.
- Screening for falls should be done yearly for all patients 65 years and older or in those with a predisposing medical condition.
- Additional specific falls prevention professional education would enable the chiropractor to better assist these patients.
- Collaboration and communication with the patient's family physician offers an opportunity for improved interprofessional dialogue and enhanced patient care related to falls risk.

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Degenerative lumbar spinal stenosis and its imposters: three case studies

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Degenerative lumbar spinal stenosis causing neurogenic claudication is a common condition impacting walking ability in older adults. There are other highly prevalent conditions in this patient population that have similar signs and symptoms and cause limited walking ability. The purpose of this study is to highlight the diagnostic challenges using three case studies of older adults who present with limited walking ability who have imaging evidence of degenerative lumbar spinal stenosis.

La sténose lombaire dégénérative à la base d'une claudication d'origine neuronale est une condition fréquente affectant la faculté de la marche chez les adultes âgés. Les patients de cette catégorie peuvent être affectés par d'autres maladies très courantes qui présentent des signes et des symptômes similaires, et qui restreignent leur capacité de marche. Le but de cette étude est de souligner les difficultés en diagnostic au moyen de trois études de cas de personnes âgées qui présentent une capacité de marche réduite et qui souffrent de sténose lombaire dégénérative mise en évidence par imagerie médicale.

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Introduction

Degenerative lumbar spinal stenosis (DLSS) is a leading cause of pain, disability, and loss of independence in older adults.¹ The prevalence and economic burden of DLSS is growing exponentially due to the aging population. It is a chronic disease caused by age related degenerative

narrowing (stenosis) of the spinal canal that can lead to compression and ischemia of the spinal nerves (neuro-ischemia).² The clinical syndrome of DLSS is known as neurogenic claudication. It is characterized by bilateral or unilateral buttock, lower extremity pain, heaviness, numbness, tingling or weakness, precipitated by walk-

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ing and standing³ and relieved by sitting and bending forward^{4,5}. Lower back pain is not necessarily associated with neurogenic claudication. Limited walking ability is the dominant functional impairment caused by DLSS.⁴ There are many other common conditions in the elderly that also give rise to lower extremity symptoms and limited walking ability.^{4,5} Often more than one condition can be present at the same time which makes diagnosis even more challenging. The ability to accurately diagnose DLSS and the various other conditions that give rise to similar symptoms and limitations is paramount for appropriate treatment. The purpose of this study is to demonstrate using three case studies the challenges when presented with an elderly patient who presents with back pain, lower extremity symptoms, and limited walking ability. Signed informed consent was obtained from three patients whose cases are presented in this study.

Case 1

Ms. AK is a 73 year old retired public health nurse who presents with chronic episodic lower back pain and a two year history of increasing bilateral calf pain. The calf pain comes on after a few minutes of walking and intensifies as she continues to walk. The calf pain is immediately relieved with sitting or lying down. She reports three bouts of severe sciatica over the past three years and otherwise experiences recurrent low grade backache. She was being treated for a recurrent infection of the right toe. She has had previous chiropractic treatment that included manual therapy, acupuncture, and flexion exercises with no help. She is normally a very active person but frustrated with her limited ability to walk. She takes high blood pressure and cholesterol lowering medication. Ms. AK had a previous history of Raynaud's Syndrome involving the upper extremities, and was under the care of a rheumatologist for Sjogrens Disease which was in remission. She had a previous arterial Doppler ultrasound test of the lower extremities, the results were equivocal. She claims to be healthy otherwise.

On examination, she is slim built, stand with a flattened lumbar lordosis and has difficulty with balance testing. She can toe-heel walk and squat without difficulty. Range of motion (ROM) of the lumbar spine is full and painless during forward flexion. Lumbar extension is moderately limited and reproduces lumbo-sacral back pain but not lower extremity symptoms. Sitting straight leg rais-

ing (SLR)⁶ is full and painless bilaterally. Supine SLR⁶ is mildly limited by tight hamstring muscles bilaterally. End range SLR with dorsiflexion of the foot⁶ reproducing moderate calf pain bilaterally. There is an absent left Achilles reflex with no evidence of lower extremity sensory or motor deficits. No atrophy of the calf muscles are noted and during palpation of the lower extremities pulses appear present and bilaterally equal and her feet appeared warm. Hip examination reveals full and painless ROM. Moderate tenderness is noted during palpation of the L4-5 and L5-S1 spinal segments. An MRI performed two year earlier revealed severe multi-level degenerative joint and disc disease with severe lateral recess stenosis at L4-5 and L5-S1.

At tentative diagnosis of neurogenic claudication due to degenerative lumbar spinal stenosis was given and a treatment program of flexion-distraction/ side posture spinal mobilization/ manipulation, neural mobilization, flexion based home exercises including a progressive stationary cycling program was prescribed. After 6 weeks of treatment at a frequency of 2-3 treatments per week she was re-evaluated. Using a self-report improvement scale (completely better, much improved, slightly improved, no change, slightly worse, much worse and worse than ever)⁷ she reported no significant change in her calf pain or walking ability. She stated she was compliant with her exercises except the stationary cycling program. She was referred to her family doctor for another arterial Doppler ultrasound test which revealed moderate bilateral tibial obstructive artery disease. She was subsequently referred to a vascular surgeon who confirmed the diagnosis and initiated a trial therapy with cilostazol 100 mg twice a day to improve blood flow. Response to the medication was excellent with little lower extremity symptoms or limitations during walking.

Case 2

Mr. JP is a 62 year old consultant who presents with a 30 year history of episodic lower back pain and nine month history of progressive right lateral thigh and leg pain. Over the past 6 months both lower back and leg pain intensifies with walking. He starts to limp after several metres and now his walking is limited to about 20 metres. The pain is described as burning and achy and appeared to travel from the back along the lateral hip and occasionally into the knee, groin and into the right foot. Stretching and

swimming provide temporary relief. Associated symptoms included urinary hesitancy which he has had on and off for 15 years. He had tried physiotherapy, chiropractic, and acupuncture without success. He takes neuropathic medication and narcotics for pain control. He states he is otherwise healthy.

On examination, he stands with a flexed posture and walks with a left leaning gait. ROM of the lumbar spine is full (finger tips reaching toes) and painless during flexion. Lumbar extension is moderately limited and reproduces moderate lower back pain not leg pain. Supine SLR⁶ and prone femoral nerve stretch⁸ are full and painless with no evidence of nerve tension signs bilaterally. Moderate muscle hypertonicity is noted over the right piriformis muscle. There is mild restriction in internal rotation and flexion of the right hip with minimal pain at the end range. Quadriceps reflexes are 2+ and bilaterally equal. Achilles reflexes could not be elicited bilaterally. No lower extremity sensory deficits are noted. There is mild atrophy of the right calf and hamstring muscles. A recent MRI of the lumbar spine revealed congenitally narrowed pedicles and severe multilevel spondylosis of lumbar spine with severe central spinal stenosis at L2-3 with associated neural compression and moderate foraminal stenosis at right L4-5 and bilaterally at L5-S1. According to Mr. JP a recent right hip x-ray revealed no significant abnormalities, (his wife is a radiologist). However this was not confirmed.

A tentative diagnosis of neurogenic claudication due to degenerative lumbar spinal stenosis with underlying congenitally narrowed pedicles was given and a six week (twice per week) treatment program consisting of flexion-distraction and side posture spinal mobilization/manipulation, neural mobilization of the femoral and sciatic nerves and, flexion based home exercises was started. After several weeks of treatment no improvement was noted. The patient was re-evaluated and a moderate deterioration in ROM (subjectively assessed) of the right hip was noted especially during internal rotation and flexion with moderate pain elicited at the end range. Combined flexion, abduction, external rotation also was moderate restricted and reproduced moderate pain. An x-ray of the right hip was performed which indicated moderate degenerative joint disease. Several months later Mr. JP received a successful total right hip replacement which significantly improved his lower extremity symptoms and walking ability.

Case 3

Ms. NK is a 71 year old retired physical therapist who presents with an 18 months history of left lateral thigh and chronic low back pain. The thigh pain is described as a dull nagging ache made worse with prolonged walking, stair climbing, getting out of a car, and lying in bed. The pain occasionally radiates to the lateral left knee and limits her walking ability. The lower back pain is described as a steady dull nagging ache worse with physical activity, twisting actions, and prolonged sitting. She has tried a lumbar epidural steroid injection, massage therapy, anti-inflammatory medication, and acupuncture with no significant improvement in symptoms. She is otherwise healthy.

On examination she stands with a flat lumbar lordosis and mild scoliosis. She is able to heel-toe walk and squat without difficulty. ROM of the lumbar spine is mildly restricted and painful during forward flexion. Moderate pain is elicited during lumbar extension without reproducing her left leg pain. There is moderate tenderness over the L4-L5 and L5-S1 articulations during deep palpation. There is moderate-severe pain elicited during palpation over the left trochanteric bursa and tensor fascia lata. Ms. NK indicated that this pain is similar to the leg pain experienced during walking. Hip examination revealed mild pain at the end range of external rotation of the left hip. Neurological examination is unremarkable. Supine SLR with dorsi-flexion of the foot⁶ did not reproduce any leg symptoms bilaterally. An MRI revealed degenerative joint and disc disease throughout the lumbar spine with a partial sequestered right L4-L5 para-central disc herniation giving rise to moderate lateral recess stenosis on the right with potential compression of the descending L5 nerve root. Similar findings were noted at the L5-S1 level with mild compression of the existing right L5 nerve.

A working diagnosis was moderate left trochanteric bursitis and chronic mechanical low back pain with moderate degenerative joint and disc disease. Her leg symptoms and limited walking ability appeared to be primarily due to the trochanteric bursitis and not due to the lumbar spinal stenosis. She began a treatment program of twice per week for six weeks consisting of deep cross-fiber massage over the left trochanteric bursa and tensor fascia lata, home stretches and icing, manual therapy directed to the lumbar spine and a home based lumbar spine exercise program. After six weeks of therapy there was slight

improvement, using a self report improvement scale⁷ in her symptoms and walking ability.

Discussion

This study highlighted three common conditions that present with similar symptoms that are often misdiagnosed as caused by degenerative lumbar spinal stenosis. All three cases involved older adults who had lower back pain, lower extremity symptoms that limited walking ability (claudication) and moderate-severe degenerative lumbar stenosis on imaging.

A common reason for misdiagnosis is the interpretation of findings on imaging, particularly MRI and CT scan. Degenerative changes seen on imaging of the lumbar spine including degenerative central canal and lateral recess narrowing are common in older adults and often do not correlate with patient symptoms. Moderate lumbar spinal stenosis is noted in up to 30% of asymptomatic individuals over the age of 55.⁹ Therefore imaging is not a reliable modality for the diagnosis of lumbar spinal stenosis causing neurogenic claudication. A diagnosis of neurogenic claudication is made clinically from a thorough history and physical examination and not solely by imaging evidence of spinal stenosis.⁵ Important clinical features include age over 70, bilateral buttock or leg pain, no pain when seated, symptoms worse standing/walking, symptoms improve when bending forward, wide stance gait and urinary disturbances.⁵

An understanding of the dynamic nature of neurogenic claudication and a comprehensive evaluation of other potential sources of symptoms and limited walking ability is paramount to appropriate diagnosis. The dynamic nature of neurogenic claudication refers to the reduction or elimination of lower extremity symptoms with sitting or leaning forward during walking or standing.⁴ This is a result of an increase in the cross sectional area of the lumbar spine with lumbar flexion which reduces compression to the spinal nerves.^{10,11} This phenomenon is also demonstrated with the *shopping cart sign* which refers to the reduced symptoms and increased walking ability when leaning forward on a shopping cart.^{4,5,11} Supine and sitting straight leg raising tests⁶ is usually negative in neurogenic claudication because these maneuvers introduces flexion to the lumbar spine and reduces neuro-ischemic compression.^{4,5} Results of lower extremity sensation and strength testing is variable in neurogenic claudication but deficits

are usually seen in more severe or long standing cases and usually correlates to the involved nerve roots. The same holds true when assessing deep tendon reflexes of the lower extremities which tend to be difficult to elicit in older individuals in general. Another important feature associated with neurogenic claudication is loss of balance⁵ which is due to impaired proprioception secondary to neuro-ischemia of spinal nerve roots¹².

Other common conditions can have similar symptoms and walking impairments.

Case 1. Peripheral vascular disease

In Case 1, the patient's main symptoms were a result of peripheral vascular disease (PVD). PVD causing intermittent claudication is common in older adults with the prevalence growing significantly due to the aging population.¹³ The risk of PVD is high among patients with diabetes mellitus, hypertension, hyperlipidemia, smoking and vasculitis due to auto-immune disease.¹⁴ Individuals with PVD have higher mortality rates and therefore early diagnosis and treatment is essential.¹⁵ In PVD, claudication symptoms are a result of ischemia to the lower extremities muscles which worsen with walking and alleviated with rest.¹⁶ This symptom pattern is not unlike that of neurogenic claudication.⁴ Moreover, the two conditions can often co-exist making diagnosis even more challenging. A recent study demonstrated that 26% of individuals with confirmed neurogenic claudication due to lumbar spinal stenosis have also objective signs of PVD.¹⁴ Although assessment of peripheral lower extremity pulses is recommended, 8% of individuals with no PVD have dorsal pedis pulses that are not palpable and 10% of individuals with normal pulses have PVD.^{14,17,18} A more accurate in office method to assess for lower extremity PVD is using the ankle-brachial and toe-brachial indexes. A blood pressure cuff is used to assess the ratio of systolic blood pressure at the two anatomical locations. Ratios less than 0.9 are considered positive for PVD with the toe-brachial index demonstrating more accuracy.¹⁴ Referral for an arterial Doppler test is recommended for confirmation of the diagnosis. Arterial Doppler testing in individuals with at least 50% lower leg vascular occlusion has a sensitivity ranging from 80 to 98% and specificity from 89 to 99% for PVD.¹⁹ Ischemic related skin discoloration and skin infections of the lower extremities, particularly of the feet, as in our Case 1 may help in the diagnosis. Features

of the history may also be useful. Using a shopping cart, stationary bike or walking uphill is not expected to improve symptoms in PVD but tend to reduce symptoms in neurogenic claudication.

Case 2. Hip-Spine Syndrome

Case 2 has hip-spine syndrome. Hip-spine syndrome refers to the coexistence of radiographic osteoarthritis (OA) of the hip and degenerative stenosis of the lumbar spine. Both degenerative conditions can result in buttock, groin, lateral hip, and leg pain and limited walking ability. The prevalence of radiographic hip OA is 27% in adults 45 years of age or older²⁰ of which 9.2% are symptomatic²¹. Therefore, like imaging for DLSS, radiographic findings of the hip must be correlated with symptoms and physical examination.²² Patients with groin pain have been shown to be seven times more likely to have a hip disorder only or a hip-plus-spine disorder than a spine-only disorder.²³ A more recent study using fluoroscopic guided intra-articular injections among patients with known hip pathology demonstrated that the buttock region was the most common anatomical location of referred hip pathology (71%) followed by combined thigh and groin pain (55%).²³ In another study, 47% of patients with isolated hip arthritis reported pain radiating below the knee.²⁴ DLSS rarely refers pain to the groin unless there is involvement of the L1-2 level. Buttock and lateral hip pain however, is a very common area of radicular pain due to DLSS. These findings emphasize the challenges in distinguishing the main source of symptoms by pain distribution alone. Physical examination can be useful in distinguishing the main pain generator. OA of the hip is usually associated with reproduction of symptoms during weight bearing and a limping gait. Passive hip flexion and internal rotation is usually limited in range and reproduces the patients' symptoms. Pain can also be reproduced when turning from a supine to side position on the exam table (or in bed) which often requires internal rotation and flexion of the hip. Patients with DLSS tend to be asymptomatic when lying or turning in bed.²⁵ Stooped forward posture can be associated with both OA of the hip and DLSS. OA of the hip can lead to contractures of the hip flexors leading to anterior leaning posture.²⁶ Muscle atrophy of the para-hip musculature can also be seen in both conditions: disuse atrophy in the case of OA of the hip and radiculopathy induced atrophy in the case of neurogenic claudication. When the diagnosis is still

unclear electrophysiological studies can be performed. Normal nerve conduction and electromyographic studies do not rule out neurogenic claudication whereas findings of radiculopathy can be indicative of this process.²⁷

A more invasive diagnostic approach involves fluoroscopic guided hip anesthetic injections. A significant relief of symptoms following an intra-articular hip bupivacaine injection is reported to have a sensitivity of 87% and a specificity of 100% in diagnosing hip OA as the primary pain generator.²⁸ On the other hand epidural spinal anesthetic injections with or with steroids are less useful in neurogenic claudication since the etiology is primarily due to neuro-ischemia not inflammation.²⁶

Case 3. Trochanter bursitis or greater trochanteric syndrome

In Case 3, the lateral hip pain is most likely due to greater trochanteric pain syndrome (GTPS). GTPS is a term used to describe chronic pain overlying the lateral aspect of the hip. This regional pain syndrome, once described as trochanteric bursitis, often mimics pain generated from spinal pathology including degenerative lumbar spinal stenosis.²⁹ The term GTPS is suggested to better characterize this condition which is described as reproducible tenderness in the region of the great trochanter in light of the inherent difficulties in localizing the true cause of the pain. Pain generators include any one of the nine bursae, muscles, and tendons that attached to the greater trochanter and surrounding areas.³⁰ The pain can travel along the lateral hip to the knee in 50% of cases²⁹ and occasionally below the knee³¹. It is estimated that GTPS affects between 10% and 25% of the population in industrialized societies³² with significantly higher prevalence in the elderly³³. GTPS is the second leading cause of hip pain in adults.³³ Risk factors are increasing age, female gender, ipsilateral ilio tibial band pain, knee OA, obesity and low back pain.³² Mechanisms of GTPS include chronic micro-trauma, regional muscle dysfunction, overuse or acute injury.³²

In addition to palpation (jump sign), pain can be reproduced by active and resisted abduction, passive abduction of the hip³⁴ and during combined passive flexion, abduction, external rotation and extension (FABERE)³⁵. A Trendelenberg sign (when standing on one leg, the pelvis drops on the side opposite to the stance leg) is often associated with GTPS especially with lateral hip tendon tears.²⁹

However, other than point tenderness there are very few diagnostics tests with high specificity for GTPS.³⁶ A key diagnostics feature that can distinguish GTPS from neurogenic claudication is lateral hip pain with lying on the affective side. Those with GTPS will often complain of night pain and difficulties sleeping because of increased pain where as individuals with neurogenic claudication are usually asymptomatic when lying down. Other distinguishing features include aggravation of GTPS during stair climbing, getting up from a seated position and cycling which causes repetitive rubbing the of iliotibial band over the greater trochanter. These activities generally do not aggravate symptoms in neurogenic claudication due to the flexed posture. A steroid and or anesthetic injections are often used for both diagnosis and therapy but the evidence for their effectiveness generally comes from lower quality evidence.^{33,37}

Other conditions that need to be ruled out when assessing the elderly patient with lower extremity symptoms include, diabetic neuropathy, meralgia paresthetica radiculopathy due to lumbar disc herniation, cervical spinal stenosis, knee OA and degenerative facet and sacroiliac joints.

Once the diagnosis of neurogenic claudication is made and other potential conditions ruled out appropriate treatment can be implemented. Treatments for neurogenic claudication include surgical and non surgical. The effectiveness of non surgical treatments including physical therapy, chiropractic, exercise, medication, epidural injections is unknown.³⁸⁻⁴² A rational approach would be to provide instruction on lumbar flexion and core stabilization exercises and overall fitness (using of a stationary forward leaning bike), provide therapy to improve lumbar spine flexibility and instruction on self management strategies to avoid lumbar extension and reduce the lumbar lordosis when standing and walking. Surgical interventions include direct and indirect decompression with and without fusion. Carefully selected patients with leg dominant symptoms usually improve with surgery however; the benefits tend to diminish over time.⁴

Conclusions

DLSS causing neurogenic claudication is a leading cause of lower extremity symptoms and limited walking ability in the elderly. Other common conditions such as a

PVD, hip osteoarthritis, and GTPS can also give rise to similar symptoms and restricted walking ability which makes identifying the main source of symptoms a challenge in the older population. A careful and thorough history and physical examination, and keen understanding of the underlying pathoanatomy and pathophysiology of the common conditions is paramount for accurate diagnosis and appropriate management.

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Is bone tenderness, as measured by manual algometry, associated with vitamin D deficiency?

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Objective: *To explore the relationship between serum 25-hydroxycholecalciferol (25[OH]D3) and pressure-pain thresholds, as measured by algometer, in advance of a main study to determine whether PPT is a potentially cost-effective proxy measure of 25[OH]D3 status in the general population.*

Methods: *The cross-sectional pilot study involved a convenience sample of twenty-two subjects (10 males, 12 females), aged 18 to 67 years. All subjects consented to three trials of pressure-pain threshold readings on both tibiae and the manubrium. Serum 25[OH]D3 levels were determined from blood samples drawn post-algometry.*

Results: *The average pressure pain thresholds were 14.92 (± 6.03), 15.07 (± 6.07), 11.10 (± 6.68) for the left and right tibia and sternum, respectively. The stability between the measurements was very high with the interclass correlation coefficient (95% CI) calculated as 0.94 (0.62-1.00), 0.9 (0.81-1.00), 0.96 (0.93-1.00). The Pearson correlation coefficients were 0.03 for the left tibia, 0.17 for the right tibia and 0.20 for the sternum,*

Objectif : *Étudier la relation entre le taux sérique de 25-hydroxycholécalférol (25 [OH] D3) et les seuils de tolérance à la pression, tels que mesurés par un algésimètre, en préparatif d'une étude principale pour déterminer si le STP pourrait être une mesure de remplacement économique de l'état de 25[OH]D3 dans la population générale.*

Méthodologie : *L'étude pilote transversale a porté sur un échantillon pratique de vingt-deux sujets (10 hommes, 12 femmes), âgés de 18 à 67 ans. Tous les sujets ont consenti à trois essais lecture des seuils de tolérance à la pression sur le tibia et le manubrium. Les taux sériques de 25[OH]D3 ont été déterminés à partir d'échantillons de sang prélevés après la mesure par l'algésimètre.*

Résultats : *Les seuils moyens de tolérance à la pression étaient 14,92 ($\pm 6,03$), 15,07 ($\pm 6,07$), 11,10 ($\pm 6,68$) pour respectivement les tibias gauche, droit et le sternum. La stabilité entre les mesures était très élevée avec le coefficient de corrélation interclasse (IC à 95 %) calculée comme 0,94 (0,62 à 1,00), 0,9 (0,81 à 1,00), 0,96 (0,93 à 1,00). Les coefficients de corrélation de Pearson ont été de 0,03 pour le tibia gauche, 0,17 pour le tibia droit et 0,20 pour le sternum, montrant une corrélation négligeable pour les tibias gauche et droit,*

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showing a negligible correlation for the left and right tibia, but a low positive correlation for the sternum.

Conclusion: We did not find preliminary evidence of a strong or otherwise clinically meaningful correlation between bone tenderness and manual algometry in this pilot study. Only a weak linear relationship between PPT in the sternum and serum 25[OH]D3 concentrations was found. Replication of this study is warranted in larger and more representative study populations of interest. Discussion on a number of feasibility issues is provided to inform those future studies.

(JCCA. 2014; 58(3):320-327)

KEY WORDS: vitamin D, pain, algometry

Introduction

Vitamin D is an essential nutrient that plays an integral role in the maintenance of strong and healthy bones. Recent research also suggests its involvement in immunity, metabolic signaling and in the protection against diabetes, cardiovascular disease, auto-immune disease and cancer.^{1,2} The precursors of vitamin D3 are produced in the body by steroidogenesis. The formal name of Vitamin D3 is cholecalciferol, which is derived from the irradiation of 7-dehydrocholesterol in the skin following exposure to UV rays.^{2,3} It can also be obtained minimally from fatty fishes and fortified foods in the diet.^{4,5} There are many factors that contribute to vitamin D deficiency in a population including season, latitude, age, skin pigmentation, and social/cultural practices.^{4,6} These factors limit the availability of vitamin D and predispose at-risk populations to deficient states. Statistics Canada reports that 32% of Canadians (age 6 to 79 years) were vitamin D deficient (according to 1997 IOMS standards).⁷ Inadequate concentrations of vitamin D for bone health was found in 10% of the population.⁷ Vitamin D deficiency definitions vary, but the symptoms include global bone sensitivity, widespread aches, weakness, and general malaise as well as more focal symptoms that commonly present to health care practices.^{5,8,9} Consequently, vitamin D deficiency is often misdiagnosed as arthritis, chronic low back pain, fibromyalgia, or chronic fatigue syndrome due to these diffuse, general symptoms. This presents a concern of particular

mais une faible corrélation positive pour le sternum.

Conclusion : Nous n'avons pas relevé dans cette étude pilote des preuves préliminaires d'une corrélation forte ou cliniquement significative entre la sensibilité des os et l'algométrie manuelle. Seule une faible relation linéaire entre le SPT dans le sternum et les taux sériques de 25[OH]D3 a été constatée. Une reproduction de cette étude est recommandée dans de plus grandes populations cibles qui seraient plus représentatives. Une discussion portant sur plusieurs questions de faisabilité est offerte pour renseigner ces futures études.

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MOTS CLÉS : vitamine D, douleur, algométrie

interest to manual therapists.⁶ Plotnikoff and Quigley (2003) demonstrated a link between nonspecific musculoskeletal pain and severe 25-hydroxyvitamin D deficiency (defined as <8.0128 nmol/mL) and have suggested all patients with chronic widespread pain ought to be screened for hypovitaminosis D.^{4,10-13} Classification has been proposed offering four categories of Vitamin D deficiency: insufficient (50-100nmol/L), mild (25-50 nmol/L), moderate (12.5-25 nmol/L) and severe (<12.5 nmol/L).¹⁴ Currently, serum analysis of 25-hydroxyvitamin D seems to be the most reliable measure of vitamin D status;^{4,15} however, this method comes with disadvantages and mass expense to the public. The government of Ontario discontinued covering Vitamin D analysis in 2010 as costs had increased by 2500% at a cost of \$66 million per year.¹⁶ Minimizing the number of lab tests and doctors visits required would reduce some of the economic burden created by chronic pain problems thus, a simpler and less expensive means of assessing vitamin D status should be explored.

Manual algometry is a safe and inexpensive method of clinically assessing tissue pain that can be easily utilized in most health care settings. Algometers provide a reliable and credible method for measuring pressure-pain thresholds (PPT) in patients without pain¹⁷ and in patients with bone sensitivity^{18,19}. This global bone discomfort can be elicited with gentle pressure on superficial bones such as the sternum, anterior tibia, radius and ulna.^{4,11} Intra-class correlation (ICC) coefficients for PPT within days

are reportedly 0.93 to 0.96 and 0.88 to 0.90 between days.¹⁷ Jones et al, found PPT to be highly consistent and repeatable over four days of testing at eight locations in young healthy women.²⁰ Errors associated with algometry originate from variation in the application of pressure by practitioners, subjective bias in the understanding of pressure versus pain by patients, application location, as well as angulation of the algometer.¹⁷ Should a relationship exist between PPT and vitamin D status, the algometer could serve as a reliable proxy measure and be a more accessible and less expensive means of assessing vitamin D status in patients.

A proposed mechanism for the bone pain associated with vitamin D deficiency is poor bone quality from insufficient calcium phosphate available to mineralize the expanding collagen matrix of bone. The rubbery matrix found in people deficient of cholecalciferol does not provide sufficient trabecular and collagenous support but instead hydrates and expands the bone, causing an outward pressure on the internal Haversian canals and external periosteal covering, richly innervated with sensory pain fibres.¹¹ Long bones have hypertrophic chondrocytes that increases the stress and deformation tolerance within the bone²¹ to help support and absorb shock from ambulation and weight bearing. Flat bones, on the other hand, have less trabeculation and collagen content and as such are more sensitive to deformation and pain, as they are structured to contain red bone marrow.²² With these features taken into consideration, it is reasonable to assume that the sternum will be more sensitive to changes in circulating 25-hydroxycholecalciferol and in pain sensation.^{23,24}

The purpose of this pilot study is to assess the association between algometer readings taken from the sternum or tibia and 25-hydroxycholecalciferol D status. If good correlation can be found, algometry could potentially be used as a safer, simpler means of investigating vitamin D status as a possible cause of chronic widespread muscle and bone pain in patients presenting to health care practices. It is not meant to provide conclusive evidence, but to determine feasibility and direction of future research.

Methods

Participant Recruitment.

Adults aged 18 years or older without any major health concerns were considered eligible for this study. Subjects

were recruited from a private, fee-for-service chronic pain clinic. Patients entering the clinic were recruited through posters in the office advertising free vitamin D testing in return for participation in a research study. Participants were then sampled based on convenience. On the day of testing, the first twenty-two patients scheduled for appointments at the clinic were asked to participate in the study, all of whom agreed to enroll in our study. Exclusion criteria included a history of uncontrolled rheumatic condition, uncontrolled diabetes, active cancer, skin lesions near regions of testing, and individuals under 18 years. This information was obtained through a questionnaire provided as part of patient intake. The questionnaire asked questions pertaining to health status, diet, and medication/supplementation.

Ethical approval was provided by the College REB (No. 1103A01)

Compensation.

Participants were given an honorarium of \$20 in the form of a Shoppers Drug Mart® gift card for completing the study. If a participant chose to withdraw from the study after having completed one, but not both, components of the study (pressure-pain readings and blood test) the subject was compensated with \$10 for their willingness to cooperate.

Protection of Patient Anonymity.

Prior to the day of data collection, all forms were coded with a letter of the alphabet. Each form was placed into an envelope with the corresponding letter. The envelope contained a general intake form, an informed consent form, and a letter-labeled test tube. The researchers had prepared a script to explain the research procedure to prevent coercion. Subjects filled out all forms with the assistance of a researcher who reviewed the informed consent form with subjects and answered all questions. After filling out all forms, subjects were escorted to an examination room where two researchers performed algometry testing. Results were recorded on a form labeled with the letter corresponding to the letter on the patient's envelope. After testing, the participant was notified they would receive their blood analysis results in a letter mailed to them when results became available. Researchers placed the result form in the envelope such that the patient's identity remained anonymous. The intake researcher did

Table 1.
Demographic Characteristics.

		Participants (n =21)
Age (yr)		47.6 ± 13.7
Height (cm)		167.2 ± 9.6
Weight (kg)		68.9 ± 13.8
Female		57.2%
Serum 25-(OH) D (nmol/L)		80.5 ± 38.9
Ethnicity	Caucasian	61.9% (13)
	Asian	28.5% (6)
	Other	0.09% (2)

Table 2.
Serum Vitamin D levels mean pressure-pain thresholds (PPT) and standard deviations, interclass coefficient and Pearson correlation coefficients (n=19).

	Left Tibia PPT	Right Tibia PPT	Sternum PPT	Serum Vitamin D level
Average	14.92	15.07	11.10	80
Standard Deviation	6.03	6.07	6.68	37.89
ICCs for multiple readings within subjects (95% CI)	0.94 (0.62-1.00)	0.90 (0.81-1.00)	0.96 (0.93-1.00)	
Pearson Correlation Coefficients (PPT versus vitamin D level)	0.03	0.17	0.20	

not view subject algometry results until data analysis was completed. Test tubes were sent to the laboratory with no identifying information besides their letter code.

Algometry.

Pressure-pain thresholds were measured by a Wagner Instrument Pain Test manual algometer at three standardized landmarks: 5cm distal to the medial joint line of the knee bilaterally and 5cm distal to the sternal notch. Three readings were taken at each landmark in a consecutive manner, as research shows that the highest inter-rater ICC coefficients improve to the highest levels with three trials (ICC=0.74 to 0.89).^{17,20} The algometer was calibrated the day before data collection. One researcher was responsible for briefing the participants as they began the study procedure. She also measured and marked the landmarks used on each patient prior to testing. The second researcher administered the algometer, while remaining blinded to the results. This was decided due to enhanced reliability when measurements are taken by one examiner.¹⁷ The other researcher then read and recorded the results. During the pressure-pain threshold testing, subjects communicated to the practitioner the moment they felt the slightest sensation of pain.

After the algometer component, each participant underwent venipuncture by a registered nurse at the centre. In order to measure 25-hydroxycholecalciferol, one

serum-separator tube (SST) was used to contain the sample of approximately 7 mL of blood. Participants were discharged at this point following a short debrief by the first researcher who was also responsible for the remuneration. The samples were stored at room temperature for ten days and then refrigerated for two weeks at an off-site lab for radioimmunoassay analysis of 25-hydroxycholecalciferol serum concentration.

Follow Up

After the blood results were analyzed, letters to the participants were mailed to them regarding their vitamin D status. The letters indicated their status and provided nutrition education and feedback appropriate to their vitamin D status. There were three standard letters created, addressing either low, normal or high vitamin D levels.

Statistical Methods

Stata Software 10.0™ was used to perform all statistical evaluations. Mean, standard deviation, confidence intervals, interclass correlation coefficients and Pearsons correlation coefficients were assessed.

Results

The results are shown in Tables 1 and 2. Twenty-one patients enrolled in this study, consisting of 9 males and 12 females (57.2% female). The average age of the partici-

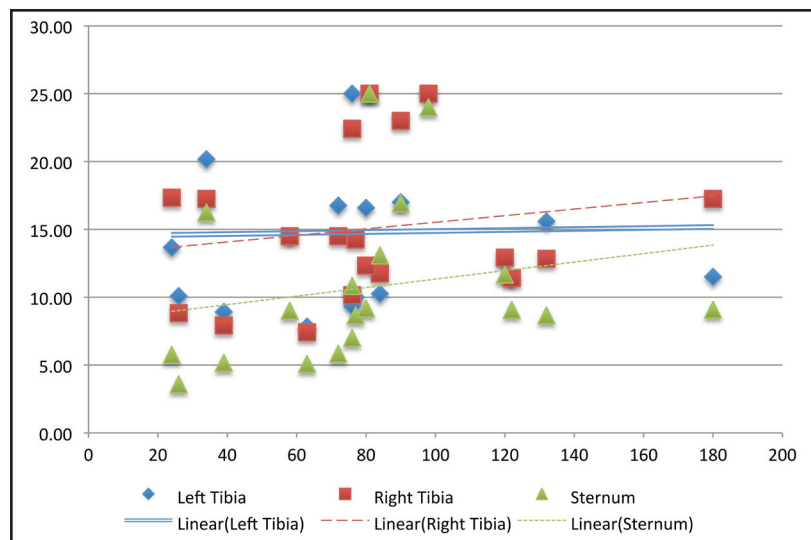


Figure 1. Comparison of Serum Vitamin D levels and pressure pain thresholds of right tibia, left tibia and sternum.

pants was 47.6 years (± 13.7 y). The average height was 167.2 cm (± 9.6 cm) and weight was 68.9kg (± 13.8 kg). The average PPTs were 14.92 (± 6.03), 15.07 (± 6.07), 11.10 (± 6.68) for the left and right tibia and sternum, respectively. During the blood analysis, three samples were unable to be analyzed. As such, results of nineteen subjects are reported. The relationship between serum levels and bone tenderness is plotted in Figure 1. The stability between the measurements was very high with the ICC (95% CI) calculated as 0.94 (0.62-1.26), 0.9 (0.81-1.00), 0.96(0.93-1.00). The Pearson correlation coefficients calculated were 0.03, 0.17, 0.20 indicating negligible correlation for both left and right tibia, but a weak association between PPTs in the sternum and serum vitamin D levels. There may be benefit in exploring this relation further. These findings are intended to be used descriptively to identify possible direction of future research.

Discussion.

This is the first study, to our knowledge, to explore the relationship between pressure-pain thresholds, as measured by algometry, and vitamin D status. The results of this study did not reveal a clear correlation between PPT and 25-hydrocholecalciferol levels at the locations tested however as this was a pilot study our results are not definitive. Our main purpose in the current study was to collect preliminary data to inform future hypothesis testing studies.

There are challenges associated with determining accurate values of vitamin D status in individuals, as there is no reported 'gold standard' that adequately and consistently is able to determine a picture of the bioavailable supply in the body. This is due to a number of different assay techniques that have different standards of normal. Further, it is currently not possible to delineate between a true vitamin D deficiency and a deficiency due to comorbidities, such as hyperparathyroidism or bone-related cancers^{25,26}, as these conditions can create artificially normal or elevated vitamin D levels in testing. This study attempts to determine the feasibility of using alternative, non-invasive testing as a measure of vitamin D status.

Perhaps the most important role of cholecalciferol is in aiding the intestinal absorption of calcium. A proposed mechanism for the bone pain associated with vitamin D deficiency is that there is insufficient calcium phosphate to mineralize the expanding collagen matrix of bone. Furthermore, 1,25-dihydroxycholecalciferol has been found to increase type I collagen production in a dose dependent manner.^{27,28} This is important, as the quality of bone is interrelated with collagen and mineral concentrations. The rubbery matrix found in people deficient of cholecalciferol does not provide sufficient trabecular and collagenous support but instead hydrates and expands the bone, causing an outward pressure under the periosteal covering, richly innervated with sensory pain fibres.¹¹

There has been research to also indicate the nutrient rich Haversian canals within bone can act as pain-sensitive structures²⁹, allowing for deep-seated bone pain in daily activities.

The density and arrangement of collagen fibres differ between the sternum and the tibia, with the tibia having more hypertrophic chondrocytes and a greater trabeculation density. Stromal cells are connective cells of any organs. In bones, the stroma consists of bone marrow, immune cells, inflammatory cells and fibroblasts.²¹ The composition of stroma in different bones varies. In adult long bones, such as the humerus or tibia, the majority of the medulla is filled with yellow bone marrow composed primarily of adipose tissue. This marrow fills the centre of long bones to protect and lighten the bone. Long bones also have hypertrophic chondrocytes that increases the stress and deformation tolerance within the bone.²¹ This is necessary as the tibia absorbs shock from ambulation, weight bearing and offers support to the entire body. On the other hand, flat bones, such as the sternum and the ilium, are filled with red bone marrow that functions to produce hematopoietic cells (such as erythrocytes, leukocytes, platelets). Flat bones have less trabeculation and collagen content and as such are more sensitive to deformation and pain.²² With these histological, physiological and mechanical features taken into consideration, it is reasonable to assume that the sternum will be more sensitive to changes in circulating 25-hydroxycholecalciferol and in pain sensation.^{23,24}

Limitations

While this study provides some insight to future research possibilities, by definition a pilot study does not allow for definitive conclusions to be drawn from the results. While we had 100% compliance, there were a number of issues. Feasibility issues that were raised in the current study will inform future definitive studies on the relationship between PPT and vitamin D levels. One significant shortcoming that we encountered was a miscue between researchers and the blood lab, resulting in unrefrigerated storage of the blood samples for ten days. The blood was not analyzed for another ten days thereafter. While there is research that indicates this does not compromise the quantity of stable 25-hydroxycholecalciferol concentrations in the blood or the quality of the sample^{30,31}, it cannot be guaranteed that the results provided are an accurate

representation of the circulating serum concentration of the participants. Another limitation of the study was the order in which the study design was carried out. There are inherent limitations to convenience sampling. Drawing from a non-randomized, non-diversified population prevents representative conclusions and the ability to extrapolate from those results. Further, reproducing the research in such a limited sample will be difficult to recreate the reported findings. There was no standardization or randomization of data collection such that the intended order (algometer readings followed by venipuncture), at times was not always feasible. The sample population was taken from a specific chronic pain clinic and had no inclusion or exclusion criteria. We consider this a limitation because the results could be confounded by previous pain disorders or medications/supplements and therefore cannot be assumed to represent the general public. There was technical error in the lab with the analysis of three blood samples. Lastly, the inducement of a reimbursement was a limitation in the study as there was an incentive for the participants to participate in the entire study process.

Considerations for Future Research

Proper care should be taken when handling blood samples. A detailed and specific standardization of data collection will minimize variance within the data set. By randomizing data collection, the feasibility concern and contamination bias can be reduced. Inclusion and exclusion criteria may be considered in order to identify factors which may affect the correlation such as medications (i.e. analgesics), sun exposure (i.e. use of sunblock or travel), conditions which alter pain sensitivity (i.e. fibromyalgia, hypothyroidism, diabetes), dietary considerations (i.e. artificial sweeteners, supplementation), physical activity level, previous trauma, and psychosocial disorders (i.e. conversion disorders, somatization disorders). Meticulous ascertainment and measurement of these variables would permit some control over these potential confounders through the use of multivariate statistical methods.

Recruiting participants from a primary care medical facility, as opposed to using a pain clinic, may minimize selection bias. This would capture a more representative sample of the general population.

The highest correlation coefficient that was found in this pilot study was 0.20; this means that the linear relationship between PPT and serum vitamin D level ac-

counted for only 4% (i.e., r -squared = 0.20 squared) of the total variance in the data. Based on this weak level of correlation, PPT cannot be considered a useful proxy measure for serum vitamin D level, at least in the current study population. Multiple replications of this study are needed to determine whether PPT is better (i.e., more strongly) correlated with serum vitamin D levels in other, larger, and more representative, study populations of interest.

Conclusions:

This pilot study found no correlation between serum 25-hydroxyvitamin D and mean pressure-pain threshold as measured by manual algometry in a limited sample. Future studies should include larger samples of patients from primary medical centers, as opposed to specialty pain clinics, in order to target more representative study populations of interest. Unless evidence of stronger correlations are revealed in future studies, pressure-pain threshold determinations cannot be regarded as a useful proxy measure for serum 25-hydroxyvitamin D levels.

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Becoming a Supple Leopard: The Ultimate Guide to Resolving Pain, Preventing Injury, and Optimizing Athletic Performance

Kelly Starrett, DPT & Glen Cordoza

Victory Belt Publishing Inc, 2013

Hard Cover, 400 pages, \$ 43.09 (CDN)

ISBN-13: 978-1936608584

Becoming a Supple Leopard written by Kelly Starrett, Doctor of Physical Therapy and CrossFit coach highlights aberrant movement patterns that may culminate into injury and deprive optimal athletic performance. The author provides step-by-step instruction with illustration of numerous self-assessment protocols and techniques to improve form and function to avoid injury.

The text consists of seven chapters, addressing an array of exercises for various anatomical/body regions. The introductory chapters focus on the rules that govern movement and mobility, the importance of engaging mid-line stabilization/bracing and organization of the spine, and laws of torque to generate force. The latter chapters provide an in depth description of innovative mobility techniques and exercises provided in a stepwise fashion. The author offers novel, cost effective ideas to treat musculoskeletal injuries throughout the entire kinetic chain.

This text is a complete training manual resource enabling one to become your own movement, mobility and performance expert. Whether you are a coach, athlete, the weekend warrior, athletic trainer or sports injury practitioner you will find value in the content of this text. *Becoming a Supple Leopard* provides the authors experiential learning in conjunction with evidenced based concepts to relieve pain, prevent injury and enhance performance. This text will be a welcome addition to any sports injury practitioners' toolbox for treating, rehabilitating and identifying athletic injuries.

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ACSM's Guidelines for Exercise Testing and Prescription 9th Ed. 2014

Linda S. Pescatello, Ross Arena, Deborah Riebe,
Paul D. Thompson

Wolters Kluwer/Lippincott Williams & Wilkins,
Philadelphia, PA

456 pp; \$43.99 CAD

ISBN: 978-1-6091-3955-1

The ninth edition of this book consists of a clinical practice guidelines for physical activity from the American College of Sports Medicine. These guidelines began in 1975 and have been continually updated every 4-6 years. There are over 50 contributing authors to this edition alone, consisting of many health professionals and researchers. The book consists of 11 chapters divided into 3 main sections: Health appraisal and risk assessment, Exercise testing, and Exercise prescription. The most valuable new addition is a chapter titled "Behavioural Theories and Strategies for Promoting Exercise". This chapter explains theories as to why individuals adapt sedentary lifestyles and provides strategies to promote an active lifestyle.

This book is a useful resource for any health care provider that deals with exercise in their practice. It supports the public health message that practitioners should be ensuring that patients are participating in an active lifestyle in a safe, effective manner. This book highlights how to assess activity levels and prescribed exercises for a variety of conditions and special populations. It focuses on the clinical applicability of exercise testing and health screening before activity. Each chapter has summary points to ensure the reader is aware of the take home concepts. After reading this book you can feel confident that you have an up to date, reliable resource for exercise testing and prescription in the clinic.

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Pain: International Research in Pain Management
 Merrick J, Schofield P, Morad M, eds. 2013; 453 pp.
 Nova Science Publishers, Inc. New York, NY
 ISBN: 978-1-62948-423-5
 US\$230

The complex, multidimensional nature of pain (e.g., at the molecular, cellular, system, and biopsychosocial levels) requires multidimensional management – and research in various domains. The editors of *Pain: IRPM* compiled recent international papers and made them each chapters populating six sections; e.g., the three chapters comprising “What Are We Talking About?” are rambling explorations of paradigms. This book can serve as a sampling menu for novices to the study of pain, but equally for those who have been so immersed in tracking one research thread in the grand tapestry of pain that they need to resurface to regain perspective and direction. For example, the utile summary of “Pharmacological treatment of neuropathic pain” would likely be a more familiar read to researchers and clinicians than the qualitative study, “Pain and its management in a traditional rural [Kenyan] community,” yet the latter’s description of how to overcome barriers to study a non-Western pain management paradigm could well prove enlightening and inspiring to those accustomed to the path well traveled.

The “chapters,” each including a bibliography, seem to have been accepted by the editors without review, some papers so poorly written that they distract readers from benefiting from their content. The index is of dubious utility; e.g., there are entries for “Chicago” and “San Salvador”, but not for “chiropractic” or “intra-articular,” the latter two being words in chapter titles and text, which more readers of a book about pain may search for than city names.

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