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JCCA Special Issue December 2015 –Sports Chiropractic

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His Excellency the Right Honourable David Johnston, Governor General of Canada declared 2015 as the “Year of Sport” in Canada. The Year of Sport promotes Canada’s position as a leading sport nation.

“The Year of Sport in Canada is a proactive pan-Canadian initiative to celebrate the role that sport plays in our country and encourage Canadians to participate in and seek the benefits of sport. During the year, sport events and other celebratory activities will highlight how sport benefits Canadians.”

More than 60 international sporting events were hosted in Canada including:

- 2015 World Junior Hockey Championships
- Canada Winter Games
- Ford Men’s World Curling Championships
- FIFA Women’s World Cup
- Toronto 2015 Pan and Parapan American Games

The field of chiropractic sports sciences has undergone tremendous growth both in Canada and internationally and the Royal College of Chiropractic Sports Sciences (Canada) (RCCSS(C)) and its Fellows have been a major source of this growth. The ability of the RCCSS(C) to foster an academic environment where Fellows and residents are encouraged to conduct research and publish their findings has helped lead to increased acceptance of chiropractic at all levels of sport including major sporting events and Games along with greater understanding of sports injuries, their diagnosis, and management. Similarly the international sports chiropractic community has seen unprecedented growth in terms of both scholarship and participation at major international sports events. To help continue this growth, the Journal of the Canadian Chiropractic Association (JCCA) is publishing its 7th annual Sports Chiropractic Issue in December 2015.

As I mentioned in my previous editorials, there has been a paucity of research in Sports Chiropractic, which drove us to start the JCCA Sports Issue 7 years ago to provide a global stage for Sports Chiropractic research publications. Many Sports Chiropractors and researchers in this field agree with me that it is time for us to step up in our research activities and take the lead in this area. To do so we need to identify the priorities for our future research and establish a Sports Chiropractic research agenda. Furthermore, a research agenda will assist us in

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channelling our limited funds appropriately and guide our young and upcoming researchers and residents in their research endeavours. This can be done using a method similar to that employed by our European colleagues, Rubinstein et al.¹ I need your assistance in establishing this agenda and will call upon our readers in the near future to commence this essential and timely process. I believe that it also time for us to have a sports chiropractic research chairperson to drive our agenda forward. I would also like to ask you to assist our researchers in their quest in any

way possible, by responding and filling out their research surveys, by providing access to your athletes and laboratories, and by getting involved.

Together we can move mountains.

Enjoy the 7th Sports Edition.

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Self-reported attitudes, skills and use of evidence-based practice among Canadian doctors of chiropractic: a national survey

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Objectives: *To identify Canadian chiropractors' attitudes, skills and use of evidence based practice (EBP), as well as their level of awareness of previously published chiropractic clinical practice guidelines (CPGs).*

Methods: *7,200 members of the Canadian Chiropractic Association were invited by e-mail to complete an online version of the Evidence Based practice Attitude & utilisation SurvEy (EBASE); a valid and reliable measure of participant attitudes, skills and use of EBP.*

Results: *Questionnaires were completed by 554 respondents. Most respondents (>75%) held positive*

Objectifs: *Cerner les comportements, les comp etences et la mise en  uvre de la pratique factuelle (pratique fond ee sur des donn ees probantes) des chiropraticiens canadiens, ainsi que leur niveau de connaissance des guides de pratique clinique chiropratiques pr ec edemment publi es.*

M ethodes: *7 200 membres de l'Association chiropratique canadienne ont  et e invit es par courriel pour remplir une version en ligne du sondage sur l'utilisation et le comportement associ es  a la pratique factuelle; une  evaluation valable et fiable des comportements, des comp etences et de la mise en  uvre de la pratique factuelle par les participants.*

R esultats: *Les questionnaires ont  et e remplis par 554 r epondants. La plupart des r epondants (> 75 %)*

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attitudes toward EBP. Over half indicated a high level of self-reported skills in EBP, and over 90% expressed an interest in improving these skills. A majority of respondents (65%) reported over half of their practice was based on evidence from clinical research, and only half (52%) agreed that chiropractic CPGs significantly impacted on their practice.

Conclusions: While most Canadian chiropractors held positive attitudes towards EBP, believed EBP was useful, and were interested in improving their skills in EBP, many did not use research evidence or CPGs to guide clinical decision making. Our findings should be interpreted cautiously due to the low response rate.

(JCCA. 2015; 59(4): 332-348)

KEY WORDS: chiropractic; complementary and alternative medicine; evidence-based practice; survey

Introduction

Evidence-based practice (EBP) refers to ‘the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients’¹. Essentially, EBP involves the integration of three key components: 1) the use of the best available research evidence, 2) knowledge arising from one’s clinical expertise/clinical reasoning, and 3) patients’ preferences and values.¹

Evidence-based practice is associated with improved clinical decision-making and patient care.^{2,3} Since the establishment of evidence-based medicine at McMaster University in the 1980s, EBP principles have been embraced in other health disciplines, including nursing^{4,5}, occupational therapy and physical therapy.⁶ Complementary and alternative medicine (CAM) professionals, including

ont révélé des comportements positifs vis-à-vis de la pratique factuelle. Plus de la moitié d’entre eux ont rapporté un niveau élevé d’aptitudes autodéclarées en matière de pratique factuelle, et plus de 90 % d’entre eux ont fait part de leur intérêt à améliorer ces compétences. La majorité des répondants (65 %) a indiqué que plus de la moitié de leur pratique était fondée sur des données probantes issues de la recherche clinique, et seulement la moitié de ces derniers (52 %) a reconnu que les guides de pratique clinique chiropratiques avaient des répercussions importantes sur leur pratique.

Conclusions: Si la plupart des chiropraticiens canadiens ont révélé des comportements positifs vis-à-vis de la pratique factuelle, pensaient que celle-ci était utile et étaient intéressés à l’idée d’améliorer leurs compétences en la matière, un grand nombre d’entre eux n’utilisaient pas les données probantes issues de la recherche ou les guides de pratique clinique pour orienter leurs prises de décisions cliniques. Nos conclusions doivent être interprétées avec précaution en raison du faible taux de réponse.

(JCCA. 2015; 59(4) : 332-348)

MOTS-CLÉS : chiropratique, médecine parallèle et médecine douce, pratique factuelle, sondage

Doctors of Chiropractic (DC), are increasingly expected to use EBP principles to guide clinical decision making.⁷

A number of indicators suggest a possible shift toward the adoption of EBP in chiropractic, including the relatively recent creation of evidence-based clinical practice guidelines (CPGs) in chiropractic⁸⁻¹², EBP educational programs¹³⁻¹⁶, and the adoption of an ‘Evidence-Informed Practice statement’ by nine out of ten Canadian provincial associations and eight of ten provincial regulatory boards (status pending in three organizations). (www.chiroguidelines.org). The statement reads as follows:

“Canadian chiropractors adopt evidence-informed practice principles to guide clinical decision making by integrating their clinical expertise, patient’s preferences and values, and the best available scientific evidence.”

However, the impact of these important initiatives is dependent on whether or not EBP principles and tools such as CPGs are routinely applied in clinical practice. Despite the growing awareness of EBP in the chiropractic profession, there still remains a large gap between the appreciation of EBP and the actual application of EBP.¹⁷ The challenges in reducing the research-practice gap have not been restricted to certain health conditions, health professions, context (primary vs. specialized care) or settings (developed vs. underdeveloped countries).¹⁸⁻²⁰ A landmark report, 'Bridging the quality chasm', published by the Institute of Medicine in the early 1990's drew attention to the gap between 'what we know' and 'what we do'.²¹ The nature of the problem is described as one of overuse, misuse and underuse of health care services. In essence, the health care delivery system has fallen far short in its ability to translate research into practice and policy, and to apply new technology safely and appropriately.²¹ A major implication from this observation is that patients do not always receive safe and effective healthcare.

Understanding how EBP is perceived and implemented across health disciplines can identify educational needs and outcomes, and predict where new research evidence is more likely to be implemented.²² This is accomplished by examining healthcare providers' knowledge, attitudes, and application of EBP, as well as practitioners' EBP behaviours in the clinical setting.²³

Significant predictors of self-reported use of research evidence among physical and occupational therapists, mental health care providers and dietitians include factors such as educational degree or academic qualification, involvement in research or EBP-related activities, and practitioners' perceptions, attitudes and beliefs about research and EBP.¹⁷ Previous surveys and interviews of chiropractors in Australia, USA, Germany and the UK generally report favorable attitudes toward EBP²⁴⁻²⁷, with respondents indicating that research is important in establishing chiropractic as a legitimate profession^{26,27}. However, in spite of their favorable inclination towards EBP, many respondents did not use CPGs or research evidence to guide clinical decision making.^{24,25,28} Lack of time, lack of clinical evidence in CAM, and lack of incentive to participate in EBP were the most commonly reported barriers to practicing EBP. Learning needs appeared to vary according to the type of profession, years

in practice, and prior research experience.²⁹ Further, accessibility to research, insufficient skills for locating, interpreting, critically appraising, and applying research findings to clinical practice were poor amongst chiropractors and other CAM providers.^{25,29-31} However, given the small and specialized samples in these studies, the generalizability of these findings is somewhat limited. Consequently, the factors associated with the uptake of EBP by the chiropractic profession in Canada still remain poorly understood.

The primary objective of this study was to investigate Canadian chiropractors' attitudes, skills and use of research evidence in clinical practice, and to identify the barriers to and facilitators of EBP uptake. A secondary objective was to explore the level of awareness and agreement with three chiropractic clinical practice guidelines (CPGs) published in the last decade on the management of adult neck pain³², whiplash-associated disorders¹⁰ and headaches³³.

Methods

Study Design & Setting

This descriptive cross-sectional survey was conducted online between December 13, 2013 and June 5, 2014. The survey was administered electronically through the University of Pittsburgh (U Pitt), Pennsylvania, using the U Pitt web platform.

Context

This study replicates the first phase of a federally-funded study of DCs in the United-States (R21 AT007547-01: Distance Education Online Intervention for Evidence-Based Practice Literacy [DELIVER]), which was designed to evaluate the effectiveness of an online EBP educational program on chiropractor attitudes, skills, and use of EBP.³⁴ The first phase of the DELIVER study was an online EBP survey of US chiropractors, which provided an opportunity to contrast the attitudes, skills, and use of research evidence between chiropractors.

Participants & Recruitment

The survey was open to all practicing Doctors of Chiropractic in Canada who had internet access and a valid email address and were members of the Canadian Chiropractic Association (CCA). A convenience sample of DCs

was recruited from a potential pool of 7,200 DCs, with the support of the CCA and all ten provincial chiropractic associations.

The above mentioned organizations provided email-forwarding services through their respective membership lists. The forwarded email and follow-up emails described a unique opportunity to participate in an online survey. Preliminary notification of the study and published advertisements in a national chiropractic publication (The Journal of the Canadian Chiropractic Association) and quarterly newsletters of the CCA and provincial associations (December 2013) provided an overview of the study and invited readers to participate in the online survey.

Questionnaire and Outcomes

The Evidence-Based practice Attitude and utilization Survey (EBASE) is a self-administered multi-dimensional instrument designed to measure CAM providers' attitudes, skills and use of EBP.³⁵ The instrument has demonstrated good internal consistency (Cronbach's alpha = 0.84), content validity (CVI = 0.899), and acceptable test-retest reliability (ICC = 0.578–0.986).^{35,36} Minor modification of the EBASE was required to ensure the language was appropriate for use with American³⁴ and Canadian chiropractors. These changes were made in consultation with the survey developer (ML) and recent administrator of the survey (MS) to ensure the structure and intent of the modified questions did not alter the validity of the original survey. Some additional questions were added to the online survey in order to explore DCs' awareness of Canadian chiropractic clinical practice guidelines (CPGs) released in the past decade. The demographics section of the survey was revised to ensure it was relevant to the Canadian chiropractor population. Modifications to the demographics section did not affect the internal validity of the other parts of the EBASE, which were not modified. The modified-EBASE was then translated into French using a forward-backward translation approach.

The modified version of the EBASE contained 76 items and was divided into seven parts (Parts A-G); Parts A-F each address a different EBP construct (i.e. Attitudes, skill, use, training & education, barriers, and facilitators), and Part G contains demographic items only. Three parts of the EBASE generate sub-scores: Parts A (Attitudes), B (Skill), and D (Use). The survey was accompanied by an

additional 12 items that examined participant awareness of prior chiropractic guidelines. The completion time of the online EBASE was approximately 20 minutes (see additional file 1 for a copy of the modified-EBASE and the scoring rubric for calculating the three sub-scores).

Survey Administration & Data Collection

DCs interested in participating in the survey were invited to follow a link to the UPitt website (<http://www.chirostudy.pitt.edu>), where they could obtain detailed information about the study procedures and register for the study by submitting an email address. Participants were subsequently emailed a password in order to enter the survey site; an effort aimed at preventing multiple responses from the same individual. To encourage honest and transparent responses, anonymity was insured by assigning a unique identification number to each registered DC, which was used to identify the individual's survey data. As participants completed the survey in the language of their choice, responses were captured through a secure data capturing feature/system, Web Data Xpress, an interface used by UPitt that allows for direct entry and storage of data within a designated SQL Server database (<http://www.wpic.pitt.edu/research/wdx/>). This method of data capture is resource-efficient and minimizes human error by avoiding the need for manual data entry.

Data Analysis

Data were analyzed using SPSS version 22 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for each item in Parts A, B, D, E, F and G (response frequencies and means), Part C and the additional items on the awareness of CPGs (response frequencies). The attitudes, skills, and use sub-scores were calculated using the scoring rubric (see additional file 1) developed for the original EBASE. This involves summing the first eight items of Part A (response range 1-5; total score range of 8-40), all 13 items of Part B (response range 1-5; total score range of 13-65), and the first 6 items of Part D (response range 0-4; total score range of 0-24). Frequency distributions for the group sub-score means for Parts A, B and D were also calculated. Higher sub-scores indicate higher self-reported attitude (Part A), skill level (Part B) and use (Part D) of EBP. We also explored possible associations between certain demographic variables and the attitudes, skills and use sub-scores.

Table 1.
Baseline demographics of the 554 Canadian chiropractors who completed the online survey.

Variable		n (%)	National (%) (CCRD) ¹
Gender	Male	363 (65.5)	67.1
	Female	191 (34.5)	32.9
Age	Mean=42.1 yrs (SD=11.4) Range=24-80 yrs		Mean = 14.7 yrs (SD=11.1)
Year in Practice	Mean=15.8 yrs (SD=11.4) Range=1-49 yrs		
Highest Education Level	High School	102 (18.4)	
	Associate Degree/Some college	36 (6.5)	
	Bachelor's Degree	352 (63.5)	
	Master's Degree/Some grad work	53 (9.6)	
	Doctorate	11 (2.0)	
Primary Language	English	482 (87.0)	
	French	72 (13.0)	
Region of Practice	Alberta	68 (12.3)	14.6
	British Columbia	70 (12.7)	14.5
	Manitoba	29 (5.3)	3.5
	Atlantic provinces	23 (4.0)	3.9
	Ontario	242 (43.7)	47.9
	Quebec	104 (18.8)	13.1
	Saskatchewan	18 (3.2)	2.8
Geographic Setting	City	337 (60.8)	
	Suburban	137 (24.7)	
	Rural	80 (14.4)	
Patients Seen Daily	0-10	130 (23.5)	
	11-20	149 (26.9)	
	21-30	131 (23.6)	
	31-40	68 (12.3)	
	41-50	36 (6.5)	
	51 or more	40 (7.2)	
Focus	Musculoskeletal Focus	367 (66.1)	
	Spine and extremities	330 (59.6)	
	Spine	7 (1.4)	
	Sports	30 (5.2)	
	Non-musculoskeletal focus	177 (31.9)	
	Pediatrics	8 (1.3)	
	Family care	77 (13.9)	
	Wellness/Prevention	48 (8.7)	
	Non-musculoskeletal care	1 (0.2)	
Subluxation-based	43 (7.8)		
Other	10 (2.0)		
Onsite Imaging	Yes	132 (23.8)	
	No	422 (76.2)	
% Patients who get Radiographs	25% or less	428 (77.3)	
	26%-50%	40 (7.2)	
	51-75%	39 (7.0)	
	Over 75%	47 (8.5)	
X-rays useful for diagnosis of acute low back pain	Strongly Disagree	132 (23.8)	
	Disagree	184 (33.2)	
	Neutral	126 (22.7)	
	Agree	76 (13.7)	
	Strongly Agree	36 (6.5)	

¹ Canadian Chiropractic Resources Databank (CCRD). National Report, The Canadian Chiropractic Association. Canada. 2011.

Ethics

Ethical approval (A07-E62-13A) for this study was obtained through McGill University’s institutional review board in July 2013. Informed consent was obtained from all subjects via the homepage of the study website, prior to participation in the survey.

Results

Participant Characteristics

Demographics

A total of 554 Canadian chiropractors responded to the survey, providing a response rate of approximately 8%. The sample was predominantly male (65.5%) with a mean age of 42 (SD 11.4) years (Table 1). The majority of respondents practiced in urban (60.8%) or suburban settings (24.7%), saw on average fewer than 30 patients daily (74%), and indicated that the main focus of their practice was musculoskeletal care (66.5%). The mean number of years in practice was 15.8 years (range: 1 to 49 years).

Self-reported use of radiography

Less than a quarter of the participants (23.8%) indicated they had access to onsite radiography, and a large majority (77.3%) reported that 25% or fewer of their patients undergo spine radiographs each week (either in their clinic or at imaging centers). Nonetheless, over 20% of respondents agreed or strongly agreed that x-rays of the lumbar spine are useful in the diagnostic work up of patients with acute (< 1 month) low back pain, and a further 22.7% indicated that they neither agreed nor disagreed (i.e., felt neutral) with this statement (Table 1).

Attitudes toward EBP

Participants generally held favorable attitudes (Part A) toward EBP, with a mean attitudes sub-score of 32 (5.5), (range 10-40); while the median (IQR) sub-score 33.0 (7.0) was close to the mean (Fig 1). The majority (>75%) of participants “agreed” or “strongly agreed” with the attitudinal statements on EBP (Table 2). A smaller proportion of the respondents agreed with statements: 1) “EBP takes into account a patient’s preference for treatment” (47.4% agree/strongly agree); and 2) “EBP takes into account my clinical experience when making clinical decisions” (70.7% agree/strongly agree). A large majority of

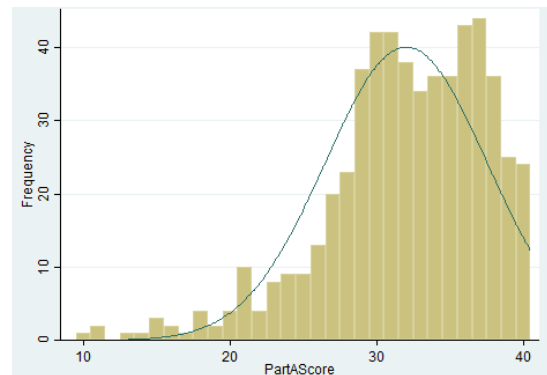


Figure 1:
Part A (attitudes) sub-scores. Mean(SD)=32.0(5.5), Range=10-40; Median(IQR)=33.0 (7.0).

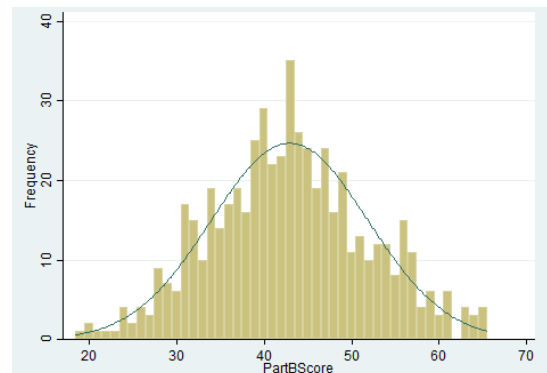


Figure 2:
Part B (skills) sub-scores. Mean(SD)=42.9 (8.9), Range=19-65; Median(IQR) =43.0 (12.0).

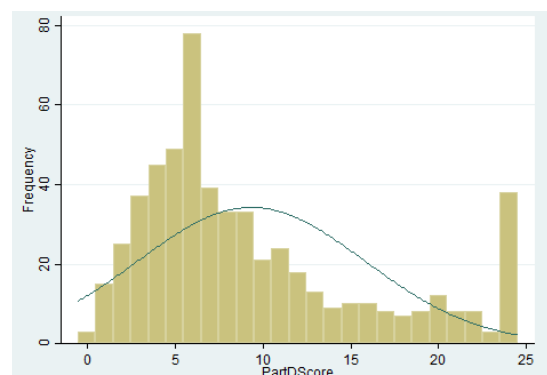


Figure 3:
Part D (use) sub-scores. Mean(SD)=9.3(6.5), Range=0-24; Median(IQR)= 8.0 (8.0).

Table 2.

Response frequency and means of Attitudes toward EBP items (Part A of E-BASE). These are responses to the question “On a scale ranging from strongly disagree to strongly agree, how would you rate your opinion on the following statements?”

Part A	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean Range=1-5
*Evidence based practice (EBP) is necessary in the practice of chiropractic	0.6%	3.3%	3.0%	34.7%	58.3%	4.5
*I am interested in learning or improving the skills necessary to incorporate EBP into my practice	0.9%	2.4%	7.3%	45.6%	43.8%	4.3
*EBP improves the quality of my patient’s care	0.9%	3.3%	9.4%	36.9%	49.5%	4.3
*EBP assists me in making decisions about patient care	0.9%	3.3%	7.3%	40.2%	48.3%	4.3
Prioritizing EBP within chiropractic practice is fundamental to the advancement of the profession	2.4%	5.7%	9.7%	38.4%	43.8%	4.2
*Professional literature (i.e. journals & textbooks) and research findings are useful in my day-to-day practice	0.6%	4.2%	11.5%	53.2%	30.5%	4.1
*EBP takes into account my clinical experience when making clinical decisions	2.4%	10.0%	16.9%	42.0%	28.7%	3.8
*The adoption of EBP places an unreasonable demand on my practice	21.8%	52.6%	18.4%	3.6%	3.6%	3.9
*EBP takes into account a patient’s preference for treatment	3.0%	20.8%	28.7%	29.0%	18.4%	3.4
There is a lack of evidence from clinical trials to support most of the treatments I use in my practice	10.3%	47.7%	17.8%	19.9%	4.2%	2.6

*The sum of the 8 items with asterisks comprises the “Attitudes” sub-score, which ranges from 8-40. See Figure 1 for frequency distribution graph of attitudes sub-scores.

the sample (89.4%) agreed or strongly agreed with the statement “I am interested in learning or improving the skills necessary to incorporate EBP into my practice”.

Skills in EBP

For self-reported skills in EBP (Part B), the mean and median (IQR) sub-score were respectively 42.9 (8.9), (range 19-65) and 43.0 (12.0) (Fig 2). For the majority of the skill items, more than half of respondents indicated a high level (‘4’ or ‘5’) of self-reported skill in EBP (Table 3); Nonetheless, nearly a third of respondents rated their skills in the mid-range (‘3’ on a 1-5 scale) for 11 of the 13 skill items. Two items were rated as having poor self-reported skills: 1) “conducting clinical research” (73.7%

of respondents), and 2) “conducting systematic reviews” (59.2% of respondents).

Level of EBP training/education

One third or less of respondents indicated that the following topics were major parts of their chiropractic education: coursework about EBP (34.7%), applying research evidence to clinical practice (28.1%), and critical thinking/analysis (27.8%) (Table 4). Ten percent of the sample indicated they never had any training in critical thinking/analysis included in their chiropractic education. A large portion of the sample reported that they had never received any education/training on clinical research (27.2%) or on conducting systematic reviews (40.2%).

Table 3.
Response frequency and means of Skills in EBP items (Part B of E-BASE). These are responses to the question “On a scale from 1 to 5, with 1 being poor and 5 being advanced, how would you rate your skills in the following areas?”

PART B	Poor (1)	(2)	(3)	(4)	Advanced (5)	Mean Range=1-5
Identifying answerable clinical questions	0.0%	1.2%	20.8%	55.3%	22.7%	4.0
Locating professional literature	0.9%	4.5%	26.9%	43.5%	24.2%	3.9
Identifying knowledge gaps in practice	0.3%	1.5%	29.3%	54.7%	14.2%	3.8
Applying research evidence to patient cases	0.6%	5.7%	22.4%	58.3%	13.0%	3.8
Using findings from clinical research	1.5%	5.4%	26.3%	52.9%	13.9%	3.7
Online database searching	4.5%	12.4%	26.3%	34.7%	22.1%	3.6
Retrieving evidence	1.5%	12.1%	28.4%	39.3%	18.7%	3.6
Critical appraisal of evidence	0.6%	13.9%	30.5%	40.8%	14.2%	3.5
Synthesis of research evidence	2.1%	15.1%	38.1%	31.1%	13.6%	3.4
Sharing evidence with colleagues	3.6%	14.8%	31.7%	37.5%	12.4%	3.4
Using findings from systematic reviews	4.2%	12.4%	32.6%	36.6%	14.2%	3.4
Conducting systematic reviews	28.7%	30.5%	20.8%	15.1%	4.8%	2.4
Conducting clinical research	40.8%	32.9%	15.1%	7.6%	3.6%	2.0

The sum of all 13 items comprises the “skills” sub-score, which ranges from 19-65. See Figure 2 for frequency distribution graph of skills sub-scores.

Table 4.
Response frequency of Training/Education items (Part C of E-BASE). These are responses to the question “Please indicate the highest level of training/ education you have received in the following areas”.

PART C	None	Seminars or short specific courses	Minor part of chiropractic education	Major part of chiropractic education	Part of diplomate education	Informal personal study
Evidence-based clinical practice/ evidence-based chiropractic	1.8%	17.8%	24.5%	34.7%	9.3%	6.6%
Applying research evidence to clinical practice	5.4%	19.6%	24.5%	28.1%	8.7%	8.5%
Conducting clinical research	27.2%	10.2%	41.7%	2.1%	8.7%	3.9%
Conducting systematic reviews or meta-analysis	40.2%	15.0%	26.0%	1.5%	7.8%	4.5%
Critical thinking / critical analysis	10.0%	16.8%	18.4%	27.8%	13.9%	6.6%

There is no sub-score associated with this part of the survey.

Table 5.

Response frequency and means of Use of EBP items (Part D of E-BASE). These are responses to the question “Indicate how often you have performed the following activities over the last month”.

PART D	None or very Small (0-25%) (1)	Small (26-50%) (2)	Moderate (51-75%) (3)	Large (76-99%) (4)	All (100%) (5)	Mean Range=1-5
What percentage of your practice do you estimate is based on clinical research evidence (i.e. evidence from clinical trials)?	11.5%	22.1%	35.7%	29.0%	1.8%	2.9
	0 times (1)	1-5 times (2)	6-10 times (3)	11-15 times (4)	16+ times (5)	Mean Range=1-5
*I have read/reviewed professional literature (i.e. professional journals & textbooks) related to my practice	3.3%	46.5%	20.9%	10.3%	19.0%	2.0
*I have used an online search engine to search for practice related literature or research	7.9%	42.9%	21.2%	8.8%	19.3%	1.9
*I have read/reviewed clinical research findings related to my practice	10.0%	48.3%	14.8%	7.9%	19.0%	1.8
*I have used professional literature or research findings to assist my clinical decision making	13.9%	49.9%	16.0%	5.7%	14.5%	1.6
*I have used an online database to search for practice related literature or research	34.1%	33.2%	9.1%	7.6%	16.0%	1.4
*I have used professional literature or research findings to change my clinical practice	24.8%	50.8%	8.8%	3.9%	11.8%	1.3
I have consulted a colleague or industry expert to assist my clinical decision making	24.2%	51.1%	13.0%	3.0%	8.8%	1.2
I have referred to magazines, layperson / self-help books, or non-government/non-education institution websites to assist my clinical decision making	47.7%	37.8%	6.0%	3.0%	5.4%	0.8

*The sum of the 6 items with asterisks comprises the “Use” sub-score, which ranges from 0-24. See Figure 3 for frequency distribution graph of the “use” sub-scores.

Use of EBP

The mean sub-score for the use of EBP (Part D) was 9.3 (6.5), (range of 0-24) while the median (IQR) sub-score 8.0 (8.0) was higher than the mean (Fig 3). Nearly two thirds of the sample (64.7%) indicated that over half of their practice was based on evidence from clinical research. Nonetheless, 34% did not use an online database to search for practice-based literature or research findings, and 24.8% reported not using professional literature or research findings to change their clinical practice (Table 5).

Barriers and Facilitators to EBP Uptake

Participants perceived the following factors to be moderate or major barriers to EBP uptake in clinical practice

(Part E): 1) lack of clinical evidence about CAM (44.1%); 2) lack of time (40.8%); and 3) lack of industry support (e.g., professional organizations) (31.2%) (Table 6). Approximately one quarter of respondents cited lack of incentive (23.2%) and insufficient skills to critically appraise (24.1%) and to interpret research (24.1%) as being moderate or major barriers to EBP uptake.

Conversely, over 70% of respondents indicated all 10 facilitator items were either “moderately useful” or “very useful” in facilitating the uptake of EBP (Part F) (Table 7). Items most frequently reported as “very useful” were: access to online education materials related to evidence-based practice (92.5%), access to the internet (92.2%), access to free online databases (87.3%), and ac-

Table 6.
Response frequency and means of Barriers to EBP uptake items (Part E of E-BASE).
 These are responses to the question “On a scale ranging from ‘not a barrier’ to ‘major barrier’,
 to what extent do the following factors prevent you from participating in EBP?”

Part E	Not a barrier (1)	Minor barrier (2)	Moderate barrier (3)	Major barrier (4)	Mean Range=1-4
Lack of clinical evidence in complementary and alternative medicine	23.6%	32.3%	32.6%	11.5%	2.3
Lack of time	27.2%	32.0%	30.2%	10.6%	2.2
Lack of industry support for EBP	37.8%	31.1%	23.0%	8.2%	2.0
Insufficient skills to critically appraise / evaluate the literature	34.4%	41.4%	19.3%	4.8%	1.9
Insufficient skills for interpreting research	36.9%	39.0%	19.0%	5.1%	1.9
Lack of incentive to participate in EBP	48.3%	28.4%	16.3%	6.9%	1.8
Patient preference for treatment	39.9%	42.0%	16.3%	1.8%	1.8
Insufficient skills for locating research	41.4%	41.4%	13.0%	4.2%	1.8
Insufficient skills to apply research findings to clinical practice	45.0%	40.5%	11.8%	2.7%	1.7
Lack of relevance to chiropractic practice	55.3%	26.3%	11.2%	7.3%	1.7
Lack of colleague support for EBP	51.1%	31.1%	12.1%	5.7%	1.7
Lack of resources (i.e. access to a computer, the internet or online databases)	55.6%	29.9%	10.6%	3.9%	1.6
Lack of interest in EBP	65.6%	24.2%	6.9%	3.3%	1.5

These items are focused on barriers to the uptake of EBP. However, there is no sub-score associated with this part of the survey.

Table 7.
Response frequency and means of Facilitators of EBP uptake items (Part F of E-BASE).
 These are responses to the question “On a scale ranging from ‘not useful’ to ‘very useful’,
 to what extent would the following strategies assist you in participating in EBP?”

Part F	Not useful (1)	Slightly useful (2)	Moderately useful (3)	Very useful (4)	Mean Range=1-4
Access to the Internet in your workplace	3.0%	5.7%	15.4%	75.8%	3.6
Ability to download full-text / full-length journal articles	2.1%	10.9%	16.3%	70.7%	3.6
Access to online education materials related to evidence based practice	0.9%	6.6%	24.5%	68.0%	3.6
Access to free online databases in the workplace, such as Cochrane and Pubmed	1.2%	11.5%	19.0%	68.3%	3.5
Access to critical reviews of research evidence relevant to your field (these are critical reviews of multiple research papers addressing a single topic)	0.9%	11.8%	28.1%	59.2%	3.5
Access to critically appraised topics relevant to your field (these are critical appraisals of single research papers)	1.2%	15.4%	33.8%	49.5%	3.3
Free access to online databases that usually require license fees, such as DynaMed and CINAHL	6.9%	15.7%	20.2%	57.1%	3.3
Access to tools used to assist the critical appraisal / evaluation of research evidence	2.7%	23.3%	36.6%	37.5%	3.1
Access to research rating tools that facilitate critical appraisal of single research papers	4.2%	20.8%	35.3%	39.6%	3.1
Access to online tools that assist you to conduct your own critical appraisals of multiple research papers related to a single topic	8.8%	23.3%	32.9%	35.0%	2.9

These items are focused on facilitators to the uptake of EBP. However, there is no sub-score associated with this part of the survey.

Table 8.

Response frequency and means of Awareness of previous CCA-CFCEAB Clinical Practice Guidelines. These are responses to the question “On a scale ranging from ‘Strongly disagree’ to ‘Strongly agree’ how would you rate your opinion about your knowledge and the impact of the guidelines?”

Awareness of previous clinical practice guidelines	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	Mean Range=1-5
Adult Neck Pain Not Due to Whiplash guideline (2005)						
I am familiar with most of the recommendations	0.0%	0.0%	15.7%	68.3%	16.0%	4.0
Overall, this guideline is representative of the evidence	0.9%	2.7%	19.9%	59.8%	16.6%	3.9
Recommendations have significantly impacted how I manage patients	3.3%	8.8%	41.1%	39.6%	7.3%	3.9
Whiplash-associated Disorders in Adults (2010)						
I am familiar with most of the recommendations	0.0%	0.0%	12.1%	67.1%	20.9%	4.1
Overall, this guideline is representative of the evidence	0.9%	2.1%	20.2%	60.4%	16.3%	3.9
Recommendations have significantly impacted how I manage patients	2.7%	9.4%	32.3%	46.8%	8.8%	3.5
Management of Headache Disorders in Adults (2011)						
I am familiar with most of the recommendations	0.0%	0.0%	18.1%	63.1%	18.7%	4.0
Overall, this guideline is representative of the evidence	0.6%	2.1%	25.1%	56.2%	16.0%	3.9
Recommendations have significantly impacted how I manage patients	2.4%	9.4%	35.1%	42.3%	10.9%	3.1

These items are focused on awareness and uptake of prior chiropractic CPGs produced in Canada. However, there is no sub-score associated with this part of the survey.

cess to critical reviews of relevant research evidence (i.e. critical reviews of multiple research papers addressing a single topic) (87.3%). In contrast, items most frequently reported as “not useful” or “slightly useful” related to the access to tools to assist clinicians in conducting their own critical appraisal of the research evidence (26%), and for evaluating single (28%) or multiple research papers (32.1%).

Awareness of past clinical practice guidelines

Table 8 presents respondents’ levels of awareness and agreement with three chiropractic clinical practice guidelines (CPGs) developed by the Canadian Chiropractic Association and the Federation. All respondents were aware of the three CPGs published between 2005 and 2011, and a large majority (over 80%) indicated that they were familiar or very familiar with most of the recommendations issued in these CPGs. Although over 70% of participants felt that the guidelines were representative of the best available evidence, only half of the respondents (51.7%) agreed or strongly agreed that these guidelines

had significantly impacted on how they managed their patients.

Associations between demographic variables and Attitude, Skills and Use Sub-scores.

DCs with a musculoskeletal focus had a more favorable attitude toward EBP ($r = .406, p < .001$) and a higher level of skill in EBP ($r = .153, p < .001$) relative to those with a non-musculoskeletal focus. Similarly, as education level increased (i.e. from associate degree, to MSc and PhD), attitudes ($r = .191, p < .001$), skills ($r = .296, p < .001$), and use ($r = .146, p = .001$) sub-scores increased. In contrast, DC’s who reported a busier practice had a less favorable attitude toward EBP ($r = -.297, p < .001$) and lower level of skill in EBP ($r = -.150, p < .001$) than those who saw fewer than 20 patients per day.

DCs who reported having onsite imaging equipment had less favorable attitudes ($r = -.235, p < .001$) and lower EBP skills ($r = -.118, p = .005$) than their counterparts. Furthermore, DC’s who reported ordering more radiography had lower attitude sub-scores ($r = -.292, p < .001$).

Similarly, those believing that lumbar spine x-ray is useful for diagnosing patients with acute LBP had less favorable attitudes ($r = -.377$, $p < .001$), skills ($r = -.128$, $p = .003$) and use ($r = -.107$, $p = .012$) sub-scores.

Discussion

Summary of findings

Understanding chiropractors' attitudes, skills and use of EBP and the potential barriers and facilitators of EBP use is a critical step in advancing EBP and increasing the uptake of research into chiropractic clinical practice. Our results suggest that Canadian chiropractors generally have moderate to strong positive attitudes about EBP and report moderate to high level skills in acquiring research evidence, but that much improvement can be made in the application of research evidence in clinical practice. These results are in line with those reported by Suter³⁰ among DCs and massage therapists in Canada; although, that sample was restricted to one province (Alberta) and did not use a standardized questionnaire.

While attitudes toward EBP were generally favorable in our sample, misconceptions regarding the importance of integrating the three pillars of EBP to guide clinical decision making (i.e. use of the best evidence, clinical expertise, and patient's preferences and values)¹ appear to persist. A large proportion of survey respondents (between 30% and 50%) were unsure or disagreed that EBP takes into account clinical experience and patient preference. These results are not surprising given that approximately half (44%) of our sample received their chiropractic training greater than 15 years ago, with many of our participants reporting no, minimal, or minor chiropractic foundational training in EBP (Table 2). Also, contrasting beliefs and approaches in chiropractic (experiential vs. EBP) are well documented and remain a source of ongoing debate in the profession.³⁷⁻⁴⁰ While chiropractors seem to recognize the 'push' towards EBP, and a growing segment of the profession appear to embrace its principles with nearly 90% of participants interested in learning or improving their EBP skills, uptake of scientific evidence is slow.⁴¹ Gaining a better understanding of chiropractors' clinical experiences, beliefs and apparent dissonance with research evidence may help to improve the translation of research into practice as well as patient care.⁴²

Between 50% and 70% of the sample reported a high

level of skill in EBP, particularly in relation to identifying answerable clinical questions, identifying knowledge gaps in practice, and literature searching. However, nearly one third of respondents rated themselves only in the mid-range on nearly all of the EBP skill items. Importantly, 40% reported poor to moderate skills in using the findings from systematic reviews, which is a common finding among many health professions.⁴³ This is worthy of attention given the value of systematic reviews to provide efficient access to potentially large volumes of research data through the synthesis of primary research studies using systematic, explicit and reproducible methods.⁴⁴ As such, well-conducted systematic reviews have replaced randomized controlled trials as the gold standard of evidence and further, are presented in a format that can facilitate the use of the best available evidence by both students and practitioners.

Over one-third of respondents estimated that only a small or very small percentage of their practice was based on clinical research evidence. Furthermore, over half reported never or rarely using an online database to search for practice-based literature or research, professional literature and research findings to change their clinical practice, or consulting a colleague or industry expert to assist their clinical decision making. Such findings are troublesome and likely result in important knowledge-practice discrepancies in chiropractic. Important gaps have also been identified in other health disciplines, with nearly 30-40% of medical patients not receiving optimal care, and a further 20-25% receiving care that is unnecessary or potentially harmful.^{45,46} While robust estimates of knowledge-practice gaps in chiropractic are lacking, we postulate that it is unlikely to be any better considering our findings. Further, cultural shifts are often slow and require concerted efforts from professional leaders to move research agendas forward and to accelerate the uptake and application of EBP to improve patient health outcomes.³⁹

Exploratory analyses suggest that DCs with a main focus on non-musculoskeletal care, reporting busier practices and with lower levels of education demonstrated poorer attitudes and lower skill levels with respect to EBP. These findings are consistent with a recent US study that found provider and practice characteristics influence chiropractic practice behaviour.³⁴ Further, poorer attitudes toward, skill levels in, and utilisation of EBP were associated with beliefs that lumbar spine x-ray is useful for

diagnosing patients with acute LBP, a practice inconsistent with the best available evidence.⁴⁷ While educational interventions may be effective in improving professional practice⁴⁸ and possibly reducing the perceived need for plain radiography in acute LBP among chiropractors⁴⁹, more active strategies will likely be required to change professional behaviours^{20,50}.

In the current study, a majority of respondents (77%) reported that 25% or fewer of their patients undergo spine radiographs each week. This is in line with figures from a national survey of Canadian DCs suggesting that the percentage of chiropractic patients who are x-rayed at least once per episode has gradually declined from 48% in 1997 to 35% in 2011.⁵¹ Furthermore, our data indicate that about 20% of respondents agreed or strongly agreed that x-rays of the lumbar spine are useful in the diagnostic work up of patients with acute (< 1 month) low back pain. This represents an important reduction from about half of respondents in an Ontario study a decade ago who agreed or strongly agreed with this same statement.⁴⁹ Such a downward trend has been observed over the past two decades among chiropractors in North America⁵²⁻⁵⁶, UK⁵⁷ and Switzerland⁵⁸.

Barriers to applying research findings in practice are numerous.^{19,59,60} For Canadian DCs, the key barriers to EBP uptake were a lack of clinical evidence about CAM, a lack of time and incentive, and a lack of support from professional chiropractic organizations. Similar factors were identified by Lawrence (2008) among professional chiropractic leaders in the US.⁶¹ In contrast, a number of facilitators were identified, including access to online education materials related to EBP, access to free online databases and access to critical reviews of relevant research evidence. This emphasizes the need for high quality continuing education programs on EBP to better meet the needs of the chiropractic profession.

Awareness of Canadian chiropractic CPGs published between 2005 and 2011 was very high, with over 80% of respondents indicating that they were familiar or very familiar with most of the recommendations. However, only half of the respondents agreed or strongly agreed that these guidelines had significantly impacted on how they managed their patients. Different reasons can explain these findings, including: compliance with recommended practice was already high among respondents; the proposed guidelines were not deemed to be of suf-

ficient quality to be implemented, or individual barriers to guideline uptake prevailed. Two recent qualitative studies focusing on chiropractors' views about barriers to using CPGs and best practice identified common theoretical domains likely to influence compliance with recommended care among DCs in North America.^{62,63} These barriers included: conflicting beliefs about the potential consequences of applying recommended care in practice (beliefs about consequences), concerns over perceived threats to professional autonomy, professional credibility, lack of standardization, and agreement with guidelines (social/professional role & identity), the influence of formal training, colleagues and patients (social influences), and guideline awareness and agreement (knowledge). Level of awareness of best practice was thought to be influenced by geographical isolation and negative views toward guidelines among US chiropractic leaders.⁶¹ These factors were thought to be relevant for Canadian DCs as well.⁶⁴ Ongoing efforts to identify these modifiable determinants of clinicians' guideline adherence are needed to design tailored knowledge translation strategies to encourage evidence-based practice.

Geographical variations

When comparing our results with those from a similar study of American chiropractors³⁴ striking similarities were observed in terms of the average scores on the attitudes, skills, and use subscales. The American study found average attitudes subscale scores of 31.4 compared with our average of 32.0. American average skills subscale scores were 44.3, compared to 43.0 for Canadian respondents. Finally, the average American and Canadian use subscale scores were equal at 10.3. Our findings are also similar to studies conducted in Australia, USA, Germany and the UK where chiropractors report favourable attitudes toward EBP^{24,27}, but many fail to routinely use EBP to inform clinical decision making^{24,25}. Failure to translate clinical and health services research into practice and policy is not limited to chiropractic, however; it is an issue spanning the wider health care system.¹⁸

Implications for education and guideline implementation

The passive dissemination of CPGs results only in small practice changes.⁶⁵ Our results suggest that educational emphasis should be focused on improving the skills of DCs

with respect to the appraisal and application of research evidence to clinical practice. This may be facilitated by providing access to EBP tools (e.g., a central repository of CPGs and best practices relevant to the scope of practice), and by offering online and face-to-face training.⁶⁶ Understanding barriers to professional behaviour change is an important component of successful dissemination and implementation efforts.⁶⁷ We are currently in the process of evaluating the feasibility of implementing a theory-based knowledge translation strategy designed to overcome previously identified barriers in the chiropractic setting.⁶³ This multifaceted strategy includes a webinar series, clinical vignettes, and online learning modules.

Study limitations

Strengths of this study include the use of a validated and reliable measure of EBP attitudes, skills and use. Nonetheless, this project has several important limitations. First, while attempts were made to maximize the response rate by using the principles of the Dillman method⁶⁸ (including pre-announcement in this journal, and sending out invitations and multiple reminders to participate by national and provincial associations), we are unable to determine the generalizability of our findings to the total population of Canadian chiropractors; this is partly because our sample was a convenience sample of members of the CCA limited to those with email addresses who did not previously opt-out from receiving these. Notwithstanding, although the response rate was low, study participants were generally representative of the target population in terms of gender, years in practice and geographical location.^{50,67} Survey respondents also had similar ages, number of patients seen daily, levels of education, and focus of practice; indicating that our sample was likely to be representative of Canadian DCs.^{51,69} Still, we cannot exclude the possibility of response bias and should be cautious about generalizing results. For example, it is possible that the 'attitudes' sub-scores were skewed toward higher values because participants were already positively biased in favour of an evidence-based practice paradigm prior to taking part in the survey. Second, as with most survey designs, there was a reliance on self-reported information, which has its own limitations. For example, the 'skills' sub-score was based on the participants' self-perceived level of skill; we did not formally test participant knowledge or skills with respect to EBP. Future evalua-

tion of DC skills, knowledge and actual behaviours related to EBP would provide an improved understanding of the chiropractic profession's needs and better inform the design of targeted EBP interventions. Also, while our exploratory analyses yielded interesting and potentially important findings regarding the relationships between practitioner characteristics and EBP attitudes, skills and behaviours, the significant findings were based upon only weak to moderate correlations. Thus, these results should be interpreted with caution and explored further in future research.

Conclusions

The results of this survey have provided additional insights into the attitudes, skills and use of EBP among Canadian chiropractors. Chiropractors generally had moderate to strong positive attitudes about EBP and moderate to high level skills in acquiring research evidence. However, the application of research evidence in clinical practice remains challenging. Results from this survey provide a baseline measure and can inform the design of future theory-based knowledge translation interventions to help improve chiropractors' level of EBP literacy and use of evidence in clinical practice.

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The effectiveness of structured patient education for the management of musculoskeletal disorders and injuries of the extremities: a systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) Collaboration

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Purpose: *To determine the effectiveness of structured patient education for the management of musculoskeletal disorders and injuries of the extremities.*

Methods: *We searched MEDLINE, EMBASE, CINAHL, PsycINFO, and the Cochrane Central Register of Controlled Trials from January 1, 1990 to March 14, 2015. Paired reviewers independently screened titles and abstracts for eligibility. The internal validity of studies was assessed using the Scottish Intercollegiate Guidelines Network (SIGN) criteria. Results from studies with a low risk of bias were synthesized using the best-evidence synthesis methodology.*

Results: *We identified two randomized trials with a low risk of bias. Our review suggests that: 1) multimodal care and corticosteroid injections lead to faster pain relief and improvement than reassurance and advice in the short-term and similar outcomes in the long-term for patients with persistent lateral epicondylitis; and 2) providing health education material alone may be less effective than multimodal care for the management of persistent patellofemoral pain syndrome.*

Conclusion: *Our systematic search of the literature demonstrates that little is known about the effectiveness of structured patient education for the management of musculoskeletal disorders and injuries of the extremities. Two studies suggest that when used alone, structured patient education may be less effective than other interventions used to manage persistent lateral epicondylitis and persistent patellofemoral syndrome.*

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KEY WORDS: chiropractic, systematic review, patient education, injury, extremity, lateral epicondylitis, patellofemoral pain

Objectif: *Déterminer l'efficacité d'une éducation des patients structurée aux fins de la prise en charge des troubles musculo-squelettiques et des lésions des extrémités.*

Méthodes: *Nous avons consulté MEDLINE, EMBASE, CINAHL, PsycINFO et le Cochrane Central Register of Controlled Trials du 1^{er} janvier 1990 au 14 mars 2015 aux fins de recherche. Les examinateurs appariés ont trié de façon indépendante les titres et résumés afin d'évaluer leur admissibilité. La validité interne des études a été évaluée à l'aide des critères du Scottish Intercollegiate Guidelines Network (SIGN). Les résultats des études présentant un faible risque de biais ont été synthétisés à l'aide de la méthodologie de la synthèse des meilleures données probantes.*

Résultats: *Nous avons identifié deux essais randomisés présentant un faible risque de biais. Notre examen suggère ce qui suit : 1) les soins multimodaux et les injections corticostéroïdes entraînent un soulagement de la douleur et une amélioration plus rapides que la reassurance et les conseils à court terme, et conduisent à des résultats similaires à long terme chez les patients souffrant d'épicondylite latérale persistante; et 2) fournir uniquement des documents d'éducation à la santé peut être moins efficace que les soins multimodaux pour la prise en charge du syndrome fémoro-rotulien douloureux persistant.*

Conclusion: *Nos recherches systématiques de la littérature démontrent que les connaissances au sujet de l'efficacité de l'éducation des patients structurée aux fins de la prise en charge des troubles musculo-squelettiques et des lésions des extrémités sont limitées. Deux études suggèrent que lorsqu'elle est utilisée seule, l'éducation des patients structurée peut être moins efficace que les autres interventions utilisées pour prendre en charge l'épicondylite latérale persistante et le syndrome fémoro-rotulien de durée variable.*

(JCCA. 2015; 59(4) : 349-362)

MOTS-CLÉS : chiropratique, examen systématique, éducation des patients, lésion, extrémité, épicondylite latérale, syndrome fémoro-rotulien douloureux

Introduction

Musculoskeletal disorders and injuries are a common source of pain in the upper and lower extremities. In the Netherlands, the point prevalence of musculoskeletal pain ranges from 5% for ankle pain to 21% for shoulder pain.¹ In the United States, 16% and 36% of all injuries presenting to emergency departments are sprains and/or strains of the upper and lower extremities respectively.^{2,3} In Saskatchewan, 35.1% and 27.5% of individuals involved in motor vehicle collisions report upper and lower extremity pain respectively.²

Musculoskeletal disorders and injuries of the extremities are associated with a significant burden of disability for individuals, workplaces and health care systems. In Australia, individuals who report shoulder pain and/or stiffness have lower health-related quality of life and are more likely to report depressive symptoms than those without shoulder complaints.⁴ In the United States, the median time away from work because of occupational injuries to the upper and lower extremities in 2013 were 10 and 12 days respectively.⁵ In Ontario, Canada, leg and ankle injuries accounted for 18% of lost time claims in 2013, while shoulder injuries accounted for 6% of lost time claims among workers.⁶ Furthermore, two thirds of Canadians with sprains or strains experience some level of disability and seek medical care.⁷

Clinicians commonly educate patients in a structured or unstructured way during a course of care to manage musculoskeletal disorders and injuries. Structured patient education involves standardized interventions delivered through pamphlets, books, videos, discussion with health-care providers, or the internet.⁸ Very little is known about the effectiveness of structured patient education for the management of musculoskeletal disorders and injuries of the extremities. A recent review on the effectiveness of structured patient education for the management of neck pain concluded that structured education alone cannot be expected to yield large benefits to patients with neck pain.⁹

The purpose of this systematic review was to determine the effectiveness of structured patient education compared to other interventions, placebo/sham interventions or no intervention in improving self-rated recovery, functional recovery (e.g., return to activities, work or school), or clinical outcomes (e.g., pain, health-related quality of life, depression) of patients with musculoskeletal disorders and injuries of the upper and lower extremities.

Methods

Registration

This review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) on April 9th, 2014 (CRD42014009287).

Eligibility Criteria

Population: Our review targeted studies of adults or children with musculoskeletal disorders and injuries of the upper and lower extremities. We excluded studies involving pathology (e.g., fractures, dislocations, infection, neoplasm, or systemic disease). We defined musculoskeletal disorders and injuries, based on the Centers for Disease Control and Prevention (CDC) definition, as grade I-II sprains or strains, nonspecific shoulder, elbow, wrist, hip, knee, ankle and/or foot pain, tendonitis, tendinopathy, tendinosis and other musculoskeletal disorders and injuries (including neuropathies) as informed by available evidence.¹⁰ Studies of grade I-III ankle sprains and strains were considered if a grade specific analysis was conducted or if a trial included the same distribution of grade III injuries across intervention groups.

Intervention: We restricted our review to studies that tested the effectiveness of structured patient education. We defined structured patient education as a process of enabling individuals to make informed decisions about their personal health-related behaviour.¹¹ For the purpose of our review, we considered patient education interventions to be structured, standardized, and condition-specific. Therefore, we investigated structured patient education strategies that were delivered through pamphlets, books, videos, formal/structured discussion with healthcare providers, or the internet, where the education interventions focused on reassurance or advice on activation, exercise, expected pain and its mechanism, prognosis, stress-coping skills, workplace ergonomics, self-care strategies or general health. Because of its nature, structured patient education can be differentiated from the usual education that is routinely provided by clinicians during the course of clinical care. Our goal was to determine the effectiveness that can be specifically attributed to structured patient education; therefore, we excluded education interventions that were provided in multimodal programs of care that did not permit an assessment of the effect of structured patient education alone.

Table 1.
Study inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> English language Studies published between January 1st, 1990 and March 14th, 2015 Study designs including: randomized controlled trials (RCTs), cohort studies, case-control studies Inception cohort of at least 30 subjects per treatment arm for RCTs or 100 subjects per exposed group for cohort studies with musculoskeletal disorders or injuries of the upper and/or lower extremities 	<ul style="list-style-type: none"> Guidelines, letters, editorials, commentaries, unpublished manuscripts, dissertations, government reports, books and book chapters, conference proceedings, meeting abstracts, lectures and addresses, consensus development statements, or guideline statements Cross-sectional studies, case reports, case series, qualitative studies, narrative reviews, systematic reviews, clinical practice guidelines, biomechanical studies, or laboratory studies Cadaveric or animal studies Studies on patients with severe injuries (e.g. grade III sprains/strains, fractures, dislocations, full ruptures, infections, malignancy, osteoarthritis, and systemic disease)

Comparison groups: We included studies that used other education interventions, placebo/sham intervention, wait list, no intervention or other conservative or invasive interventions.

Outcomes: To be eligible, studies had to include one of the following outcomes: 1) self-rated recovery; 2) functional recovery (e.g. disability, return to activities, work, or school); 3) clinical outcomes (e.g. pain, health-related quality of life, depression); 4) administrative data (e.g. time on benefits); or 5) adverse events.

Study characteristics: Study inclusion and exclusion criteria are listed in Table 1.

Information sources

We developed our search strategy with a health sciences librarian (Appendix 1). A second librarian reviewed the search strategy for completeness and accuracy using the Peer Review of Electronic Search Strategies (PRESS) Checklist.^{12,13} We searched the following databases: MEDLINE, EMBASE, CINAHL (EBSCO), PsycINFO, and the Cochrane Central Register of Controlled Trials (Ovid). We searched all bibliographic databases from January 1st, 1990 to March 14th, 2015.

We first developed the search strategy in MEDLINE and subsequently adapted it to other bibliographic databases. The search terms included subject headings (e.g.

MeSH for MEDLINE) specific to each database and free text words relevant to our research question and inclusion criteria.

Study Selection

We used a two-phase screening process to select eligible studies. In phase one, random pairs of independent reviewers screened titles and abstracts of citations to determine the eligibility of studies. Phase one screening resulted in studies being classified as relevant, possibly relevant, or irrelevant. In phase two, the same pairs of reviewers independently screened possibly relevant studies to determine eligibility. Reviewers met to resolve disagreements and reach consensus on the eligibility of studies. We involved a third reviewer if consensus could not be reached.

Assessment of Risk of Bias

Random pairs of independent reviewers critically appraised the internal validity of eligible studies using the Scottish Intercollegiate Guidelines Network (SIGN) criteria.¹⁴ The SIGN criteria were used to qualitatively evaluate the presence and impact of selection bias, information bias, and confounding on the results of a study. We did not use a quantitative score or a cut-off to determine the internal validity of studies.¹⁵ Rather, the SIGN criteria

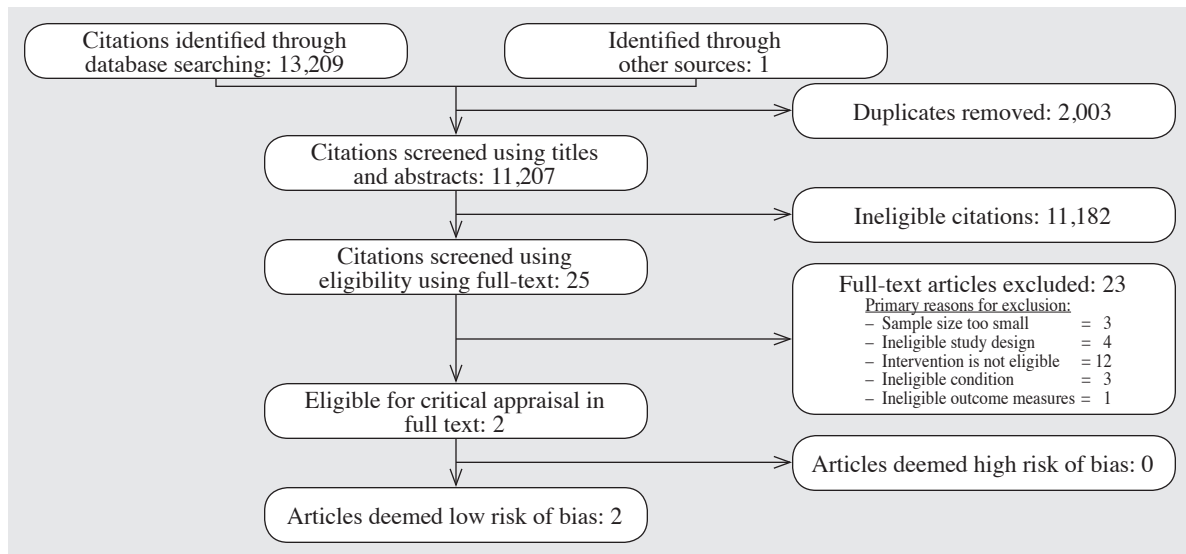


Figure 1:
Flow diagram of the number (n) of selected studies for effectiveness.

were used to assist reviewers to make an informed overall judgment on the internal validity of studies. This methodology has been previously described.¹⁶⁻²¹

Specifically, we critically appraised the following methodological aspects of an RCT: 1) clarity of the research question; 2) randomization method; 3) concealment of treatment allocation; 4) blinding of treatment and outcomes; 5) similarity of baseline characteristics between/among treatment arms; 6) co-intervention contamination; 7) validity and reliability of outcome measures; 8) follow-up rates; 9) analysis according to intention to treat principles; and 10) comparability of results across study sites (where applicable). Reviewers reached consensus through discussion. An independent third reviewer was used to resolve disagreements if consensus could not be reached. Following critical appraisal, studies with a low risk of bias were included in our synthesis.

Data Extraction and Synthesis of Results

The lead author extracted data from studies with a low risk of bias and built evidence tables (Table 3). A second reviewer independently checked the extracted data.

We performed a qualitative synthesis of findings from studies with a low risk of bias to develop evidence statements according to principles of best evidence synthesis.²² An intervention was deemed to be effective if it was associated with statistically significant and clinically important improvements in outcomes.

Statistical Analysis

We computed agreements between reviewers for the screening of articles and reported the kappa statistic (k) and 95% confidence interval (CI).²³ We computed differences in mean changes between groups (with 95% CI) where data were available. The computation of CIs assumed an $r=0.80$ between baseline and follow-up outcome values.^{24,25}

We stratified our results according to the type of disorder, duration [i.e. recent (≤ 3 months) versus persistent (>3 months)].

We used standardized cut-off values to determine if clinically important changes were reached in each trial for common outcome measures. These include a between-group difference of 10/100 mm or 10% difference

Table 2.
Summary of assessment of risk of bias for accepted randomized controlled trials (RCTs) based on the Scottish Intercollegiate Guidelines Network (SIGN) criteria¹⁴.

Author, Year	Research Question	Randomization	Concealment	Blinding	Similarity at baseline	Similarity between arms	Outcome measurement	Percent drop-out*	Intention to treat	Results comparable between sites
Bisset et al. ³¹	Y	Y	Y	Y	Y	N	Y	6 Weeks: Multimodal Care: 5% Corticosteroid Injection: 0% Reassurance and advice: 10% 52 Weeks: Multimodal Care: 5% Corticosteroid Injection: 0% Reassurance and advice: 7%	Y	CS
Song et al. ³⁰	Y	CS	Y	Y	Y	Y	Y	LPHA: 2/29 = 6.9% LP: 3/30 = 10 % Control: 5/30 = 16.7%	Y	NA

*Percent drop-out includes drop-outs and loss to follow-up

Acronyms: Y: Yes, N: No, CS: Can't Say, NA: Not Applicable; LP: leg press; LPHA: leg press and hip adduction

on the Visual Analog Scale (VAS)²⁶, 2/10 points on the Numeric Rating Scale (NRS)²⁷, and 9/80 points on the Lower Extremity Functional Scale (LEFS).²⁸

Reporting

The systematic review was organized and reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.²⁹

Results

Study Selection

We identified 13,210 citations of studies (which included one study identified in a related systematic review by our group).³⁰ We removed 2,003 duplicates and screened 11,207 citations (Figure 1). Of those, we found two relevant studies and both had a low risk of bias.^{30,31} The primary reasons for exclusion in full text screening were: small sample size (RCTs n<30, cohort studies n<100), ineligible study design, inability to determine the effectiveness of patient education alone, ineligible condition, and ineligible outcome measures. We were unable to com-

pute the inter-rater agreement for the screening of articles because only one relevant study was found through screening of the citations retrieved from the electronic search. The percentage agreement for the critical appraisal of articles was 100% (2/2 RCTs) based on admissible/inadmissible results.

Study Characteristics

We identified two RCTs with a low risk of bias; one study addressed the management of persistent lateral epicondylitis³¹ and the other focused on persistent patellofemoral pain syndrome.³⁰ We did not identify studies that investigated the effectiveness of structured patient education for the management of nerve entrapment syndromes.

Risk of Bias within Studies

Both RCTs with a low risk of bias had: 1) adequate treatment randomization and concealment methods; 2) similar groups at baseline; 3) valid and reliable outcome measures; and 4) intention to treat analyses (Table 2). The study follow-up rates were greater than 80% in both studies.

Table 3.

Evidence table for accepted randomized controlled trials assessing the effectiveness of structured patient education for musculoskeletal disorders and injuries of the extremities.

Author(s), Year	Subjects and Setting; Number (n) Enrolled	Interventions; Number (n) of Subjects	Comparisons; Number (n) of Subjects	Follow-up	Outcomes	Key Findings
Bisset et al., ³¹	Participants (18-65 y.o.) from Brisbane, Australia. Case definition: lateral elbow pain with palpation of the lateral epicondyle, gripping, resisted wrist or second or third finger extension of >6 weeks duration. (n=198)	Reassurance and Advice: reassurance (ADL modifications, analgesic drugs, heat, cold, braces), educational booklet (disease process, self-management advice, ergonomics) (n=67)	Corticosteroid injection by a GP (1 ml 1% lidocaine with 10 mg triamcinolone acetonide in 1 ml); 1 injection at painful points and second injection after two weeks if necessary; advice to return gradually to normal activities; educational booklet (disease process, self-management advice, ergonomics) (n=65) Multimodal care by a PT (8 visits/6 weeks): elbow manipulation, exercise (supervised and home-based), self-manipulation educational booklet (disease process, self-management advice, ergonomics). (n=66)	6, 12, 26 and 52 weeks	Primary Outcome: Global improvement (6 point Likert Scale); success = "completely recovered" or "much improved"; recurrence ("successful" to "unsuccessful"); pain-free grip force (digital grip dynamometer, affected side/unaffected side x 100) Secondary Outcome: pain severity (VAS 0-100 mm); elbow disability (Pain Free Function Questionnaire (PFFQ 0-100)); Sensorimotor function: SRT(ms); RT1(ms); RT2(ms); S1(cm/s); S2(cm/s) Adverse events.	<u>Relative Risk Reduction (Reassurance and Advice vs. Multimodal Care):*</u> <u>Success</u> 6 weeks: RR 0.38 (95% CI 0.24; 0.61) 12 weeks: RR 0.77 (95% CI 0.58; 1.02) 26 weeks: RR 1.08 (99% CI 0.88; 1.32) 52 weeks: RR 0.93 (95% CI 0.82; 1.07) <u>Recurrence</u> 6 weeks: RR 1.18 (95% CI 0.38; 3.69) <u>Difference in Mean Change from Baseline (Reassurance and Advice – Multimodal care*):</u> <u>Pain-free Grip Force</u> 6 weeks: -20.1 (99% CI -30.0; -10.3) 12 weeks: -9.4 (99% CI -20.9; 2.1) 26 weeks: -15.4 (99% CI -20.9; -9.9) 52 weeks: -4.3 (99% CI -16.2; 7.5) <u>Pain Severity</u> 6 weeks: -15.6 (99% CI -26.4; -4.7) 12 weeks: -11.2 (99% CI -24.1; 1.8) 26 weeks: -4.9 (99% CI -10.3, 0.5) 52 weeks: -6.9 (99% CI -17.3; 3.6) <u>PFFQ</u> 6 weeks: -15.6 (99% CI -28.4; -2.8) 12 weeks: -17.2 (99% CI -31.9; -2.4) 26 weeks: -5.0 (99% CI -11.1, 1.1) 52 weeks: -11.0 (99% CI -24.0; 2.1) <u>Relative Risk Reduction (Reassurance and Advice vs. Corticosteroid Injections):*</u> <u>Success</u> 6 weeks: RR 0.30 (95% CI 0.19; 0.48) 12 weeks: RR 1.17(95% CI 0.82; 1.67) 26 weeks: RR 1.61 (95% CI 1.18; 2.19) 52 weeks: RR 1.23 (95% CI 1.01; 1.51) <u>Recurrence</u> 6 weeks: RR 0.12 (95% CI 0.06; 0.27) <u>Difference in Mean Change from Baseline (Reassurance and Advice – Corticosteroid Injections):*</u> <u>Pain-free Grip Force</u> 6 weeks: -36.4 (99% CI -46.3; -26.5) 12 weeks: 5.4 (99% CI -6.0; 16.7) 26 weeks: 19.6 (99% CI 6.2; 33.0) 52 weeks: 12.1 (99% CI -0.3; 23.6) <u>Pain Severity</u> 6 weeks: -31.3 (99% CI -42.2; -20.5) 12 weeks: 5.2 (99% CI -7.5; 17.8) 26 weeks: 11.4 (99% CI -0.1; 23.0) 52 weeks: 7.7 (99% CI 2.7; 18.0) <u>PFFQ</u> 6 weeks: -33.3 (99% CI -46.0; -20.5) 12 weeks: -2.5 (99% CI -16.8; 11.9) 26 weeks: 19.5 (99% CI 5.8; 33.1) 52 weeks: 11.5 (99% CI -1.5; 24.5) <u>Sensorimotor Function</u> No differences between groups in SRT, RT1, RT2, S1 or S2 at any follow-up point. <u>Adverse Events</u> Minor: pain following treatment, loss of skin pigment; subcutaneous tissue atrophy Multimodal Care: 10.6%; Corticosteroid Injection: 20.0%; Wait and see: 0.0%.

*recalculated data from study; Acronyms: CI – confidence interval; LP – leg press; LPHA – leg press and hip adduction; VAS – Visual Analog Scale; y.o – years old; VMO – vastus medialis oblique; RR: Relative Risk; PFFQ – Pain Free Function Questionnaire; RT1 – 1-choice reaction time; RT2 – 2-choice reaction time; S1 – 1-choice speed of movement; S2 – 2-choice speed of movement; SRT – Simple Reaction Time

Table 3. (continued)

Evidence table for accepted randomized controlled trials assessing the effectiveness of structured patient education for musculoskeletal disorders and injuries of the extremities.

Author(s), Year	Subjects and Setting; Number (n) Enrolled	Interventions; Number (n) of Subjects	Comparisons; Number (n) of Subjects	Follow-up	Outcomes	Key Findings
Song et al., 2009 ³⁰	Patients (≤ 50 years) referred to kinesiology laboratory were enrolled. Case definition: at least 2 of the following positive signs: (1) patellar crepitus, (2) pain following isometric quadriceps femoris muscle contraction against suprapatellar resistance (Clarke's sign), (3) pain following compression of the patella against the femoral condyles (patellar grind test), (4) tenderness upon palpation of the posterior surface of the patella or surrounding structures, and (5) pain following resisted knee extension. (n=89)	Health education material regarding patellofemoral pain (n=30).	Leg press (LP) using an EN-Dynamic Track Machine. Patients unilaterally trained at 60% of 1-repetition maximum for 5 sets of 10 repetitions (3x/week for 8 weeks) with 15 minutes of hot pack applied to quadriceps femoris prior to exercise (n=30). Leg press and hip adduction (LPHA), same as leg press with addition of 50-N hip adduction force applied to the distal one third of the thigh (3x/week for 8 weeks) with 15 minutes of hot pack applied to quadriceps femoris prior to exercise (n=29).	8 weeks (post-intervention)	Worst pain (VAS 100mm) Functional evaluation (Lysholm scale 0-100) Measurement of vastus medialis oblique (VMO) muscle morphology-ultrasonography (HDI 5000)	Difference in mean change (Control-LP)*: Pain (100mm): -2.41 (95% CI -3.20, -1.62) Functional evaluation (Lysholm scale): -10.2 (95% CI -13.89, -6.51) VMO cross-sectional area (cm ²): -0.72 (95% CI -1.26, -0.18) VMO volume (cm ³): -1.01 (-1.74, -0.28) Results for LPHA vs. Control cannot be used due to low sample size in the LPHA group. Adverse Events: Not reported

*recalculated data from study; Acronyms: CI – confidence interval; LP – leg press; LPHA – leg press and hip adduction; VAS – Visual Analog Scale; y.o – years old; VMO – vastus medialis oblique; RR: Relative Risk; PFFQ – Pain Free Function Questionnaire; RT1 – 1-choice reaction time; RT2 – 2-choice reaction time; S1 – 1-choice speed of movement; S2 – 2-choice speed of movement; SRT – Simple Reaction Time

Summary of Evidence

Persistent Lateral Epicondylitis

Evidence from one RCT suggests that reassurance and advice by a physician is less effective, in the short-term, than multimodal care by a physical therapist or corticosteroid injection by a physician for persistent lateral epicondylitis (Table 3).³¹ However, there are no differences in long-term outcomes between groups. Bisset et al. randomized participants to: 1) reassurance and advice on self-management (activity modification, analgesic drugs, heat, cold or braces as needed); 2) multimodal care (elbow manipulation, clinic and home based exercise) provided in eight sessions over six weeks; or 3) one corticosteroid injection of the painful elbow joint and advice to return to normal activities (a second injection was offered after two weeks if necessary). All participants received an information booklet covering the disease process, self-management, and ergonomics. Participants randomized to the reassurance and advice group were less likely to report self-perceived improvement than those in the multimodal care group [Relative Risk (RR) = 0.38 (99% CI 0.24; 0.61)] at six weeks (Table 3). There were statistically significant and clinically important differences in pain severity [mean change difference on VAS: 15.6/100mm (99% CI

4.7; 26.4)] favouring multimodal care over reassurance and advice at the six-week follow-up. Similarly, the authors reported statistically significant differences in pain-free grip at six weeks and elbow disability at six weeks and 12 weeks favouring multimodal care over reassurance and advice. The minimal clinically important differences (MCIDs) for pain-free grip strength and elbow disability are unknown. When compared to the corticosteroid group, participants randomized to reassurance and advice were less likely to report self-perceived improvement [RR 0.30 (95% CI 0.19; 0.48)] at the six week follow-up (Table 3). There were statistically significant and clinically important improvements in pain severity [mean change difference on VAS: 31.3/100mm (99% CI 20.5; 42.2)] favouring corticosteroid injections over reassurance and advice at the six-week follow-up. Similarly, the corticosteroid group reported statistically significant improvements in pain-free grip force and elbow disability at the six-week follow-up. However, those in the reassurance and advice group reported greater improvements compared to the corticosteroid group in pain-free grip strength and elbow disability at 26 weeks (Table 3). At 52 weeks, improvements in pain severity favoured the reassurance and advice group; however, these improvements were not clinically important.

Persistent Patellofemoral Pain Syndrome

Evidence from one RCT suggests that an exercise-based multimodal care program by a physical therapist may provide superior outcomes to health education for the management of persistent patellofemoral pain syndrome.³⁰ In their study, Song et al. randomized participants to: 1) multimodal care that included hot pack application to the quadriceps femoris, followed by leg press exercises, stretching and cold pack; 2) multimodal care plus hip adduction strengthening; or 3) health education material regarding patellofemoral pain (format not specified). Results from the multimodal care plus hip adduction arm are not presented due to the small sample size ($n < 30$). Leg press exercises were carried out using an EN-Dynamic Track Machine (5 sets of 10 repetitions; 3 times/week; over 8 weeks) with 15 minutes of hot pack applied to the quadriceps femoris prior to exercise. The control group received health education material regarding patellofemoral pain (specific content not reported). Immediately following the eight week intervention, participants who received the multimodal intervention of leg press exercises combined with hot pack experienced statistically significant but not clinically important improvements in pain [mean change difference on VAS: 2.41/100mm (95% CI 1.62; 3.20)] compared to the patient education group (Table 3). Additionally, participants who received the multimodal care program had statistically significant improvement in function, vastus medialis oblique (VMO) cross-sectional area and VMO volume. The clinical importance of these differences is unclear. Although there were statistically significant differences in all outcome measures, there is marked uncertainty for the reported pain value. Specifically, the pain measurement scale (VAS 0-100 mm) described in the methodology and tables is incongruent, e.g. the value is very small, given that the primary complaint in patellofemoral pain syndrome would be anticipated to be pain. Extensive efforts were undertaken to contact the authors for clarification, but no response was received. Therefore, the results of this study should be interpreted with caution.

Adverse events

One of the two studies reported on adverse events.³¹ Bisset et al. reported that 20% of participants experienced adverse events associated with the corticosteroid injection. In the same study, 10.6% of participants reported ad-

verse events associated with multimodal care. The most common adverse event was pain after treatment (19/20 events). No adverse events were reported by those randomized to reassurance and advice.³¹

Discussion

Although structured patient education is commonly recommended for the management of musculoskeletal disorders and injuries, our review demonstrates that very little is known about its effectiveness. We found two RCTs with a low risk of bias that provide evidence on the effectiveness of structured patient education for the management of musculoskeletal injuries in the upper and lower extremities. We found that, in the short-term, structured patient education is less effective, than multimodal care or corticosteroid injection for the management of persistent lateral epicondylitis. We also found evidence that an exercise-based multimodal program of care may be superior to structured patient education for persistent patellofemoral syndrome immediately post-intervention. However, the clinical importance of this result is unknown. We found no admissible studies to inform the use of patient education for the management of musculoskeletal disorders and injuries of other extremities.

Our review reached similar conclusions on structured patient education as the previous review on the effectiveness of structured patient education for the management of neck pain. Yu et al. recently reported that structured patient education alone may be less effective than other non-invasive interventions (i.e. physiotherapy, supervised exercises and massage) in improving pain, functional recovery and clinical outcomes.⁹ However, their review also found no evidence to suggest that one method of delivering an education intervention (i.e. oral versus written) is more effective than the other.⁹ We did not find any studies with a low risk of bias comparing one form of structured patient education to another.

Our review has important clinical implications. Although it suggests that structured patient education may not be effective on its own for the management of extremity injuries, it does not suggest that clinicians should abandon educating patients. Educating patients about their condition, prognosis and appropriate treatment is always indicated and necessary when providing clinical care. Furthermore, in the study by Bisset et al., multimodal care that included an education booklet (disease

process, self-management, ergonomics) along with elbow manipulation, exercise (supervised and home-based), and self-manipulation was found to be statistically and clinically more important than education alone for persistent lateral epicondylitis.³¹ Another systematic review by Sutton et al., suggested that multimodal care that includes manual therapy, education and exercise may benefit patients with grades I and II whiplash associated disorders and neck pain and associated disorders.³² Therefore, our review suggests that education should not be used as a standalone intervention, but may be provided in combination with other effective interventions for musculoskeletal disorders and injuries of the extremities.

Our review has several strengths. First, we implemented a comprehensive and rigorous search strategy that was reviewed by a second librarian to help minimize errors. Second, we defined clear inclusion and exclusion criteria for the selection of relevant studies. Third, we used trained pairs of independent reviewers to screen and critically appraise the literature to minimize error and bias. Fourth, the SIGN criteria were used to standardize the critical appraisal process and to inform our scientific judgment. Lastly, our conclusions were based on a best-evidence synthesis, which involves excluding studies of low quality to minimize the risk of bias.

Our review also has limitations. First, we limited our search to studies published in the English language, which may have excluded some relevant studies. However, this is an unlikely source of bias as the majority of trials are published in English. The sole inclusion of trials published in English has not previously led to biased results.³³⁻³⁶ Secondly, the critical appraisal process entails scientific judgment that may differ between reviewers. This potential bias was minimized by training reviewers to utilize a standardized critical appraisal tool and by using a consensus process. Lastly, we chose to exclude grey literature and unpublished trials because there are no systematic methods to search for this literature and these articles are often not peer reviewed.

Conclusion

Our systematic review demonstrates that very little is known about the effectiveness of structured patient education for the management of musculoskeletal disorders and injuries in the upper or lower extremities. For persistent lateral epicondylitis, the evidence suggests that

reassurance and advice is associated with worse short-term outcomes than multimodal care or corticosteroid injections; however, the long-term outcomes are similar between interventions. Moreover, the evidence suggests that health education is less effective than strengthening exercises and hot packs in the short-term management of persistent patellofemoral syndrome. The effectiveness of structured patient education for musculoskeletal disorders and injuries in other extremities needs to be explored. Future research must have a low risk of bias and focus on specific forms of structured patient education for upper and lower extremities. Until further evidence indicates otherwise, it seems clinically reasonable that patient education should not be used as a standalone intervention, but rather in combination with other effective interventions for musculoskeletal disorders and injuries of the extremities.

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Appendix 1:
Search Strategy –

search terms for musculoskeletal disorders and injuries of the extremities and structured patient education.

1. exp Upper Extremity/
2. Shoulder Pain/
3. exp “Sprains and Strains”/
4. exp Cumulative Trauma Disorders/
5. exp Median Neuropathy/
6. Shoulder Impingement Syndrome/
7. exp Arm Injuries/
8. exp Hand Injuries/
9. Rotator Cuff/in [Injuries]
10. exp Tendinopathy/
11. Radial Neuropathy/
12. exp Ulnar Neuropathies/
13. exp Brachial Plexus/
14. Bursitis/
15. Thoracic Outlet Syndrome/
16. carpal tunnel syndrome.ab,ti.
17. (medial adj (epicondylitis or epicondylosis or epicondylopathy)).ab,ti.
18. (lateral adj (epicondylitis or epicondylosis or epicondylopathy)).ab,ti.
19. (shoulder* and (sprain* or strain*)).ab,ti.
20. (forearm* and (sprain* or strain*)).ab,ti.
21. (arm* and (sprain* or strain*)).ab,ti.
22. (wrist* and (sprain* or strain*)).ab,ti.
23. (hand* and (sprain* or strain*)).ab,ti.
24. tennis elbow.ab,ti.
25. (forearm and (injur* or pain)).ab,ti.
26. (wrist and (injur* or pain)).ab,ti.
27. peritendinitis.ab,ti.
28. (rotator cuff and (injur* or disorder*)).ab,ti.
29. (median adj neuropath*).ab,ti.
30. (radial adj neuropath*).ab,ti.
31. “De Quervain’s tenosynovit*”.ab,ti.
32. (shoulder and (tendonitis or impingement or capsulitis)).ab,ti.
33. frozen shoulder.ab,ti.
34. “thoracic outlet syndrome*”.ab,ti.
35. brachial plexus.ab,ti.
36. bursitis.ab,ti.
37. “shoulder impingement syndrome*”.ab,ti.
38. “upper extremit* injur*”.ab,ti.
39. ((radial or ulnar) adj neuropath*).ab,ti.
40. (hand* and (injur* or pain)).ab,ti.
41. (arm* and (injur* or pain)).ab,ti.
42. (forearm* and (injur* or pain)).ab,ti.
43. (wrist* and (injur* or pain)).ab,ti.
44. (shoulder* and (injur* or pain)).ab,ti.
45. “cumulative trauma disorder*”.ab,ti.
46. “cubital tunnel syndrome*”.ab,ti.
47. “overuse syndrome*”.ab,ti.
48. (repetit* and (strain* or sprain* or injur* or disorder*)).ab,ti.
49. or/1-48
50. exp Lower Extremity/
51. exp Hip Injuries/
52. exp Leg Injuries/
53. exp Knee Injuries/
54. exp Foot/
55. exp Toes/in [Injuries]
56. exp Knee Joint/
57. exp Foot Bones/
58. Anterior Cruciate Ligament/
59. Posterior Cruciate Ligament/
60. exp Collateral Ligaments/
61. Ankle Injuries/
62. Ankle Joint/
63. Ankle/
64. Lateral Ligament, Ankle/in [Injuries]
65. Fasciitis, Plantar/
66. (lower adj3 (extremit* or limb* or injur*)).ab,ti.
67. (ankle* and (sprain* or strain* or injur*)).ab,ti.
68. ((talofibular or calcaneofibular or calcaneotibial or tibio*) and (sprain* or strain* or injur*)).ab,ti.
69. (deltoid and ankle*).ab,ti.
70. (fibularis and strain*).ab,ti.
71. ((peroneal or peroneus) and strain*).ab,ti.
72. (tibialis and strain* and (anterior or posterior)).ab,ti.
73. (band syndrome and (illiotibial or IT)).ab,ti.
74. achilles.ab,ti.
75. (ACL or LCL or MCL or PCL).ab,ti.
76. “adductor muscle*”.ab,ti.
77. “collateral ligament*”.ab,ti.
78. gastrocnemius.ab,ti.

79. (gluteus or gluteal).ab,ti.
80. "hamstring*".ab,ti.
81. "hip flexor*".ab,ti.
82. "hoffa* syndrome".ab,ti.
83. iliofemoral.ab,ti.
84. impingement.ab,ti.
85. (buttock* and (injur* or pain*)).ab,ti.
86. (foot and (injur* or pain*)).ab,ti.
87. (hip* and (injur* or pain*)).ab,ti.
88. (knee* and (injur* or pain*)).ab,ti.
89. (leg* and (injur* or pain*)).ab,ti.
90. (thigh* and (injur* or pain*)).ab,ti.
91. (toe* and (injur* or pain* or turf)).ab,ti.
92. ischiofemoral.ab,ti.
93. "metatars*".ab,ti.
94. "patellofemoral pain syndrome*".ab,ti.
95. "patellar tendon*".ab,ti.
96. popliteus.ab,ti.
97. pubofemoral.ab,ti.
98. "quadricep*".ab,ti.
99. soleus.ab,ti.
100. talocrural.ab,ti.
101. "tarsal*".ab,ti.
102. tendinosis.ab,ti.
103. tendinopathy.ab,ti.
104. plantar fasciitis.ab,ti.
105. tibialis.ab,ti.
106. or/50-105
107. 49 or 106
108. exp Professional-Patient Relations/
109. exp Patient Education as Topic/
110. exp Patient Compliance/
111. exp Patient Participation/
112. exp Self Care/
113. Program Evaluation/
114. exp Health Knowledge, Attitudes, Practice/
115. Learning/
116. exp Videotape Recording/
117. Communication/
118. exp Internet/
119. exp Cognitive Therapy/
120. (patient* adj4 (educat* or inform* or learn* or teach* or knowledge or advice or advise*)).ab,ti.
121. (doctor* patient* adj4 (communicat* or educat* or relations* or interact*)).ab,ti.
122. (physician* patient* adj4 (communicat* or educat* or relations* or interact*)).ab,ti.
123. (nurse* patient* adj4 (communicat* or educat* or relations* or interact*)).ab,ti.
124. (educat* adj4 (consumer* or health)).ab,ti.
125. (email* or e-mail* or pamphlet* or book* or neck book* or neck school* or internet or facebook or twitter or youtube or linkedin or social media or advise or advice or advised).ab,ti.
126. ((cognitive or behavi*) adj3 (therap* or treatment*)).ab,ti.
127. "small adj3 group*".ab,ti.
128. (group* adj3 (learn* or teach*)).ab,ti.
129. "self manage*".ab,ti.
130. (brief adj2 intervention).ab,ti.
131. SBIRT.ab,ti.
132. or/108-131
133. Randomized Controlled Trials as Topic/
134. Controlled Clinical Trials as Topic/
135. Clinical Trials as Topic/
136. exp Case-Control Studies/
137. exp Cohort Studies/
138. Double-Blind Method/
139. Single-Blind Method/
140. Placebos/
141. randomized controlled trial.pt.
142. controlled clinical trial.pt.
143. comparative study.pt.
144. (meta analys* or meta-analys* or metaanalys*).ab,ti.
145. (cohort and (study or studies or analys*)).ab,ti.
146. (random* and (control* or clinical or allocat*)).ab,ti.
147. (case adj control*).ab,ti.
148. ((double or single) and blind*).ab,ti.
149. "placebo*".ab,ti.
150. (comparative and (study or studies)).ab,ti.
151. (case adj control*).ab,ti.
152. (meta analys* or meta-analys* or metaanalys*).ab,ti.
153. or/133-152
154. 107 and 132 and 153
155. limit 154 to (english language and humans and yr="1990 – Current")

Initial integration of chiropractic services into a provincially funded inner city community health centre: a program description

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Background: The burden of fees for chiropractic services rendered often falls on the patient and must be provided out-of-pocket regardless of their socioeconomic status and clinical need. Universal healthcare coverage reduces the financial barrier to healthcare utilization, thereby increasing the opportunity for the financially disadvantaged to have access to care. In 2011 the Canadian Province of Manitoba initiated a pilot program providing access to chiropractic care within the Mount Carmel Clinic (MCC), a non-secular, non-profit, inner city community health centre.

Objective: To describe the initial integration of chiropractic services into a publically funded healthcare

Contexte : Les frais de chiropratique sont souvent imputés aux patients et doivent être déboursés de la poche de ces derniers, et ce, quels que soient leur situation socioéconomique et leurs besoins cliniques. La couverture maladie universelle réduit les obstacles financiers au recours aux soins de santé, augmentant ainsi les possibilités pour les personnes défavorisées sur le plan financier d'avoir accès aux soins. En 2011, la province canadienne du Manitoba a lancé un programme pilote offrant l'accès à la chiropratique au sein de la Mount Carmel Clinic (MCC), un centre de santé communautaire confessionnel du centre-ville sans but lucratif.

Objectif : Décrire l'intégration initiale de la chiropratique dans un établissement de soins de santé financé par l'État en fournissant des données démographiques, des tendances d'acheminement, des

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facility including patient demographics, referral patterns, treatment practices and clinical outcomes.

Method: A retrospective database review of chiropractic consultations in 2011 (N=177) was performed.

Results: The typical patient referred for chiropractic care was a non-working (86%), 47.3(SD=16.8) year old, who self-identified as Caucasian (52.2%), or Aboriginal (35.8%) and female (68.3%) with a body mass index considered obese at 30.4(SD=7.0). New patient consultations were primarily referrals from other health providers internal to the MCC (71.2%), frequently primary care physicians (76%). Baseline to discharge comparisons of numeric rating scale scores for the cervical, thoracic, lumbar, sacroiliac and extremity regions all exceeded the minimally clinically important difference for reduction in musculoskeletal pain. Improvements occurred over an average of 12.7 (SD=14.3) treatments, and pain reductions were also statistically significant at $p < 0.05$.

Conclusion: Chiropractic services are being utilized by patients, and referring providers. Clinical outcomes indicate that services rendered decrease musculoskeletal pain in an inner city population.

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KEY WORDS: populations, underserved; spinal manipulation; musculoskeletal; multidisciplinary; chiropractic; low-income population; program description

Introduction

A predominant reason for seeking healthcare is for the treatment of back pain.¹ The lifetime prevalence of back pain, specifically low back pain, for the general population is thought to be as high as 84%, with up to 48.9%

pratiques de traitement et des résultats cliniques relatifs aux patients.

Méthode : Un examen rétrospectif de la base de données des consultations en chiropratique en 2011 (N = 177) a été réalisé.

Résultats : Le patient type aiguillé vers des soins en chiropratique était une personne de 47,3 ans (écart-type = 16,8) inactive (86 %), qui se considérait comme étant Caucasiennne (52,2 %) ou Aborigène (35,8 %), et de sexe féminin (68,3 %) possédant un indice de masse corporelle de 30,4 (écart-type = 7,0) associé à l'obésité. Les consultations de nouveaux patients consistaient principalement en des aiguillages d'autres intervenants en matière de santé du MCC (71,2 %), souvent des médecins de premier recours (76 %). Les données de référence pour élargir les comparaisons des résultats obtenus sur l'échelle d'évaluation numérique pour les régions cervicale, thoracique, lombaire, sacro-iliaque et des extrémités des membres étaient toutes supérieures à la différence minimale cliniquement importante relative à la réduction de la douleur musculo-squelettique. Les améliorations sont apparues après une moyenne de 12,7 traitements (écart-type = 14,3). De plus, les réductions de la douleur étaient également importantes sur le plan statistique au niveau de $p < 0,05$.

Conclusion : Les patients et les intervenants en matière de santé aiguillant les patients ont recours à la chiropratique. Les résultats cliniques indiquent que les soins dispensés ont pour effet de réduire la douleur musculo-squelettique chez une population du centre-ville.

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MOTS-CLÉS: chiropratique, populations, mal desservie, manipulation vertébrale, musculo-squelettique, multidisciplinaire, population à faible revenu, description de programme

of affected individuals experiencing pain in the previous 6 months.^{2,3} Chiropractors are healthcare providers that deliver conservative non-pharmacological, and non-surgical management of mechanical muscle and joint pain, most typically back pain.⁴ Chiropractors do not oppose

pharmacological or surgical treatment options when such approaches are clinically necessary.⁵ Chiropractic intervention targets the muscles and joints, using manual and physical procedures, most commonly including manipulation, massage, exercise and nutrition.⁶ Typically chiropractic patients report high levels of satisfaction with care.⁷ Chiropractic services are considered relatively cost effective.^{8,9} Chiropractic intervention is considered safe, as there are a low number of adverse events that occur directly as a result of treatment.¹⁰

Low-income populations utilize chiropractic care less than the general population.¹¹ The financially disadvantaged must carefully manage their limited economic resources. Engaging in a course of chiropractic care typically involves financial consideration as it is excluded from many public and private health insurance plans.¹² Out of pocket expense for healthcare forces low income individuals to weigh the costs and benefits of healthcare against their other basic necessities of life.¹² The poor are more likely to utilize healthcare services when they can be provided by a universal healthcare system. The reason is that universal healthcare coverage reduces the financial barrier to healthcare utilization.^{13,14}

A lower income results in a greater propensity toward having unmet healthcare needs in both Canada and the United States.¹⁵ A possible reason, at least in Canada, is that healthcare services such as dentistry, optometry, physical therapy and chiropractic are largely not reimbursed by provincial healthcare plans. Delisted services, that were previously partially covered, have specifically been less accessed by the lowest income groups of the population.¹⁴ User fees are the barrier to utilization of services for chiropractic and optometry, according to a study on the provision of free supplemental health care benefits for low-income families.¹⁶ The result is that in order to be provided with reimbursement for services such as chiropractic, patients require coverage from a worker's compensation board, motor vehicle accident insurance provider, or other supplemental health insurance benefits provided by an employer. Without healthcare coverage, the burden of fee for services rendered falls on the patient and must be provided out-of-pocket regardless of their socioeconomic status and clinical need.

In 2011, the Mount Carmel Clinic (MCC), a provincially funded health centre in Winnipeg, Manitoba, Canada implemented fully government subsidized chiroprac-

tic services, alongside its existing medical and dental services. The public funding of the chiropractic clinic addresses an issue raised by Soklaridis, Kelner, Love and Cassidy (2009) regarding the typical lack of funding allocated by the Canadian healthcare system toward complementary and alternative medicine.¹⁷ Manitoba Health Family Services is demonstrating an interest in exploring universal and equitable access to health care that includes chiropractic services for underprivileged Manitobans.

The MCC serves a demographic of the poor and underserved within Winnipeg, specifically an area with the highest unemployment rate, and lowest average family income in the city. Since the chiropractic clinic was implemented a prospective quality assurance (QA) database has been maintained by the on-site chiropractors in collaboration with the administration at the MCC. The purpose of maintaining a prospective QA database is that the data can be used to evaluate service utilization, and relevant impacts of clinic implementation.¹⁸ The purpose of this manuscript is to evaluate what the outcome of the initial integration has been in the first year of a publically funded inner city chiropractic clinic integrated within a multidisciplinary health centre targeting the poor and underserved.

Methods

The study utilized a cross-sectional, retrospective examination of prospectively collected QA data attained from the MCC chiropractic clinic database. All data were collected during calendar year 2011. The database is maintained at the MCC by the chiropractic clinicians on site. A university-based researcher, with a clinical background, summarized all data. Patient data was completely de-identified upon entry into an anonymous database prior to analysis and interpretation. Permission to conduct the study of the database was attained from the officer of records at the MCC as well as the University of Manitoba Health Research Ethics Board.

The MCC is a provincially funded, non-secular, non-profit, inner city multidisciplinary community health centre located centrally in Winnipeg, Manitoba, Canada. The MCC chiropractors receive an hourly wage, on par with physician pay grade as approved by Manitoba Health. There is no financial incentive to see patients for a longer course of care than the minimum clinically warranted to induce difference, or long enough to determine that their presentation does not respond to chiropractic

care and an appropriate referral can be identified. The two chiropractors are part-time independent contractors, each spending 1-day per week at the clinic. Services that the chiropractors at the MCC provide are summarized in Table 1.

New patients referred to the clinic received a new patient assessment and then either underwent informed consent procedures to initiate a course of chiropractic management, or were referred to another appropriate health care provider if chiropractic intervention was not clinically warranted. Follow up visits during a typical course of care included spinal or extremity joint manipulation and/or mobilization, soft tissue therapy, and potentially other modalities including contemporary medical acupuncture. Re-evaluation visits were scheduled after every 4-6 treatment visits to assess whether patients were responding to care, not responding to care, or had reached a plateau in therapeutic response to intervention. Time slot durations for new patient assessments, re-evaluations, and follow up visit time duration allotments were designed by the clinicians in tandem with the MCC. Typical new patient assessments were scheduled for 30-60 minutes, while treatment visits and re-evaluation visits were 15-30 minutes in duration.

Analysis

Analysis of reported data consists of interpretation of raw numbers, and percentages of respondents to items from the database. Most unique patients (N=177) attended the clinic on multiple occasions, which is why the completed treatment visit total is 1803. Any discrepancies between the number of patients in the study (N=177), and the numbers used for comparison to derive percentages, is due to participants choosing to abstain from a question, or if the course of care was completed (from intake to discharge) during calendar year 2011.

Paired two-tailed Student's T-tests were used for analysis comparing baseline, and discharge outcome measures. Specifically, separate analyses were performed for the numeric rating scale (NRS) scores of completed courses of management that were targeted to the cervical, thoracic, lumbar, sacroiliac, and extremity regions. Some patients had multiple regions of complaint, and treatment and thus reported separate NRS scores for each region. Raw NRS point change, and percentages of baseline at discharge changes were also reported.

Table 1.
Chiropractic Services – Services chiropractors provide at the Mount Carmel Clinic (MCC)

(a)	Record patient health history
(b)	Conduct patient examination (chiropractic, physical and orthopaedic)
(c)	Determine if additional diagnostic tests are required (radiographs)
(d)	Report of findings to patients (review of examination results)
(e)	Determine if chiropractic treatment is clinically warranted for presenting condition or if referral for other healthcare management is required
(f)	Communicate a diagnosis
(g)	Design a treatment plan
(h)	Engage patient in informed consent procedures
(i)	Treat patients
(j)	Document clinical encounters
(k)	Provide patient education (exercise, healthy living)
(l)	Assist MCC with community program activities
(m)	Promote “Manitoba Healthy Living” strategies
(n)	Deliver presentations to MCC staff
(o)	Work with the MCC Health Team to achieve full integration of services

Results

Female patients represented just over two-thirds (68.3%) of patient treatment visits at the MCC chiropractic clinic. While there was a diverse range for ages of patients, that data is skewed toward the aging population, with 48.9% of all treatment visits going to patients 51 years of age or older. Patients self reported their height and weight, which facilitated body mass index (BMI) calculation. The average BMI was 30.4 ($SD=7.0$) based on 120 unique respondents, which is considered obese. Of all unique patients who visited the chiropractic clinic, 91/177 (54.8%) patients had a BMI < 30 and were not considered obese. Patients were asked to voluntarily self-identify their ethnic background. While a full spectrum of cultural backgrounds were reported Caucasian, and Aboriginal individuals made up 52.2% and 35.8% of the clinic's population respectively. Details of the specific breakdown of all

Table 2.

Patient Demographics – Chiropractic patient demographic data of all visits at the Mount Carmel Clinic (MCC) in 2011

Gender (total clinic visits) – 1,803		
Male	572	(31.7%)
Female	1,231	(68.3%)
Age Category (total clinic visits) – 1,803		
0-10	5	(0.3%)
11-20	65	(3.6%)
21-29	148	(8.2%)
30-39	211	(11.7%)
40-50	492	(27.3%)
51-60	461	(25.6%)
61+	421	(23.3%)
Ethnicity (159 unique respondents)		
Aboriginal	57	(35.8%)
African	2	(1.3%)
Asian	5	(3.1%)
Caucasian	83	(52.2%)
Hispanic	5	(3.1%)
Middle Eastern	1	(0.6%)
Other	6	(3.8%)
Employment Status (total clinic visits) – 1803		
Working	254	(14%)
Not Working	1,549	(86%)

collected patient demographic data can be found in Table 2. Patients not currently working (86%) utilized the majority of chiropractic clinic visits. Only 9 of 161 (6.0%) of new patients who completed treatment required new radiographs that were not already in their medical record, prior to initiating a course of care. A typical course of care from intake to discharge on average consisted of 12.7 ($SD=14.3$) treatment visits based on 160 completed cases in calendar year 2011.

Of appointments scheduled 74.5% (1763/2365) of total clinic visits were kept, presently there is no penalty for failing to attend a scheduled visit. Only 2.9% (52/1803) of patient visits to the clinic were unscheduled “walk-ins”. When patients were asked if their “initial chiropractic visit saved them from making an additional PCP visit” of the 161 respondents, 132 (82.0%) stated “yes” it did. When discharged from chiropractic only 7 (4.0%) of 161 respondents required referral to another healthcare provider for additional care.

Table 3.

Referral Sources – New patient referral sources for Mount Carmel Clinic’s (MCC) chiropractic patients (N=177).

Health Professional – Internal to MCC	126	(71.2%)
Health Professional – External to MCC	7	(4.0%)
Marketing	2	(1.1%)
Signage	14	(7.9%)
Reactivated patient	0	(0.0%)
Other patients (word of mouth)	15	(8.5%)
Other	13	(7.3%)

Table 4.

Duration of Complaint – Duration of complaint from new patients (N=177), some with multiple regions, at the Mount Carmel Clinic’s (MCC) chiropractic clinic.

	Acute Pain (% of Acute)	Chronic Pain [>3 months] (% of Chronic)	Ratio (acute to chronic)
Cervical Spine	18 (20.7%)	76 (19.4%)	1 : 4.2
Thoracic Spine	21 (24.1%)	91 (23.2%)	1 : 4.3
Lumbar Spine	17 (19.5%)	105 (26.8%)	1 : 6.2
Sacroiliac	7 (8.0%)	69 (17.6%)	1 : 9.9
Extremity	24 (27.6%)	51 (13.0%)	1 : 2.1

Referral by other healthcare providers on-site within the MCC made up the majority (71.2%) of new patients at the chiropractic clinic (Table 3). Referral by healthcare providers from outside of the MCC consisted of a small number of patients (4.0%). Primary care physicians were the greatest referral source from healthcare providers (76.0%).

During the first four months of clinic operation both new patient visits (Figure 1), and total patient visits (Figure 2) increased steadily. During the final five months of the year it appeared that a steady state of clinic operation had been reached. There was a mean of 14.8 new patients (177/12) per month, and 135.5 ([1803-177]/12) follow-up visits per month during the inaugural clinic year.

There were consistently more patients seeking management for chronic conditions (symptoms >3 months in duration) as revealed by examination of the ratio of acute to chronic condition patients (Table 4). For those with acute pain seeking treatment, there was a relatively even dis-

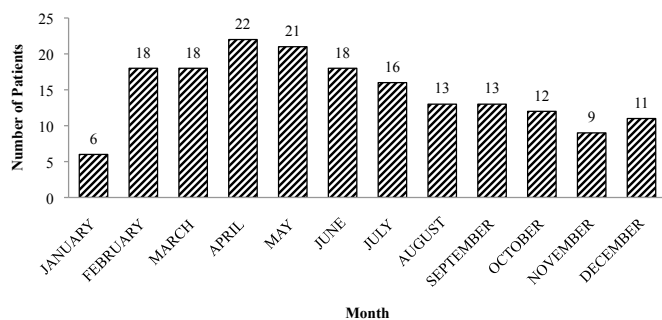


Figure 1.

Number of new patients, by month, presenting to the Mount Carmel Clinic for chiropractic services in 2011 (N=177).

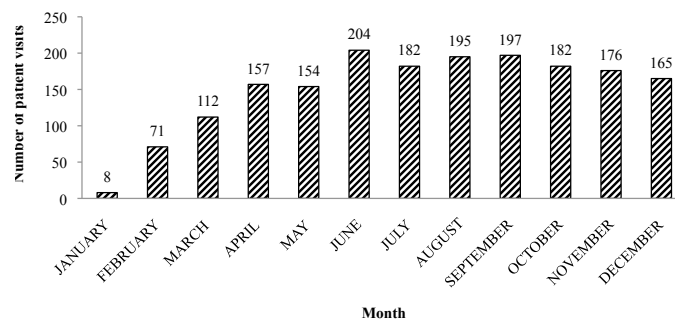


Figure 2.

Total number of patient visits (evaluation and follow-up), by month, presenting to the Mount Carmel Clinic for chiropractic services in 2011 (N=1803).

tribution of patients by spinal region with the exception of those with sacroiliac joint pain who were substantially fewer in number (8.0%) (Table 4). For patients with chronic pain seeking treatment, the fewest number of patients had extremity region pain (13.0%), while the greatest proportion of patients sought care for pain in the lumbar region (26.8%).

Patients who received high-velocity low-amplitude (HVLA) joint manipulation, mobilization, and soft tissue intervention, had those interventions directed most often toward the thoracic and lumbar spinal regions followed by the cervical region (Table 5). Similar numbers of patients received HVLA joint manipulation, mobilization, and soft

tissue intervention to the same treatment regions, likely due to the multifaceted nature of chiropractic intervention (Table 5). Contemporary medical acupuncture when used (48 cases) was most commonly targeted toward the cervical (16/48 cases; 33.3%) and extremity (14/48 cases; 29.2%) regions. The greatest use of other care modalities within a course of chiropractic management were those directed toward the lumbar spine (67 cases; 25.4%) and the sacroiliac regions (62; 23.5%).

Statistically, all five regions assessed by the NRS demonstrated significant improvement when comparing baseline and follow up scores for a completed course of management. Beyond statistical significance, when

Table 5.

Treatment Intervention – Type of treatment intervention, by region, delivered by chiropractors at the Mount Carmel Clinic (MCC). Data reflects the number of unique patients receiving intervention per region (% receiving the respective intervention)

	HVLA SM	Mobilization	Soft Tissue	Acupuncture	Other Modalities
CS	98 (21.2%)	94 (20.6%)	96 (21.1%)	16 (33.3%)	44 (16.7%)
TS	121 (26.2%)	114 (25.0%)	118 (25.9%)	9 (18.8%)	57 (21.6%)
LS	120 (26.0%)	118 (25.9%)	114 (25.1%)	5 (10.4%)	67 (25.4%)
SI	81 (17.5%)	80 (17.5%)	81 (17.8%)	4 (8.3%)	62 (23.5%)
Ext	42 (9.1%)	50 (11.0%)	46 (10.1%)	14 (29.2%)	34 (12.9%)

Legend: HVLA is high-velocity low-amplitude; SM is spinal manipulation; CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region, Ext is extremity.

Table 6.
Patient Outcomes – Patient outcomes by region for the Pain Numeric Rating Scale (NRS): M (SD).

	Baseline	Discharge	Point Change	% Change	P-Value
CS (n=38)	6.5 (2.5)	4.7 (3.0)	-1.8	-28.3	0.00009
TS (n=46)	6.7 (2.3)	5.2 (3.0)	-1.5	-22.3	0.0004
LS (n=55)	6.8 (2.5)	4.8 (2.9)	-2.0	-30.1	0.000001
SI (n=25)	7.7 (2.8)	5.2 (3.4)	-2.5	-32.8	0.001
Ext (n=35)	7.3 (2.1)	4.9 (3.0)	-2.4	-33.2	0.00003

Legend: MCID for chronic musculoskeletal pain for NRS is -1 point, or -15% from baseline (Salaffi et al., 2004); p-values are derived from 2-tailed paired T-tests, significant differences are $p < 0.05$. CS is cervical spine; TS is thoracic spine; LS is lumbar spine; SI is sacroiliac region, Ext is extremity. MCID is minimally clinically important difference.

considering clinical populations the minimally clinically important difference (MCID) is an important and meaningful metric. According to Salaffi et al. (2004), the MCID for chronic musculoskeletal pain is a NRS change of -15.0% or at least -1 point.¹⁹ A change of -33.0% or at least -2 points is associated with a patient reporting they feel “much better”. Based on the NRS data collected from baseline compared to discharge all four spinal (cervical, thoracic, lumbar, and sacroiliac) and the extremity regions responded to chiropractic intervention in excess of a MCID (Table 6). In terms of percent improvement, a course of care directed to the extremity regions attained improvement beyond 33.0% (Table 6). In terms of point change, the LS, SI and extremity regions (Table 6) all demonstrated change beyond 2 points, an improvement associated with patients feeling “much better”, following chiropractic intervention. Upon completion of a course of care of 161 chiropractic cases, 154 (96%) did not warrant referral to another healthcare provider.

Discussion

While the integration of chiropractic care into an inner city government funded multidisciplinary healthcare facility is relatively novel, there are isolated examples that can be used for comparison. For example integration of chiropractic services occurred a decade ago within the United States Veterans Health Administration, and a unique community health centre example in the province of Ontario, Canada. The characteristics of a typical MCC chiropractic patient differ drastically from those who are seen in a

United States Veterans Affairs hospital chiropractic clinic most notably in age and gender representation. The typical veteran chiropractic patient was a 54.8 (SD=15.9) year old male (88.4%).²⁰ MCC patients referred for chiropractic care were typically 47.3(SD=16.8) year old females (68.3%), who self identified as Caucasian (52.2%), or Aboriginal (35.8%) and non-working (86%) (Table 2). The MCC chiropractic patient population more closely resembled the Southern Ontario Community Health Centre (CHC) chiropractic clinic population in terms of age and gender representation.²¹ Patients over the age of 50 made up 44.1% of the CHC population, and 48.9% of the MCC population. Also similar was that the gender representation of the CHC was 73.0% female. The CHC is a chiropractic clinic that was created in Ottawa, Ontario, Canada as a demonstration project by the Ontario Ministry of Health and Long Term Care, who were also exploring the integration of chiropractors into multidisciplinary primary care settings.

Differences between the populations seen by the CHC chiropractic clinic and the MCC chiropractic clinic include the distribution of regions of complaint. The CHC data reveals their clinic largely treated the low back region (56.0%) with no other spinal region exceeding 11.6% of their population, or extremity region exceeding 6.6%.²¹ In contrast, treatment of the lumbar region made up only 19.8% (acute pain) and 26.8% (chronic pain) of MCC chiropractic visits. Treatment of the cervical and thoracic spinal regions (Table 4) was greater at the MCC as was treatment of extremity regions that were 27.6%

(acute pain) and 13.0% (chronic pain) visits respectively (Table 4). Baseline, discharge, and change in NRS pain scores were similar between the CHC chiropractic clinic, and the MCC chiropractic clinic. Garner et al., did not report the NRS by region, but the typical NRS at baseline was $M=6.2(SD=2.4)$, and discharge $M=3.9(SD=2.7)$ for a change of -2.3 points.²¹ If the MCC chiropractic lumbar region data is used for comparison, NRS at baseline was $M=6.8(SD=2.5)$ and discharge was $M=4.8(SD=2.9)$ for a change of -2.0 points, which is similar to the CHC findings.

At the MCC chiropractic clinic while 74.5% of scheduled visits were kept, 25.5% is a noteworthy no-show rate. Higher no-show rates are predicted in underserved populations.²² In a primary care setting no-show rates as high as 50% have been reported.²³ Strategies to decrease no-show rates include implementing a phone-call reminder system, and discharging the patient from care following 2 or more no-show visits. Strategies to lessen the burden of no-show visits on clinic performance include using predictions of no-show rates to strategically overbook a clinic or encouraging “walk-in” treatment visits.²³ The observation that nearly three quarters of chiropractic appointments are kept is an indication that patients value the care they are receiving.

There are examples of other health clinics that target inner city or include low-income populations and deliver chiropractic services. At least twenty-four chiropractic programs in academic institutions provide free or low-cost services targeted to those who live in poverty.⁵ The programs take place around the globe in countries such as Canada, England, South Africa, The United States, Brazil, Korea, France, and Australia. The MCC differs from those sites in three specific ways. The first difference is financial, the MCC chiropractic clinic is directly supported by provincial healthcare family services funding for its operating costs including clinician salaries, as opposed to being funded by an academic institution.²⁴ The second difference is that the services provided come directly from an experienced chiropractor. Clinical student interns supervised by academic clinicians deliver care in other “outreach” model clinics.²⁵ The third difference is that patients do not require a specific vocational or service background (veterans) to qualify as a patient.²⁰ At the MCC to be eligible for care you must simply be: 1) on social assistance, or classified as “working poor”; 2) have

a postal code that reflects you are a resident of the Point Douglas neighbourhood or North End of Winnipeg; 3) be a refugee who has recently moved to Manitoba; or 4) be referred by another community outreach program. Also, all MCC patients must not have standing claims with organizations that would otherwise pay for healthcare services such as the Workers Compensation Board (WCB), or Manitoba Public Insurance (MPI) which covers services related to automobile accidents.

While the QA database was maintained prospectively, the concept of data utilization for research purposes is retrospective. A limitation of the present study is that research questions and interpretation are limited as to the headings included for data capture in the initial design of the database. In addition caution should be taken with the generalization of the results. The study population was the entire intake in the first year of chiropractic patients in an inner city clinic in Manitoba, and may not exactly reflect a rural population, or other urban centers across North America.

Lessons Learned

In order to integrate a new clinical specialty for underprivileged patients, a clinic requires adequate funding. In the case of the MCC that funding comes from provincial taxpayers through Manitoba Health Family Services. The support of Manitoba Health Family Services provided the salary lines to attract highly skilled professionals. By providing funding as an hourly wage, and not fee for service, providers are not motivated to see a patient any more than is clinically warranted to induce a positive therapeutic change. Our results indicate that bringing a chiropractor into a publically funded healthcare team anecdotally decreases the number of primary care visits a patient perceives they need. Reduction in number of primary care visits made by the aforementioned patients, increases the amount of time the primary care provider can spend interacting with patients who are in absolute need of the services of a medical physician.

Upon discharge from clinical care very few patients who benefited from chiropractic intervention required other clinical services. No longer requiring other clinical services further unburdens other care providers in the clinic who may have heavy clinic loads, or even patient waiting lists. According to our results the implementation of chiropractic services to a publically funded clinic was:

1) a service that is utilized for referral by other health-care providers; 2) reduces pain in patients with acute and chronic spine or extremity pain, and; 3) a service that is valued by patients who would otherwise be unable to afford chiropractic services.

Federal, and provincial policy makers, academics or philanthropic agencies may utilize the presented findings to gain insight as to QA measures to record, and what the potential benefit of adding chiropractic services to an inner city multidisciplinary healthcare facility targeted to the poor and underserved may be. Chiropractors typically practice in private outpatient clinics, or multidisciplinary clinics alongside physical therapists, registered massage therapists, or athletic therapists.⁶ Popularity of inclusion of chiropractic services in private hospital facilities,^{26,27} veterans hospital facilities,^{20,28-30} and active military base settings³¹, are endeavours that have occurred in the past decade but continue to grow^{26,20,30}.

The data presented in this manuscript reflect clinic performance and patient demographics during the inaugural year in which the clinic was created. Follow-up studies exploring the evolution of this type of clinic are warranted to determine the need for expansion or reduction of services, or if a steady-state plateau is attained based on current clinic size and operation. Future studies will be able to compare year-year clinic growth/reduction, patient demographics, outcomes and overall clinical performance from a broader perspective.

Future considerations in working with chiropractic integration of inner city populations include greater utilization of empirically validated outcome measures. Although, questionnaire-based outcome measures should be applied with caution as results may be limited by the literacy and comprehension abilities of the population.²¹ Objective performance-based outcome measures may provide better clinical insight in this and other populations.³² In future studies, the comparison of chiropractic care to other services provided at the MCC with regard to utilization, efficacy and patient satisfaction should be explored.

In conclusion, chiropractic services within a provincially funded, non-secular, non-profit, inner city multidisciplinary community health centre are being utilized with positive results in pain reduction. Prospectively maintained QA data provides a useful window into clinic operation, and performance during clinic implemen-

tation. The outcome of the initial integration in the first year of a publically funded chiropractic clinic targeting the poor and underserved has been successful in terms of exceeding minimally clinically important differences in all painful regions of the body targeted for treatment. The high clinic attendance rate and percentage of referrals for chiropractic services from primary healthcare providers in the MCC facility highlights the value that both patients and other clinicians place on the integration of chiropractic services.

Publically funded inner city chiropractic clinics targeting the poor and underserved allow chiropractic services to be offered and utilized, specifically for more chronic pain conditions, by a component of the population that would otherwise likely be unable to attain healthcare due to a financial barrier. Future research on chiropractic clinic implementation into publically funded multidisciplinary facilities may include the number of primary care visits saved via integration, clinic model sustainability, and the cost/benefit of having chiropractic services added to a government funded healthcare system.

Conflicts of interest

The authors report no conflict of interest. The authors alone are responsible for the content and composition of the manuscript.

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A posterior ring apophyseal fracture and disc herniation in a 21-year-old competitive basketball player: a case report

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Objective: To describe the diagnosis and management of a competitive male basketball player with discogenic low back pain and presence of an old posterior ring apophyseal fracture (PRAF). This case will highlight the importance of early recognition and considerations regarding patient management for this differential of radiating low back pain.

Clinical Features: A 21-year-old provincial basketball player presented with recurrent radiating low back pain into the left groin and lower limb. After several weeks of persistent symptoms including pain, muscle weakness, and changes in the Achilles deep tendon reflex, imaging was obtained that revealed a large disc extrusion with an old posterior ring apophyseal fracture. In collaboration

Objectif : Décrire le diagnostic et la prise en charge d'un joueur de basketball de compétition atteint de lombalgie d'origine discale et présentant une ancienne fracture des apophyses postérieures. Ce cas mettra en évidence l'importance d'un dépistage précoce ainsi que des considérations relatives à la prise en charge du patient pour ce différentiel de lombalgie irradiée.

Caractéristiques cliniques : Un joueur de basketball provincial de 21 ans présentait une lombalgie irradiée récurrente au niveau de la partie gauche de l'aîne et du membre inférieur. Après plusieurs semaines de symptômes persistants parmi lesquels la douleur, une faiblesse musculaire et des modifications du réflexe achilléen, l'imagerie médicale a été obtenue. Cette dernière a révélé une importante extrusion discale ainsi qu'une ancienne fracture des apophyses postérieures. En collaboration avec un chirurgien spécialiste de la colonne vertébrale et un médecin de famille, le patient a été soigné à l'aide d'une approche multimodale conventionnelle. Le traitement consistait en des mobilisations graduelles, en

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with a spine surgeon and family physician, the patient was treated using a conservative, multimodal approach. Treatment consisted of graded mobilizations, spinal manipulative therapy, interferential current, and soft tissue therapy to the lumbar spine. Rehabilitation exercises focused on centralizing symptoms and improving strength, proprioception and function of the lower limb. After a period of 8 weeks, the patient was able to complete all activities of daily living without pain in addition to returning to basketball practice.

Summary: PRAF is a unique condition in the immature spine and recent evidence suggests that those involved in sports requiring repetitive motion of the lumbar spine may be at increased risk. The astute clinician must consider this differential in young populations presenting with discogenic low back pain, as a timely diagnosis and necessary referral may allow for effective conservative management to reduce symptoms. Equally as important, one must be aware of the complications from PRAF as a contributing source of low back pain and dysfunction into adulthood. Knowing when to refer for advanced imaging and/or a surgical consult given the variable clinical presentation and prognosis is an essential component to care.

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KEY WORDS: chiropractic, case report, posterior ring apophyseal fracture, PRAF, posterior limbus bone

Introduction

Lumbar disc herniation is a common condition which has been reported to affect as many as 40% of adults in their lifetime.¹ Rarely in adults, lumbar disc herniations are associated with posterior ring apophyseal fractures (PRAF).¹ Also known as posterior limbus bones or fractures, these injuries are unique to the immature spine and are characterized by separation of an osseous fragment at the superior or inferior edge of the posterior vertebral body.^{1,2} In

des manipulations vertébrales, en une électrothérapie à courants interférentiels, et en un traitement des tissus mous au niveau du rachis lombaire. Les exercices de rééducation étaient axés sur la centralisation des symptômes et l'accroissement de la puissance, de la proprioception et du fonctionnement du membre inférieur. Après huit semaines, le patient était en mesure de réaliser l'ensemble des activités de la vie quotidienne sans ressentir de douleur et de reprendre les entraînements de basketball.

Résumé : Les fractures des apophyses postérieures sont un état unique de la colonne vertébrale immature. Des données probantes récentes suggèrent que les sujets pratiquant une activité sportive requérant un mouvement répétitif du rachis lombaire peuvent présenter un risque plus élevé. Les cliniciens avisés doivent tenir compte du différentiel chez les populations de jeunes personnes souffrant d'une lombalgie d'origine discale dans la mesure où un diagnostic en temps opportun et un aiguillage nécessaire peuvent permettre une prise en charge conventionnelle efficace pour réduire les symptômes. Il est tout aussi important et nécessaire d'avoir connaissance des complications associées aux fractures des apophyses postérieures, qui peuvent entraîner une lombalgie et un dysfonctionnement du rachis lombaire à l'âge adulte. Savoir quand se référer à des technologies d'imagerie de pointe ou à l'avis d'un chirurgien au vu de la présentation clinique et du pronostic variables est une composante essentielle du traitement.

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MOTS-CLÉS : chiropratique, étude de cas, fracture des apophyses postérieures, os limbique postérieur

pediatric patients (those <18 years of age), the incidence of reported lumbar disc herniation is substantially lower than adults, with ranges in the literature falling between 0.5-5%.^{2,3} Despite these findings, the occurrence of PRAF is a far more common entity present in pediatric patients with associated lumbar disc herniation. Recent literature reporting the incidence of PRAF occurring in conjunction with pediatric disc herniation ranges from 19-42%.⁴⁻⁶

Managing disc-related injuries in the pediatric and

adolescent populations pose difficulty to the clinician as the history, clinical presentation, and response to care can be highly variable and atypical when compared to adults. Injuries such as PRAF and pars interarticularis fractures are unique to the immature spine and can mimic disc-like symptoms.⁶ Unlike adult lumbar disc herniation, it has been reported that approximately 30-45% of pediatric patients suffer from a history of trauma, such as heavy lifting or athletic activity, prior to developing discogenic symptoms.^{3,7-10} Furthermore, it has been theorized that PRAF can occur in adolescent athletes as a result of cumulative or repetitive stress from sport-dependent movements.⁹ With these issues taken into consideration, it is imperative to understand the clinical presentation in young active populations and to be aware of unique structures that are vulnerable in the skeletally immature spine. Since skeletal maturity may not be reached until the ages of 18-25 years, formulating a differential diagnosis that includes PRAF in children, adolescents, or young adults presenting with discogenic symptoms, is essential for patient management.

The purpose of this paper is to discuss the clinical presentation and management of a case involving a posterior ring apophyseal fracture in a 21-year-old male provincial basketball player with a subsequent lumbar disc extrusion. An update on the literature regarding this pathology will highlight relevant features of the clinical presentation, diagnosis, and patient management.

Case Presentation

A 21-year-old male provincial basketball player sought chiropractic care for an episode of insidious left-sided radicular low back pain that travelled into the posterior thigh, lateral leg and ankle that persisted for eight days. He could not recall a specific mechanism of injury, but stated that pain began after participation in a recent weekend tournament with approximately 5 games in three days. In addition to the leg pain, the patient described a sharp, spasm-like pain in the left groin. The intensity of the pain was rated 8/10 on a visual analogue scale (VAS) and was most aggravated by prolonged sitting (greater than 1 hour), flexed postures, putting on socks and shoes, and participation in basketball and off-court resistance training. Activities most provoking during sport were repetitive sprints, intervals of dribbling, and running. Both coughing and straining during resistance exercise aggra-

vated his groin symptoms. Short-term relieving factors included relative rest while lying on his back with a pillow underneath his legs.

Past medical history revealed a severe episode of acute low back pain that occurred two years prior when he was 19 years old. At the time, the pain was significant and sidelined him from off-season training and basketball for several weeks. Although he could not recall a specific onset or mechanism of injury, he stated that the acute low back pain began one evening after taking part in a lower body conditioning session that included squats, deadlifts, and interval training. He did not seek any medical attention during the episode of acute low back pain and reported that his symptoms subsided with relative rest over several weeks. Since that incident, the patient reported a two-year history of recurrent local, non-radiating low back pain that would present intermittently after rigorous activity. The patient reported no previous imaging, medical management, or health concerns other than his recurrent low back pain.

Physical examination revealed an alordotic posture, while gait analysis demonstrated fatigability in left toe and heel walking. Both active and passive lumbar flexion were reduced to 20° due to recreation of groin pain and tension in the posterior left limb. All other active, passive and resisted ranges of motion in the lumbar spine and hips were unremarkable. Palpation and resisted muscle testing for the hip musculature on the left was unremarkable and unable to reproduce the chief complaints. Provocative orthopaedic testing for the sacroiliac joint, including the thigh thrust, sacral thrust, and both sacroiliac joint compression and distraction tests, were also negative bilaterally. Active and passive straight leg raise (SLR) were positive at 35° on the left with recreation of groin and leg symptoms. Crossed SLR recreated groin and low back pain at 80°. Palpation revealed hypertonicity in the lumbar paraspinal musculature and tenderness with spinous challenge at L3-S1. Motion palpation revealed local painful restriction with rotation and posterior-anterior joint challenge at L2-S1, while Kemp's test caused local pain bilaterally at L3-5. Neurological evaluation for the lower limb revealed weakness in left ankle range of motion, as dorsiflexion, plantar flexion and great toe extension were rated 4/5. The left S1 (Achilles) deep tendon reflex was rated 1+ and deemed asymmetric in comparison to the right. Sensory findings were intact and symmetrical for the lower limb.

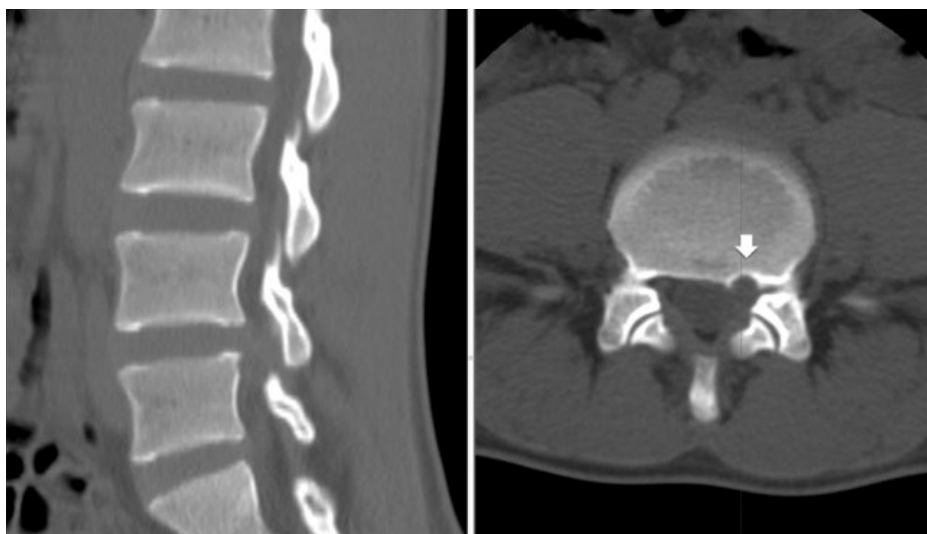


Figure 1. Sagittal CT bone window lumbar spine (left) and axial CT bone window of the superior endplate of L5 (right). There is a semi-oval bony erosion at the left posterolateral corner of L5 vertebral body with suggestion of a defect at the adjacent endplate rim (white arrow).

A working diagnosis of a left posterolateral L4-5 disc herniation was made and the patient was referred to his family physician for radiographs given his previous history and current neurological findings. Within two days of the initial examination, results from plain radiographs were taken and read negative for lumbar spine pathology. As such, a conservative plan of management was initiated and included a multimodal approach over a 4-week period, 2 times per week. The first two weeks of treatment consisted of interferential current (IFC), soft tissue therapy, spinal mobilizations, spinal manipulative therapy (SMT), and rehabilitation exercises. As the patient was most comfortable side-lying (left side facing up), IFC was applied to the lumbar spine in this position for 15 minutes at a frequency of 80-150 Hz (continuous) at an amplitude providing a gentle paraspinal muscle contraction. Following the IFC application, soft-tissue techniques were used that involved stretching and mobilizing the paraspinal muscles while the patient remained in the side-lying position. In the first week of treatment, grade II and III segmental lumbar spine mobilizations achieving flexion and rotation were implemented. As treatment sessions progressed, side-lying spinal manipulative therapy was applied to the affected segments in the lumbosacral spine. The initial goals of rehabilitation exercises were to centralize the radiating low back pain and facilitate core stability and endurance. Initial rehabilitation exercises included the McKenzie protocol^{11,12} to centralize radicular

symptoms. This was utilized in the first two weeks as the patient laid prone and created lumbar extension by lifting their chest off the ground with elbows contacting the floor (push up position). Since pain was centralized to the low back with this procedure, the patient was instructed to perform this hourly for 10-15 minutes as tolerated. The patient was also taught abdominal hollowing and core bracing with use of the modified curl-up exercise in the first weeks of treatment.¹³ This was performed as the patient was supine with one leg extended (parallel to the floor) while the other was positioned in 45° knee flexion and 90° hip flexion.¹³ The patient was asked to co-contract core musculature in this position via active feedback from the practitioner palpating the abdomen and low back. Education was provided in which the patient was made aware of provocative postures and taught to bend at the hips to avoid flexion of the lumbar spine (hip-hinge).¹³ Additionally, he was instructed to modify daily activities, which included avoiding sport until signs and symptoms had resolved.

After two weeks the patient only found relief of radicular pain during the McKenzie exercises. As such, the family physician ordered computed tomography (CT) images at the end of the second week. CT images demonstrated an intraspinal and extradural mass at the entrance of the left L5-S1 lateral recess with a focal defect in the vertebral body of L5 (Figure 1). Since the CT images could not differentiate the mass, magnetic resonance

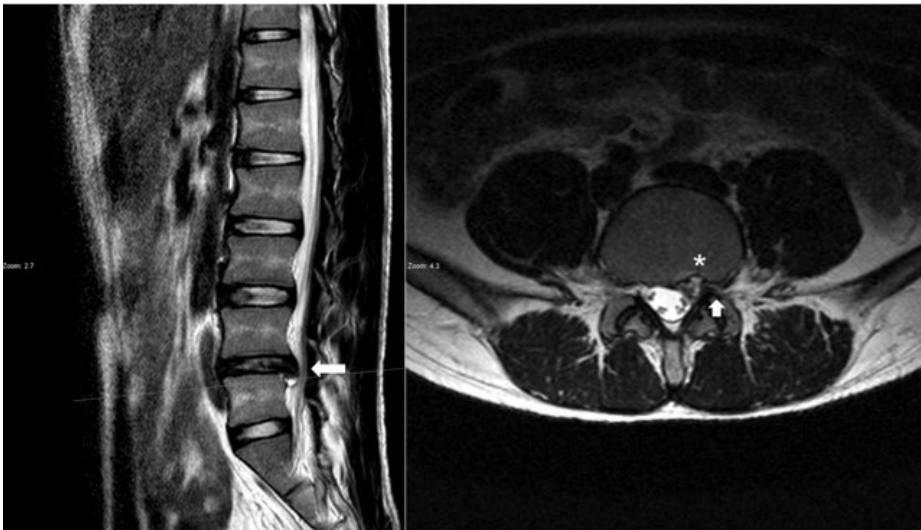


Figure 2. Sagittal T2 weighted MRI lumbar spine (left) and axial T2 weighted MRI at the level of the L5 superior vertebral endplate (right). There is a large left paramedian and intraforaminal disc extrusion occluding the entrance of the left L5-S1 lateral recess (white arrows). There is a semi-circular rim defect is seen at the left posterolateral corner of the L5 superior endplate consistent with an old type III PRAF (white asterisk).

(MR) imaging and a consult with a spine surgeon was initiated. MR imaging was obtained during the 5th week of treatment and confirmed a large paramedian disc extrusion at L4-5 with compression of the left L5 nerve root and posterior displacement of the left S1 nerve root. It also identified an old type III posterior ring apophysis fracture at the superior endplate of L5 (Figure 2). The spine surgeon had suggested continuing with a conservative plan of management and would monitor his symptoms over the next 8-12 weeks.

At 6 weeks, the patient's symptoms began to subside significantly (3/10 on VAS) and he had attributed this to an increased focus on core strengthening and bracing with activity. While soft tissue therapy and SMT continued to be the predominant form of passive therapy, rehabilitation exercises had progressed to place more emphasis on maintenance of a neutral spine during dynamic activities, especially those requiring flexion-extension. Exercises included the modified curl-up, front plank, side-bridge, supine gluteal bridge, and bird-dog.^{13,14} These exercises were preformed daily at a volume of 2-3 sets with 12-15 repetitions. The front planks and side bridges were performed with three repetitions utilizing 45-second holds. Wall squats with an exercise ball placed behind the torso was used to teach the patient active core bracing and maintenance of a neutral spine in a dynamic upright posture. Progressions from this exercise included static single leg variations to enhance proprioception and balance.

At 8 weeks, the patient was able to return to basketball practice as he had no further provocative pain or functional issues. Progressive rehabilitation exercises focused on dynamic core stability, endurance, and whole-body strength which included goblet squats, farmer-carries, multi-angle lunges, and standing Pallof presses. Following 2 weeks of basketball practice and rehabilitation exercises with no exacerbation of previous symptoms, he was able to return to game play at 10 weeks.

Discussion

This case highlights several important issues that can complicate clinical decision making when young adults or adolescents present with discogenic low back pain. Although there is no objective way to measure the contribution in which the disc extrusion or existence of an old PRAF had on pain or dysfunction, early detection is essential for optimizing patient management. Therefore, it is necessary for clinicians to recognize the clinical presentation and implement best-practices regarding this pathology for a timely diagnosis and prompt orthopaedic referral.

Posterior ring apophyseal fractures most commonly present in children and adolescents.¹¹ These types of fractures occur almost exclusively with the presence of a single level lumbar disc herniation and are more prevalent in those who are overweight or obese.⁶ True incidence is difficult to estimate as these types of fractures are fre-

quently undetected when they occur in combination with lumbar disc herniations.⁵ Further complicating the incidence of PRAF, lumbar disc herniations are themselves rare in children and adolescents, occurring in as little as 3% of those who presented with low back pain below the age of 20 who needed surgery.¹⁶ To date, PRAF have been estimated to occur in 0.5-6.8% of those adolescents who present with lumbar disc herniation.¹² PRAF presents most frequently at the levels of L4, L5, and S1, but can occur anywhere from the 12th thoracic vertebra to the second sacral vertebra.¹⁷ The L5 and S1 superior vertebral body endplates have been shown to be the most common area for these lesions.⁹ Among acute trauma, participation in sports such as weight lifting or gymnastics are the most cited risk factors for this type of injury.^{16,17,19} Males are almost three times more likely to suffer a PRAF since the ring apophysis fuses later in age than females.¹⁹ The ring apophysis appears around the age of 5 in children and begins to ossify between the ages of 6 and 9 years.⁴ Fusion typically occurs between the ages of 11 and 15 years in females and between 14 and 17 years in males. Complete fusion does not often occur until the ages of 18-25 and can leave the annulus fibrosis of the vertebral body vulnerable to insult.⁷ The mean age for those found to have PRAF is 14 years, but the reported range in age is variable from 8 to 69 years.¹⁶ Genetics have also been shown to predispose an individual to this type of injury, as gymnasts with a TT genotype of COL1181 were found to have a higher incidence of PRAF due to the decreased tensile strength of their collagen.²⁰

Several theories exist regarding the etiology of PRAF, though it is widely thought that age, activity level, and trauma are the main factors that can lead to this injury.²¹ Acute macrotrauma has been associated with 30-60% of patients presenting with a PRAF.²² A fatigue phenomenon (microtrauma) has also been proposed from repetitive compression and shear stress on the annulus fibrosis.^{19,21,22} Some authors have postulated that injuries such as PRAF and pars stress reactions may be due to early sport specialization, as children expose themselves to similar repetitive motions that chronically load the non-fused structures in the spine.²³ Recent finite element model studies have provided evidence that repetitive stress to the posterior ring in extension ultimately weakens the structure, making it more prone to avulsion with tensile loads in flexion.^{24,25} Additionally, the material properties of the

Table 1.
Differential diagnoses for PRAF

Macro & Microtrauma	Pars Stress Continuum Disc herniation SCIWORA
Space Occupying Lesion	Disc herniation Tumours Cysts
Infection	Discitis
Mechanical Low Back Pain	Facet irritation/syndrome Sacroiliac joint syndrome Paraspinal strain Dynamic muscular instability

SCIWORA: spinal cord injury without radiographic abnormality

ossified apophyseal ring is subject to significantly higher stresses than both the adult (fused) and earlier cartilaginous models.^{24,25} This may explain the higher prevalence of PRAF between the ages of 11-17 years.²⁵

Clinical presentation of PRAF is difficult to differentiate from other forms of discogenic low back pain in children, adolescents and young adults. Several competing differential diagnoses are essential to rule out, such as infection in young populations (Table 1). Since PRAF in the lumbar spine most often occurs with a subsequent disc herniation, one must recognize signs and symptoms of pediatric disc herniation.^{5,7,9,26} Unlike adults, pediatric disc herniations typically have a prior history of trauma, usually from athletic activity resulting in falls or trauma sustained from heavy lifting.^{7,26} Probing the patient for a family history regarding disc herniation has also been suggested due to familial-linked issues in connective tissues formation.^{7,27} Singhal et al.¹ found that 13-57% of pediatric patients with disc herniation have a first degree relative whom also suffers from disc herniation, further suggesting familial predisposition to the condition.

A recent review by Wu et al.¹⁸ found that the most common signs and symptoms of those suffering from PRAF include paravertebral muscle spasm and tenderness, diminished deep tendon reflexes, sensory loss and motor loss.¹⁸ It has been suggested by some authors that radiculopathy without back pain is the most common symptom.⁷ However, Ozgen et al.²⁸ reported that 88% of their adolescent

disc herniation patients presented with a chief complaint of low back pain, and just 35% had pain along the L4-S1 dermatomes. Valsalva manoeuvres, forward lumbar flexion, and assessment of bowel and bladder dysfunction for potential complication of Cauda Equina Syndrome (CES) have been indicated as important parts of routine screening for detection of pediatric disc herniation.⁷ The literature suggests evaluating for sensory deficit, manual motor testing, deep tendon reflexes, and using the straight leg raise test for detection of a pediatric disc herniation.^{7,26} Several authors have presented cases of adolescent PRAF in which patients demonstrated a marked reduction in straight leg raise testing (as minimal as 30°) with minimal pain accompanying the finding.^{16,21,30,31}

When PRAF presents in adulthood, physical signs and symptoms are similar to lumbar disc herniation.^{2,5,17,18,32,33} A recent study found that in adult patients who underwent surgery for lumbar disc herniation and PRAF, 99.1% suffered from low back pain and leg pain, 9.8% had bilateral leg pain, and 13.8% of patients demonstrated unilateral leg weakness.⁶ In adults, the most common symptoms of lumbar PRAF included low back pain with or without a history of trauma along with radicular pain in one or both legs.⁹ It was also suggested that those who suffer from PRAF have greater severity of symptoms than those who suffer from lumbar disc herniation alone.^{5,18}

Since PRAF is an imaging-dependent diagnosis and that it often presents similar to lumbar disc herniation alone, this injury is easily missed when initial conservative management is effective. When there is concern in the clinical history to warrant imaging, techniques such as radiographs, MRI and CT can all be used to diagnose PRAF. Lateral lumbar radiographs have been shown to detect PRAF at a rate of 79.3%, with a visible wedge-shaped osseous fragment along the posterior corner of the vertebral body.²² The difficulty with diagnosing PRAF at L5-S1 on plain radiographs occurs from the osseous overlap of the iliac crest as witnessed in the case presented.¹⁷ MRI does not use ionizing radiation and provides a better evaluation of soft tissue lesions and degree of spinal stenosis. However, small PRAF are often missed on MRI due to low signal intensity.²³ As such, CT is the diagnostic study of choice as it has a sensitivity and specificity reaching 100% and is also able to detect PRAF previously missed in plain radiographic and MR studies.^{1,6,22,23}

Takata et al.³⁴ proposed a classification that is subdivid-

ed into three categories based on CT findings. Type I corresponds to a simple separation of the posterior vertebral margin without bony defect; type II represents a fracture on the posterior margin with avulsion from the vertebral body; and type III consists of a small posterior fracture due to a cartilaginous irregularity of motor plate.³⁴ An additional class of type IV lesions was developed to describe a complete dislocation of the vertebral body posterior wall.³² Types I, II, and IV lesions are more clinically significant, occur in younger patients, cause more bilateral symptoms, and are more likely to be surgical candidates.^{18,22} Type III lesions occur in older adolescents or young adults as most of the ring is fused. These have been shown to be less clinically significant, present unilaterally, and both conservative and microsurgical approaches are favoured.^{18,22} The patient in our case presented with a type III lesion, suggesting an onset later in adolescence which may have been a factor contributing to success with conservative interventions (Figures 1 and 2). Most often, CT classifications systems categorize lesions based on the size and location of the lesion. Lesions that are large (greater than 50% of the width of the posterior vertebral body wall) are more likely to be clinically significant and surgical candidates.¹⁴ Chang et al.⁵ reported patients with small central or lateral fragments had excellent results with conservative treatment, while patients with large fragments had poor results.^{5,18} Therefore, imaging findings may help the clinician provide more insight to the relative prognosis of the patient or aid in directing appropriate conservative management strategies.

Currently, there are controversial and contradicting theories to determine whether a patient should receive conservative or operative treatment for PRAF. Wu et al.¹⁸ concluded that indications for surgery include: failed trial of conservative care (6-12 weeks), declines in neurological status, intolerable low back and/or leg pain, severely affected function (ADLs), and any signs of CES. The principles of conservative treatment for PRAF are similar to those for a herniated nucleus pulposus.²³ This includes bed rest, analgesic and non-steroidal anti-inflammatory drugs, physical therapy and activity modification with or without lumbar braces.^{18,23} However, the duration for attempting conservative treatment has not been consistently reported with some trials lasting 6-12 weeks, and there is considerable heterogeneity in baseline patient characteristics.¹⁸ Another important consideration in response to

conservative care is age. Children and adolescents have been reported to have less favourable response to conservative care when they have both PRAF and lumbar disc herniation present. Damage to the annulus fibrosis from trauma, state of the nucleus pulposus, presence of larger osseous fragments, and issues with treatment compliance have all been cited.¹⁸ When conservative therapy is ineffective or the patient maintains persistent back pain that adversely compromises daily activities, regardless of neurological deficits, the need for operative treatment has been emphasized.^{18,23} The debate whether or not the bony fragment should be removed during surgery has been contentious. One must consider if the existence of the osseous or disc material alone is responsible for symptom severity. If the fragment is untreated or unrecognized, the fracture could heal with residual bony spinal stenosis.¹⁸ Currently, posterior discectomy with excision of a mobile osseous fragment without fusion is the preferred approach.¹⁸ It is important for both the patient and surgeon to consider the associated risks of such procedures which can include dural damage, painful paresthesia, infection, and recurrence of disc herniation.¹⁸

Several case reports involving the chiropractic management of pediatric and/or adolescent lumbar disc herniation with and without PRAF have been published.^{16,21,30,35} Despite being retrospective case studies, they provide clinical insight on how a rare condition can be managed in a chiropractic setting where the literature is scarce. Upon analysis of these reports, many patients presented in the expected mean age of 14 years and all implemented a multimodal approach including spinal manipulation, soft tissue techniques, therapeutic modalities, and rehabilitation exercises. Of important note, those patients initially presenting with hard neurological findings (motor weakness, atrophy, and loss of deep tendon reflexes) and functional limitations were more likely to have failed conservative care and undergo surgery. Those with minimal or no neurological compromise and functional limitations upon initial evaluation responded favourably to conservative care, with complete resolution of symptoms within 2-4 months.

On revisiting the case, several key aspects of the patient presentation should have raised concerns and played a role dictating appropriate management. The patient history was critical in this case as it described an inciting event 2 years prior, in which a 2-3 week episode of severe

acute low back pain followed a weight training session. Furthermore, this was an event that preceded a 2-year history of recurrent low back pain that was left untreated and undiagnosed. Although speculative, this may have been the development of the initial PRAF lesion as the mechanism of injury and both the classification and age of the fracture (type III) are consistent. Given the age, past medical history, and pain during the initial presentation to the chiropractor, a space occupying lesion and/or fracture such as PRAF is an appropriate differential diagnosis. As such, this differential diagnosis in conjunction with the presence of hard neurological findings warranted imaging and referral. The overall goals were to reduce and centralize pain, restore mobility, address functional limitations and return the athlete to play. This was accomplished through a multidisciplinary effort to aid in both the diagnosis and construction of an appropriate conservative plan of management. Addressing functional limitations through rehabilitation exercises and patient education were critical to centralizing symptoms and improving strength, proprioception, and function. As with other injuries occurring in the skeletally immature lumbar spine, such as pars interticularis fractures, establishing core strength and placing emphasis on lumbopelvic stability are essential to facilitate proper low back loading and may prevent recurrent dysfunction.^{13,14} Prior to retuning the athlete to play, care was taken to implement rehab in a sport specific upright posture, focusing on dynamic core stability and perturbation training.

Summary

PRAF is a condition which is most prevalent in adolescent patients and must be considered when these populations present with discogenic symptoms.²⁻⁶ The severity of symptoms are believed to be increased when PRAF is present rather than lumbar disc herniation alone.^{5,18} Appreciation for the clinical presentation including progressive symptoms, trauma, repetitive lumbar loading, and patient age are critical to guide appropriate imaging measures to attain the diagnosis of PRAF. Conservative treatment should be initiated first unless red flags are present and include a multimodal approach.^{16,21,30,35} Surgery is indicated with a failed trial of conservative care (6-12 weeks), declines in neurological status, intolerable low back and/or leg pain, severely affected function, and any signs of CES.¹⁴

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Chronic pain due to Little Leaguer's Shoulder in an adolescent baseball pitcher: a case report

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Objective: *To describe a case of chronic Little Leaguer's Shoulder in reference to pain presentation, physical capabilities, and recovery time.*

Clinical Features: *A 17-year-old, junior baseball pitcher presented with shoulder pain when performing high velocity pitching. Conservative treatment for an assumed soft tissue injury failed to resolve the pain, which was regularly aggravated by pitching, and which subsequently prompted further evaluation, and eventual confirmation of Little Leaguer's Shoulder on subsequent computerized tomography (CT) imaging.*

Intervention and Outcome: *Prior to proper diagnosis, conservative treatment had consisted of activity modification, spinal adjusting, laser therapy, shockwave therapy, Active Release Techniques®, Kinesiotape®, and rehabilitation. Later, rehabilitation, consisting of general muscle and core strengthening, continued for a further six months under the supervision of college athletic trainers. The athlete was able to return to normal pitching duties approximately 12 months later.*

Objectif : *Décrire un cas d'épiphysite humérale proximale chronique en faisant référence à la présentation de la douleur, aux capacités physiques et au temps de rétablissement.*

Caractéristiques cliniques : *Un lanceur de baseball junior de 17 ans souffrait d'une douleur au niveau de l'épaule lorsqu'il réalisait des lancements à grande vitesse. Le traitement conventionnel mis en œuvre pour une lésion des tissus mous présumée n'a pas permis de résorber la douleur, laquelle a été aggravée de façon régulière par les lancers effectués, et a par la suite rendu nécessaire la réalisation d'une évaluation plus approfondie, ainsi que la confirmation définitive d'un cas d'épiphysite humérale proximale grâce au recours à la tomographie par ordinateur.*

Intervention et résultat : *Préalablement au diagnostic en bonne et due forme, le traitement conventionnel mis en œuvre avait consisté en une modification des activités, un ajustement vertébral, une thérapie laser, une thérapie par ondes de choc, des techniques de relâchement actif (Active Release Technique®), le Kinesiotape®, et la réadaptation. Ensuite, la réadaptation, axée sur le renforcement des muscles superficiels et profonds, s'est poursuivie durant six mois supplémentaires sous la supervision d'entraîneurs d'athlètes de l'enseignement supérieur. L'athlète a pu reprendre normalement son poste de lanceur environ 12 mois plus tard.*

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Summary: *In this case, a potentially damaging bone injury masquerading as a simple musculo-tendinous injury created a diagnostic challenge. The patient eventually recovered with rest, time, strengthening, and eventual compliance to prescribed activity modification.*

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KEY WORDS: chiropractic, Little leaguers shoulder, overuse injury, humeral epiphyseolysis

Introduction

Little Leaguer's Shoulder is the term given to an epiphyseal injury of the proximal humerus. This condition presents itself in young individuals involved in throwing sports such as baseball or javelin. Other synonyms used to describe an injury of this type are epiphyseolysis, osteochondrosis, stress fracture, and rotational stress fracture of the epiphyseal plate.¹ According to Binder et al.² epiphyseal injuries of the proximal humerus are the most common injuries of the shoulder and upper arm in adolescents. Because the proximal humeral epiphysis is responsible for 80% of the humeral growth in length, it is not surprising that this region would be susceptible to damage during the developmental years. The usual age of onset for this condition ranges from 11 to 16 years, with a peak at around 14 years of age.^{1,2} The epiphyseal plates will usually close at some point between 20 to 22 years of age.

Structurally, the shape of the epiphyseal plate produces an interlocking of the physis and metaphysis of the plate. The thickened periosteum of the epiphysis anchors the head and the tuberosities, while simultaneously strengthening this region of the shaft; however, that strength is not uniform throughout the entire growth plate. The growth plate is weaker and thinner anteriorly resulting in a greater incidence of anterior displacement of the distal fragment.³

The physeal injury sustained is primarily a Salter-Harris type 1 fracture in which a transverse fracture through the physis separates the epiphysis from the metaphysis.⁴ A Salter-Harris 1 fracture occurs in 6% of Salter-Harris

Résumé : *Dans ce cas, une lésion osseuse potentiellement dangereuse déguisée en simple lésion musculo-tendineuse a rendu l'établissement du diagnostic difficile. Le patient s'est finalement rétabli avec du repos, du temps, du renforcement et une observance de la modification des activités prescrite.*

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MOTS-CLÉS : chiropratique, épiphysite humérale proximale, blessure due au surmenage, épiphysiolysse humérale

fractures.⁵ According to Hatem et al. it is common to find bone marrow edema in the epiphysis and metaphysis, particularly next to the growth plate.¹ They state that the earliest and most frequent finding is a widened epiphyseal plate, with less frequent signs of demineralization, sclerosis, fragmentation of the physis, and cystic changes.¹ Additionally, symptoms appear to be dependent on the amount of edema present. The two main mechanisms of proximal humeral injury in adults involve falls onto the shoulder, and falls onto an extended arm in abduction and external rotation. In adolescent baseball pitchers, however, the primary etiology appears to be repetitive throwing, producing significant torque, particularly with breaking pitches. The decreased velocity found in the late cocking or deceleration phases of the throw also plays a role in this type of injury.⁶

Following an injury to the epiphysis, various degrees of healing will occur, depending on the length of rest, or, more commonly, the amount of overuse. Unfortunately, many of these injuries are poorly managed, resulting in overuse strain on the growth plate and subsequent irregular and/or partial healing. There are very few validated treatment options mentioned in the literature. To date, the best evidence available supports rest for chronic conditions, and pain management for the acute stage. However, given the low level of evidence for most of the interventions, the clinician must also rely on clinical judgement, and experience to treat the condition. The following case presentation describes an example of Little Leaguer's Shoulder, a potentially serious bone injury, which initially masqueraded as an uncomplicated musculo-tendinous injury.

Case Presentation

A 17-year-old pitcher presented with sharp shoulder pain of approximately 1-month duration, following a hard throwing session at training. More detailed questioning revealed that the pain actually began several months before during winter training, and that the patient had experienced shoulder pain off and on for several years prior to this recent event. His current pain occurred during the follow-through and deceleration stages of pitching. Sub-maximal throwing did not create any discomfort at the time of the assessment. The patient appeared to be otherwise healthy, and physically fit.

Clinical Findings

The shoulder pain was located on the posterolateral aspect of the proximal humerus near the insertion of the deltoid tendon. The patient experienced pain on palpation of this area. Manual testing of the shoulder musculature was painless, revealing functionally strong muscles. Active and passive shoulder ranges of motion were full and pain-free. His base-line level of pain could not be provoked during the examination. Orthopedic tests for impingement (Hawkins-Kennedy), instability (apprehension), labral damage (biceps load, load and compression) and musculo-tendinous injury (rotator cuff strength) were also unremarkable. There were no signs of swelling, and palpation did not reveal any abnormal masses. Although there was some loss of joint play, and minor tenderness on palpation of the posterior joints in the cervical and thoracic spine, it was not considered significant in nature.

Diagnostic Focus and Assessment:

The initial diagnosis was a musculo-tendinous injury to the deltoid muscle; however, the differential diagnosis included rotator cuff strain, specifically of the supraspinatus tendon, with or without calcification; biceps tendon injury; and referred pain from the cervical spine. Although unlikely, malignant tumors such as osteosarcoma and Ewings, and benign tumors in the form of osteoid osteoma and solitary enchondroma were also considered⁷. The initial diagnosis was based on the presentation of localized pain, aggravated during throwing. The lack of a palpable mass, swelling, or fever, helped somewhat to assuage any concerns about a destructive bone lesion. In the meantime, several factors made the presence of a bone injury appear to be unlikely, including the patient's ability to

painlessly tolerate both significant torsional stresses, and aggressive maneuvering of the humerus during orthopedic testing. Additionally, the condition of Little Leaguer's Shoulder is not commonly seen in general Chiropractic practice, even though in retrospect the presence of pain on throwing should have been a red flag. Although the patient's initial palpatory symptoms responded favourably within a week of treatment initiation, (consisting of multi-modal pain management and strengthening exercise), his symptoms continued to recur with hard throwing.

Following approximately two months of conservative care, the diagnosis was revised to include the possibility of a more significant bone or epiphyseal plate injury (Little Leaguer's Shoulder). This was confirmed following a CT scan performed at the University of British Columbia sports medicine clinic (see Figure 1).

The CT scan described the humeral head growth plate as irregular, possessing both fused and unfused regions with metaphyseal and the epiphyseal overgrowth and remodeling. There was also a curvilinear, ossific fragment arising from the attenuated antero-inferior glenoid. This fragment was thought to be secondary to an impact shear injury, although clinically, it appeared to be asymptomatic. The findings of growth plate irregularity, and bone overgrowth and remodelling indicated a diagnosis of chronic overuse osteochondrosis (Little Leaguer's Shoulder).

Therapeutic Focus

The initial treatment protocol was a multi-modal approach, designed to treat what originally was misdiagnosed as a musculotendinous injury. The use of shockwave, although minimally mentioned in the literature for muscle injuries, was used in this case to possibly expedite the healing process due to the chronic nature of the injury.⁸ In addition, Chiropractic Manipulative treatment, Active Release Technique[®], Low Intensity Laser, and Kinesiotape[®] techniques were also utilized.

The patient was seen three times during the first week. The treatment protocol for the first visit consisted of Active Release Technique[®] to the deltoid, shoulder and scapular muscles. Kinesiotape[®] was applied to the shoulder for muscle support, possibly reducing stress on the joint and muscles. The subsequent visits incorporated shockwave therapy, and laser to the area of deltoid insertion. By the third visit the athlete reported significantly de-

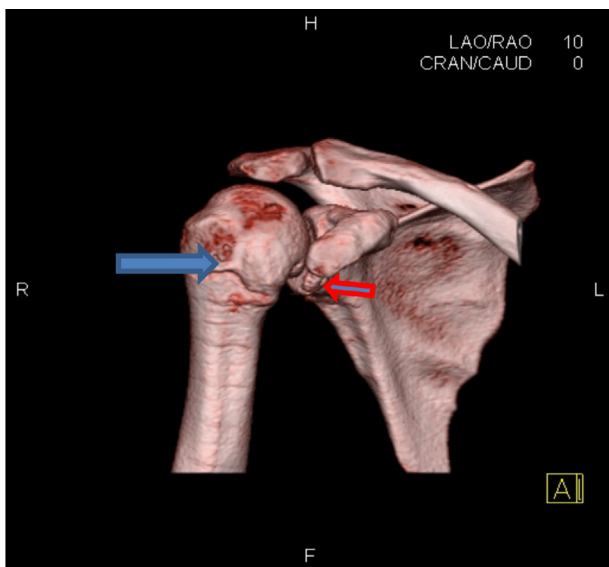


Figure 1A.

The blue arrow points to the irregular epiphyseal plate, the red arrow point to an ossific fragment.



Figure 1B.

The blue arrow points to an irregular epiphyseal plate

creased point tenderness on palpation. He was instructed to refrain from throwing hard for two to four weeks, and to slowly build up the intensity from easy short throws.

The patient received another treatment nine days later after he experienced the same pain in the upper arm following a brief pitching appearance, contrary to his rehabilitation instructions to not pitch. He was only able to throw six pitches before the pain forced him to stop. He received two more similar treatments over the next ten days, and was given instructions not to throw for the next week. Following that interval of rest, he was instructed to begin light throwing within a pain-free range. Although the presenting palpatory symptoms seemed to resolve quickly, any harder throwing continued to aggravate the initial injury.

This athlete initially underwent a wide variety of treatment. In addition, rest, followed by progressive rehabilitation involving light shoulder exercises, with general strengthening, and a slow progression of throwing were implemented. The coach's, parents, and athlete's expectations for a return to play are always high, therefore, it is not unusual to attempt multiple forms of treatment options to heal the injury, and have the athlete return to play as quickly as possible. However, because of this, treatment

is often administered contrary to current evidence-based care. At this time, there is little evidence-based research to confirm the use of these treatments, either individually, or as a multi-modal therapy in the treatment of Little Leaguer's Shoulder.

After several months of conservative care, the rehabilitative process of strength and conditioning continued for a further seven months under the supervision of college baseball team trainers. At approximately one year following the initiation of treatment, the patient was able to throw pain-free, at full ability. Although the length of time for recovery seems excessive, Hatem et al. point out that in their experience it is not unusual for some cases to take seven months to a year to resolve¹.

Discussion

This case would have been challenging to any clinician unfamiliar with an injury such as Little Leaguer's Shoulder, because the athlete was able to play a collision sport, encountering repeated contact, as well as forceful distraction to the arm, without experiencing the pain that resulting from throwing hard. The patient's ability to play a high-impact sport simply highlights the fact that Little Leaguer's Shoulder is but one example of a sport-related

injury with a highly specific mechanism of injury (high velocity throwing in this case), which may not be provoked, or even painful, during alternate (non-throwing) types of activities, even when those activities involved high-impact forces through the shoulder. On a related note, this patient was also able to consistently perform strength and conditioning routines, albeit with lighter weights, and stretch tubing for maintaining general strength in the shoulder muscles.

There is some support for the treatment of tendon and bone injuries with shockwave therapy, possibly creating another direction of treatment for the management of epiphyseal fractures.⁹ Active Release Techniques®, a well-established soft tissue technique for the treatment of muscles and tendons, was also utilized, although current evidence for its use tends to be more anecdotal.^{10,11} Low Intensity Laser has been used clinically for many decades to treat bone, muscle, tendon and ligament injuries, however, there is mixed support in the literature.^{12,13} The lack of solid evidence may be due to the many different types of laser devices commonly used, and the variation in dose and frequency, creating a problem with uniformity when investigating the treatment's validity for different conditions. The application of Kinesiotape®, and similar products have mixed reviews in the literature for shoulder injuries, however, it seems to be a treatment that has some degree of benefit for muscle pain, albeit the evidence may often be anecdotal.^{14,15} Chiropractic manipulative therapy was administered to the restricted cervical and thoracic spine segments. The anatomical and functional connections of these joints can, at times, account for a referred pain pattern to the shoulder from the cervicothoracic spine.¹⁶

According to Popkin et al.¹⁷ examination findings of Little Leaguer's Shoulder often include "tenderness on the antero-lateral proximal humerus as well as pain and weakness with resisted shoulder abduction and internal and external rotation". The examination findings were quite different in this case, as evidenced by postero-lateral pain, and no muscle weakness in any ranges of motion. This could possibly be explained by the chronic nature of the condition. Shanley and Thigpen¹⁸ state that "the clinical examination of these athletes is not often definitive, and diagnosis must be confirmed through imaging studies". This opinion is also shared by Frick and Hilgers¹⁹ who maintain that radiographs are very useful in the diagnosis of Little Leaguer's Shoulder.

When an adolescent baseball pitcher presents with upper arm/shoulder pain, the clinician should always consider the diagnosis of Little Leaguer's Shoulder. Unfortunately, this diagnosis may be commonly missed in chiropractor's offices due to a lack of familiarity with the condition, potentially resulting in extended damage to the growth plate, and a prolonged symptomatic picture. In this particular case, the signs, symptoms, and limited recovery did eventually point in the direction of an epiphyseal injury. The initial diagnosis could have been somewhat difficult for the general chiropractic practitioner due to a number of factors: 1) the athlete's ability to continue playing a physical contact sport, 2) the lack of discomfort with an aggressive physical examination, 3) the ability to tolerate vibration of the bone tissue during shockwave therapy, and 4) a somewhat unusual symptom pattern in terms of pain. However, in retrospect, none of these factors precludes a differential diagnosis of Little Leaguer's Shoulder.

Young baseball pitchers are particularly susceptible to injuries of the proximal humeral epiphysis due to rotational and distractive stresses on the proximal humerus. Early sports specialization and excessive training of young athletes is a common problem, creating an ever-increasing risk of overuse injuries. This is particularly evident if baseball pitchers are poorly coached, and continuously utilize poor throwing mechanics. The harder throws and more variable types of pitches add significant stress to the shoulder girdle. In addition, higher pitch counts and innings thrown, in combination with a longer season, creates an environment for overuse stresses to the growth plate.

Injury biomechanics

Sabick et al.²⁰ state that over the course of time, the high torque created late in arm cocking, provides a shear stress, with the resultant deformation of the epiphyseal cartilage and humeral retro-torsion. Immature growth plates tend to be associated with increased joint laxity, and underdeveloped musculature, creating a situation where the growth plate must bear the brunt of the imposed forces, which ultimately stresses the bone, creating injury. This becomes more apparent during a growth spurt, where strength and flexibility become imbalanced, ultimately resulting in a growth plate that is weaker than the ligaments and muscles around it. This weakness may then lead to epiphyseal injury. At the end of the arm-cocking phase,

significant internal rotational stresses are placed proximal to the growth plate by the subscapularis, latissimus dorsi, and pectoralis major muscles, while at the same time external stresses are placed on the distal humerus by the forearm and hand. The result of these two different directions of torque creates a net external rotation of the distal humerus, and damaging shearing force between the epiphysis and metaphysis. Over time, this may create the development of humeral retrotorsion that can be seen in professional pitchers.²⁰

Although the true incidence of Little Leaguer's Shoulder is not accurately known, the increase in training intensity with youth baseball, could likely result in far more frequent occurrences of this injury. As this case demonstrates, shoulder pain in an adolescent pitcher may be indicative of a significant injury.

The literature is mixed when it comes to recommending the most effective method of treatment for this particular condition. Hatem et al.¹ state that the decision to return to play should be based on clinical rather than radiographic factors. Numerous authors concur that the best course of treatment involves rest, ice, physiotherapy, and gradual throwing progression. They also feel the athlete should refrain from pitching for two to three months while undergoing a strengthening program, and correction of throwing mechanics.^{2, 17,19} It also appears that there is general agreement among clinicians that a slow return to throwing at low intensity is an appropriate recommendation.^{2,6,17,19} Therapy should consist of rotator cuff strengthening, posterior shoulder capsule stretches, and core strengthening and stretching. However, Hatem et al.¹ feel that the athlete could return to play within three months with a gradual throwing program, and do not see a need for any physical therapy. Carson and Gasser⁴ state that the athlete could return to gradual throwing when symptoms have subsided, usually at around three months, and advance the throwing as tolerated. They also did not utilize physical therapy, and stated that several patients had actually become worse with strengthening exercises. It appears that the stage of injury may be important when designing a treatment program, utilizing a slower approach in the acute phase, with the addition of therapeutic modalities.²¹

Based on the existing literature, and results of this case, it appears the common ground resides with rest for at least two to three months. The use of any therapy would be on a case-to-case basis, but there does not appear to be any

definitive evidence that supports the use of therapeutic modalities, unless in an acute stage to reduce inflammation and pain¹⁴, however, a progressive protocol of throwing with a structured rehabilitation program is important, emphasizing the need to avoid exacerbation of symptoms. The need to maintain strength and flexibility following injury is also important, therefore, progressive strengthening exercises are useful, particularly in combination with an extended period of time away from usual training. As with progressive throwing, strength training should be advanced at a slow pace with a view towards maintaining an asymptomatic state, and utilizing commonly accepted principles and stages of rehabilitation. Shanley and Thigpen¹⁸ outline a return to play rehabilitation schedule starting with a cessation of throwing, modalities to remove inflammation and support healing tissue, then a progression to promoting functional motion and endurance. The final stage involves sport-specific strength protocols, and pain free activity.

Summary

Although Little Leaguer's Shoulder may not be a condition readily found in the average Chiropractor's office, its low incidence could possibly be due to unfamiliarity with the injury. In addition, the lack of direction from physical examination, and significant movement specificity related to the nature of this condition, indicates the limitations of physical findings in this particular condition.

Little Leaguer's Shoulder should be suspected in all adolescent athletes who experience refractory shoulder pain, and are involved in throwing sports. This is particularly true if there is no history of a traumatic event, and the pain can be easily localized to the proximal humerus. Suspicion of this injury should be followed up with plain x-rays and a CT scan if needed. Treatment is somewhat variable but will require at least 2 to 3 months of rest, and a progression of asymptomatic throwing. Treatment will depend on whether the condition is acute or chronic, as well as the severity of injury. Future research is needed to better understand the optimal combination of therapy, and length of rest, during the various stages of bone healing.

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Multidisciplinary approach to non-surgical management of inguinal disruption in a professional hockey player treated with platelet-rich plasma, manual therapy and exercise: a case report

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Objective: To present the clinical management of inguinal disruption in a professional hockey player and highlight the importance of a multidisciplinary approach to diagnosis and management.

Clinical Features: A professional hockey player with recurrent groin pain presented to the clinic after an acute exacerbation of pain while playing hockey.

Intervention: The patient received a clinical diagnosis of inguinal disruption. Imaging revealed a tear in the

Objectif : Présenter la prise en charge clinique d'une perturbation inguinale chez un joueur de hockey et mettre en évidence l'importance que revêt une approche multidisciplinaire pour le diagnostic et la prise en charge.

Caractéristiques cliniques : Un joueur de hockey professionnel souffrant d'une douleur récurrente au niveau de l'aîne s'est présenté à la clinique à la suite d'une exacerbation aiguë de la douleur survenue au cours de la pratique de son sport.

Intervention : Le patient a reçu un diagnostic clinique d'une perturbation inguinale. L'imagerie médicale a

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rectus abdominis. Management included two platelet-rich plasma (PRP) injections to the injured tissue, and subsequent manual therapy and exercise. The patient returned to his prior level of performance in 3.5 weeks.

Discussion: This case demonstrated the importance of a multidisciplinary team and the need for advanced imaging in athletes with groin pain.

Summary: Research quality concerning the non-surgical management of inguinal disruption remains low. This case adds evidence that PRP, with the addition of manual therapy and exercise may serve as a relatively quick and effective non-surgical management strategy.

(JCCA. 2015; 59(4):390-397)

KEY WORDS: chiropractic, sports hernia, athletic pubalgia, inguinal disruption, PRP, platelet-rich plasma

Introduction

Groin pain is a common complaint in athletes. It is estimated that approximately 5% to 18% of all sports injuries are groin-related.¹ How many of these injuries are athletic pubalgia is unclear, due to the lack of consistent diagnostic criteria proposed in the literature. Unfortunately, the majority of research in this area are retrospective studies, non-randomised studies, case-controlled studies, and case reports.^{2,3} This may be due to the vast amount of disagreement in the literature regarding the diagnosis, pathophysiology, and treatment options.

The terminology for this injury is still controversial. Arguably, the most commonly used term is Sports Hernia (SH). This term is a misnomer and misleading. The condition does not involve a true hernia and it may also present in a non-athletic population. Other terms that have been used in the literature are: pubic inguinal pain syndrome, Gilmore's groin, incipient hernia, conjoint tendon lesion, posterior abdominal wall deficiency, and sportsman's groin.²⁻⁶

The term Athletic Pubalgia (AP) has also been used

révélé la présence d'une déchirure au niveau du grand droit de l'abdomen. La prise en charge comprenait deux injections de plasma riche en plaquettes (PRP) dans le tissu lésé, ainsi qu'une thérapie manuelle et des exercices ultérieurs. Le patient a retrouvé son niveau de performance antérieur en 3,5 semaines.

Discussion : Ce cas prouve l'importance de recourir à une équipe pluridisciplinaire et la nécessité d'utiliser des technologies d'imagerie de pointe chez les athlètes souffrant de douleurs récurrentes au niveau de l'aîne.

Résumé : La qualité des recherches relatives à la prise en charge non-chirurgicale des perturbations inguinales demeure faible. Ce cas est une preuve supplémentaire que le PRP, associé à une thérapie manuelle et à des exercices, peut constituer une stratégie de prise en charge non-chirurgicale relativement rapide et efficace.

(JCCA. 2015; 59(4) : 390-397)

MOTS-CLÉS : chiropratique, hernie du sportif, pubalgie du sportif, perturbation inguinale, PRP, plasma riche en plaquettes

interchangeably with SH in the literature. AP can also be deemed a misnomer since it implies that the injury only takes place in athletes. However, there are some sources that describe AP as an injury to the many musculotendinous structures that cross the anterior pelvis, such as the rectus abdominis insertion onto the pubic symphysis, the adductors and conjoint tendon insertion.⁷⁻⁹

The British Hernia Society's 2014 position statement based on the Manchester Consensus Conference proposed eliminating the various terms such as athletic pubalgia, sports hernia, sportsman's groin, pubic inguinal pain syndrome, etc., and to replace them with the preferred term Inguinal Disruption (ID).⁶ The term ID is thought to describe the condition more accurately. The consensus statement reports that this injury includes posterior inguinal wall weakness (this area represents a combination of the transversalis fascia and the parietal peritoneum), external ring dilation, conjoint tendon damage and tears in the inguinal ligament. It was noted that not all of these features are present in every case, and that other pathologies involving the muscle, ligaments and joints may also be

Table 1.
Diagnostic criteria of Inguinal Disruption⁶

Clinical diagnosis of Inguinal Disruption (ID) can be made if 3 of the following 5 signs are present:	
1	Pinpoint tenderness over the pubic tubercle at the point of insertion of the conjoint tendon
2	Palpable tenderness over the deep inguinal ring
3	Pain and/or dilation of the external ring with no obvious hernia evident
4	Pain at the origin of the adductor longus tendon
5	Dull, diffused pain in the groin, often radiating to the perineum and inner thigh or across the midline

affected.⁶ To remain consistent with the updated terminology from the consensus statement, the remainder of this article shall only use the term ID.

Platelet-rich plasma (PRP) injections have recently gained attention in the treatment of sports injuries. The rationale behind PRP is that there would be enhancement of the natural healing process if additional growth factors were introduced into the damaged tissue.^{10,11} There is evidence that these growth factors are needed in muscle repair and regeneration process.¹¹

Our case describes the non-surgical management of ID due to a tear of the rectus abdominis and conjoint tendon. This case demonstrates the importance of a multidisciplinary approach to diagnosis and co-management.

Case Presentation

A 31-year-old male professional hockey player presented to a sports chiropractor after an acute exacerbation of lower abdominal pain. Two weeks prior to presentation, he was experiencing a feeling that he described as a tight groin and hip flexor, which responded well to stretching and warm-up but would tighten up quickly with skating. He described receiving soft tissue therapy from the team athletic trainer on the lower abdominal region, which seemed to temporarily ease the tension. During a practice session just prior to presentation to the clinic, he executed a slap shot and immediately felt a sharp pain above the pubic symphysis and along the left inguinal ligament. The pain forced him to discontinue skating and practice. He

stated he had pain with walking, straining and coughing with a general ache at rest. He received an MRI that night which revealed a tear in the left rectus abdominis, rectus sheath and a portion of the conjoint tendon. The team physician recommended surgery based on the MRI findings. The player decided to get a second opinion from a sports chiropractor.

Upon presentation to the sports chiropractor, the patient indicated a general feeling of tightness through the left lower abdominal region and left anterior/medial thigh, and a sharp pain just superior to the pubic symphysis slightly left of midline.

Physical examination revealed sharp local pain on palpation over the left medial inguinal ligament, pubic symphysis, conjoint tendon and rectus abdominis insertion. Passive hip range of motion was unremarkable. Lumbar spine range of motion was within normal range. Patellar, hamstring and Achilles tendon reflexes were 2+ bilaterally. Sensory examination was unremarkable. Straight leg raise was normal. Resisted hip adduction was graded 3/5 with inguinal pain. Resisted sit-up was positive for weakness and inguinal pain. Valsalva's maneuver produced inguinal pain. The patient received a working diagnosis of ID, as per the criteria in Table 1.

The patient was subsequently referred to a sports physician. Diagnostic ultrasound imaging revealed a left rectus abdominis tear at the insertion on the pubic tubercle and a tear of a portion of the left conjoint tendon. The tear measured 12.6mm x 4.4mm. The patient was treated with

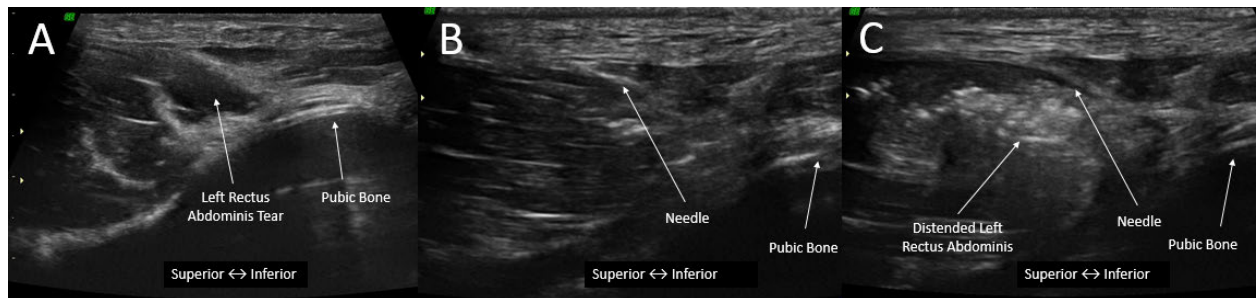


Figure 1.

First ultrasound-guided PRP injection of left rectus abdominis (week 1). A) 12.6mm x 4.4mm tear of the left rectus abdominis. B) Insertion of needle into the tear (pre-injection). C) Distended left rectus abdominis (post-injection).

an ultrasound-guided PRP injection (Figure 1). One week later, the tear measured 4.6mm x 2.6mm. A second PRP injection was administered (Figure 2). At this point, he was referred back to the sports chiropractor and a strength and conditioning coach to commence rehabilitation.

Treatment by the sports chiropractor was performed daily and included myofascial release to the quadriceps, adductors, psoas, medial hamstring group and tensor fascia lata (TFL) in order to normalise the abnormal muscle tension crossing the anterior pelvis. Care was taken not to treat directly over the torn site. Due to the fact that the tear was still maturing, manual therapy over the injection site may have disrupted the regenerative process of PRP, potentially negating its effectiveness.

Exercises were supervised by a strength and conditioning coach. The exercises were performed daily and included 2 sets of 15 repetitions of: transversus abdominis setting, monster walks with a blue theraband, high hurdle

steps, walking lunges with overhead reach, hip airplanes, one leg squat with opposite leg towel slide and bowler squats (Figures 3-9). The goal of the exercises was to strengthen the muscles crossing the anterior pelvis.

As his pain decreased, the player gradually transitioned back to hockey. At the end of week two, the player began skating lightly. A few days later, he began shooting drills. At the start of week three, he participated in full practice with the team and resumed training with his hockey team's strength and conditioning coach. Full return to play occurred in the middle of week three. The player was asymptomatic at return to play and remains asymptomatic at six months follow-up.

Discussion

This case describes the non-surgical management of ID due to a rectus abdominis and conjoint tendon tear. The injury occurred in the player's pre-season training and



Figure 2.

Second ultrasound-guided PRP injection of left rectus abdominis (week 2). A) 4.6mm x 2.6mm tear of the left rectus abdominis. B) Insertion of needle into the tear (pre-injection). C) Distended left rectus abdominis (post-injection).

therefore a timely recovery and return-to-play was of utmost importance to him. High quality evidence regarding athletic pubalgia is lacking. Only a few case reports and case series demonstrate successful treatment of ID by purely non-surgical means.^{4,9,12,13} The majority of the literature concur that treatment by surgery more often leads to favorable outcomes compared to non-surgical manage-

ment alone.^{2,3,14} Currently, there is only one case report that has shown successful treatment of ID with PRP.⁸

Etiology

The exact etiology of ID is under debate. Meyers has described the relationship between the rectus abdominis and the adductor longus and how they play a crucial role in



Figure 3.
Transversus abdominis setting



Figure 4.
Monster walks with blue theraband

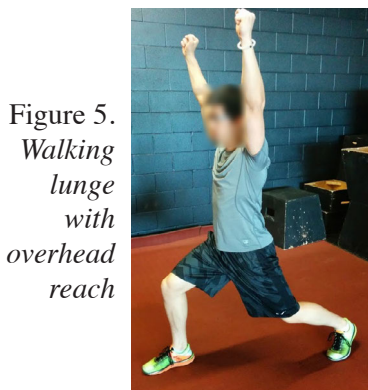


Figure 5.
Walking lunge with overhead reach



Figure 6.
Hip airplane

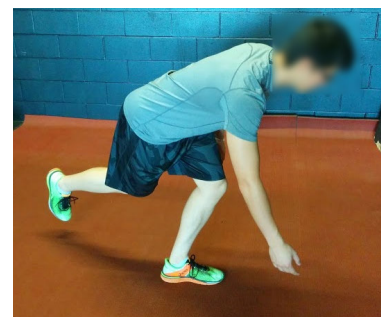


Figure 7.
Bowler squat

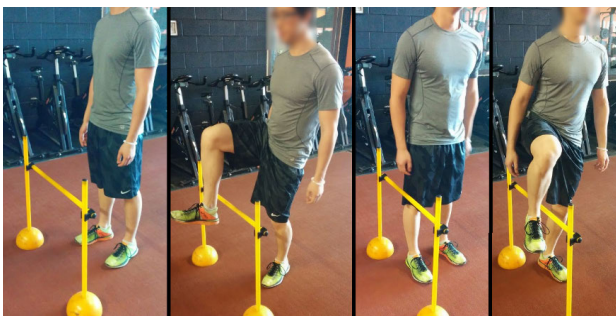


Figure 8.
High hurdle steps



Figure 9.
One leg squat with opposite leg towel slide

the stability of the anterior pelvis.¹⁵⁻¹⁷ The rectus abdominis provides a supero-posterior tension, while the adductors provide an infero-anterior tension to the anterior pelvis.¹⁶ Motions such as repetitive hip hyperabduction and lumbar hyperextension, a movement commonly seen in sports, can induce sheering at the pubic symphysis and may lead to a tear or series of microtears of the rectus abdominis muscle or tendon as it inserts onto the pubis.^{4,17} Cadaveric dissections have shown that when the rectus abdominis is cut, the pelvis tilts anteriorly.¹⁵ This finding may suggest that muscle balance is altered in these athletes and this may be the start of a cascade of events that lead to ID.^{15,17} Meyers performed surgery to strengthen the anterior pelvic floor and reported a 95% success rate via his surgical method.¹⁵

Typical presentation of a patient with ID will be a young athletic male who plays a sport that involves running while changing directions, twisting, skating and kicking.^{2,3,18} The most common sports are soccer, rugby, football and hockey.^{2,4} They will describe an insidious onset of deep lower abdominal and/or groin pain that is exacerbated with sporting activity, coughing or straining.²

Diagnosis

Groin pain is common among athletes. Anatomically speaking, the groin represents a complex confluence of structures. There are multiple anatomical structures that, when injured, may present as groin pain.^{2,3,9,15,18} Between 27% and 90% of athletes who present with symptoms of ID may have multiple pathologies, thus examination may require a multidisciplinary approach.^{2,3} Considering the vast differential diagnosis for groin pain, ID is considered a diagnosis of exclusion^{2,3,13,18,19} and can only be confirmed by endoscopic examination.^{4,20} Differentials of groin pain include: femoroacetabular impingement, labral tears, muscle contusion, sacroiliac or iliolumbar ligament injury, sprain nerve entrapment/neuropathy, stress fracture, osteoarthritis and referred pain from viscera.^{2,3,6,18}

It has been proposed that diagnostic imaging is mainly used to rule out other causes of groin pain.^{2,18,21,22} MRI typically reveals non-specific findings in patients with ID.¹⁹ The main findings are bone marrow edema and increased signal of the rectus abdominis/adductor aponeurosis.^{6,23} A dynamic ultrasound may also be used to assess the integrity of the posterior inguinal wall while having the patient

strain.^{2,6} If weakened, the posterior inguinal wall will displace anteriorly rather than remain taut.² The sensitivity for this test is 100%, however the specificity is 0%.^{24,25} It should be noted that this particular phenomenon is often present in asymptomatic athletes, and thus these findings should be clinically correlated.^{6,26} The gold standard to detect posterior inguinal wall deficiencies is surgical exploration.²⁴

A recent consensus statement on ID proposed a set of criteria to aid in the diagnosis of ID (see Table 1).⁶ The validity and reliability of these criteria are unknown at this time. Further studies should be conducted to evaluate these criteria. It was also noted that all other causes of groin pain must be excluded.⁶ In our presented case, 3 of the 5 criteria were met (numbers 1, 4, and 5).

Once the diagnosis of ID is made, a trial of conservative care lasting six to eight weeks should commence.^{2,4,6,12,27}

Non-surgical Management

There are several case reports/series that describe a proposed rehabilitation protocol for ID. Woodward et al¹² described a 3-phase rehabilitation protocol of a professional hockey player with the signs and symptoms of ID. Phase 1 (4 days) focused on pain management. Phase 2 (14 days) focused on strength and stability. Phase 3 (31 days) focused on functional progression and return to sport. Treatment lasted a total of 49 days. The athlete was able to return to play without recurrence of these symptoms for the following 8 seasons.

Yuill et al⁴ reported the non-surgical management (a combination of manual therapy and rehabilitation exercises) of two high-level and one recreational soccer player with ID. Manual therapy for all three patients occurred one to two times per week for six to eight weeks in total, and included soft tissue therapy, laser, microcurrent, electro-acupuncture, and wobenzyme. Rehabilitation exercises were performed three times per week for eight weeks and progressed from strengthening, to functional, to sport specific. All three athletes were able to return to play after eight weeks of treatment without recurrence of symptoms at two years follow-up.

There were similarities between the exercises used in our presented case and the previous cases. All programs included exercises that strengthened and stabilized the muscles that cross the anterior pelvis. However, in our case, the player returned to play in much less time. This

can be due to any combination of the PRP injection, manual therapy and exercises.

Surgery

A recent systematic review by Serner et al concluded that there is moderate evidence (evidence provided by one high-quality study and/or two or more low-quality studies and by generally consistent findings in all studies) suggesting that surgery results in better treatment success than non-surgical treatment.¹ Surgery should be considered if a trial of conservative care has failed.^{2,6}

The two surgical approaches to treat ID are the open (anterior) approach and the laparoscopic (posterior) approach, and there are various methods within each.^{2,6,22} Favourable outcomes are reported in 63% to 97% of cases for both relief of symptoms and return to previous levels of sport activity.^{2,6}

It should be noted that there are currently no studies that directly compare the various surgical methods.⁶ There is no clear recommendation as to which method is most appropriate and it is largely determined by the level of the surgeon's experience and expertise of a particular technique.⁶ The goal of surgery, independent of the type of surgery used, is to normalize any abnormal tension surrounding the injured tissue (often including an adductor tenotomy).^{2,6}

Platelet-Rich Plasma

Platelet-rich plasma (PRP) has gained interest in the treatment of sport injuries.¹⁰ PRP is prepared by collecting a blood sample from the subject. The sample is then put in a centrifuge to separate the platelets from the rest of the sample; this platelet portion is then injected into the injured tissue.^{10,28,29} Platelets can release several growth factors which may promote tissue healing.^{10,28,29}

In our case, the sports physician decided to inject PRP into the rectus abdominis tear. The patient was informed of the treatment plan and gave consent to treatment. The PRP was prepared using the Angel Hematocrit Setting. A sample of 10mL of blood was drawn in preparation for each injection. A 7% hematocrit setting was used. This method yields a 5.4-fold increase in platelet concentration. There is currently a lack of standardization regarding PRP preparation.²⁸ As a result, it is difficult to conclude efficacy of PRP across the literature due to the heterogeneity of the PRP preparation.^{10,29} In the author's (AMG)

experience, the Angel Hematocrit Setting has resulted in good results and was used in this particular case.

A recent case report by Scholten et al reported the treatment of a lacrosse player with ID due to a distal rectus abdominis tendinopathy.⁸ This patient was treated with one injection of PRP into the left distal rectus abdominis muscle. At four weeks post injection, the patient had no pain or tenderness at the pubic symphysis on palpation. At week six, the player was cleared for sport-specific training and modified practice. At eight weeks, the player returned to his normal level of performance prior to injury.

Post-PRP injection, it is recommended to introduce a rehabilitation programme as a synergist to repair and remodel the injured tissue.¹¹ Loading of the tissue (via manual therapy and exercise) leads to upregulation of mechanogrowth factor, leading to activation of satellite cells, which in turn improves the alignment of the regenerating myotubes.^{11,30} In our case, the patient was referred by the sports physician to the sports chiropractor and the strength and conditioning specialist. The goal of the manual therapy performed by the sports chiropractor included normalizing the abnormal muscular tension across the anterior pelvis. The goal of the strength and conditioning specialist was to strengthen the musculature of the anterior pelvis. Both manual therapy and exercise contributed to loading of the tissue and subsequent cellular processes as described above.

Summary

The scientific literature regarding the conservative management of ID are currently limited to retrospective studies, non-randomised studies, case-controlled studies and case reports.^{2,3} There is still disagreement in the literature regarding the pathophysiology of ID.² It includes any combination of injuries to the posterior inguinal wall, conjoint tendon, inguinal ligament, rectus abdominis, hip adductors, external oblique musculature, etc.^{2-4,6,19,27} There is a need for higher quality studies regarding non-surgical intervention for ID.

ID is common in sports involving running, kicking and twisting motions. We reported a case of a professional hockey player who was non-surgically treated with PRP, chiropractic, and rehabilitation exercises with a relatively quick recovery in 3.5 weeks. This case highlights the importance of a multidisciplinary approach to the diagnosis and management of ID.

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Conservative management of an elite ice hockey goaltender with femoroacetabular impingement (FAI): a case report

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Objective: *To detail the presentation of an elite male ice hockey goaltender with cam-type femoroacetabular impingement (FAI) and acetabular labral tears. This case will outline the prevalence, clinical presentation, imaging criteria, pathomechanics, and management of FAI, with specific emphasis on the ice hockey goaltender.*

Clinical Features: *A 22-year old retired ice hockey goaltender presented to a chiropractor after being diagnosed by an orthopaedic surgeon with MRI confirmed left longitudinal and chondral flap acetabular labral tears and cam-type femoroacetabular impingement (FAI). As the patient was not a candidate for surgical intervention, a multimodal conservative treatment approach including manual therapy,*

Objectif : *Décrire la présentation d'un gardien de but de hockey sur glace d'élite souffrant d'un conflit fémoro-acétabulaire (CFA) de type came et de déchirures du labrum acétabulaire. Ce cas présentera la prévalence, la présentation clinique, les critères d'imagerie, la pathomécanique et la prise en charge du CFA, en mettant l'accent sur le gardien de but de hockey sur glace.*

Caractéristiques cliniques : *Un gardien de but de hockey sur glace à la retraite de 22 ans a consulté un chiropraticien après avoir reçu, de la part d'un chirurgien orthopédique, un diagnostic, confirmé par IRM, de déchirures du labrum acétabulaire chondrales et longitudinales du côté gauche et d'un conflit fémoro-acétabulaire (CFA). Comme le patient n'était pas candidat à une intervention chirurgicale, une approche thérapeutique conventionnelle multimodale comprenant*

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electroacupuncture and rehabilitation exercises were implemented.

Summary: FAI is prevalent in ice hockey players, particularly with goaltenders. Both skating and position-dependent hip joint mechanics involved in ice hockey may exacerbate or contribute to acquired and congenital forms of symptomatic FAI. As such, practitioners managing this population must address sport-specific demands in manual therapy, rehabilitation and physical training, to improve functional outcomes and prevent future injury.

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KEY WORDS: chiropractic, case report, femoroacetabular impingement, FAI, intra-articular hip injuries, acetabular labral tear, ice-hockey, goaltenders

Introduction

Femoroacetabular impingement (FAI) is a mechanism that clinically leads to pain and has been associated with several intra-articular injuries including acetabular labral tears and early-onset osteoarthritis of the hip.¹⁻³ The morphological characteristics associated with FAI have helped define subtypes that include cam impingement when there is overgrowth of the femoral head; pincer impingement when the acetabulum excessively covers the femoral head; and a combined impingement involving both cam and pincer characteristics.^{1,2,4} Diagnostic imaging is necessary to confirm the presence and severity of the deformity and is used to predict symptomatic impingement.⁵ The alpha angle is used quantitatively to evaluate the degree of femoral head deformity for cam-type FAI, while evaluation of acetabulum morphology allows for the determination of pincer-type FAI (Figure 1).⁵⁻⁷ A review by Emary⁸ highlights these pertinent radiographic findings in a clinical context for use in chiropractic practice.

There is a growing body of evidence to suggest that

la thérapie manuelle, l'électroacupuncture et des exercices de réadaptation a été mise en œuvre.

Résumé : Le CFA est prévalent chez les joueurs de hockey sur glace, en particulier chez les gardiens de but. Les pas de patinage et le mécanisme dépendant de la position de l'articulation de la hanche utilisés dans le hockey sur glace peuvent exacerber les formes congénitales ou acquises du CFA symptomatique, ou y contribuer. Ainsi, les praticiens prenant en charge cette population doivent traiter les demandes propres au domaine sportif en ayant recours à la thérapie manuelle, à la réadaptation et à l'exercice physique, afin d'améliorer les résultats fonctionnels et de prévenir les lésions futures.

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MOTS-CLÉS : chiropratique, étude de cas, conflit fémoro-acétabulaire, CFA, lésions de la hanche intra-articulaires, déchirure du labrum acétabulaire, hockey sur glace, gardiens de but

FAI may be more prevalent in athletes, specifically sports which require end-range movements of hip flexion, adduction, and internal rotation.^{9,10} Although involvement in sport was once thought to merely expose or self-select those with these congenital anomalies, increasing evidence has suggested these lesions may be due to sport-specific acquired adaptations over time.⁹ Given the demands of the sport, ice hockey players are particularly susceptible to symptomatic FAI, with the cam and combined deformity being the two most common subtypes.⁹⁻¹² Furthermore, hockey goaltenders are exposed to a series of unique mechanical positions, particularly movements utilized in the butterfly technique, which may increase their risk of FAI.⁹ The butterfly style for ice hockey goaltenders is popular, especially with younger, developing players. It is defined as a technique where the goaltender drops to their knees and internally rotates the hips to 90° with the intention of guarding the bottom portion of the net.^{9,13,14} Recently, there has been much interest and controversy surrounding this topic with respect to position-specific demands in ice hockey players. There has

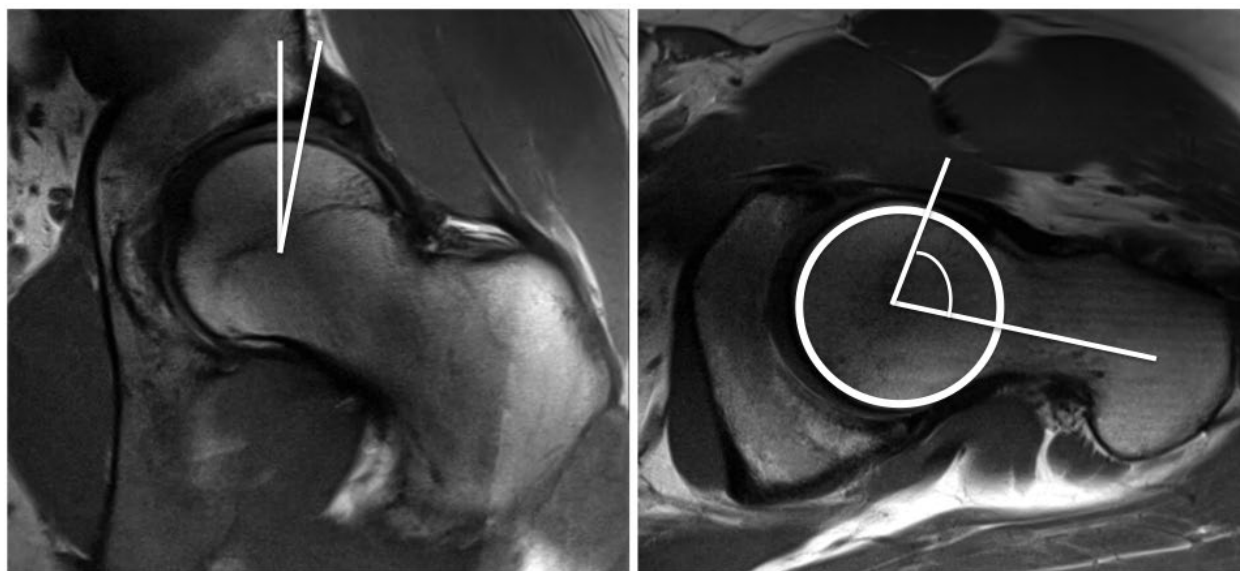


Figure 1.

T1-weighted coronal (left) and axial (right) MR images of the left hip. The coronal image on the left is demonstrating the measurement of the lateral centre edge angle. The axial image on the right is demonstrating measurement of the alpha angle.

been an increasing number of professional, junior and collegiate ice hockey goaltenders who have undergone surgery to treat symptomatic FAI, and media attention towards this sports phenomenon has become prevalent.¹³ In a recent surveillance study of National Hockey League (NHL) players from 2006 to 2010, goaltenders had significantly higher hip and groin injury rates (1.84 per 1000 appearances) when compared with positional players (0.34-0.47 per 1000 appearances).¹⁴ Interestingly, when analyzing intra-articular hip injuries, acetabular labral tears were most prevalent. With respect to positions, these injuries present more frequently in goaltenders in comparison to both forwards and defencemen.¹⁴

Since ice hockey is a Canadian national sport and it is common for clinicians to treat this population, there must be an increased awareness of sport-specific movements and injury patterns to optimize patient management. It is therefore critical to understand the pathomechanics at work and apply these principles to patient care, such as physical therapy and rehabilitation. The purpose of this case report is to detail the presentation of a male com-

petitive hockey goaltender with symptomatic cam-type FAI and subsequent labral tears. This case will explore FAI with specific emphasis on athletes and ice hockey players, outlining the prevalence, clinical presentation, and management options. It will also expand on the importance of understanding sport-specific biomechanics to employ a thorough, non-surgical approach to aid in the treatment in FAI cases.

Case Presentation

A 22-year old male retired Ontario Junior Hockey (OHL) goaltender presented to a chiropractor at a sports clinic after being advised by an orthopaedic surgeon to seek conservative management for his symptomatic FAI. The patient had a 4-year history of recurrent left hip pain that had forced him to retire from competitive play. Six-months prior to presenting to the sports clinic, an orthopaedic surgeon had diagnosed him with left chondral flap and longitudinal acetabular labral tears with morphologic features of a cam-type femoroacetabular impingement (Figures 2-3). The patient was told he was not a surgical

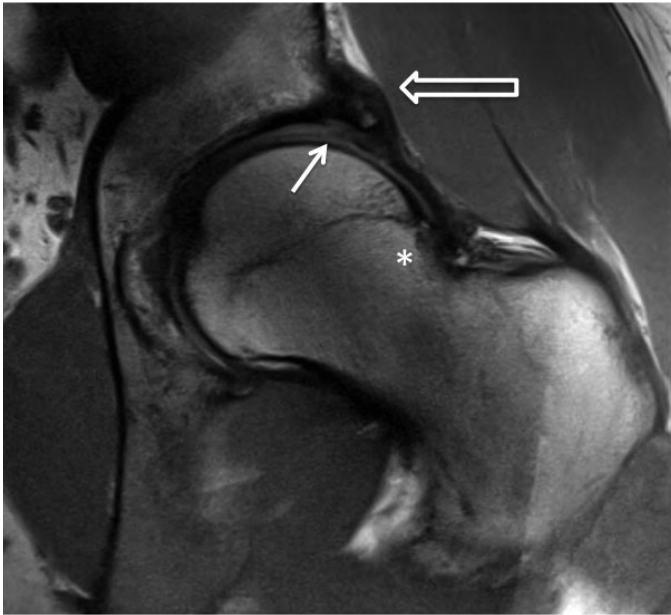


Figure 2.

T1-weighted coronal (left) MR image of the left hip demonstrating a mild cam-type morphology (white asterisk) with an acetabular labral tear (solid white arrow). The image also depicts a large os-acetabuli adjacent to the superolateral portion of the femoral head and acetabulum (hollow arrow).

candidate at the time since he had no previous attempts at conservative care, such as exercise and physical therapy. Furthermore, the patient was apprehensive to undergo surgery due to time constraints and fear of complications. As a result, the patient made a career choice to leave the sport of hockey and pursue further education to preserve future hip function. Since his left hip pain started to complicate other activities of daily living, such as long sitting and jogging, he felt that physical therapy was now warranted. The pain was described as a local, deep dull sensation that would present with intermittent bouts of sharp pain and catching that could radiate into the proximal anteromedial thigh. The pain was rated a 7/10 on a visual analogue scale (VAS) and his medical history revealed previous bilateral adductor strains and a left shoulder dislocation. When asked about his goals, the patient wanted to alleviate his consistent hip pain and improve his function for daily activities. He felt that he would never be able to play ice hockey competitively again considering the reported ‘damage’ to his left hip, but his ability to play at some level in the future was a long-term goal.

Physical examination revealed a 20% limitation and pain in both active and passive hip flexion and internal rotation. There was pain on palpation in several left hip girdle muscles, most notably the distal capsular portion of

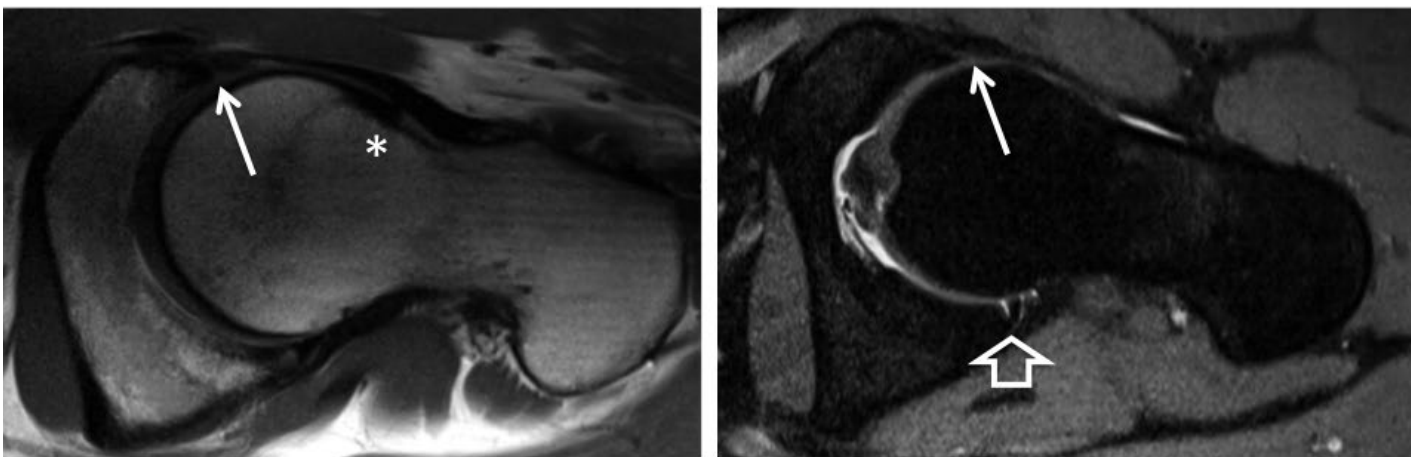


Figure 3.

T1-weighted (left) and T2 fat-suppressed (right) axial MR images of the left hip. An anterior acetabular labral tear is demonstrated on both images (white arrows). On the left T1-weighted image, the mild osseous cam-type deformity is visualized (white asterisk). A normal posterior labral recess is highlighted in the T2 fat-suppressed image on the right (arrow head).

the iliopsoas, proximal myotendinous junctions of the adductor longus and rectus femoris, and bellies of the pectineus, adductor magnus, and gluteal complex. Resisted left hip flexion and adduction were rated 4/5 with manual muscle testing (MMT), in which the patient was asked to meet the applied force of the practitioner at a fixed position.^{15,16} Left hip abduction was rated 5/5 using the same MMT technique with pain reported during sustained contraction.¹⁶ The hip scour and flexion-adduction-internal rotation (FADIR or FADDIR) tests^{3,17} recreated the chief complaint, produced a palpable non-painful click, and had a hard end-feel. The left FABER (flexion-abduction-external rotation) test was positive, in which the vertical distance from the lateral knee to the examination table was increased on the symptomatic hip in comparison to the unaffected hip.³ When the concurrent battery of testing is positive, clinical anterior hip impingement should be considered with a heightened suspicion for intra-articular hip pathology (including FAI).¹⁷ Active straight leg raise (SLR), lumbar Kemp's, thigh thrust, and both sacroiliac joint compression and distraction tests were negative. Painful restriction was noted locally at the right sacroiliac joint with posterior-anterior joint challenge. Hip log roll, hip axial loading, resisted trunk flexion (sit-up), and valsalva tests were negative. These tests were implemented to rule out competing differential diagnoses (Table 1).

In addition to the imaging-confirmed diagnosis provided by the orthopaedic surgeon, a clinical diagnosis of left anterior hip impingement with associated tendinopathies of the left hip flexors and adductors was rendered. Treatment consisted of a conservative multimodal approach to address the secondary neuromusculoskeletal deficits associated with the underlying intra-articular hip joint pathology. The goals of the plan of management were to decrease pain, improve hip function (i.e. range of motion, strength, endurance, proprioception), and build more active lumbopelvic stability to allow participation in sport. The treatment was delivered at a frequency of 1-2 times per week over a 6-week period. Active Release Technique (ART)[®] and instrument-assisted soft tissue therapy was directed to the affected muscles and fascial planes. Spinal manipulative therapy was used to improve the range of motion and affect the overlying tissues of the right sacroiliac joint to optimize lumbopelvic function. Hip capsule distraction and release was delivered to the affected left hip using the Mulligan Mobilizations with Movement

Table 1.
Differential diagnosis for persistent hip and thigh injuries in hockey players.

- Hip flexor or adductor strain
- Osteitis pubis
- Sports hernia/athletic pubalgia
- Inguinal or femoral hernia
- Femoroacetabular impingement (FAI) or capsular impingement
- Acetabular labral tear
- Femoral neck stress fracture
- Degenerative osteoarthritis
- Referred pain: low back or genitourinary
- Infection

(MWM) concept.¹⁸ Contemporary medical electroacupuncture was also incorporated into the plan of management. Spinal inputs included L2-L5 bilaterally and local inputs to the left hip muscles and nerves (SP-12, LR-10, GB-29, BL-53, BL-54) at a low (2 Hz) frequency stimulation. Rehabilitation exercises were used to increase muscle coordination, strength, endurance, and improve lumbopelvic stability. These were implemented in progressive phases: neuromuscular facilitation, functional training and sport specific training (Table 2).

After 6 weeks of treatment (total of 8 treatments) the patient was pain free at rest, during daily activities (including exercise), and with all stress tests used in the initial physical exam. Despite having less pain, the hip scour and FADIR tests still provided a hard end-feel and palpable click at extreme ROM. The patient was able to complete more taxing, sport-specific rehabilitation that incorporated both complex movement patterns and explosive plyometric training. At 8 weeks the patient was able to return to the ice with no further hip pain in a men's recreational hockey league at a frequency of once per week. Currently, he plays for 2 competitive men's hockey teams in both the winter and summer seasons at a frequency of 3 games per week. Although the underlying hip morphology and acetabular labral tears are irreversible with conservative care, this case demonstrates the importance of

Table 2.
 Rehabilitation program utilized with the case patient over a period of 8 weeks.

Phase	Exercises/Stretches	Reps	Sets	Time
Phase 1	Posterior hip capsule stretching	15	2	30 sec
	Dynamic hip capsule stretching	15	2	30 sec
	Potato squat with 5lb medicine ball	12	2	
	Modified curl-up	12	3	
	Side bridge track	2	3	45 sec
	Bird dog track	12	3	
	Pelvic (supine) bridge with theraband at knees	12	3	
	Side-lying hip abduction	15	2	
	Deadbug with isolated single limb movement	15	3	
	Single leg balance on disc/pillow		3	60 sec
	BOSU squats	15	2	
	Goblet Squat with 20lb dumbbell	12	2	
Phase 2	Deadbug (contralateral movement + exercise ball)	15	3	
	Standing Pallof press	15	3	
	Exercise ball plank to stir-the-pot	2	3	15 sec
	Single leg squat (BOSU)	15	3	
	Step ups & lateral cross-over step up	15	3	
	Multi-angle lunge (clock lunge)	15	3	
	Multi-plane monster walks	15	3	
	Split squats	10	2	
Phase 3	Slideboard multi-angle lunges	15	3	
	Slideboard lateral slides	15	3	
	Single leg box squat	12	3	
	Pallof press on BOSU/stability disc	15	3	
	Zigzag bounds	10	3	
	Front & lateral shuffles (ladder agility drills)	Max	3	5 min
	Tuck jumps to tuck holds on BOSU	10	3	
	On-ice lunges	Max	3	5 min
	On-ice post-to-post recovery drills	15	3	

soft tissue structures that can be contributing sources of hip pain and dysfunction. Addressing these biomechanical limitations with a patient-centred approach can contribute to the overall integrity and function of the hip and lumbopelvic joints.

Discussion

Epidemiology

The prevalence of FAI has been shown to vary based on age, gender, and the type of activities one predominant-

ly performs.^{3,19} The cam-type deformity accounts for approximately two-thirds to three-quarters of all FAI cases, while the pincer-type deformity accounts for the remaining one-quarter of cases.¹⁹ There is evidence suggesting that FAI is not as rare as once thought among the asymptomatic population. Jung et al.²⁰ retrospectively examined anterior-posterior (AP) pelvic CT scout views of 419 randomly selected patients, looking for the prevalence of cam-type deformity and evaluating alpha angle measurements. Among asymptomatic adults, 215 male hips were assessed revealing 13.5% as pathological, 14.88% as borderline and 71.16% as normal. Among 204 asymptomatic female hip joints, 5.56% were pathological, 6.11% were borderline, and 83.33% were deemed normal.²⁰ Hack et al.²¹ further demonstrated that in asymptomatic volunteers with no prior hip issues, 28% showed either a cam deformity or an elevated alpha angle, predisposing them to FAI.

FAI has been anecdotally reported to have a higher incidence in athletic populations compared to non-athletic populations. FAI is reported with an estimated prevalence of 24% to 67% in asymptomatic athletes.^{22,23} In comparing a group of 22 semi-professional soccer players to 22 amateur soccer players, it was found that the semi-professional group had a significantly higher mean alpha angle, which predisposes impingement.²³ In a systematic review and meta-analysis it was found that high-level male athletes (participating in basketball, soccer, hockey, and running) are 1.9 to 8.0 times more likely to develop a cam-type deformity than male controls.²⁴ While many studies have reported on male athletes, it is important to distinguish the prevalence of FAI in female athletes due to their unique hip anatomy. Kapron et al.²⁵ analyzed 63 female collegiate athletes who participated in volleyball, soccer, and track and field, assessing for radiographic evidence of FAI. Cam-type deformities were found in 48% of all hips with track and field athletes having significantly higher alpha angles compared to soccer and volleyball athletes.²⁵ Additionally, several main sexual dimorphisms have been observed with FAI, in which males are significantly more likely than females to have both radiographic and symptomatic bilateral cam-type FAI.²⁶ Other differences include smaller alpha angles and greater hip anteversion observed in females with symptomatic FAI. Despite these morphological differences, it has been demonstrated clinically that subjective hip function outcome scores are lower in females with symptomatic FAI in comparison to male counterparts.²⁶

With specific reference to hockey players, Ayeni et al.¹¹ demonstrated that elite ice hockey players had significantly greater alpha angles than non-athletes. Even some of the youngest hockey players when compared to skiers of the same age (10-18 years) showed significantly greater alpha angles, and were 4.5 times more likely to have an alpha angle associated with cam impingement.¹² Siebenrock et al.²⁷ further displayed that elite-level youth hockey players had greater alpha angles with a closed femoral physes versus open physes, as well as higher alpha angles in symptomatic athletes when compared to asymptomatic counterparts. In addition, Ross et al.¹³ revealed that 90% of butterfly goaltenders had an elevated alpha angle greater than 50°, resulting in a higher prevalence of FAI when compared to positional players. As is the focus of this case study, athletes appear to have a higher prevalence of FAI, and specifically hockey players, even at young ages, show a higher prevalence of FAI than participants in other sports. While the exact causation for such prevalence cannot be attributed to sports participation alone, it is important for the clinician to be aware of these differential diagnoses for persistent hip pain in these populations.

Clinical Presentation and Imaging

The literature describing clinical history and physical examination findings in patients with FAI is limited with considerable heterogeneity in population characteristics. Considering the vast amount of competing injuries that can occur at the hip, specifically in athletes such as ice hockey players, several important differential diagnoses must be evaluated and ruled out (Table 1). Patients with FAI will often present with groin pain, pain with prolonged sitting or walking, and pain during athletic activities requiring end-range motion, such as deep squatting.^{22,28-30} Several clues in the clinical history include sharp or deep intermittent hip pain. With potential osteochondral or labral injuries, patients may report catching, locking, or give-way (instability) sensations.^{3,28} A classic physical examination finding is a positive anterior impingement or FADIR test whereby the patients hip is passively flexed to 90°, followed by full adduction and internal rotation, with the presence of hip pain indicating a positive test.^{3,17} In a study by Philippon et al.³, the anterior impingement test was positive in 99% of patients with radiographic confirmed FAI. Ganz et al.²⁸ also reported

that this test is almost exclusively positive in FAI-confirmed patients. Another common finding in FAI patients is a positive FABER test with reduced range of motion on the affected side or a less commonly reported positive posterior impingement test.^{3,17} Common subjective measures used in FAI cases include the modified Harris hip score, the non-arthritis hip score, and the hip outcome score.³ Although these clinical tests may allude to potential hip pathology if positive, both FAI and intra-articular injuries are imaging-based diagnoses.²⁸⁻³¹

Conventionally, there are two imaging procedures used to diagnose and guide treatment in FAI cases; radiographic examination and MRI, with MR arthrography remaining the gold standard to evaluate the labrum and articular cartilage.^{8,31,32} Regarding radiographs, a supine AP pelvis and cross-table lateral are used with assessment of the lateral center edge angle (to assess pincer deformity) and the alpha angle, which is the most frequently cited parameter for the assessment of cam deformity.^{8,31,32} The lateral center edge angle is formed by a vertical line and a line connecting the femoral head centre with the lateral edge of the acetabulum (Figure 1).³² This measurement is used to assess lateral coverage of the acetabulum. The normal range is stated to be 25-39°, with angles greater than 39° indicating over coverage.^{31,32} On an axial view, the alpha angle is defined as the angle between a line from the center of the femoral neck to a line connecting the center of the femoral head to the point at which excess bone deviates the normal spherical shape of the femoral head (Figure 1).^{7,8,32} An alpha angle greater than 50° is present when defining a cam deformity.⁷ A previous narrative review has discussed these findings in detail for use in chiropractic practice.⁸

Ross et al.¹³ set out to characterize radiographic deformity between butterfly goaltenders and positional players with symptomatic FAI who were surgical candidates. They found that butterfly goaltenders had a higher prevalence of acetabular dysplasia and significantly greater maximum alpha angles when compared to positional players. They also demonstrated that there were significant differences in the location of the cam deformity among hockey positions, with a more lateral offset found in butterfly goaltenders.¹³ Although firm clinical implications cannot be drawn from this study, it does highlight potential adaptations that are unique to the positional demands of the ice hockey goaltender.

Pathomechanics

FAI is becoming a more predominant and detectable condition and is currently regarded as the most common cause of osteoarthritis in the non-dysplastic hip.^{9,30,31} As previously discussed, FAI is a condition that has two distinctive biomechanical categories: cam and pincer impingement.^{3-6, 24-32} Regardless of which impingement is occurring, the morphological changes and the subsequent inability to properly transmit forces efficiently will lead to future joint damage or insufficiency.^{2,7,9}

The cam impingement is an abnormality with regards to the proximal femoral structures presenting unusually large or misshapen (often aspherical). This abnormal structural formation causes an unusual articular interaction to occur in the hip, particularly in the anterosuperior portion of the acetabulum.^{26,28} Abutment occurs between the abnormal proximal femur and acetabulum, inflicting most of their effect to the cartilaginous structures and rarely to the labrum.^{2,24,28} Alternatively, the pincer impingement is the result of an acetabulum abnormality where the proximal femur is partially, or fully engulfed by the bony protuberance of the acetabular rim. In cases of coxa profunda or protrusion, over coverage of the proximal femur leads to more insult on the labrum versus the cartilagenous portions of the joint.^{2,26,28} With mixed impingement, both the articular cartilage and labrum are subject to injury.³²⁻³⁴ The muscles most commonly affected with symptomatic FAI are the adductor longus, proximal hamstrings, hip abductors, and hip flexors (such as the iliopsoas).³³ As the body attempts to adapt to impingement, these muscles are often mechanically affected due to altered joint motion.^{33,35}

Athletes who partake in rigorous sporting movements are more likely to experience impingement, especially if internal rotation of the hip and axial loading are frequent.^{2,9,36,37} Cam impingement is most symptomatic in sports requiring excessive hip flexion while the pincer impingement can limit athletes in multiple planes.^{23,24,27} Ice hockey players have been reported to undergo more FAI-related corrective surgery than athletes from other sports.^{37,38} When analyzing essential movements of the hockey stride, propulsion requires forceful extension, external rotation, and abduction of the hip (posterior impingement mechanism); while stride recovery requires the components of the anterior hip impingement mechanism: flexion, adduction, and internal rotation.^{9,10,24} Stull et al.¹⁰ confirmed these two at-risk positions during the skat-

ing stride in a population of youth hockey players with a mean age of 10.8 years. They noted that the push-off phase required an average of 11.5° of external rotation with concurrent 13.2° of abduction and 13.8° of extension. During the swing phase (or recovery period), a mean of 5.6° of internal rotation was measured with 44.2° of concurrent hip flexion.⁹ Although the magnitude of these values are smaller than those measured during preoperative FAI resection, the repeated use of these hip positions throughout an ice-hockey players career may be a contributing mechanism in cases of acquired or congenital symptomatic hip impingement.⁹

The demands of ice hockey goaltenders require unique movements when compared to positional hockey players and other athletes. Some of these movements include dropping into and rising from the butterfly position, lateral push-offs, and sprawling movements.^{9,13,14,39} It has been previously hypothesized that the butterfly movement performed by ice hockey goaltenders involves combined flexion, internal rotation, and axial load at the hip, leading to a higher risk of developing FAI.^{13,14} Whiteside et al.⁹ set out to quantify hip mechanics during a “long rebound sequence” task, composed of three movements: skating and decelerating to a stop, dropping into a butterfly save, and pushing laterally from the butterfly position using the skate blade (recovery). Interestingly, none of the aforementioned movements involved concomitant hip flexion, adduction, and internal rotation in adequate ranges of motion that replicate those achieved in the FADIR test.⁹ Internal rotation of the hip was found to be 21.2° at maximum and 11.5° at peak axial loading (femoral shock) during the butterfly save, while the deceleration movement had internal rotation values of 32.6° at maximum and 29.5° at peak femoral shock.⁹ As confirmed by Stull et al.,¹⁰ end-range hip internal rotation alone may be the primary mechanism behind anterosuperior impingement in the hip. When comparing other sport-specific movements where cam-type FAI is prevalent, such as the side-splits in dance (38°), golf swing (35°), and taekwondo kick (31°), they experience similar internal ranges of motion as witnessed in on-ice deceleration movements.^{9,40-42} Although the hip internal rotation experienced in the deceleration phases of the skating stride are not unique to goaltenders, future research may provide more clinical insight as to mechanisms resulting in more symptomatic FAI in this population.⁹

Management

When considering the treatment options for patients diagnosed with FAI and possible hip labrum complications, it is important to note the age, level of sport/activity, and physical findings.^{37,43} Both conservative and surgical treatment aim to restore normal hip function, while decreasing pain, and enabling the individual or athlete to return to their previous level of activity or sport.²⁻⁴ A systematic review on FAI corrective surgery stated the main indications for surgery were an imaging-confirmed diagnosis of FAI accompanied by persistent pain and impaired function that has not resolved from conservative management.⁴⁴ Indications for hip labrum reconstruction constitute young, active patients, without arthritis, along with findings of instability, pain, and hip dysfunction.⁴⁵ It is generally agreed that a trial of conservative care is initiated first in the absence of red flags or surgical indications mentioned previously, in an attempt to manage symptoms and improve function.⁴⁴⁻⁴⁶ This was the scenario in the case presented as the patient was not a surgical candidate despite having acetabular labral tears and associated cam-type FAI. Previous literature detailing the role of chiropractic care for FAI is consistent with the approaches used in this case.^{8,39} It is important to note that conservative approaches can only address secondary functional neuromusculoskeletal issues attributing to pain and do not modify the osseous abnormality.⁸

Currently, FAI surgery is generally based on an open or closed (arthroscopic) technique. The open technique allows for a fully exposed view of the femoral head and acetabulum, as the hip is openly dislocated.^{2,17,44,47} For cam-type FAI, the aspherical head is corrected via resection osteoplasty, while the acetabulum is trimmed or reoriented via periacetabular osteotomy.^{2,47} However, the open technique comes with inherent risks and slower recovery time when compared to the closed technique (arthroscopy), which allows for a less invasive and reduced exposure during the surgery as well as a quicker recovery time.^{2,44} The surgical intervention of choice for FAI with associated labrum pathology is labral debridement and repair.⁴⁵ Ayeni et al.^{45,46} revealed that labral repair resulted in superior outcomes when compared to labral debridement. When considering return to play for high-level athletes with FAI, it is important to note the success surgical intervention can have. Naal et al.⁴⁸ found that in professional athletes undergoing FAI surgery with hip dislocation (14

Table 3.
Goals in FAI arthroscopic post-operative rehabilitation
(Adapted from Pierce et al.³⁹).

Phase	Goals
Phase 1 (2-10 weeks)	Protection Maintain constant passive range of motion Decrease inflammation Prevent muscle inhibition
Phase 2 (weeks 4-12)	Normalize gait Restore full range of motion Enhance neuromuscular control
Phase 3 (weeks 5-16)	Restore endurance and fitness Progress to more unilateral movements Restoration of balance
Phase 4 (16+ weeks)	Restore power and strength Return to play

of which were ice hockey players), 21 of 22 patients were still competing professionally 12-79 months post-surgery, and showed favourable satisfaction with the hip surgery and their athletic ability. Another method using an iliotibial band autograft produced similar patient satisfaction and returning to a similar level of competition in elite athletes.⁴⁹ A recent systematic review showed that all studies with various surgical techniques all reported significant improvements in patient pain, function, and satisfaction rate, as well as improved range of motion and a high return to sport rate of 98.2%.⁴⁴

Regardless if a patient or athlete with FAI is involved in a non-surgical or operative plan of management, rehabilitation is the cornerstone of treatment and must address any lumbopelvic and lower kinetic chain deficiencies.^{39,50} The rehabilitation process is similar after open or arthroscopic hip surgery and is broken down into four phases (Table 3).³⁹ The end goal of any rehabilitation program is to return the athlete to play at their previous level of competition. With respect to the hip, it is imperative to restore full range of motion (ROM), mobility, and build both endurance and strength.³⁹ When assessing the hip complex after corrective FAI surgery, the gluteal mus-

cles, most notably gluteus medius, must be addressed as a priority since they are weakened and inactivated.^{39,50} By restoring the strength, endurance, and dynamic control of the gluteal muscles through progressive exercises as demonstrated in the case (Table 2), patients can reintegrate proper hip function and lower limb kinematics.³⁹ A well-designed post-operative rehabilitation program for the hip should limit excessive hip flexion, or over-activation of the iliopsoas muscle short-term, which may cause irritation and prolong recovery.³⁹ Stationary hip abduction exercises are recommended for the activation of gluteus medius, while maintaining a relaxed iliopsoas. An over-aggressive exercise program should be avoided as it can lead to hip flexor irritation, muscle weakness, failure of a labral repair, and intra-articular adhesions.³⁹ When initiating sport-specific exercises for ice hockey goaltenders after post-arthroscopic hip surgery, progression should begin with normalizing skating mechanics without equipment. Once skating mechanics are attained without pain or functional issues, adding equipment and moving to light goalie specific movements (post-to-post lateral glide) can begin.³⁹ Once these goals are achieved, adding speed, incorporating butterfly-specific positions, and utilizing explosive movements should be initiated. The final stage prior to returning a goaltender to play is to integrate all components in game-like situations with a conditioning component.³⁹

Summary

FAI has been observed to be more prevalent in athletic populations, and ice hockey goaltenders may be a specific at-risk athletic population.^{9,13,14} Although the exact causes for this prevalence are unknown, recent literature has shown increasing evidence that acquired changes from sport demands over time may be a contributing factor. It is still important to consider the exposure of pre-existing congenital bone features and the potential of self-selection to occur given this morphology for success in sport. As demonstrated by the case presentation, elite-level hockey goaltenders can present with morphological characteristics such as FAI or associated soft-tissue adaptations that may be further exposed or aggravated with their unique sport-specific demands. The butterfly technique was previously thought to be the main precipitating factor for FAI development in hockey goaltenders, but recent research suggests that skating mechanics, specifically de-

celerating to a stop repetitively, may impose the greatest at-risk hip biomechanics leading to future intra-articular injury.⁹ Conservative management utilizing a multimodal approach, as described in the case, should be first line treatment.^{44,46} Surgery with a comprehensive post-operative rehabilitation program is warranted with failed conservative care, severe functional limitations, or complications from associated labral damage.^{44,45} While surgery has very positive outcomes and a high return to play rate for athletes, it is imperative that rehabilitation maintain range of motion, endurance, strength, and power in the hip complex if the athlete wishes to return to the previous level of competition.^{14,40,43-46}

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Unexpected Salter-Harris type II fracture of the proximal phalanx of the second toe: a chiropractic perspective

Mark Murdock, BS, RN, DC¹

Objectives: *To discuss the diagnosis and management of a Salter-Harris type II fracture in a nine-year-old girl who was managed conservatively.*

Clinical Features: *A nine-year-old girl fell while playing in bare feet in the grass. She experienced pain when she walked or moved her toe. There was minor swelling and bruising.*

Intervention and Outcome: *Plain film radiographs revealed a Salter-Harris type II fracture of the 2nd proximal phalanx. Her toe was stabilized and she was referred to an orthopedist. Orthopedic management involved a taping procedure. After three weeks, her fracture healed and she was pain free.*

Summary: *Chiropractors may consider radiography of post-traumatic injury sites even with equivocal*

Objectifs : *Discuter du diagnostic et de la prise en charge d'une fracture de type II selon la classification de Salter et Harris chez une jeune fille de neuf ans qui a reçu un traitement conventionnel.*

Caractéristiques cliniques : *Une jeune fille de neuf ans est tombée alors qu'elle jouait pieds nus dans l'herbe. Elle ressentait une douleur en marchant ou en bougeant son orteil. Des gonflements et des contusions mineurs ont été observés.*

Intervention et résultat : *Des radiographies simples ont révélé une fracture de type II de la 2^e phalange proximale, selon la classification de Salter et Harris. Son orteil a été stabilisé et elle a été aiguillée vers un orthopédiste. La prise en charge orthopédique englobait une procédure de bandage. À l'issue d'une période de trois semaines, sa fracture avait guéri et la douleur avait disparu.*

Résumé : *Les chiropraticiens peuvent tenir compte des radiographies des sites des lésions post-traumatiques, même en cas de résultats d'examen équivoques et*

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examination findings despite histories suggesting seemingly innocuous mechanisms of injury.

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KEY WORDS: chiropractic, toe fracture, Salter-Harris, pediatrics

Introduction

The Salter-Harris (SH) classification system is used for fractures involving the growth plate (physis) in children. This system classifies fractures according to the pattern of involvement of the growth plate and surrounding bone as seen on radiographs (Figure 1). Type II fractures are identified by radiolucency in part of the growth plate accompanied by radiolucency of a part of the metaphysis.

Salter-Harris fractures of the toe and fractures in general are not commonly seen or treated in chiropractic practice.¹ However, toe fractures are one of the more common fractures diagnosed by primary care physicians, accounting for 8-9% of fractures seen in primary care.^{2,3} Physeal fractures account for 15-30% of all childhood fractures.^{4,5} The incidence of such fractures has been reported at a rate of 14 cases per 10,000.⁶ Boys are approximately twice^{5,7} as likely to have this type of fracture. For girls, these injuries usually occur between ages nine to twelve.^{4,7} Brown⁸ indicated that 75% of all SH fractures were type

malgré des récits suggérant des mécanismes de blessure semblant anodins.

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MOTS-CLÉS : chiropratique, fracture de l'orteil, Salter et Harris, pédiatrie

II; therefore it is the most common physal injury. Fractures of digits two through five are nearly four times more common than fractures of digit one.² For all age groups, phalangeal fractures are the most common fractures of the forefoot.⁶

The symptoms of SH II (Salter-Harris type II) fracture can be explained using the mnemonic CC-OPQRSTA (see Table1). These symptoms warrant further physical examination including observation. The skin should be inspected for significant injuries such as “open” wounds that may lead to skin necrosis.² A fracture is considered “open” if there is a full thickness laceration around the fracture.⁶ Toenails should be inspected for injuries such as subungual hematomas.² Deformity of the digit should be noted^{2,6} as most displaced fractures and dislocations present with visible deformity². Unfortunately, non-displaced fractures are not as apparent. Most patients with toe fractures have point tenderness over the fracture site², but contusions may also have point tenderness.

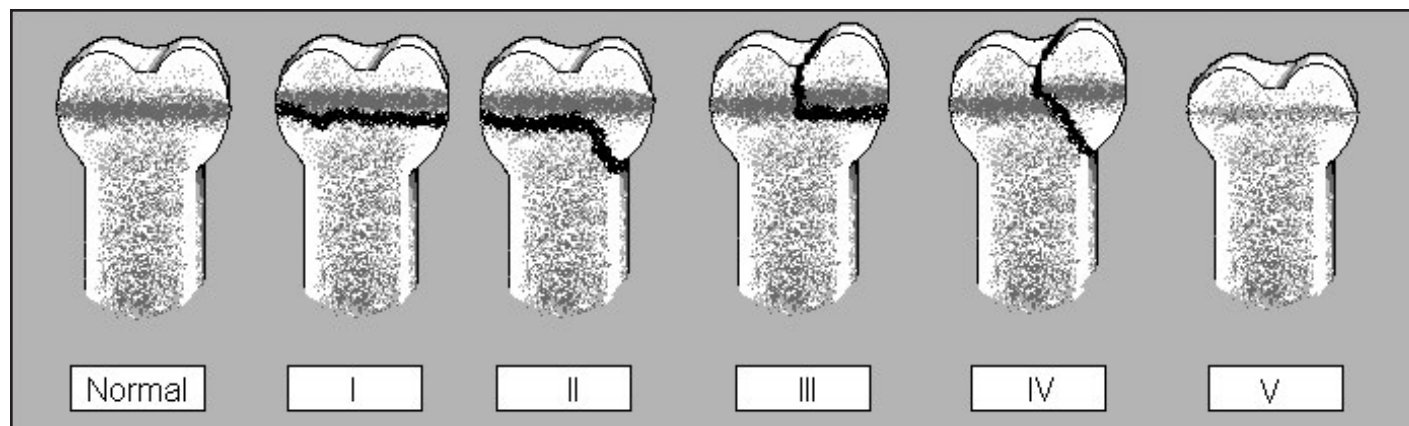


Figure 1.
Salter-Harris Fracture Types.

Table 1.
Typical symptom pattern for Salter-Harris type II fractures.

CC – Chief complaint	Pain at the fracture site and swelling ^{2,6}
O – Onset	Bruising normally develops two to three hours after injury. ⁶ Toe fractures are commonly a result of “axial force (e.g., a stubbed toe) ² or a crushing injury (e.g., from a falling object)” ^{2,9} The most commonly associated activities include: assault, motor vehicle accidents, falls (recreation, sports) and striking objects. ⁶
P – Palliative and Provocative factors	Relieving factors often include the use of splinting, rest, ice, compression and elevation. Aggravating factors often include movement of the joint, discomfort while wearing shoes, and difficulty walking. ⁶
Q – Quality and Quantity of pain	Normally a throbbing ² ache that becomes sharp with movement. Pain intensity varies from asymptomatic to severe.
R – Radicular or Referred pain	Technically does not apply to toe fractures. Pain distal or proximal to the fracture site can occur due to swelling or damage to adjacent nerves or blood vessels.
S – Site	If present, pain is at the site of injury. ²
T – Timing	Constant and increased with activity.
A – Associated conditions	Possibly an isolated subungual hematoma. ² History of a significant mechanism of injury should prompt a lower back and extremity exam. ⁶

A thorough neurological and orthopedic evaluation that includes taking pulses and capillary refill, should be conducted.⁶ Posterior tibial and dorsal pedis pulses should be evaluated with the understanding that 12% of healthy patients may not have a palpable dorsal pedis pulse.⁶ Capillary refill should be assessed while being cognizant that a delay in capillary refill may indicate circulatory compromise.² Holding the distal phalanx while applying a gentle, gradual, axial loading force is an important orthopedic maneuver that results in a sharp pain in the proximal phalanx if a fracture site is present, thus differentiating it from a contusion.² Uncommonly, tendon injuries may accompany a toe fracture.² Muscle injuries can be assessed by first having the patient initiate a very light contraction. Muscle testing may reveal heightened pain with gradual isotonic contraction in the presence of injury. Vibration with a 128 Hz tuning fork may cause heightened discomfort.

The presence of these subjective and objective findings would increase the suspicion of toe fracture. Chiropractic guidelines to determine the necessity of radiography support their use with trauma and findings of injury in adults.¹⁰ However, there is controversy regarding radiography of children as there is concern about unnecessarily exposing children to ionizing radiation. Failure to diagnose a fracture could be harmful if the fractured

fragments are not stabilized. This instability could lead to pain, weight-bearing dysfunction and/or displacement of bone fragments, which could in turn cause apparent or actual toe misalignment. Many cases of missed fracture exist in the literature.¹¹ With a history of trauma and significant examination findings, consideration of radiography before conservative treatment is important to avoid missing fractures. The objective of this paper is to present a case of a nine-year-old who was found to have a Salter-Harris type II fracture.

Case Presentation

A nine-year-old child sought chiropractic care for second digit pain three days after she fell while playing barefoot in the grass. She stated that she rolled her toes on the ground. She indicated moderate to severe pain when she walked or when digital pressure was applied to her toe. Using a splint and walking on the lateral edge of her foot decreased the pain, although there was still a constant ache. On examination there was mild swelling of the proximal aspect of the toe as well as antalgic gait. She was unable to walk without pain unless she favoured the lateral side of the affected foot. The alignment of the second digit was unaltered. The second digit was sensitive to applied pressure and slight motion. A tuning fork test mildly increased her pain when compared with no vi-

Figure 2.



2A – DP foot demonstrating fracture of 2nd digit to right foot.

2B – Oblique view demonstrating the oblique fracture with minimal lateral displacement of the distal fragment.

bration. These findings coupled with parental preference led to x-rays being taken.

A radiological series including dorsoplantar (DP), lateral and oblique views of the foot was obtained (Figure 2). A fracture extending from the medial cortex of the metaphysis at the base of the second proximal phalanx into the adjacent physis was noted. There was minimal displacement at the fracture site, although adjacent soft tissue swelling was observed. Bone mineralization was noted to be adequate. Based on these findings, a diagnosis of a Salter-Harris type II fracture was made. The consulting radiologist suggested an orthopedic consultation. In the meantime, the patient's first and second toes were splinted together and she began using a set of crutches.

The patient was evaluated by an orthopedist who recommended taping digit two to digit three with a cotton swab between her toes and wearing a loosely fastened shoe as needed. The orthopedist recommended against the use of crutches. The patient noted that she was pain-free at a three-week follow-up appointment with the orthopedist. Follow-up radiographs demonstrated "excellent callus formation across the fracture. No new displacement is seen and early remodeling is present."

Discussion

This case involved a nine to twelve-year-old girl with a Salter-Harris type II fracture of the second digit. As such, it resembles the typical demographics for such injuries described in the literature. However, this case was unique due to the unusual mechanism of injury (rolling of her toes in grass), the relative rarity of evaluation of such injuries in chiropractic clinics, and the subtle nature of the complaint. Thus, several issues arise from this case. First, can seemingly minor, unusual events result in a Salter-Harris type II fracture? Secondly, should trauma with modest clinical findings prompt the practitioner to use radiography? Finally, can uncomplicated Salter-Harris type I and II fractures be managed by chiropractors?

In this case, the mechanism of injury was considered unusual as it was not an obvious axial trauma² nor a crushing injury.^{2,9} The chiropractor initially decided that the mechanism of injury and physical findings did not warrant radiography, but eventually referred the patient due to parental preference. With respect to the literature on the appropriateness of radiography for foot injuries, Bussieres *et al*¹⁰ state that "radiography of the foot for an adult is not required in the absence of metatarsal injury

and normal physical exam". These authors do not indicate a threshold for "abnormal physical exam findings." Axial trauma to the digits of the foot is common and generally has minimal findings without resultant fracture. Therefore, "abnormal physical exam findings" should be clarified. In the present case, the child had minimal physical exam findings including slight ecchymosis, difficulty ambulating, slight swelling, and a mildly positive tuning fork test. Parental preference coupled with those findings suggested a need for performing radiography. In the chiropractic setting, ruling out a fracture is pivotal since a fracture is a contraindication to manual therapy including manipulation.^{10,12} Radiographic studies of a suspected toe fracture should include dorsoplantar, lateral, and oblique views.⁶ In addition, it is advisable to have multiple opinions on a radiograph for the purposes of risk management.¹³ Historically, most SH I or II fractures have been viewed as innocuous injuries.¹⁴ George *et al*¹⁵ state that "the alert emergency physician understands that for many urgent problems the adult and child may differ quite widely in pathophysiology. " Chiropractors should be familiar with classification methods for physeal injuries.^{4,15} The Salter-Harris classification is the most accepted.^{4,6,16,17} The classification often provides evidence to determine the mechanism of injury.

Mechanism of Injury

The term mechanism of injury (MOI) can refer to the event or the details of the forces involved in the event. According to Armagan and Shereff¹⁸, an abrupt abduction force is the most common cause of fractures to the lesser toes. More specifically, Brown⁸ remarked that SH I and II fractures result from "shearing or avulsion forces that parallel the growth plate." The type of SH fracture is dependent upon mechanism of injury.¹⁹ As per Devalentine¹⁶, SH fractures occur more often on the metaphyseal side of the growth plate. This helps explain why SH I and II do not normally affect growth.⁴ Furthermore, avulsion of small fragments of bone from the phalanges can occur due to the insertion sites of the flexor and extensor tendons. Conversely, these tendons can be injured when a fracture is nearby.² Therefore the mechanisms of injury of SH fractures can include shear, crush, avulsion, abduction or axial load. In this case the fracture seems to have been caused by common abduction forces, however the event is unique as many children fall in the grass without result-

ant fractures. As such these mechanisms of injury may result in emergent, complex presentations.

Emergency Referral

Emergency referral following foot trauma may be needed whether or not x-rays have been taken. In some circumstances radiography may be postponed in the interest of a timely emergency referral. Referral to the emergency department without radiography should be performed for patients in significant distress, in shock, with vascular² or neurological compromise, obvious dislocation, open fractures or skin necrosis. The latter are at high risk for osteomyelitis.² Open fractures of the proximal phalanx are a surgical emergency and immediate orthopedic consultation is recommended to reduce complications, particularly infection.⁶ Referral to the emergency room after radiography is necessary for fractures with dislocation or intra-articular involvement (SHIII and IV).²⁰ Management of the following rare conditions would also require referral to an orthopedist: growth plate closure^{14,21}, bony bridge^{5,13}, avascular necrosis,²² persistent pain²⁰ or malunion^{2,20}. For general practitioners, referral is not recommended for children with uncomplicated (closed, non-displaced) SHI and II.² However, the chiropractor must be mindful of medicolegal issues such as the consequences of missed fractures^{11,23} and their scope of practice with respect to fracture management²⁴⁻²⁶.

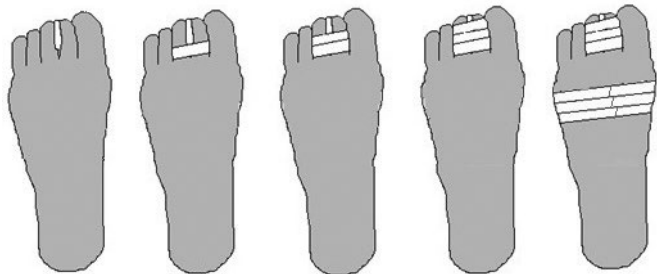
Radiograph Necessity

The application of clinical practice guidelines can help clinicians determine the necessity of radiographic studies.^{10,27} Warning signs of severe injury can be summarized by the mnemonic **PUMPS**. Clinicians should assess for the following: history of a **p**op, snap or noises during injury, loss of **u**sability, **m**ode/mechanism of injury, **p**ositional misalignment (may include swelling or bruising), **s**ensation, motor, or vascular loss (pulse, warmth, color and capillary refill). As illustrated in the present case even subtle evidence of these signs could indicate the presence of a fracture.

Importance of Foot Fractures for Chiropractors

Findings related to fractures may be confused with evidence for joint misalignment. According to Burns²⁸, a misalignment of the MTP joint will present with loss of fluid motion, point tenderness and a soft tissue callus "over the

Plantar surface



Dorsal surface

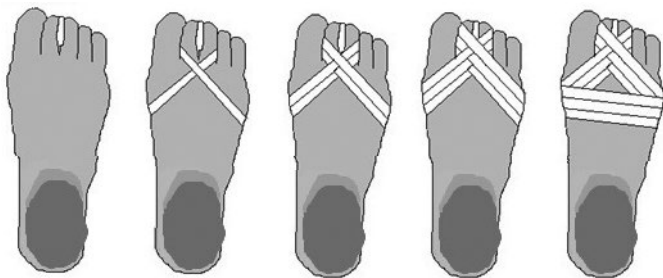


Figure 3.

Steps for basket weave splinting technique.

metatarsal head which has dropped” inferiorly. The practical application of this case study is for chiropractors to be aware that minor mechanisms of injury can sometimes cause significant injuries such as fractures. Radiographic assessment should be considered to avoid mistaking a fractured toe for a joint misalignment and then manipulating that fractured toe. Such treatment could result in additional pain and displacement of the fragment. In this case, performing radiographic evaluation of the toe saved the patient from possible displacement of the fracture site and longer healing time if the joint was instead presumed to be misaligned in a chiropractic sense as described by Burns’ criterion.²⁸

Management of Uncomplicated Salter-Harris Fractures by Chiropractors

As chiropractors rarely manage fractures of this nature, additional training beyond traditional first aid training is likely warranted. This training would enhance pre-referral management of SH fractures to orthopedists. Training could include many of the details presented in this

article: demographics, clinical presentation, examination, radiography and treatment. In this case, treatment included using cushioning (a cotton ball) between the toes before applying a splint.¹⁸ This cushioning decreases the chance of pressure sores and helps maintain the normal alignment of the structure. Since the first digit carries a third of the body weight during stance phase,¹⁸ taping digits two and three together is more appropriate than taping digits one and two when digit two is fractured. The splint recommended for lesser digit fractures is a basket weave and buddy combination (Figure 3).^{6,29} Prevention of uncomplicated lesser toe fracture includes encouraging the use of shoes during physical play.⁹ When either of digits four or five are fractured, using a shoe with a rigid sole for support is recommended if well-tolerated.¹⁸ The shoe can be loosened as needed. Crutches are often not recommended since weight-bearing aids in the healing of the fracture. Moreover, studies suggest that family physicians can manage most toe fractures with good results.^{2,20} SH I and II have a low chance of resultant disability.¹⁸ If a review course would be adequate for family practitioners to manage fractures³, then chiropractors could potentially learn to manage uncomplicated fractures as well, although it would have to fall within their scope of practice in their respective jurisdiction. This case study raises the question as to whether chiropractors need further education in the management of fractures prior to referral to an orthopedist.

Summary

This case illustrates two main points. Firstly, seemingly minor but unusual mechanisms of injury can result in SHII fractures. Secondly, chiropractors who evaluate patients with toe pain secondary to trauma should consider radiography even with equivocal findings.

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Fascia: The Tensional Network of the Human Body: The science and clinical applications in manual and movement therapy

Robert Schleip and Thomas W. Findley
Churchill, Livingstone, 2012, 475 pp.,
Paperback Price: CAN \$86.24
ISBN: 978-0-7020-3425-1

As its title suggests, this textbook succeeds in establishing a valuable link between the growing bodies of scientific research on fascia and applying it practically. While fascial therapy and theory have been getting increased attention in recent years, there was still an apparent conceptual and practical disconnect in its understanding. Over 100 researchers and specialists on fascia from around the world contributed to the text, making its contents extremely well researched and diverse.

This text is highly detailed and specific but progresses gradually, making it very readable. The book is divided into seven sections that are subcategorized into chapters and allow topics to build on one another. The numerous images, both photographs and drawings, greatly enrich learning and the concepts presented.

In my opinion the thoroughness and comprehensive nature of the book make it essential for anyone working with fascia to own and read. In particular, section seven of the book gives an overview to many of the current fascial treatment systems and modalities in use today and their function and clinical significance. Without doubt, a seminal book in the field of fascial therapy, this text informs and guides everyone who comes in contact with fascia.

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High Performance Training for Sports

David Joyce and Daniel Lewindon
Human Kinetics, 2014, 393 pp.,
Paperback Price: CAN \$23.16
ISBN: 978-1-4504-4482-8

High Performance Training for Sports is a book at the forefront of the ever evolving and progressing field of sports strength and conditioning. The text provides a comprehensive yet practical overview in administering both general and specific aspects of sport exercise to patients or clients. Its pages cover current, pertinent information applicable to strength coaches, rehabilitation specialists and manual therapists for clinical or everyday use. 29 leading academics and experts in the field of sports performance training make contributions in this text, drawing from their skills and experiences working with professional teams and educational institutions from around the world. There is a very nice balance between current, high-level scientific research and practical, experiential insight.

Among the numerous topics aptly covered in this text are many issues that are beneficial to any clinician working with athletes. Topics like overtraining, injury prevention and rehabilitation, athletics in youth, motor control learning and periodization are such examples. The book includes many relevant photographs to reinforce concepts as well as abundant graphs, tables and case studies to aid understanding.

Overall, *High Performance Training for Sports* provides significant value for the price along with easy reading. While a background of knowledge in strength and condition is recommended for this book, I still recommend this text highly for those involved sports medicine and rehabilitation to enrich understanding of co-managing athletes year round. Although some topics in this book are presented in incredible depth and detail, there is an abundance of general and easily applied information.

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ROYAL COLLEGE OF CHIROPRACTIC SPORTS SCIENCES (CANADA)
COLLEGE ROYAL DES SCIENCES SPORTS CHIROPRACTIQUE (CANADA)

Call for Submissions: RCCSS(C) Research Funding Awards

ANNOUNCEMENT:

The Royal College of Chiropractic Sports Sciences (Canada) is proud to announce a call for submissions for the annual RCCSS(C) Research Funding Awards. These awards are open to all members (Fellows, Residents and Members) of the RCCSS(C) and are meant to stimulate interest in chiropractic sports science and encourage members to undertake research.

OVERVIEW:

VALUE OF AWARDS GRANTED	Total Amount of Funds available for rewards: \$3000
AWARDS ALLOCATION	3 awards at \$1000
APPLICATION DEADLINE	May 1st on a yearly basis
HOW TO APPLY	See below for submission guidelines. Email submissions to rccssc@shaw.ca
FOR MORE INFORMATION	Contact Dr. Alex Lee, Chair RCCSS(C) Research Committee

Decisions on awards will be made by Aug 1st yearly, and announced each year via the sport report and AGM.

SUBMISSION GUIDELINES:

- Qualified submissions include original research projects that are proposed, ongoing, or recently completed but not yet submitted for publication
- Submissions must utilize the format below and should be no longer than 1500 words (not including abstract, references, budget or intent for knowledge dissemination sections)
 - Abstract
 - Introduction
 - Methods
 - Any preliminary pilot work (if available)
 - Implications of your work to sports health care
 - Budget/use of funds applied for, if received
 - Intent for knowledge dissemination

REVIEW PROCESS:

The RCCSS(C) Research Committee will adjudicate all submissions and oversee the granting process.

- The Chair of the committee will referee the peer review process
- All submissions will be blinded and reviewed by 3 reviewers
- A total summative score using a standardized scoring rubric by reviewers will determine who will win the awards
- Peer reviewers have the option of providing blinded comments about the project to the applicants if they choose to do so during the peer review process
- Double blind peer review
 - Submissions will be removed of any identifying information
 - Applicants will be blinded to the reviewers
- Peer reviewers will not include anyone who has directly or indirectly applied for the RCCSS(C) Research Funding Awards for the current calendar year

STIPULATIONS OF THE RCCSS(C) RESEARCH FUNDING AWARDS:

- The recipient must acknowledge the RCCSS(C) in any presentation and in the publication of the awarded work (in the acknowledgement and declaration of funding sources sections)
- The recipient must either present their work at a RCCSS(C) conference as a 15 minute platform presentation OR create a poster for presentation at a RCCSS(C) conference OR create an e-presentation to be used by the RCCSS(C) website at the completion of the project. If the awarded applicant fails to meet this requirement within 2 calendar years of the award being granted, all funds must be paid back in full to the RCCSS(C).
- Funds are forwarded to the applicant only after the recipient forwards proof of acceptance for publication from a peer-reviewed journal of the awarded work to the RCCSS(C) Research Committee
- The project must be submitted for publication within 2 calendar years of the award being granted (the Research Committee reserves the right to consider and extend this deadline under extenuating circumstances)

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