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# Editorial Board

# Immunization in Canada: Update for 2015

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## Introduction

In our first immunization update in 2003,[1] we briefly described the clinical and epidemiological features of vaccine-preventable diseases and outlined the routine, publicly funded immunization programs in Canada. At that time, children were immunized with vaccines to prevent 9 infectious diseases (diphtheria, tetanus, pertussis, polio, *Haemophilus influenzae* type b, measles, mumps, rubella, and hepatitis B). Vaccination was also recommended to prevent pneumococcal infection (7-valent pneumococcal conjugate), meningococcal infection (meningococcal C conjugate vaccine), pertussis in adolescents, and varicella, but publicly funded programs were not available in most provinces/territories. Publicly funded vaccination programs were also available for older adults to prevent influenza and pneumococcal infection (pneumococcal polysaccharide vaccine). In that commentary, we also discussed the risk-benefit of vaccination and described the safety surveillance system in place in Canada that monitors the safety of our publicly funded vaccination programs.

In our 2009/2010 update,[2] we described the seven new vaccines that had been introduced into the Canadian immunization schedule. The four vaccines that were previously recommended but not funded (varicella vaccine, Tdap for adolescents, meningococcal C conjugate, 7-valent pneumococcal conjugate) had been incorporated into the publicly funded programs in all provinces/territories. Influenza vaccine was also recommended and funded for all children 6–23 months of age and for pregnant women. Quadrivalent meningococcal conjugate vaccine was available as an option where its use was supported by local epidemiology; three provinces had incorporated it into their publicly funded programs. Human papillomavirus (HPV) vaccine was also recommended and funded for all pre-adolescent girls in Canada. In the 2009/2010 commentary we also described the new Canadian Immunization Committee (CIC), its relationship to the longstanding National Advisory Committee on Immunization (NACI), and CIC's use of the Erickson–De Wals framework[3] for assessing whether a new vaccine should be incorporated into the publicly funded vaccine programs in Canada.

In this 2015 immunization update, we will review new immunization recommendations that have been introduced in the last 5–6 years. We will group these into new uses of "old vaccines" and new vaccines that have been introduced into Canada. We will also look at new vaccines that are on the horizon in the next 5–6 years. Finally, we will review some recent changes to the immunization infrastructure in Canada, emphasizing Canadian capabilities for research and evaluation of existing and new vaccination programs.

### *Old Vaccines, New Uses*

A number of programmatic changes have been implemented by provinces/territories to vaccine programs that are already funded publicly.[4,5] Based on the proven effectiveness of a two-dose priming regimen in the first year of life with a booster in the second year,[6] pneumococcal conjugate vaccine is now being given at 2, 4, and 12 months of age rather than at 2, 4, 6, and 12–18 months of age in all provinces/territories except the Northwest Territories and Nunavut, thereby saving substantially on vaccine purchase and administrative costs. High-risk individuals are still provided with the six-month dose. Similarly, some provinces/territories have moved to a two-dose HPV vaccination schedule based on satisfactory immunogenicity compared to the three-dose regimen.[7] An increasing number of jurisdictions have substituted the quadrivalent meningococcal conjugate vaccine for the meningococcal C conjugate vaccine for the pre-adolescent/adolescent booster dose.[4] A single dose of Tdap vaccine is now recommended and publicly funded for all adults not previously immunized with Tdap.[5] The annual influenza vaccine is now recommended more broadly; NACI now recommends universal influenza vaccination for the entire population, and many provinces/territories have joined Ontario in implementing this recommendation.[4] Because of ongoing outbreaks of varicella,[8] nearly all provinces/territories have moved to a two-dose varicella vaccine schedule.[4] Finally, in keeping with the NACI recommendation for a universal HPV vaccination program for pre-adolescents using a quadrivalent HPV vaccine, Alberta, PEI, and Nova Scotia have extended their programs to include pre-adolescent boys.[4]

### *New Vaccines, New Recommendations*

New vaccines that have entered the Canadian market and are recommended by NACI since the last immunization update include rotavirus vaccine, a combination MMRV vaccine, 13-valent pneumococcal conjugate vaccine,

zoster vaccine, and adjuvanted and high-dose influenza vaccines. NACI and CIC recommend universal infant immunization against rotavirus, the major cause of hospitalization for diarrhea and dehydration among Canadian infants.[9] Two vaccines are available in Canada for prevention of severe disease caused by rotavirus: RotaTeq® (Merck Canada Inc.) and Rotarix® (GlaxoSmithKline Inc.). Both vaccines are live virus oral vaccines given at 2 and 4 months (Rotarix®) or 2, 4, and 6 months (RotaTeq®). Both have been demonstrated to be highly efficacious against severe diarrhea causing hospitalization in studies done in low and middle income countries which have substantial morbidity and mortality related to rotavirus infection.[10,11] While deaths caused by rotavirus infection are uncommon in Canada, rotavirus gastroenteritis severe enough to require hospitalization is not. Rotavirus vaccine has been shown to be cost effective in the Canadian context[12] and effective when implemented in universal vaccination programs.[13] Presently, universal rotavirus vaccination is provided in all provinces/territories except Nova Scotia, New Brunswick, Newfoundland and Labrador, and Nunavut.

A combination MMRV vaccine is now available in Canada which facilitates the implementation of the two-dose varicella recommendation discussed previously. MMRV is associated with higher rates of fever and subsequent febrile seizures when used at 12–18 months of age than MMR and varicella vaccine given separately;[14] therefore, individual risk factors and preferences can be considered when deciding whether or not to use the combination vaccine product or the MMR and varicella vaccine given as separate injections.[15]

All Canadian provinces and territories are now using the 13-valent pneumococcal conjugate vaccine for immunization of infants in the first year of life with a booster dose at 12 months of age.[4] The 13-valent vaccine contains all of the pneumococcal serotypes in the 7-valent vaccine with the addition of serotypes 1, 3, 5, 6A, 7F, and 19A. This is particularly important given several outbreaks of invasive pneumococcal disease caused by serotype 5 in Canada and the frequency of penicillin resistance in serotype 19A.[16,17]

A meningococcal B vaccine (4CMenB) is now available in Canada for use in infants, children, and adolescents. Based on cost-effectiveness data, the vaccine has not been recommended for universal use but rather during outbreaks of invasive meningococcal disease. The vaccine has been used for universal immunization in the Saguenay–Lac-Saint-Jean region of Quebec which was experiencing high rates of invasive meningococcal B disease and at Acadia University in Nova Scotia to control a meningococcal B outbreak.

Since the last immunization update, there have also been several advances in the immunization of adults. In addition to the universal recommendation for Tdap in adults discussed previously, the 13-valent pneumococcal conjugate vaccine has been demonstrated to be effective in the prevention of community-acquired pneumonia caused by *S. pneumoniae* in adults 50 years of age and older.[18] As a result, pneumococcal conjugate vaccine is now recommended in some provinces/territories for the immunization of adults with immunocompromising conditions;[5] no recommendation has been made yet for universal immunization of adults with the pneumococcal conjugate vaccine. With increasing age, as a result of immunosenescence, antibody response to the seasonal influenza vaccine diminishes. Indeed, immunogenicity is severely compromised in those older than 85 years of age.[19] New influenza vaccines with greater immunogenicity and efficacy in the elderly are now available in Canada;[20] one vaccine uses an adjuvant to boost immunogenicity while the other uses higher antigen content. In some provinces, these vaccines are being used selectively for older adults who are at the highest risk of influenza mortality.[21] Finally, zoster vaccine is now recommended by NACI for all adults 60 years of age or older.[22] The incidence of zoster increases substantially with age, again as a result of increasing immunosenescence. Zoster vaccine has been demonstrated to be effective in reducing the incidence of zoster and its most debilitating complication, postherpetic neuralgia.[23] Although recommended by NACI, no province/territory has included zoster vaccine in its publicly funded immunization program yet. While some private insurance companies cover the cost of zoster vaccine, many Canadians must purchase the vaccine themselves in order to protect themselves. The lack of uniform access to these recommended but unfunded vaccines across the country is problematic.[24]

### *The Vaccine Pipeline: What Does the Future Hold?*

Although predicting the future is always fraught with uncertainty, there may be a number of new vaccines and new

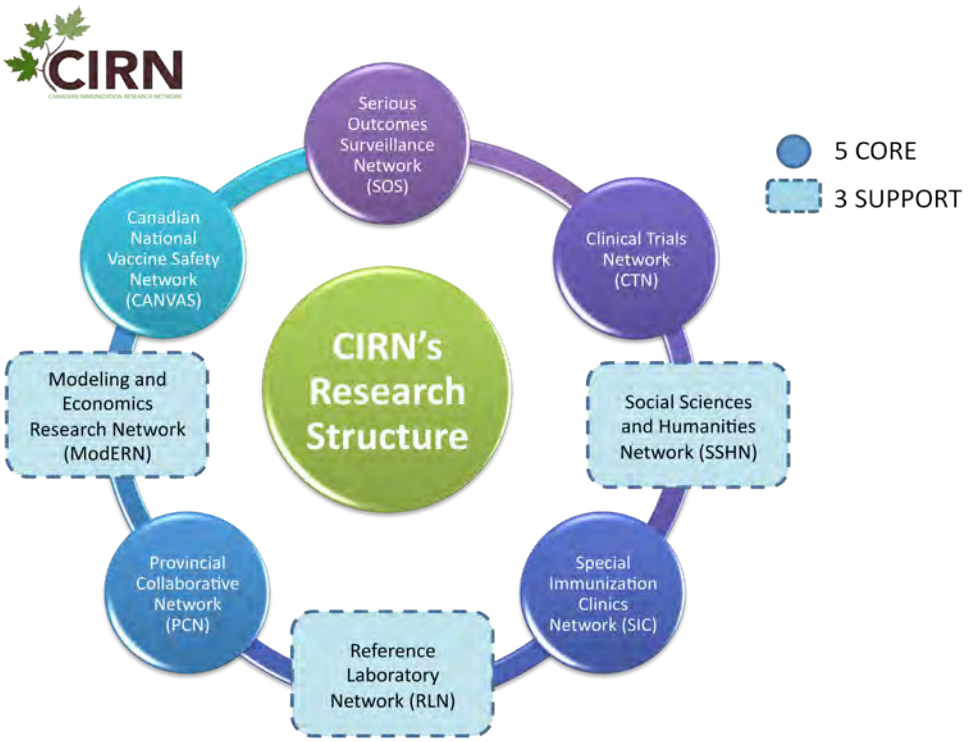


Figure 1.
*Subnetworks that comprise the Canadian Immunization Research Network (CIRN).*

recommendations in the next 5–6 years. Although there is currently a permissive NACI recommendation to administer Tdap during pregnancy in periods of increased pertussis activity, routine administration of Tdap during pregnancy may need to be considered.[25] Currently, the US and the UK recommend that Tdap be given to all pregnant women to prevent pertussis in the first months of life,[26,27] and the UK has reported on the effectiveness of the policy.[28] Other vaccines that are under development to be part of a maternal immunization strategy to protect the newborn and young infant include vaccines against group B streptococcus,[29] respiratory syncytial virus (RSV),[30] and cytomegalovirus (CMV).[31] All of these pathogens adversely affect the fetus or newborn, and immunization during pregnancy may provide benefit to the woman, the fetus, and the newborn, similar to what is achieved through maternal immunization with influenza vaccine.[32] A vaccine to prevent diarrhea and dehydration from norovirus infection is also in clinical trials[33] and could provide an additional benefit to that achieved by rotavirus vaccine in the prevention of severe gastroenteritis. A new zoster vaccine with higher reported efficacy and duration of protection is undergoing clinical trials.[34] Finally, although not of direct benefit to Canadians but with substantial "Canadian content," a vaccine to prevent Ebola virus may be available within the next few years to prevent future devastating outbreaks of this deadly virus. A vesicular stomatitis virus (VSV)-vectored Ebola virus vaccine was developed at the Canadian National Microbiology Laboratory,[35] underwent phase 1 clinical trials in Canada and elsewhere,[36,37] and looks promising in phase 3 studies in West Africa.[38]

### *Changes to the Canadian Immunization Research Infrastructure*

In the last six years, there has been a concerted effort by the Public Health Agency of Canada (PHAC) to coordinate and fund evaluative research to support public health decision making.[39] This effort was catalyzed by pandemic influenza planning, when PHAC and the Canadian Insti-

tutes of Health Research (CIHR) funded the PHAC/CIHR Influenza Research Network (PCIRN) in 2009. Although initially intended to be part of the pandemic planning exercise, PCIRN was created and funded just after the 2009 H1N1 pandemic was declared. Over six years, PCIRN undertook a broad range of research of high public health priority, addressing issues such as rapid clinical trials to inform vaccine utilization and issues related to vaccine coverage, effectiveness, safety, and delivery in the face of outbreaks. PCIRN was created as a network of networks, linking academic-institution-based and public-health-based investigators across Canada and ensuring that multidirectional communication between decision makers, front-line public health staff, and researchers was established and maintained so that research findings could be translated into practice rapidly. The PCIRN model was felt to be sufficiently successful in meeting public health goals that, in 2015, PCIRN was transitioned to a new network named the Canadian Immunization Network (CIRN) which would have as its mandate all vaccine research of public health importance, not just research related to influenza. CIRN is also designed as a network of networks (Figure 1) and includes a Clinical Trials Network, an ambulatory Canadian National Vaccine Safety Network, the Serious Outcomes Surveillance Network (SOS) which is an adult inpatient, hospital-based network, the Provincial Collaborative Network which brings together research expertise located in provincial public health agencies and Departments of Health, a Research Laboratory Network, a Social Sciences and Humanities Network, a Special Immunization Clinics Network for evaluation of serious adverse events following immunization, and the Modeling and Economic Research Network (ModERN). These networks will increasingly be used to provide the data needed for program implementation decisions and for evaluating the effectiveness of Canada's immunization programs.

## Conclusion

Given the nature of infectious diseases, what we describe in this update can only be viewed as a snapshot in time in an ever-changing environment. Canada's immunization programs continue to evolve in response to the changing epidemiology of infectious diseases and the availability of new vaccines. Decisions to implement new programs and evaluations of existing and new programs are increasingly becoming evidence-based. In an era of competing demands for shrinking health care funding, vaccines continue to be one of the most cost-effective health interventions and compare favorably with any other preventive or therapeutic intervention.

## References:


1. Halperin SA, Pless R. Immunization in Canada: a success to build on. J Can Chiropr Assoc. 2003; 47(3):153–160.
2. Halperin SA, Pianosi K. Immunization in Canada: a 6 year update. J Can Chiropr Assoc. 2010;55(2): 85–91.
3. Erickson LJ, De Wals P, Farand L. An analytical framework for immunization programs in Canada. Vaccine. 2005; 23(19):2470–2476.
4. Public Health Agency of Canada. Canada's provincial and territorial routine (and catch-up) vaccination programs for infants and children. Available from: http://healthycanadians.gc.ca/healthy-living-vie-saine/immunization-immunisation/children-enfants/schedule-calendrier-table-1-eng.php. Accessed on 6 November 2015.
5. Public Health Agency of Canada. Canada's provincial and territorial routine vaccination programs for healthy, previously immunized adults (aged 18 years and older). Available from: http://healthycanadians.gc.ca/healthy-living-vie-saine/immunization-immunisation/children-enfants/schedule-calendrier-table-3-eng.php. Accessed on 6 November 2015.
6. De Wals P, Lefebvre B, Markowski F, Deceuninck G, Defay F, Douville-Fradet M, et al. Impact of 2+1 pneumococcal conjugate vaccine program in the province of Quebec, Canada. Vaccine. 2014; 32(13):1501–1506.
7. Dobson SR, McNeil S, Dionne M, Dawar M, Ogilvie G, Krajden M, et al. Immunogenicity of 2 doses of HPV vaccine in younger adolescents vs 3 doses in young women: A randomized clinical trial. JAMA. 2013; 309(17):1793–1802.
8. Hoey J. Varicella vaccine update: need for a booster? CMAJ. 2003; 168(5):589.
9. National Advisory Committee on Immunization. Updated statement on the use of rotavirus vaccines. http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/10vol36/acs-4/index-eng.php. Accessed 11 December 2015.
10. Vesikari T, Matson DO, Dennehy P, Van Damme P, Santosham M, Rodriguez Z, et al.; Rotavirus Efficacy and Safety Trial (REST) Study Team. Safety and efficacy of a pentavalent human-bovine (WC3) reassortant rotavirus vaccine. N Engl J Med. 2006; 354(1):23–33.
11. Ruiz-Palacios GM, Pérez-Schael I, Velázquez FR, Abate H, Breuer T, Clemens SC, et al.; Human Rotavirus Vaccine Study Group. Safety and efficacy of an attenuated vaccine against severe rotavirus gastroenteritis. N Engl J Med. 2006; 354(1):11–22.

12. Coyle D, Coyle K, Bettinger JA, Halperin SA, Vaudry W, Scheifele DW, et al. Cost effectiveness of infant vaccination for rotavirus in Canada. Can J Infect Dis Med Microbiol. 2012; 23(2):71–77.
13. Sanford C, Langley JM, Halperin SA, Zelman M; MURVP. A universal infant rotavirus vaccine program in two delivery models: Effectiveness and adverse events following immunization. Hum Vaccin Immunother. 2015; 11(4):870–874.
14. Schink T, Holstiege J, Kowalzik F, Zepp F, Garbe E. Risk of febrile convulsions after MMRV vaccination in comparison to MMR or MMR+V vaccination. Vaccine. 2014; 32(6):645–650.
15. National Advisory Committee on Immunization. Statement on measles, mumps, rubella and varicella vaccine. Can Commun Dis Rep. 2010; 36 (ACS-9.) Available from http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/10vol36/acs-9/index-eng.php. Accessed 11 August 2015.
16. Romney MG, Hull MW, Gustafson R, Sandhu J, Champagne S, Wong T, et al. Large community outbreak of *Streptococcus pneumoniae* serotype 5 invasive infection in an impoverished, urban population. Clin Infect Dis. 2008; 47(6):768–774.
17. Schillberg E, Isaac M, Deng X, Peirano G, Wylie JL, Van Caeseele P, et al. Outbreak of invasive *Streptococcus pneumoniae* serotype 12F among a marginalized inner-city population in Winnipeg, Canada, 2009–2011. Clin Infect Dis. 2014; 59(5):651–657.
18. Isturiz R, Webber C. Prevention of adult pneumococcal pneumonia with the 13-valent pneumococcal conjugate vaccine: CAPiTA, the community-acquired pneumonia immunization trial in adults. Hum Vaccin Immunother. 2015; 11(7):1825–1827.
19. Cao W, Kim JH, Chirkova T, Reber AJ, Biber R, Shay DK, et al. Improving immunogenicity and effectiveness of influenza vaccine in older adults. Expert Rev Vaccines. 2011; 10(11):1529–1537.
20. National Advisory Committee on Immunization. Statement on seasonal influenza vaccine for 2014–2015. Ottawa, ON: Public Health Agency of Canada; 2014. Available from: http://www.phac-aspc.gc.ca/naci-ccni/flu-grippe-eng.php. Accessed 11 August 2015.
21. Van Buynder PG, Konrad S, Van Buynder JL, Brodkin E, Krajden M, Ramler G, et al. The comparative effectiveness of adjuvanted and unadjuvanted trivalent inactivated influenza vaccine (TIV) in the elderly. Vaccine. 2013; 31(51):6122–6128.
22. National Advisory Committee on Immunization. Statement on the recommended use of Herpes Zoster vaccine. Can Commun Dis Rep. 2010;36(ACS-1):1–19.
23. Langan SM, Smeeth L, Margolis DJ, Thomas SL. Herpes zoster vaccine effectiveness against incident herpes zoster and post-herpetic neuralgia in an older US population: a cohort study. PLoS Med. 2013;10(4):e1001420.
24. Scheifele DW, Ward BJ, Halperin SA, McNeil SA, Crowcroft NS, Bjornson G. Approved but non-funded vaccines: accessing individual protection. Vaccine. 2014; 32(7):766–770.
25. National Advisory Committee on Immunization. Pertussis vaccine. In: Canadian Immunization Guide. Ottawa, ON: Public Health Agency of Canada; 2014. Available from: http://www.phac-aspc.gc.ca/publicat/cig-gci/p04-pert-coqu-eng.php. Accessed 11 August 2015.
26. Centers for Disease Control and Prevention. Updated recommendations for use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap) in pregnant women – Advisory Committee on Immunization Practices (ACIP), 2012. MMWR Morb Mortal Wkly Rep. 2013; 62(7):131–135.
27. National Health Service. Whooping cough vaccination in pregnancy. http://www.nhs.uk/conditions/pregnancy-and-baby/pages/whooping-cough-vaccination-pregnant.aspx. Accessed 11 August 2015.
28. Amirthalingam G, Andrews N, Campbell H, Ribeiro S, Kara E, Donegan K, et al. Effectiveness of maternal pertussis vaccination in England: an observational study. Lancet. 2014; 384(9953):1521–1528.
29. Madhi SA, Dangor Z, Heath PT, Schrag S, Izu A, Sobanjo-Ter Meulen A, et al. Considerations for a phase-III trial to evaluate a group B *Streptococcus* polysaccharide-protein conjugate vaccine in pregnant women for the prevention of early- and late-onset invasive disease in young-infants. Vaccine. 2013;31 Suppl 4:D52–D57.
30. Munoz FM. Respiratory syncytial virus in infants: is maternal vaccination a realistic strategy? Curr Opin Infect Dis. 2015; 28(3):221–224.
31. Kirchmeier M, Fluckiger AC, Soare C, Bozic J, Ontsouka B, Ahmed T, et al. Enveloped virus-like particle expression of human cytomegalovirus glycoprotein B antigen induces antibodies with potent and broad neutralizing activity. Clin Vaccine Immunol. 2014; 21(2):174–180.
32. Zaman K, Roy E, Arifeen SE, Rahman M, Raqib R, Wilson E, et al. Effectiveness of maternal influenza immunization in mothers and infants. N Engl J Med. 2008; 359(15):1555–1564.
33. Bernstein DI, Atmar RL, Lyon GM, Treanor JJ, Chen WH, Jiang X, et al. Norovirus vaccine against experimental human GII.4 virus illness: a challenge study in healthy adults. J Infect Dis. 2015; 211(6):870–878.
34. Lal H, Cunningham AL, Godeaux O, Chlibek R, Diez-Domingo J, Hwang SJ, et al.; ZOE-50 Study Group. Efficacy of an adjuvanted herpes zoster subunit vaccine in older adults. N Engl J Med. 2015; 372:2087–2096.
35. Richardson JS, Dekker JD, Croyle MA, Kobinger GP. Recent advances in *Ebolavirus* vaccine development. Hum Vaccin. 2010; 6(6):439–449.
36. Huttner A, Dayer JA, Yerly S, Combescure C, Auderset F, Desmeules J, et al.; VSV-Ebola Consortium. The effect

of dose on the safety and immunogenicity of the VSV Ebola candidate vaccine: a randomised double-blind, placebo-controlled phase 1/2 trial. Lancet Infect Dis. 2015;15(10):1156–1166.
37. Regules JA, Beigel JH, Paolino KM, Voell J, Castellano AR, Muñoz P, et al.; rVSVΔG-ZEBOV-GP Study Group. A recombinant vesicular stomatitis virus Ebola vaccine – Preliminary Report. N Engl J Med. 2015 Apr 1. Epub ahead of print.
38. World Health Organization. World on the verge of an effective Ebola vaccine. Available from: http://www.who.int/mediacentre/news/releases/2015/effective-ebola-vaccine/en/. Accessed on August 12, 2015.
39. McCarthy J, Halperin SA, Bettinger JA, Langley JM, Crowcroft NS, Deeks S, et al.; Canadian Immunization Research Network (CIRN) Investigators. Canadian vaccine research networks: Vaccine safety resources for Canada. Can Commun Dis Rep. 2015;41 Suppl 1:18–23.
40. Centers for Disease Control and Prevention. Ten great public health achievements – United States 1900–1999. MMWR Morb Mortal Wkly Rep. 1999;48(12):241–243.

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# Relationship between Ontario chiropractors' attitudes toward drug prescription rights and Canadian versus non-Canadian college of graduation: results from an online survey

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*Objective: To investigate differences between chiropractors' attitudes toward drug prescription rights based on chiropractic college of graduation.*

*Methods: A secondary data analysis of a 2015 survey of chiropractors from Ontario, Canada was performed. The questionnaire included 14 items concerning chiropractors' knowledge and attitudes toward drug prescription including demographics.*

*Results: 960 of 2,677 deliverable questionnaires were completed (36% response rate). The majority of respondents favoured limited prescribing rights for chiropractors regardless of college of graduation. Respondents who graduated from Canadian institutions were significantly more in favour of these privileges compared to graduates from non-Canadian schools. Over three-quarters of all respondents opposed the idea of chiropractors having full prescribing rights. No significant association was found between respondents' philosophical orientation and school attended.*

*Objectif : Étudier les différences entre les attitudes des chiropraticiens à l'égard des droits de prescription de médicaments par les diplômés des collèges de chiropratique.*

*Méthodologie : Une analyse de données secondaires d'un sondage de 2015 de chiropraticiens de l'Ontario, Canada, a été réalisée. Le questionnaire comprenait 14 questions concernant les connaissances des chiropraticiens de la prescription de médicaments, leurs attitudes à cet égard, et des données démographiques.*

*Résultats : 960 questionnaires sur 2 677 ont été remplis (un taux de réponse de 36 %). La majorité des répondants se sont exprimés en faveur des droits de prescription limités pour les chiropraticiens, quel que soit leur niveau d'éducation. Les répondants diplômés des établissements canadiens étaient nettement plus favorables à ces privilèges par rapport aux diplômés des écoles en dehors du Canada. Plus de trois quarts de tous les répondants se sont opposés à l'idée de donner aux chiropraticiens les pleins droits de prescription. Aucun lien important n'a été trouvé entre l'orientation philosophique des répondants et l'établissement scolaire qu'ils ont fréquenté.*

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*Conclusion: Ontario chiropractors who graduated from Canadian chiropractic institutions were most interested in obtaining limited drug prescription rights for the profession compared to non-Canadian chiropractic institution graduates.*

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KEY WORDS: chiropractic, attitudes, knowledge, drug prescription, cross-sectional survey

*Conclusion : Les chiropraticiens de l'Ontario qui sont des diplômés des institutions chiropratiques canadiennes étaient les plus intéressés à obtenir des droits limités de prescription de médicaments pour la profession par rapport aux diplômés des institutions chiropratiques en dehors du Canada.*

(JCCA. 2016;60(1):13-20)

MOTS-CLÉS : chiropratique, attitudes, connaissances, prescription de médicaments, sondage transversal

## Introduction

The right to prescribe drugs continues to be a contentious issue for the chiropractic profession.[1-3] Regardless, recent reports indicate that a growing number of chiropractors in various jurisdictions may be interested in expanding their scopes of practice to include limited drug prescription for treating spine-related and other musculoskeletal conditions.[4-8] Limited prescribing rights have already been incorporated into the chiropractic scopes of practice in Switzerland[9] and New Mexico, USA[10]. Swiss chiropractors indicate that these privileges are an advantage for the profession in Switzerland;[9,11] and they are also one of only two groups of medical professionals (including physicians) with primary care status for managing patients with musculoskeletal disorders in that country[12].

Some research suggests that the ongoing contention over prescribing rights in chiropractic may be related to philosophical divisions within the profession.[8,13] For example, in a recent survey of chiropractors from Ontario, Canada[8] over 90% of respondents who aligned themselves with a "broad" (or the often described 'mixer') scope of chiropractic practice favoured the idea of gaining limited prescriptive authority for prescribing over-the-counter (OTC) and prescription-based musculoskeletal medications. Conversely very few of those who classified themselves as practising within a "focused" (or the often described 'straight') scope of chiropractic practice felt the same. Interestingly, the majority (approximately 60%) of "middle scope" respondents in this study also favoured musculoskeletal prescribing rights, indicating that there is potential for unity among the majority of chiropractors regarding limited drug prescription for the profession. Similar results regarding the association between philosophical ideologies and prescribing rights in chiropractic have also been shown by others.[13]

There is further evidence to suggest that differences in philosophical orientation among doctors of chiropractic may be reflective of graduation from particular chiropractic teaching institutions.[14-16] For instance, in the United States (US) there are currently 15 chiropractic colleges that span the chiropractic ideological spectrum, from "conservative" (i.e. 'straight' colleges that believe in continuing the traditions of chiropractic as espoused by either D.D. or B.J. Palmer) to "liberal" (i.e. colleges that promote an evidence-based approach to the practice of chiropractic, focusing on the treatment of spine-related/musculoskeletal disorders).[17,18] In Canada there are only two chiropractic educational institutions, the Canadian Memorial Chiropractic College (CMCC) and the Université de Québec à Trois Riviéres (UQTR), both of which fall on the liberal/evidence-based end of the chiropractic spectrum.[19,20] In 2010, Puhl and colleagues[16] surveyed chiropractors across Canada and found that respondents who aligned themselves with an "unorthodox" (or 'straight') style of chiropractic were most likely to have graduated from one of the conservative chiropractic schools in the US. Chiropractors in this group were also more likely to exhibit professional attitudes and practice behaviours concerning treatment efficacy, use of radiographic imaging, and views toward vaccination, that were incongruent with current evidence-based practice.[15,16] Several clinical guidelines endorse the use of mild anal-

gesics and/or anti-inflammatories in the management of various spine-related/musculoskeletal conditions.[21-23] Yet at present it is unknown if chiropractic educational institutions play a role in influencing chiropractors' general attitudes toward drug prescription.

The purpose of this study was to determine if there was a difference between attitudes toward drug prescription rights among a sample of chiropractors from Ontario, Canada[8] based on chiropractic college of graduation. The relationship between educational programs and respondents' philosophical orientation / preferred style of practice was also explored.

## Methods

The methods of this study have been described in detail elsewhere.[8] Briefly, a 14-item online questionnaire was developed by the authors based on previous research on this topic and pilot tested on a random sample of 20 chiropractors registered with the Waterloo Regional Chiropractic Society. Twelve respondents completed the pilot testing, agreed on the face validity of the instrument, and provided feedback that led to revisions and creation of the final study instrument.

All active members of the College of Chiropractors of Ontario (CCO) who had a valid e-mail address listed in the CCO's electronic directory ($n$ = 2,847) were invited to complete the questionnaire. Retired or inactive chiropractors and/or those who did not have an e-mail address listed on the CCO's electronic directory were ineligible to participate in the study.

Potential participants were contacted up to six times over six weeks including a pre-notification message, followed weekly for five weeks by a message including a cover letter and link to the survey instrument. The survey was distributed and administered online from February 2, 2015 to February 27, 2015 using SurveyMonkey®. Ethics approval for this study was obtained through the Anglo-European College of Chiropractic Research Ethics Sub-Committee (approval number E67/05/15). All data was collected anonymously and stored securely in a password protected electronic database.

The questionnaire was divided into four sections: Section 1 consisted of four questions asking about chiropractors' attitudes to drug prescription rights, Section 2 had two questions about OTC drug recommendations in chiropractic practice, Section 3 contained three questions about chiropractors' knowledge of drug prescription, while Section 4 asked demographic questions including chiropractic educational institution of graduation and chiropractic philosophical orientation / preferred scope of practice.

Summary responses to all questions were analyzed using descriptive statistics and presented previously.[8] In the current analysis inferential statistics were used to investigate differences between chiropractors who graduated from different chiropractic educational institutions in terms of their attitudes toward drug prescription rights. Differences between respondents' philosophical orientation and educational institution of graduation were also explored. Chiropractic institutions were divided into two categories: (i) 'Canadian' (graduates from the CMCC and the UQTR) and (ii) 'non-Canadian' (including graduates from programs within and outside the USA). It was hypothesized that graduates from non-Canadian chiropractic educational programs would hold more negative views toward drug prescription rights and be more frequently associated with a focused (or 'straight') chiropractic scope of practice compared to those who graduated from Canadian chiropractic educational institutions. Relationships between the educational program grouping variable and the various attitudinal response variables from Section 1 of the questionnaire including the scope of practice variable from Section 4 were explored using the chi-square test of independence.[24] Logistic regression was not performed. Statistical significance was set at $p < 0.05$, and all data analysis was carried out using SPSS (IBM SPSS Statistics ©, Version 20).

## Results

Deliverable questionnaires were sent to 2,677 chiropractors in Ontario and 960 were completed for a 35.9% response rate. The mean age of the respondents was 44.1 (SD [standard deviation] 10.5) years, 70.4% were male, and the average time in practice for all respondents was 16.6 (SD 10.6) years. With respect to chiropractic college of graduation, nearly three-quarters (72.7%) of respondents were Canadian graduates (72.4% CMCC, 0.3% UQTR), just over one-quarter (25.7%) graduated from US colleges, and the remaining 1.6% (15/952) of respondents graduated from chiropractic schools outside North America. A demographic comparison between the study sample

Table 1.
*Comparison of Ontario chiropractors' attitudes to drug prescription rights based on chiropractic college of graduation*

| College of graduation | Agree or Strongly Agree % | Neutral % | Disagree or Strongly Disagree % |
|---|---|---|---|
| **Attitudes to chiropractors prescribing OTC MSK medications*** | | | |
| CMCC / UQTR | 68.3 (472/691) | 5.6 (39/691) | 26.0 (180/691) |
| USA / outside USA | 56.5 (147/260) | 7.3 (19/260) | 36.2 (94/260) |
| **Attitudes to chiropractors prescribing prescription-based MSK medications†** | | | |
| CMCC / UQTR | 64.3 (442/687) | 5.8 (40/687) | 29.8 (205/687) |
| USA / outside USA | 54.7 (141/258) | 4.3 (11/258) | 41.1 (106/258) |
| **Attitudes to chiropractors prescribing any and all medications‡** | | | |
| CMCC / UQTR | 11.4 (79/690) | 11.7 (81/690) | 76.8 (530/690) |
| USA / outside USA | 11.9 (31/260) | 12.3 (32/260) | 75.8 (197/260) |
| **Attitudes to chiropractors counselling patients on MSK medication use§** | | | |
| CMCC / UQTR | 71.7 (493/688) | 10.5 (72/688) | 17.9 (123/688) |
| USA / outside USA | 59.1 (153/259) | 11.6 (30/259) | 29.3 (76/259) |

OTC = over-the-counter, MSK = musculoskeletal, CMCC = Canadian Memorial Chiropractic College, UQTR = Université de Québec à Trois Riviéres, USA = United States of America.
* $\chi^2_{2df} = 11.57$; $P = 0.003$. † $\chi^2_{2df} = 10.90$; $P = 0.004$. ‡ $\chi^2_{2df} = 0.12$; $P = 0.944$. § $\chi^2_{2df} = 16.36$; $P < 0.001$.

Table 2.
*Comparison of Ontario chiropractors' philosophical orientation based on chiropractic college of graduation*

| College of graduation | Philosophical orientation* | | |
|---|---|---|---|
| | Broad scope % | Middle scope % | Focused scope % |
| CMCC / UQTR | 32.1 (222/691) | 55.7 (385/691) | 12.2 (84/691) |
| USA / outside USA | 31.0 (80/258) | 52.3 (135/258) | 16.7 (43/258) |

CMCC = Canadian Memorial Chiropractic College, UQTR = Université de Québec à Trois Riviéres, USA = United States of America.
* $\chi^2_{2df} = 3.32$; $P = 0.190$.

and the general population of Ontario chiropractors has been previously presented by the authors.[8]

Comparisons between Ontario chiropractors' attitudes to drug prescription rights and chiropractic college of graduation are displayed in Table 1. The majority of respondents were in favour of incorporating limited drug prescription rights into their scope of practice regardless of their college of graduation. However, a statistically significant greater proportion of respondents who graduated from the two Canadian chiropractic schools agreed that Ontario chiropractors should be able to prescribe OTC and prescription-based medications for musculoskeletal conditions (i.e. 68.3% for OTC medications and 64.3% for prescription-based medications) compared to those who graduated from schools within and outside the USA (i.e. 56.5% and 54.7% respectively). Respondents from the Canadian colleges also agreed significantly more so than those from the non-Canadian college graduates (71.7% versus 59.1%) with the idea that chiropractors with limited prescriptive authority could counsel patients on medication use for musculoskeletal conditions. With respect to the issue of full prescribing rights, no statistically significant difference in opinion was found between chiropractors who graduated from different chiropractic colleges.

Comparisons between Ontario chiropractors' philosophical orientation / preferred scope of practice and educational institution of graduation are displayed in Table 2.

A greater proportion of respondents who graduated from chiropractic colleges within and outside the US were associated with the 'focused' chiropractic scope of practice group compared to those who graduated from the two Canadian chiropractic schools (i.e. 16.7% versus 12.2%, respectively) but this difference was not statistically significant.

## Discussion

This study found that Ontario chiropractors who responded to this survey and graduated from a Canadian chiropractic institution were significantly more in favour of incorporating limited drug prescription rights into their scope of practice compared to respondents who graduated from US colleges including schools outside the USA. Two-thirds of Canadian institution graduates agreed that chiropractors should be permitted to prescribe OTC and prescription-based anti-inflammatories, analgesics, and muscle relaxants, whereas just over half (approximately 56%) of graduates from schools outside of Canada felt the same way. Nearly three-quarters of respondents from the Canadian schools also felt that with limited prescriptive authority chiropractors could help counsel patients against overuse and over-reliance on musculoskeletal medications while less than 60% from non-Canadian chiropractic colleges similarly agreed. This difference in opinion between the two groups (Canadian graduates versus non-Canadian) is comparable to the findings of previous surveys of Canadian chiropractors[14-16] in which various professional attitudes and practice characteristics differed between respondents matriculating from US chiropractic schools compared to graduates of the CMCC. Chiropractors who graduated from institutions outside of Canada in the present study may have been less favourable towards drug prescription than Canadian institution graduates partly because of the longstanding history of division over chiropractic prescribing rights among the profession in the USA.[1] The difference between these two groups could be a reflection of CMCC's curriculum which is evidence-based[19] and includes a greater number of hours in pharmacology education[25] compared to that typically required of other chiropractic institutions[26]. Regardless, results from previous surveys[14-16] together with the findings of the current study reiterate that the chiropractic educational system may be contributing to multiple identities among chiropractors within the profession[16]. Unlike the methodology used by Puhl and colleagues[15,16] however, the current study did not differentiate between individual US colleges. It is unclear whether respondents who held more negative views toward prescribing rights graduated from so-called "conservative"[17] (versus "liberal") programs in the US. In spite of this, the majority of respondents from both the Canadian and non-Canadian educated groups still favoured the idea of limited prescribing rights for chiropractors regardless of their college of graduation.

Concerning the issue of limited chiropractic prescribing rights, there is evidence from several surveys including that in the present study to indicate that there may be a growing interest among Canadian chiropractors towards gaining limited drug prescription privileges for the profession. For instance, in surveys involving Canadian chiropractors from 2004[13], 2007[6], 2011[6], and 2015[8], increasing majorities of respondents (i.e. 54%, 55%, 61%, and 68% respectively) indicated at least some level of support for chiropractic prescribing rights for OTC and/or prescription-based musculoskeletal medications. An even greater majority among Ontario chiropractors graduating from Canadian chiropractic institutions favouring these privileges in the current study suggests that chiropractors may not be as divided on this topic in Canada as previously thought.[1-3] Arguably a nationwide survey of chiropractors from all Canadian provinces is warranted in order to confirm these findings.

If obtained by the profession limited drug prescription rights would have the potential to change the present role of chiropractors and to positively influence public health. For instance, with a limited formulary chiropractors would gain access to an additional evidence-based modality for managing patients with spine-related and other musculoskeletal complaints.[21-23] These privileges would also give chiropractors the authority to counsel patients against overusing anti-inflammatory and analgesic medications (e.g. opioids). This notion is supported by evidence from Switzerland where chiropractors tend to prescribe medications significantly less frequently than asked for by their patients.[11] In the present study the majority of respondents, including almost three-quarters of graduates from the two Canadian chiropractic institutions, expressed interest in limited prescription rights because of this potential role for the profession. Musculoskeletal prescribing rights could also help pave the way for

chiropractors to become 'first-contact' (or primary) spine care providers within the healthcare system;[7,27,28] however other implications would first need to be considered[29] including changes to chiropractic education and legislation.

Another finding of the present study was that a large majority of respondents, regardless of college affiliation, were opposed to the idea of chiropractors having full prescribing rights. For instance, more than three-quarters of Canadian and non-Canadian chiropractic institution graduates disagreed with chiropractors being able to gain an expanded scope of practice to allow for the prescription of any and all medications, including controlled substances. This finding is consistent with previous chiropractic surveys[8,13,30,31] where respondents were generally opposed to chiropractors writing drug prescriptions for non-musculoskeletal conditions.

Although Canadian chiropractic institution graduates in the current study were less frequently associated with a focused (or 'straight') chiropractic scope of practice compared to those graduating from schools within and outside the USA, this difference was not statistically significant. Over 12% of Canadian (most of which were CMCC) graduates identified themselves as 'straight' chiropractors while less than 17% of those who graduated from non-Canadian (mostly American) chiropractic institutions did the same. These results are inconsistent with the findings of previous studies[14,16] where significant associations were found between chiropractors' philosophical orientation and affiliation with non-CMCC / "conservative" chiropractic colleges in the US. A possible explanation for this difference is that no differentiation was made in the present study between "conservative" and "liberal" US chiropractic colleges among the non-Canadian graduates. It is possible that a significant association may have been found regarding ideology and academic affiliation among these respondents had these two sub-groupings of US chiropractic colleges been investigated. Regardless, this study's findings indicate that despite matriculating from an evidence-based curriculum[19] more than one out of every 10 graduates from the CMCC currently practising in Ontario align themselves with a focused (or 'straight') style of chiropractic. It is plausible that clinicians' philosophical views may be preconceived prior to entering chiropractic college (and never change) or are influenced sometime after graduation. Whatever the reason(s), this ideology continues to create negative physician attitudes toward the profession as well as barriers to medical-chiropractic collaboration both locally and internationally.[32-34]

### *Limitations*

The main limitations of this study were that it had a relatively low response rate (36%) and it excluded retired chiropractors and those who did not have an e-mail address listed with the CCO. When comparing demographic characteristics however, the study sample was shown to be representative of the general population of practising chiropractors in Ontario.[8] Nevertheless, a 64% non-response rate suggests that these survey results should be interpreted with caution as respondents' views toward drug prescription rights obtained may not be generalizable to those of all Ontario chiropractors.

## Conclusion

This study found that Ontario chiropractors who graduated from Canadian chiropractic educational institutions favoured the idea of gaining limited prescribing rights more so than chiropractors who graduated from schools within and outside the USA. Over three-quarters of respondents were opposed to chiropractors having full prescribing rights regardless of college affiliation. No statistically significant differences were found between respondents' philosophical orientation and educational institution of graduation. A nationwide survey is warranted to further explore Canadian chiropractors' attitudes toward gaining limited drug prescription rights for the profession.

## References:

1. Emary PC, Stuber KJ. Chiropractors' attitudes toward drug prescription rights: a narrative review. Chiropr Man Therap. 2014; 22:34.
2. The Chiropractic Report: The prescription drug debate. Should the chiropractic profession remain drug free? Available from: https://www.chiropracticreport.com/index.php/past-issues/view_document/68-no-6-the-prescription-drug-debate (Accessed 23 July 2014).
3. Gliedt JA, Hawk C, Anderson M, Ahmad K, Bunn D, Cambron J, Gleberzon B, Hart J, Kizhakkeveettil A, Perle SM, Ramcharan M, Sullivan S, Zhang L. Chiropractic identity, role and future: a survey of North American chiropractic students. Chiropr Man Therap. 2015; 23:4.
4. British Chiropractic Association: Limited prescribing rights. Reading: British Chiropractic Association, *In Touch*. 2009; 142:4-5.
5. Alabama State Chiropractic Association: 2010 Scope of Practice Survey. Available from: http://www.mccoypress.

net/subluxation/docs/ASCAscope.pdf (Accessed 11 March 2015).
6. B. Haig, Chief Executive Officer, Ontario Chiropractic Association; personal communication, 3 November 2014.
7. Wisconsin Chiropractic Association: Filling the shortage of primary care health care providers in Wisconsin: the Primary Spine Care Physician, a new class of health care provider. Available from: http://www.wichiro.org/wpwca/wp-content/uploads/2014/09/PSPC_white_paper.pdf (Accessed 30 January 2015).
8. Emary PC, Stuber KJ. Attitudes toward drug prescription rights: a survey of Ontario chiropractors. Chiropr Man Therap. 2015; 23:22.
9. Robert J. The multiple facets of the Swiss chiropractic profession. Eur J Chiropr. 2003; 50:199-210.
10. New Mexico Regulation & Licensing Department: New Mexico administrative code: chiropractic advanced practice certification registry. Available from: http://www.rld.state.nm.us/uploads/files/2010%20APC%20Formulary.pdf (Accessed 9 October 2013).
11. Wangler M, Zaugg B, Faigaux E. Medication prescription: a pilot survey of Bernese doctors of chiropractic practicing in Switzerland. J Manipulative Physiol Ther. 2010; 33(3):231-237.
12. Houweling TAW, Braga AV, Hausheer T, Vogelsang M, Peterson C, Humphreys BK. First-contact care with a medical vs chiropractic provider after consultation with a Swiss telemedicine provider: comparison of outcomes, patient satisfaction, and health care costs in spinal, hip, and shoulder pain patients. J Manipulative Physiol Ther. 2015; 38(7):477-483.
13. McDonald WP, Durkin KF, Pfefer M. How chiropractors think and practice: the survey of North American chiropractors. Semin Integr Med. 2004; 2:92-98.
14. Biggs L, Hay D, Mierau D. Canadian chiropractors' attitudes towards chiropractic philosophy and scope of practice: implications for the implementation of clinical practice guidelines. J Can Chiropr Assoc. 1997; 41(3):145-154.
15. McGregor M, Puhl AA, Reinhart C, Injeyan HS, Soave D. Differentiating intraprofessional attitudes toward paradigms in health care delivery among chiropractic factions: results from a randomly sampled survey. BMC Complement Altern Med. 2014; 14:51.
16. Puhl AA, Reinhart CJ, Doan JB, McGregor M, Injeyan HS. Relationship between chiropractic teaching institutions and practice characteristics among Canadian doctors of chiropractic: a random sample survey. J Manipulative Physiol Ther. 2014; 37(9):709-718.
17. Institute for Alternative Futures: The future of chiropractic revisited: 2005 to 2015. Available from: http://www.altfutures.org/pubs/health/Future%20of%20Chiropractic%20Revisted%20v1.pdf (Accessed 21 August 2015).
18. The Council on Chiropractic Education: Accredited doctor of chiropractic programs / institutions. Available from: http://cce-usa.org/Accredited_Doctor_Chiro.html (Accessed 21 August 2015).
19. Canadian Memorial Chiropractic College: Education overview. Available from: http://www.cmcc.ca/page.aspx?pid=290 (Accessed 28 August 2015).
20. Université de Québec à Trois Riviéres: Département de chiropratique. Available from: https://oraprdnt.uqtr.uquebec.ca/pls/public/gscw030?owa_no_site=360 (Accessed 28 August 2015).
21. Chou R, Huffman LH. Medications for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians Clinical Practice Guideline. Ann Intern Med. 2007; 147(7):505-514.
22. Dagenais S, Tricco AC, Haldeman S. Synthesis of recommendations for the assessment and management of low back pain from recent clinical practice guidelines. Spine J. 2010; 10(6):514-529.
23. Wong JJ, Côté P, Shearer HM, Carroll LJ, Yu H, Varatharajan S, Southerst D, van der Velde G, Jacobs C, Taylor-Vaisley A. Clinical practice guidelines for the management of conditions related to traffic collisions: a systematic review by the OPTIMa Collaboration. Disabil Rehabil. 2015; 37(6):471-489.
24. Haneline MT. Evidence-based chiropractic practice. Sudbury: Jones and Bartlett; 2007.
25. Canadian Memorial Chiropractic College: Academic calendar 2015-2016. Available from: http://www.cmcc.ca/document.doc?id=2113 (Accessed 16 September 2015).
26. World Health Organization: WHO guidelines on basic training and safety in chiropractic. Available from: http://apps.who.int/medicinedocs/documents/s14076e/s14076e.pdf (Accessed 6 November 2013).
27. Erwin WM, Korpela AP, Jones RC. Chiropractors as Primary Spine Care Providers: precedents and essential measures. J Can Chiropr Assoc. 2013; 57(4):285-291.
28. Foster NE, Hartvigsen J, Croft PR. Taking responsibility for the early assessment and treatment of patients with musculoskeletal pain: a review and critical analysis. Arthritis Res Ther. 2012; 14:205.
29. The College of Family Physicians of Canada. Position statement: prescribing rights for health professionals. Available from: http://www.cfpc.ca/uploadedFiles/Resources/Resource_Items/CFPC/Position/Statement/Prescribing/Rights/January/2010.pdf (Accessed 23 September 2013).
30. Jamison JR. Chiropractic in the Australian health care system: the chiropractors' comment on drug therapy. Chiropr J Aust. 1991; 21(2):53-55.
31. Jacobson BH, Gemmell HA. A survey of chiropractors in Oklahoma. J Chiropr Educ. 1999; 13(2):137-142.

32. Busse JW, Jacobs C, Ngo T, Rodine R, Torrance D, Jim J, Kulkarni AV, Petrisor B, Drew B, Bhandari M. Attitudes toward chiropractic: a survey of North American orthopedic surgeons. Spine (Phila Pa 1976). 2009; 34(25): 2818-2825.
33. Busse JW, Jim J, Jacobs C, Ngo T, Rodine R, Torrance D, Kulkarni AV, Petrisor B, Drew B, Bhandari M. Attitudes towards chiropractic: an analysis of written comments from a survey of North American orthopaedic surgeons. Chiropr Man Therap. 2011; 19:25.
34. Weis CA, Stuber K, Barrett J, Greco A, Kipershlak A, Glenn T, Desjardins R, Nash J, Busse J. Attitudes toward chiropractic: a survey of Canadian obstetricians. J Evid Based Complementary Altern Med. 2015; Sep 8. (Epub ahead of print).

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# Benign sacrococcygeal teratoma incidentally found on routine scoliosis radiographs in a 12-year-old female: a case report

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Objective: *To describe the imaging characteristics of sacrococcygeal teratomas and to review appropriate diagnostic evaluation and management.*

Clinical Features: *12-year-old otherwise healthy, asymptomatic female with an incidental pelvic mass found on routine scoliosis radiographs.*

Intervention and Outcome: *The pelvic mass was further evaluated by MRI and CT scan. Management consisted of successful surgical resection with no post-operative complications. Pathology confirmed a mature, benign, sacrococcygeal teratoma.*

Conclusions: *Chiropractors manage patients with scoliosis, which may include radiographic surveillance. Familiarity with the radiographic features of masses such as sacrococcygeal teratomas is important for prompt diagnosis and management.*

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KEY WORDS: sacrococcygeal teratoma, pediatric

Objectif : *Décrire les caractéristiques d'imagerie des tératomes sacrococcygiens et examiner l'évaluation et la prise en charge du diagnostic approprié.*

Caractéristiques cliniques : *Jeune fille asymptomatique de 12 ans en bonne santé avec une masse pelvienne découverte fortuitement après des radiographies de routine pour la scoliose.*

Intervention et résultats : *La masse pelvienne a davantage été évaluée à partir d'images d'IRM et de TDM. La solution était la résection chirurgicale réussie sans complications postopératoires. La pathologie a confirmé un tératome sacrococcygien mature bénin.*

Conclusions : *Les chiropraticiens prennent en charge les patients atteints de scoliose, ce qui peut inclure la surveillance radiographique. La familiarité avec les caractéristiques radiographiques des masses, comme les tératomes sacrococcygiens, est importante pour leur diagnostic et la prise en charge rapide.*

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MOTS-CLÉS : tératome sacrococcygien, pédiatrique

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## Introduction

Mature cystic teratomas are defined as neoplasms comprised of well-differentiated derivations of two or more germ cell layers (ectoderm, mesoderm and endoderm). They are well known for their diverse anatomic locations and can occur anywhere from the brain to the gonads, however they occur most commonly along the midline (mid-axial).[1] In children, as in our case presentation, these tumors are often extra-ovarian, in contrast to an ovarian predilection in adults.[2] Mature teratomas are the commonest germ cell tumor, and are often incidental findings.[5] Incidental discovery on radiographic evaluation for routine chiropractic investigations would therefore not be considered an isolated or rare event, although their incidence appears to be underreported in the literature. The purpose of this report is to describe the imaging characteristics of an incidental sacrococcygeal teratoma found on routine surveillance scoliosis radiographs and to review appropriate diagnostic evaluations and management.

## Methods & Results

A literature search was performed using PubMed with the search terms, "teratoma" AND "case report" AND "radiograph" as well as "teratoma OR dermoid" AND "incidental" AND "case report". No similar case reports were found. Images were obtained from the institutional picturing archiving and communication system (PACS). The patient's electronic medical record was reviewed for details on patient demographics, clinical history, operative report and pathology results.

## Case Presentation

Routine spine radiographs were obtained on a 12-year-old, otherwise healthy, asymptomatic girl for follow-up of scoliosis. Incidental note was made of a large, well-defined, heterogeneous mass within the pelvis containing calcified and likely ossified densities (Figures 1A, 1B). Radiographs from one-year prior did not include the pelvis so chronicity could not be determined. Given the unclear etiology of this density and suspicion for an underlying mass, further evaluation was performed.

An unenhanced MR of the pelvis was obtained, using axial and coronal T1 spin echo, and axial and sagittal T2 fat saturation fast spin echo sequences (Figures 2A, 2B). MRI demonstrated a large (11.0 x 12.1 x 14.6 cm), complex, pre-sacral mass, which contained fat, calcium, and

Figure 1: *(page 22) A. Posteroanterior full spine radiograph shows a calcified, and likely ossified, amorphous pelvis mass (arrowhead). (right) B. Cropped, magnified view of pelvic mass.*


Figure 2:
*A. Axial T1 Spin Echo, B. Sagittal T2 Fat Saturated (FS) Fast Spin Echo MR images of the pelvis show a large heterogeneous presacral mass (arrows). The mass shows a component with fluid-fluid level (asterisk) and calcified component (arrowhead).*

cystic components (both clear and hemorrhagic), one of which contained a fluid-fluid level. The mass extended from the level of S2 to the anal canal, displacing the rectum anterolaterally, and the vagina and bladder anteriorly. The uterus was displaced anteriorly and to the right. The left ovary was clearly visualized in the left iliac fossa and a small right ovary was suspected adjacent to the right iliac vessels. There was no direct extension to the spine, and no signal abnormalities were seen within the bony sacrum. These findings were felt to be most consistent with a non-ovarian, mature pre-sacral teratoma. Gynecologic consultation was recommended for clinical evaluation and management.

Further evaluation with CT was performed to better characterize the calcifications and for pre-operative planning. CT confirmed the presence of a large heterogeneous mass with macroscopic fat (asterisk), calcific foci and a central, ossified bony component (arrowhead) (Figure 3). A reasonable adjunct in work-up could include pelvic ultrasound, although this was not performed in this particular case.

The patient was taken to surgery and the mass was excised. There was no involvement of the bony sacrum or soft tissue extension beyond the pelvic cavity. The mass contained a central bony core which had to be divided and removed in piecemeal. Both ovaries were visualized and deemed to be preserved and uninvolved.

Pathologic assessment of fresh gross surgical specimen revealed a large fragmented mass, composed primarily of fibroadipose tissue and bone. Hemorrhagic components and hair were visualized within the specimen. The mass had a maximal dimension of 20cm, with the bony fragment measuring 7.5cm in length. The final diagnosis was a mature sacrococcygeal teratoma with degenerative changes.

## Discussion

Incidentally discovered teratomas in various clinical settings have been described[3], however no cases have been described related to incidental discovery on routine scoliosis radiographs. Given the gravity of potential complications, such as bowel obstruction, ovarian torsion, hemorrhage and rupture, and consequently, peritonitis, it is important for the chiropractic community to familiarize themselves with the typical radiographic appearance and epidemiology of mature pelvic teratomas.


Figure 3:
*Sagittal unenhanced CT image of the pelvis shows the presacral mass (arrows) containing fat (asterisk), calcification (arrowhead) and soft tissue. The calcified components show hyperdense attenuation on CT image.*

In a large study of childhood teratomas conducted at an exclusively pediatric medical centre, Bale et al. describe and classify 107 teratomas over a 40-year period.[2] There was a significant female predilection (63%) which is consistent with the general literature. Sacrococcygeal teratomas accounted for 48% of cases.[2] They further subdivided the sacrococcygeal masses into posterior (with no intra-pelvic component), pelvic and dumbbell (tumor straddles pelvic and posterior compartments). The majority (67%) were situated posteriorly. The diagnosis of the pelvic subtype is usually delayed (diagnosed after 2 years of age).[2,4] Using Bale's criteria our case would be further characterized as a pelvic (or pre-sacral) teratoma as there was no extra-pelvic extension. Teratomas can be benign (mature) or malignant. The malignant potential (roughly 20% of lesions) increases with the internalization of tumor such that the risk of malignancy is greater in the pelvic subtype.[2,4] Malignant tumors were almost

exclusively carcinomatous. Conversely, the incidence of malignancy fell with posterior/external location. Benign teratomas are predominantly cystic, and contain mature tissue including fat, calcification and a small volume of solid soft tissue.[4] The larger the volume of solid, immature elements increases the risk of malignant potential[4] and the size of immature teratomas was larger than that of mature teratomas[5]. Histologic maturity did not vary by age of the patient.[5]

Tapper and Lack further described 254 benign teratomas assessed at a pediatric medical centre over a 54-year period.[1] Similarly, most were detected in the newborn period, had a strong female predilection (84%) and the majority were sacrococcygeal in location (40%).

Teratomas are commonly found within the pelvis and typically contain a variety of tissues such as hair, calcium and fat. Their classic radiographic appearance is that of a pelvic mass containing tissue of fatty density, often with calcification (and/or ossification), though it can be quite variable.[7] CT often confirms the presence of cystic, fatty and bony components. MR will again demonstrate fat signal within the lesion and drop out on fat saturation sequences. Cystic components will frequently contain a fluid-fluid level, specifically fat-fluid, primarily from liquid sebum.[7] While the differential of a fat and calcium containing pelvic mass is quite limited, one could consider the possibility of malignant degeneration of a teratoma, or an atypical liposarcoma. However, given the classic imaging features in our case, the radiologic diagnosis was most consistent with that of a mature cystic teratoma.

The size of the mass in our case presentation (20 cm) may have been underestimated by imaging which was reported as 14.6 cm in maximal dimension. Unfortunately, the true size of the mass may have been difficult to confirm as it had to be removed in piecemeal during the surgery. The gross specimen size was larger than measurements reported in the literature[1], which describe an average diameter of 7.5 cm in mature teratomas of the sacrococcygeal region.

Our report describes a large, mature pelvic-subtype sacrococcygeal teratoma which was found incidentally in an asymptomatic 12-year-old girl. The epidemiologic features are considered classic, with patient age and tumor size at presentation both being greater than that of the general literature.

Significant risks associated with pelvic teratomas include ovarian torsion, spontaneous rupture, hemorrhage, bowel obstruction, infertility, pregnancy complications, and malignant transformation.[5] Although the malignant potential is low, given this, as well as the other serious potential complications, and to prevent local recurrence, definitive and complete surgical excision of the lesion using minimally invasive and fertility-preserving techniques, remains best practice at all ages.[1,5,6] For this reason, further evaluation with CT or MRI and referral to a gynecologist or general surgeon for definitive management is indicated once the diagnosis of teratoma is suspected.

## Conclusion

Mature, cystic teratomas are the most common type of germ cell tumor. Location depends on age, occurring primarily in the sacrococcygeal region in children and in the ovary in adolescents and young women. While they are typically benign they do demonstrate a small malignant potential and can cause severe complications such as bowel obstruction, ovarian torsion and peritonitis. Identification and intervention is therefore important for optimal management. Given their location, young age at presentation, as well as their indolent and often asymptomatic course, this presents a unique opportunity for the chiropractic community to recognize these lesions during routine skeletal evaluations such as scoliosis radiographs.

## References:

1. Tapper D, Lack EE. Teratomas in infancy and childhood. Ann Surg. 1983; 198: 398-410.
2. Bale PM, Painter DM, Cohen D. Teratomas in childhood. Pathology. 1975; 7: 209-218.
3. Hong JH, Lee JK, Song SH, Hwang JH, So KA, Shin BK, Lee NW, Lee KW. Unilateral ovarian dermoid cyst accompanied by an ipsilateral paratubal cyst in a girl with Proteus Syndrome discovered by laparoscopic surgery. J PediatrAdolesc Gynecol. 2010; 23: 107-110.
4. Kocaoglu M, Frush DP. Pediatric presacral masses. Radiographics. 2006; 26: 833-857.
5. Comerci JT, Licciardi F, Bergh PA, Gregori C, Breen JL. Mature cystic teratoma: a clinicopathologic evaluation of 517 cases and review of the literature. Obstet Gynecol. 1994; 84:22-28.
6. Oelschlager AEA, Sawin R. Teratomas and ovarian lesions in children. Surg Clin North Am. 2012; 92: 599-613.
7. Dodd GD, Budzik RF. Lipomatous tumors of the pelvis in women: spectrum of imaging findings. AJR. 1990; 155: 317-322.

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# Clinical evaluation tools: a survey of doctors of chiropractic and students at one chiropractic college

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Introduction: *The reliability and validity of many evaluation tools leading to clinical decision-making for spinal manipulation are varied. We surveyed senior students and DC employees at one chiropractic college regarding 1) which analysis tools should be used and 2) factors that influence their choices.*

Methods: *The survey queried which tools should be used on a routine patient encounter. Clinical evaluation tools included palpation, skin temperature analysis, leg length analysis, and radiographs.*

Results: *Surveys were collected from 58 doctors of chiropractic (DCs) and 74 students. Respondents from both groups reported to most commonly use static palpation, followed by motion palpation and leg length analysis. DC respondents ranked evidence and personal experience high for rationale; student respondents frequently chose patient preference.*

Introduction : *La fiabilité et la validité de nombreux outils d'évaluation menant à la prise de décision clinique pour la manipulation vertébrale sont variées. Nous avons interrogé les étudiants de cycle supérieur et les employés chiropraticiens d'un collège de chiropratique concernant 1) les outils d'analyse à utiliser et 2) les facteurs qui influencent leurs choix.*

Méthodologie : *Le sondage interrogeait sur les outils qui devraient être utilisés lors d'une rencontre ordinaire avec un patient. Les outils d'évaluation clinique comprenaient la palpation, l'analyse de la température de la peau, l'analyse de la longueur des membres inférieurs et les radiographies.*

Résultats : *58 chiropraticiens et 74 étudiants ont répondu au sondage. Les répondants de ces deux groupes ont mentionné l'utilisation très fréquente de la palpation statique, suivie de la palpation dynamique et de l'analyse de la longueur des membres inférieurs. Les chiropraticiens ont souligné l'importance de se fonder sur les preuves et l'expérience personnelle; par contre,*

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Conclusion: *DC and student respondents reported use of clinical evaluation tools consistently. However, some variations in rationale were noted. It is important for educators to provide a balanced presentation of the strengths and limitations of clinical analysis procedures to support the development of well-justified evidence-based clinical decision-making skills.*

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KEY WORDS: chiropractic, spinal manipulation, palpation, decision making

*les étudiants interrogés ont choisi souvent la préférence du patient.*

Conclusion : *Les chiropraticiens et les étudiants interrogés ont signalé l'utilisation régulière des outils d'évaluation clinique. Cependant, quelques variations dans la justification ont été notées. Il est important que les éducateurs fournissent une présentation équilibrée des points forts et des limites des procédures d'analyses cliniques afin de soutenir le développement de compétences décisionnelles cliniques bien justifiées et fondées sur des preuves.*

(JCCA. 2016;60(1):26-35)

MOTS CLÉS : chiropratique, manipulation vertébrale, palpation, prise de décision

## Introduction

Doctors of chiropractic (DCs) use information from multiple sources to render clinical decisions regarding where, when, and how to perform spinal manipulative procedures.[1,2] Information is obtained from static and motion palpatory findings, skin temperature analysis, postural and leg length analysis, radiographic assessment, symptoms, the primary diagnosis of the condition being treated, and other physical examination findings.[3] Additional information derived from the patient interview includes prior response(s) to care, patient preferences, co-morbid conditions, and goals. Incorporating multi-faceted information into clinical decision-making is therefore, a complex process.[4,5]

Evidence-based practice suggests skillfully incorporating research evidence, patient values, and practitioner experience when determining which clinical evaluation tools to use and how to appropriately weigh the clinical information gleaned from them when rendering clinical decisions.[6] However, the reliability and validity of many evaluation tools leading to clinical decision-making for spinal manipulation (SM) have not been robustly established,[7–17] leaving evidence-based practitioners to depend more on clinical experience, patient values, and other aspects of the clinical presentation. Despite limited reliability and the lack of research studying the validity of some analysis procedures, patients with a range of musculoskeletal conditions often improve following SM performed by doctors of chiropractic using a variety of analysis tools and technique methods.[18] Evaluation tools are learned in educational settings, where students are challenged to develop appropriate patient assessment habits and decision-making skills.

The purpose of this study is to survey chiropractic students and DC employees at a United States chiropractic college regarding 1) which clinical analysis tools should be used during routine patient encounters when evaluating patients for SM, and 2) what factors most influence respondent choices.

## Methods

The Human Protections Administrator determined this study exempt from full IRB review, IRB Assurance # X2013-7-12-M. The study was conducted in 2013.

### *Participants*

The survey was administered both to chiropractic students in the ninth term (final year) and all DC employees (faculty, staff and administrators) at the Davenport campus of Palmer College of Chiropractic. Respondents were not compensated in any way for participating.

Students in ninth term were surveyed as a convenience sample of interns who had previously completed coursework covering spinal analysis protocols, taught in 2nd

Figure 1.
*Survey instrument inquiring of DC employees and senior students regarding use of chiropractic evaluation tools*

Consider a routine patient encounter and the evaluation prior to performing a chiropractic adjustment.

| | 1a. On how many patient encounters do you think the following procedures should be performed? (**mark only one**) | | | | 1b. Which of the following reasons best describe your rationale for the answers provided for each procedure? **(mark only one most influential)** | | | |
|---|---|---|---|---|---|---|---|---|
| | **All patient encounters** | **Most patient encounters** | **Some patient encounters** | **No patient encounters** | **Personal Experience** | **Personal Philosophy** | **Patient Preference** | **Research Evidence** |
| **Palpation** | | | | | | | | |
| Static/soft tissue prominence | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Motion palpation | | | | | | | | |
| Seated | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Supine | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| **Instrumentation/Skin Temperature Assessment** | | | | | | | | |
| Galvanic/Dual Probe [1] | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Tytron [2] | | | | | | | | |
| Segmental | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Pattern | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Fossa Differential | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| **Leg Check** | | | | | | | | |
| Supine | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Prone (extension only) | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Cervical Syndrome | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| +D [3] | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| - D [4] | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Sacral Leg Check (SLC) [5] | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| **Radiographs (x-rays)** | | | | | | | | |
| Biomechanical analysis (segmental listings) | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |
| Additional findings (Abnormal curvatures [global], degenerative changes, spondylolisthesis) | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ | ❍ |

[1] Galvanic/dual probe instruments measure skin temperature conductance and are used to determine sharp differences in bilateral skin temperature from one vertebra to another.
[2] Tytron® infrared skin temperature analysis used to compare bilateral spinal temperature either from one vertebral level to another (segmentally) or as changes from sacrum to occiput (pattern). This infrared instrument can also be used to show bilateral difference between the region superficial to the atlas transverse processes (fossa differential).
For +D and –D, leg length is viewed in extension (position 1) and then flexed to 90° (position 2) while the patient is prone.
[3] +D implicated when an observed short leg in position 1 appears to be longer when viewed in position 2.
[4] –D implicated when an observed short leg in position 1 appears to stay short when viewed in position 2.
[5] SLC observes a patient's ability to symmetrically lift each leg individually presumably evaluating the associated sacroiliac joint and sacral deviation.

through 7th terms.[19] Students surveyed were engaged in outpatient care under the direct supervision of licensed college faculty members. The paper-based survey was implemented during a clinical instruction class in 2013, in which 111 students were registered. We chose the students from ninth term (of 10) as the convenience sample because they 1) completed prior training regarding chiropractic analysis tools, 2) participated in some supervised patient care activities, and 3) were in the final term of required classroom attendance.

Table 1.
*Respondent demographics (n=132)*

| | n(%) |
|---|---|
| **Group one (students)** | 74(67) |
| *Anticipated graduation* | |
| February 2014 (following term) | 74(100) |
| **Group two (DC employees)** | 58(61) |
| Licensed | 55(95) |
| Currently seeing patients | 29(50) |
| Seeing patients off campus | 9(16) |
| *Primary Department* | |
| Academic Health Center | 8(14) |
| Administration | 11(19) |
| Campus Health Center | 4(7) |
| Diagnosis & Radiology | 5(9) |
| Life Sciences | 2(3) |
| Philosophy & Practice Mgmt | 1(2) |
| Rehab & Sports Injury | 2(3) |
| Research | 9(16) |
| Technique | 11(19) |
| Other | 4(7) |

Table 2.
*Respondent reported technique use*

| **Group one (students) n=74** | n(%) | **Group two (DC employees) n=58** | n(%) |
|---|---|---|---|
| Palmer Package | 54(73.0) | Palmer Package | 43(74.1) |
| Diversified | 24(32.4) | Diversified | 42(72.4) |
| Gonstead | 23(31.1) | Gonstead | 29(50.0) |
| Drop | 23(31.1) | Thompson | 24(41.4) |
| Thompson | 18(24.3) | Drop | 22(37.9) |
| Activator | 15(20.3) | Activator | 18(31.0) |
| Other | 13(17.6) | Flexion/Distraction | 17(29.3) |
| Flexion/Distraction | 6(8.1) | Toggle-Recoil | 14(24.1) |
| Toggle-Recoil | 4(5.4) | Other | 11(18.9) |
| SOT | 3(4.1) | SOT | 4(6.8) |
| Atlas Orthogonal | 3(4.1) | Atlas Orthogonal | 3(5.2) |
| NUCCA | 3(4.1) | Blair | 2(3.4) |
| Pettibon | 1(1.4) | NUCCA | 1(1.7) |
| Blair | 0(0) | Pettibon | 1(1.7) |

Table 3.

*Responses from senior students regarding a routine patient encounter and the evaluation prior to performing a chiropractic adjustment (n=74).*

| | *On how many encounters should this procedure be performed?* | | | | | *Which best describe your rationale for this frequency?* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Procedure** | **All n(%)** | **Most n(%)** | **Some n(%)** | **Never n(%)** | **Missing n(%)** | **Personal Experience n(%)** | **Personal Philosophy n(%)** | **Patient Preference n(%)** | **Research Evidence n(%)** | **Missing n(%)** |
| Palpation-static/soft tissue prominence | 62(83.4) | 11(14.9) | 1(1.4) | 0(0) | 0(0.0) | 8(18.6) | 12(27.9) | 21(48.8) | 2(4.7) | 2(2.8) |
| Leg checks (prone, extension only) | 41(55.4) | 18(24.3) | 10(13.5) | 5(6.8) | 0(0.0) | 28(38.9) | 3(4.2) | 31(43.1) | 10(13.9) | 2(2.8) |
| Palpation-motion supine | 40(54.8) | 22(30.1) | 8(11.0) | 3(4.1) | 1(1.4) | 26(36.6) | 9(12.7) | 27(38.0) | 9(12.7) | 3(4.2) |
| Leg checks (+D) | 34(46.0) | 19(25.7) | 16(21.6) | 5(6.8) | 0(0.0) | 26(36.1) | 3(4.2) | 34(47.2) | 9(12.5) | 7(13.7) |
| Leg checks (cervical syndrome) | 33(45.2) | 20(27.4) | 14(19.2) | 6(8.2) | 1(1.4) | 29(40.3) | 2(2.8) | 31(43.1) | 10(13.9) | 2(2.8) |
| Leg checks (-D) | 32(43.2) | 19(25.7) | 18(24.3) | 5(6.8) | 0(0.0) | 26(36.1) | 3(4.2) | 34(47.2) | 9(12.5) | 2(2.8) |
| Leg checks (sacral leg check) | 28(37.8) | 23(31.1) | 18(24.3) | 5(6.8) | 0(0.0) | 31(43.1) | 3(4.2) | 29(40.3) | 9(12.5) | 2(2.8) |
| Palpation-motion seated | 20(27.4) | 21(28.8) | 29(39.7) | 3(4.1) | 1(1.4) | 28(40.0) | 8(11.4) | 23(32.9) | 11(15.7) | 4(5.7) |
| Radiographs (abnormal curvatures, degenerative changes, spondylolisthesis) | 20(27.8) | 24(33.3) | 27(37.5) | 1(1.4) | 2(2.8) | 24(34.8) | 2(2.9) | 14(20.3) | 29(42.0) | 5(7.3) |
| Leg checks (supine) | 14(19.2) | 8(10.1) | 27(50.1) | 26(35.6) | 1(1.4) | 22(31.9) | 4(5.8) | 33(47.8) | 10(14.5) | 5(7.3) |
| Instrumentation (galvanic/dual probe) | 12(16.4) | 1(1.4) | 33(45.2) | 27(37.0) | 1(1.4) | 6(10.0) | 8(13.3) | 29(39.2) | 17(28.3) | 14(23.3) |
| Radiographs (biomechanical segmental analysis) | 11(15.1) | 16(21.9) | 33(45.2) | 13(17.8) | 1(1.4) | 19(29.2) | 2(3.1) | 22(33.9) | 22(33.9) | 9(13.9) |
| Radiographs (other) | 8(18.6) | 12(27.9) | 21(48.8) | 2(4.7) | 31(72.1) | 15(20.3) | 2(4.8) | 11(26.2) | 14(33.3) | 32(76.2) |
| Instrumentation (Tytron fossa differential) | 7(9.6) | 3(4.1) | 28(38.4) | 35(48.0) | 1(1.4) | 8(14.8) | 4(7.4) | 29(53.7) | 13(24.1) | 20(37.0) |
| Instrumentation (Tytron segmental) | 4(5.5) | 2(2.7) | 30(41.1) | 37(50.7) | 1(1.4) | 7(12.5) | 4(7.1) | 32(57.1) | 13(23.2) | 18(32.1) |
| Instrumentation (Tytron pattern) | 4(5.5) | 4(5.5) | 28(38.4) | 37(50.7) | 1(1.4) | 7(12.5) | 4(7.1) | 32(57.1) | 13(23.2) | 18(32.1) |

Table 4.

*Responses from DC faculty regarding a routine patient encounter and the evaluation prior to performing a chiropractic adjustment (n=58).*

| | *On how many encounters should this procedure be performed?* | | | | | *Which best describe your rationale for this frequency?* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Procedure** | **All n(%)** | **Most n(%)** | **Some n(%)** | **Never n(%)** | **Missing n(%)** | **Personal Experience n(%)** | **Personal Philosophy n(%)** | **Patient Preference n(%)** | **Research Evidence n(%)** | **Missing n(%)** |
| Palpation-static/soft tissue prom | 49(84.5) | 7(12.1) | 2(3.5) | 0(0.0) | 0(0.0) | 40(74.1) | 3(5.6) | 2(3.7) | 9(16.7) | 4(7.4) |
| Palpation-motion seated | 31(53.5) | 13(22.4) | 14(24.1) | 0(0.0) | 0(0.0) | 39(75.0) | 4(7.7) | 3(5.8) | 6(11.5) | 6(11.5) |
| Palpation-motion supine | 24(44.4) | 13(24.1) | 15(27.8) | 2(3.7) | 4(6.9) | 39(80.0) | 10(18.5) | 0(0.0) | 4(8.2) | 9(18.4) |
| Leg checks (prone, ext only) | 15(26.8) | 14(25.0) | 17(30.3) | 10(17.9) | 2(3.6) | 31(62.0) | 4(10.0) | 2(4.0) | 12(24.0) | 8(16.0) |
| Radiographs (biomechanical segmental analysis) | 11(19.3) | 9(15.8) | 27(47.4) | 10(17.5) | 1(1.2) | 24(43.6) | 7(12.7) | 0(0.0) | 24(43.6) | 3(5.5) |
| Leg checks (cervical syndrome) | 10(18.9) | 9(17.0) | 15(28.3) | 19(35.9) | 5(9.4) | 30(61.2) | 5(10.2) | 2(4.1) | 12(24.5) | 9(18.4) |
| Instrumentation (galv/dual probe) | 10(18.2) | 2(3.6) | 11(20.8) | 29(52.8) | 3(5.5) | 23(42.6) | 10(18.5) | 0(0.0) | 21(38.9) | 4(7.4) |
| Leg checks (sacral leg check) | 10(18.9) | 11(20.8) | 17(32.1) | 15(28.3) | 5(9.4) | 33(63.5) | 4(7.7) | 2(3.9) | 13(25.0) | 6(11.5) |
| Radiographs (abnormal curvatures, degenerative changes, spondylolisthesis) | 10(17.5) | 18(31.6) | 29(50.9) | 0(0.0) | 1(1.1) | 22(39.3) | 4(7.1) | 0(0.0) | 30(53.6) | 2(3.6) |
| Leg checks (+D) | 9(17.0) | 12(22.6) | 13(24.5) | 19(35.9) | 5(9.4) | 33(64.7) | 3(5.9) | 2(3.9) | 13(25.5) | 7(13.7) |
| Leg checks (-D) | 8(15.4) | 10(19.2) | 15(28.9) | 19(36.5) | 6(11.5) | 31(62.0) | 4(8.0) | 2(4.0) | 13(26.0) | 8(16.0) |
| Leg checks (supine) | 6(11.3) | 4(7.6) | 27(50.1) | 16(30.2) | 5(9.4) | 32(60.4) | 6(11.3) | 2(3.8) | 13(24.5) | 5(9.4) |
| Instrumentation (Tytron segmental) | 5(9.4) | 4(7.6) | 11(20.8) | 31(62.0) | 5(9.4) | 17(34.7) | 10(20.4) | 0(0.0) | 22(44.5) | 9(18.4) |
| Instrumentation (Tytron fossa diff) | 5(10.0) | 5(10.0) | 9(18.0) | 31(62.0) | 8(16.0) | 17(36.2) | 9(19.2) | 0(0.0) | 21(44.7) | 11(23.4) |
| Instrumentation (Tytron pattern) | 4(7.8) | 4(7.8) | 13(25.5) | 30(51.7) | 7(13.7) | 16(33.3) | 10(20.8) | 1(2.1) | 21(43.8) | 10(20.8) |

DC employees (93 faculty, staff, and administrators) were sent a paper survey (11" x 17") via campus mail in a hand-addressed envelope one month following the student survey in 2013, which included a signed descriptive cover letter from the principal investigator and an informed consent disclaimer. Respondents were asked to return the completed survey (re-folded as an anonymous self-mailer) to the principal investigator (BM), thus maintaining confidentiality and blinding investigators. All DC employees received follow-up e-mail reminders during three consecutive weeks including a reminder that they could request an electronic copy for anonymous submission directly to the data manager.

### *Survey Instrument*

This survey queried respondents on which clinical evaluation tools (including palpation, paraspinal skin temperature measurement, leg length inequality, and/or radiographic analysis) should be used during patient encounters when evaluating a patient prior to delivering chiropractic SM. The survey instrument was designed in consultation with chiropractic college faculty with expertise in teaching SM techniques. Clinical evaluation tools queried are taught in the core curriculum. Response choices included "all," "most," "some," or "no" patient encounters and were not further defined. Respondents were asked to rate which of the following reasons best describes the rationale for the rating: "personal experience," "personal philosophy," "patient preference," or "research evidence." See Figure 1.

### *Data Analysis and confidentiality*

The Data Manager collected and secured hardcopy data collection forms. The Data Manager prepared form keys and data entry formats with validation schemes. Data entry clerks entered and verified data through a Windows-based application for double key-entry verification. Data entry formats and electronic data files in a secured server environment. Hardcopy data form packets were stored in a locked cabinet during key-entry process. Final project datasets were assembled by transferring data from flat data entry files to SAS System for Windows (Release 9.2). The Data Manager wrote and tested SAS programs to create datasets as requested by the Principal Investigator. The analyzable dataset was imported into SPSS (Version 17.0.0, SPSS, Inc. Somers, NY). Survey results are reported with descriptive statistics.

## Results

### *Response rate*

Surveys were completed for 74 of 111 students for a response rate of 67%. All students anticipated graduating by the end of the following ($10^{th}$) term. Fifty-eight of 93 DC employees returned surveys for a response rate of 61%, representing 10 department affiliations; 55(95%) held a current license to practice chiropractic, and 29(50%) reported actively rendering care to patients. See Table 1.

### *Chiropractic analysis tools favored by ninth term student respondents*

Eighty-three percent reported that static palpation should be performed on *all* routine patient encounters. Prone leg length inequality (LLI) assessment ranked next, ranging from 38-55% depending upon type and variation of leg length analysis. Supine LLI assessment faired much lower at 20%. Nearly 55% of respondents rated motion palpation should be performed on all patient encounters for supine cervical assessment while only 27% for seated patient positioning. While 28% of respondents reported that radiographic assessment for general biomechanical alignment and patterns should be used on all routine encounters; approximately 15% responded that radiographic vertebral segment analysis should be used on all encounters. Only 16% reported that a paraspinal dual temperature analysis should be used on all routine encounters, while 5-10% reported Tytron® infrared thermography (for paraspinal skin temperature readings, as a skin temperature pattern assessment, or for bilateral mastoid fossa temperature measurements) should be used on all encounters.

Twenty-two and 45% of respondents reported biomechanical segmental analysis of radiographs should be used on *most* and *some* patient encounters, respectively; the range of those reporting that radiographic assessment should be used as a visual aid to further inform the practitioner about abnormal curvatures or degenerative changes on most/some patient encounters was 33/38%. Between 10 and 31% responded that prone LLI should be used on some/most encounters. Supine LLI was rated for use on most encounters by 10%, on some encounters by

50%. While 28-45% of student respondents reported various forms of paraspinal thermographic instrumentation should be performed on some patient encounters, only 3-6% reported some form of this measure should be used on most routine encounters.

Fifty percent of student respondents reported that Tytron® infrared thermography should *never* be used during patient encounters, and 37% reported that galvanic/dual probe should never be used. Less than 10% reported prone LLI should never be used while 36% reported supine LLI should never be used. Eighteen percent conveyed that segmental radiographic analysis should never be used. Zero percent of student respondents reported that static palpation should never be used.

### *Chiropractic analysis tools used by DC employee respondents*

Eighty five percent of DC employee respondents reported that static palpation should be performed on *all* encounters. Next frequent, they reported motion palpation (seated) 54% and motion palpation (supine) 44%. While 27% reported prone LLI should be performed on all encounters, other LLI analyses responses ranged from 11-19%. Less than 20% of DC employee respondents indicated radiographic biomechanical segmental analysis or other radiographic findings should be used on all patient encounters. Eighteen percent reported that paraspinal dual probe temperature analysis should be used on all patient encounters, while 4-5% reported Tytron® or paraspinal infrared thermographic measurements should be used all of the time.

Fifty percent of DC employee respondents stated that radiographs should be performed on *some* encounters; 32% reported *most* encounters. Ten to 17% of respondents considered some component of prone LLI assessment as an evaluation that should be performed on some/most encounters; 4% rated supine LLI for most encounters, while 50% related supine for LLI some encounters. Respondents reported 4/26% for most/some patient encounters regarding all types of paraspinal temperature measurement. Motion palpation was chosen by about ¼ of respondents for most/some, while static palpation was chosen most by 12% and some by 4%.

Sixty-two percent of respondents reported that Tytron® infrared thermography should *never* be performed, while 53% reported that galvanic or dual probe paraspinal temperature analysis should never be performed. LLI was reported as should never be performed by 28-36% of respondents, except for LLI prone, extension only, which was reported "never" by 18% of respondents. Eighteen percent reported that biomechanical segmental analysis of radiographs should never be performed.

### *Rationale for use of chiropractic analysis tools by ninth term students*

Thirty-six to 43% of student respondents reported personal experience as their rationale for their use of LLI and motion palpation. Nearly 35% used personal experience as their rationale for responses to using radiographic analysis. Less than 15% of student respondents reported personal experience as rationale for use of paraspinal temperature measurements.

The use of static palpation originated from personal philosophy for 28% of student respondents. Student respondents chose personal philosophy less than 15% of the time for all other categories. Ranking close with personal experience, nearly one half of student respondents chose patient preference at their rationale for reporting various analysis tools.

Forty-two percent of student respondents chose research evidence as their rationale for their use of radiographs to assess abnormal curvatures and degenerative changes, which most responded should be used or referenced on most or some encounters. This rationale was chosen by less than 15% for static and motion palpation as well as LLI assessments. Further, between 23-28% of respondents chose research evidence as rationale for their use of various thermographic assessment methods, considered by most respondents to be used some or never during patient encounters.

### *Rationale for use of chiropractic analysis tools by DC employees*

Thirty-three to 80% of DC employee respondents chose personal experience as their rationale when recommending frequency of use of chiropractic analysis tools. Personal experience was also chosen as a frequent rationale (60-80%) regarding palpation and LLI assessment. Personal experience was chosen infrequently as rationale for instrumentation use (33%).

Only 20% of DC respondents chose personal philosophy rationale, as recorded in the thermography categor-

ies. The highest percentage of DC employee respondents chose patient preference (only 6%) for seated motion palpation.

Forty-three and 53% of respondents chose research evidence for use of radiographs (biomechanical segmental analysis) and (abnormal curvatures), both recommended by nearly half of respondents for use on some patient encounters. Research evidence was ranked as rationale for thermography, chosen by 39-45% of responders, most of which ranked thermographic measurements to be used "never" for patient encounters.

### *Technique systems used by senior students*

Seventy-three percent of students responded with "Palmer Package" as a technique used. Palmer Package is comprised of components from Diversified, Gonstead, and Thompson or drop table SM techniques. Closely following is Activator, chosen by 20% of respondents.

### *Technique systems used by DC employees*

Over 70% of DC employees responded with Palmer Package or Diversified for technique used, with Gonstead, Thompson, Drop, following. Activator was ranked by 32% of respondents, flexion/distraction by 30%, Toggle-Recoil by 25%. See Table 2.

## Discussion

This survey quantifies perceptions of DC employees and senior students at a single chiropractic college regarding the use of clinical analysis procedures used prior to performing SM. Static palpation was rated most consistently as a necessary procedure. This result may not be surprising given a manually delivered treatment often requires some palpation component to identify anatomical landmarks, local tissue characteristics and tenderness. Segmental motion palpation was not rated as highly by survey respondents in both groups. In a recent comprehensive review of methods that can inform providers about treatment localization for SM, static palpation, motion palpation, and LLI assessment (pelvic only) were favorably recommended with limitations; radiographic imaging, paraspinal skin temperature, and galvanic skin response were unfavorably recommended.[3] While this review was published in the same year that the current was performed, it is unlikely that survey respondents were intimately familiar with its recommendations due to a lag in dissemination. Further, a challenge to change practice behavior may occur if "new" recommendations are different from an individual's clinical experience.

Over half of DCs rated research evidence as a rationale for their opinion regarding radiographic analysis, although the preponderance of rationale reported for other procedures is personal experience. Note that most DC employees reported the use of radiographic interpretation on some, but not most or all, patient encounters. DC respondents more commonly reported personal experience as rationale for clinical decision-making than students. It is logical to expect practitioners with a larger reservoir of clinical experience to use personal experience as a rationale more often than students.

Research evidence was rated slightly higher than personal experience among DC respondents for their rationale regarding the use of thermography; most (over half) recommended it never be used and over 20% suggested only on some encounters. Over 80% of students reported that paraspinal temperature measurements should never be used or only on some encounters. These responses are likely influenced by the lack of available evidence demonstrating validity as an assessment measure, a lack of personal experience with this type of assessment tool, or both. Similarly, research evidence ranked slightly above personal experience in rationale for recommending the frequency of use of radiographic analysis, even though research evidence is unfavorable for using radiography to determining the site of routine spinal manipulative care.[3] However, it is unclear whether respondents who indicated radiographic analysis was important on routine encounters considered it as necessary for determining the site of care or as additional clinical information that should be reviewed at each encounter when available. It appears that the research evidence rationale increases as the frequency and specificity of the recommendation decreases, e.g., research evidence rationale increases by 10% from segmental analysis to overall curvature and degenerative changes. A similar trend may be observed when advancing from a simple prone LLI evaluation to more elaborate (and less reliable) leg length procedures. This could suggest that respondents used research evidence in a negative rather than a supportive manner.

DC respondents commonly chose research evidence second highest to those procedures rated as useful for "some" or "no" patient encounters. This suggests that re-

spondents answered this question in 2 ways, 1) to justify use of a clinical evaluation tool; and 2) to justify why they rarely or never use it because they believe research evidence does not support regular use. Students rarely chose research evidence as rationale, which may represent a lack of awareness of, experience with, or confidence interpreting scientific evidence regarding procedures included in the survey. It may also represent the general lack of high-quality research evidence available for many diagnostic procedures, an area noted by Haas *et al*. as a research priority for the chiropractic profession.[20]

Technique systems reported were similar between faculty and students, which may be expected when most respondents were educated at the same institution, although DCs did report greater use of Activator® and Flexion/distraction techniques. It could be surmised that attitudes of students will similarly follow faculty attitudes. This phenomenon does seem to exist, with some exceptions.

The lack of research evidence informing the appropriate use of some clinical analysis procedures included in this survey may have led respondents to rely more on personal experience and patient preference to influence their clinical decision-making. Survey responses indicating the use of clinical assessments unsupported by research evidence or considered to be fair, poor, or unknown suggests the following question. What is the most appropriate way to incorporate the practitioners' art and experience into an educational curriculum dedicated to teaching evidence-based principles, skills, and decision-making? For procedures that have demonstrated poor reliability or validity, it seems clear that further use in educational settings is not well justified. Because evidence-based care includes what has been learned from experience, we do not suggest that chiropractic educators refrain from sharing their unique beliefs, as long as those unsupported by research are clearly stipulated as such. We suggest that it is vital for educators to provide balanced presentations of available literature describing both strengths and limitations of existing clinical analysis procedures and to consider the negative ramifications of directly or indirectly supporting the use of procedures no longer considered valid.

### *Limitations*

This was the initial application of this survey, which has not been validated. The questionnaire asked respondents to consider a routine patient encounter, which was not further defined. Also, the terms "most" and "some" were not defined for participants. Therefore individual respondents likely defined this differently. While the entire faculty was surveyed, only one term of current students were surveyed. It cannot be generalizable to the entire student body during that period.

Respondents cited research evidence as the reason for and against using certain procedures, and the survey was conducted using a convenience sample at a single chiropractic college campus. This survey gathered data regarding the use of clinical tools and reasons that primarily influenced their use.

### *Future Recommendations*

It is beyond the scope of this survey to speculate how students and faculty are using assessment procedures included in this survey to make decisions based on evidence-informed principles. Major categories could be consolidated and the more defined rationale collected to identify how research evidence (or other motivation) is driving respondent's decisions for or against clinical use. Descriptions of specific clinical scenarios could also be more clearly defined. We suggest that it is important to assess faculty and students opinions regarding applicability and interpretation of research in daily clinical decision-making. Subsequent research seeking to further understand how diagnostic information informs care decisions is necessary to inform both the teaching of and the practice of skilled evidence-based clinical decision-making.

## Conclusions

The majority of respondents from both students and DC employees reported that static palpation should be used on all patient encounters. Survey responses were varied for other clinical evaluation methods, perhaps due to the lack of available research on many procedures. Respondents reported often relying primarily on experience and provider and patient preferences for evaluation procedures used. An evidence-based educational and clinical setting requires a balanced presentation of practitioner experience and available literature for clinical analysis procedures.

## References:


1. Van de Veen EA, de Vet HCW, Pool JJM, Schuller W, de Zoete A, Bouter LM. Variance in manual treatment of nonspecific low back pain between orthomanual physicians, manual therapists, and chiropractors. J Manipulative Physiol Ther. 2005;28(2):108-116.
2. Gleberzon B, Stuber K. Frequency of use of diagnostic and manual therapeutic procedures of the spine currently taught at the Canadian Memorial Chiropractic College: A preliminary survey of Ontario chiropractors. Part 2 - procedure usage rates. J Can Chiropr Assoc. 2013;57(2):165-175.
3. Triano JJ, Budgell B, Bagnulo A, et al. Review of methods used by chiropractors to determine the site for applying manipulation. Chiropr Man Therap. 2013;21(1):36.
4. Goertz CM, Pohlman KA, Vining RD, Brantingham JW, Long CR. Patient-centered outcomes of high-velocity, low-amplitude spinal manipulation for low back pain: a systematic review. J Electromyogr Kinesiol. 2012;22(5):670-691.
5. Vining R, Potocki E, Seidman M, Morgenthal A P. An evidence-based diagnostic classification system for low back pain. J Can Chiropr Assoc. 2013;57(3):189-204.
6. Sackett DL, Rosenberg WMC, Gray JAM, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. 1996. Clin Orthop Relat Res. 2007;455:3-5.
7. Cooperstein R, Young M, Haneline M. Interexaminer reliability of cervical motion palpation using continuous measures and rater confidence levels. J Can Chiropr Assoc. 2013;57(2):156-164.
8. Cooperstein R. Heuristic exploration of how leg checking procedures may lead to inappropriate sacroiliac clinical interventions. J Chiropr Med. 2010;9(3):146-153.
9. Cooperstein R, Haneline M, Young M. Interexaminer reliability of thoracic motion palpation using confidence ratings and continuous analysis. J Chiropr Med. 2010;9(3):99-106.
10. Haneline M, Cooperstein R, Young M, Birkeland K. An annotated bibliography of spinal motion palpation reliability studies. J Can Chiropr Assoc. 2009;53(1):40-58.
11. Haneline MT, Young M. A review of intraexaminer and interexaminer reliability of static spinal palpation: a literature synthesis. J Manipulative Physiol Ther. 2009;32(5):379-386.
12. Harrison DE, Harrison DD, Troyanovich SJ. Reliability of spinal displacement analysis of plain X-rays: a review of commonly accepted facts and fallacies with implications for chiropractic education and technique. J Manipulative Physiol Ther. 1998;21(4):252-266.
13. Harrison DE, Harrison DD, Colloca CJ, Betz J, Janik TJ, Holland B. Repeatability over time of posture, radiograph positioning, and radiograph line drawing: an analysis of six control groups. J Manipulative Physiol Ther. 2003;26(2):87-98.
14. Hart J, Neely C. Allowing a possible margin of error when assessing student skills in spinous process location. J Chiropr Educ. 2011;25(2):182-185.
15. Hestbaek L, Leboeuf-Yde C. Are chiropractic tests for the lumbo-pelvic spine reliable and valid? A systematic critical literature review. J Manipulative Physiol Ther. 2000;23(4):258-275.
16. Hubbard TA, Vowles BM, Forest T. Inter- and intraexaminer reliability of the Blair protractoview method: examination of a chiropractic radiographic technique. J Chiropr Med. 2010;9(2):60-68.
17. Kilby J, Heneghan NR, Maybury M. Manual palpation of lumbo-pelvic landmarks: a validity study. Man Ther. 2012;17(3):259-262.
18. Goertz CM, Long CR, Hondras MA, et al. Adding chiropractic manipulative therapy to standard medical care for patients with acute low back pain: results of a pragmatic randomized comparative effectiveness study. Spine (Phila Pa 1976). 2013;38(8):627-634.
19. Curriculum - D.C. Palmer College of Chiropractic. http://www.palmer.edu/CurriculumDC/. Accessed February 23, 2015.
20. Haas M, Bronfort G, Evans RL. Chiropractic clinical research: progress and recommendations. J Manipulative Physiol Ther. 29(9):695-706.

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# The reliability of palpating the posterior superior iliac spine: a systematic review

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Introduction: *Among pelvic landmarks routinely palpated by manual therapists, the posterior superior iliac spines (PSISs) are particularly important. In addition to serving as landmarks for identifying possible pelvic torsion, contacting the PSISs is integral to many other static and dynamic pelvic palpatory procedures. The primary study goal was to systematically review the literature on the intra- and interexaminer reliability of PSIS palpation.*

Methods: *Electronic databases and secondary searches led to the retrieval of articles that satisfied inclusion criteria. Two investigators rated the quality of included articles using the QAREL instrument.*

Results: *The search identified 13 articles, one judged high quality, satisfying the inclusion criteria. Intraexaminer exceeded interexaminer reliability. Among 8 studies that reported interexaminer agreement using kappa, mean $\varkappa$=0.27 (adjusted for sample size).*

Introduction : *En ce qui concerne la région pelvienne régulièrement palpée par des thérapeutes manuels, les épines iliaques postéro-supérieures (EIPS) sont particulièrement importantes. En plus de servir de points de repère pour l'identification d'une possible torsion pelvienne, la palpation de l'EIPS fait partie intégrante de nombreuses autres procédures palpatoires pelviennes statiques et dynamiques. L'objectif principal de l'étude était d'examiner systématiquement les documents scientifiques concernant la fiabilité intra- et inter-examinateurs de la palpation de l'EIPS.*

Méthodologie : *Les bases de données électroniques et les recherches secondaires ont abouti à la découverte d'articles qui répondaient aux critères d'inclusion. À l'aide de l'instrument QAREL, deux enquêteurs ont évalué la qualité des articles inclus.*

Résultats : *La recherche a révélé 13 articles, dont un de haute qualité, répondant aux critères*

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[2] Palmer Center for Chiropractic Research
[3] Life Chiropractic College West

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None of the authors has any commercial interest in the results of this study or belongs to any organizations that may benefit from the publication.

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Discussion and Conclusion: *Current methods of palpating for PSIS asymmetry do not result in levels of interexaminer reliability supporting clinical utility. Improved methods should be sought.*

(JCCA. 2016;60(1):36-46)

KEY WORDS: chiropractic, palpation, posterior superior iliac spine, systematic review

*d'inclusion. Le nombre d'articles traitant de la fiabilité intraexaminateurs était supérieur à ceux traitant de la fiabilité interexaminateurs. Pour les 8 études qui ont mentionné un accord d'interexaminateurs utilisant l'indice kappa, la moyenne $\varkappa = 0,27$ (ajusté à la taille de l'échantillon).*

Discussion et conclusion : *Les méthodes actuelles de palpation pour l'asymétrie de l'EIPS ne mènent pas à des niveaux de fiabilité interexaminateurs pour soutenir l'utilité clinique. Il faut rechercher des méthodes améliorées.*

(JCCA. 2016;60(1):36-46)

MOTS CLÉS : chiropratique, palpation, épine iliaque postéro-supérieure, examen systématique

## Introduction

Manual therapists draw upon a number of physical examination procedures to establish indications for sacroiliac interventions.[1] Broadly speaking these procedures fall into four categories: palpation for positional asymmetry of bony landmarks, tests for joint hypomobility or hypermobility, assessment of changes in tissue texture, and tests for pain provocation and/or amelioration. The anatomical landmarks that are commonly located and contacted to perform these tests include the anterior superior iliac spine (ASIS), the posterior superior iliac spine (PSIS), the iliac crest, the sacral sulcus, the sacral apex, and the inferior lateral angle of the sacrum (SILA). Among the pelvic landmarks routinely palpated, the posterior superior iliac spines (PSISs) may be singled out as particularly important, in that identifying them is the starting point for a variety of patient assessment procedures (see Table 1). As the most posterior projection of the iliac crest, it serves for the attachment of the long posterior sacroiliac ligament, which blends with the sacrotuberous ligament, as well as the multifidus and gluteus maximus muscles. Figure 1 depicts the muscular and ligamentous attachments to the PSIS.

Given the importance of PSIS palpation, the authors elected to conduct a systematic review of the literature pertaining to the intra and interexaminer reliability of identifying the location of a single PSIS, or the bilateral positional asymmetry of the left and right PSISs. The primary goals of this study were to both identify such articles and summarize their data; and to assess their methodological quality.

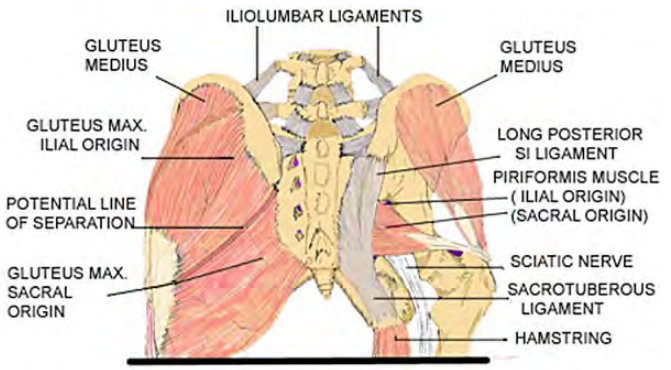


Figure 1.
*Muscular and ligamentous attachments to the PSIS (Permission to reprint from http://www.thelowback.com/ granted by Richard DonTigny)*

## Methods

Inclusion criterion for an article to be included in this review was that it concerned the intraexaminer or interexaminer reliability of static palpation of the PSIS(s) and was published in an English language peer reviewed

Table 1.
*Some orthopedic tests requiring PSIS identification*

| **Procedure** | **How performed** | **Interpretation** |
|---|---|---|
| Seated bilateral PSIS palpation | Examiner places thumbs on PSISs, assessing for vertical displacement. | Inferior PSIS –> posterior innominate rotation; Superior PSIS–>anterior rotation[2,3] |
| Prone PSIS identification as anatomical landmark | Examiner identifies PSIS in relation to sacrum. | Using a PSIS landmark may increase accuracy of numerating lumbar segments[4,5] |
| Palpation of PSIS Y-axis unleveling, seated vs. standing, as indicator of anatomic LLI | Vertical PSIS displacement seated compared with standing displacement. | Any difference in vertical PSIS displacement seated compared with standing displacement suggests anatomical LLI[6,7] |
| Sacroiliac motion palpation | Seated or standing, examiner observes or palpates for sacroiliac excursion during movement (sitting flexion test[8], step test[9], etc.) or endfeel with digital pressure. | Lack of excursion during active or passive sacroiliac movement indicates restriction; hard end-feel with digital pressure indicates fixation[10,11] |
| Pain provocation | Digital pressure applied to PSISs. | Tenderness of PSIS on palpation indicates sacroiliac dysfunction[12] |
| PSIS identification to allow sulcus depth determination | Thumbs probe relative depth of the sacroiliac joints. | Asymmetry indicates inter-innominate sacral base rotation[13] |

journal. Reliability could pertain to assessing the location of a single PSIS, or to assessing the bilateral symmetry of the PSISs on the superior-inferior axis (i.e., assessing whether one PSIS was caudal to the other). Review articles and validity studies related to PSIS palpation were excluded, as were articles concerned with pelvic landmarks other than the PSIS. Theses written in connection with obtaining a degree in an academic program were also excluded. Databases consulted included PubMed, ICL, CINAHL, AMED, Osteopathic Research Web, OstMed, and MANTIS. After searching these biomedical databases, we supplemented our search using the global Google search engine. Searches were conducted using the following terms and combinations of them: reliability, agreement, PSIS, palpation, physical examination, posterior superior iliac spine, pelvis, pelvic, sacroiliac, and landmark. It was not necessary to construct complicated Boolean phrases to limit the number of returned citations, because even very inclusive search terms returned relatively few citations; e.g., "posterior superior iliac spine + reliability" returned only 11 citations in the PubMed database, and sacroiliac + palpation only 70 citations. The "related citations" function was deployed when articles were retrieved which fit the inclusion criteria. In one case, an email was sent to an author to clarify the methodology used. The bibliographies for included articles were also inspected for additional candidates for inclusion. Each of the included articles was rated for quality using the *The Quality Appraisal of Reliability Studies* (QAREL) instrument.[14] These articles were rated for quality by two reviewers using the QAREL instrument[14]; disagreements between reviewers were resolved by coming to consensus following discussion. QAREL index quality scores ranged from 2 to 10, average 5.1. Table 2 summarizes the search strategy used in this study.

## Results

The original search retrieved 215 citations. Another 5 articles were included based on a secondary search of the included articles, or because the first author was personally familiar with them. After removing duplicates, there were 195 citations remaining. After inspecting their titles, 153

Table 2.
*STARLITE Mnemonic summarizing search strategy*

| | |
|---|---|
| **Sampling Strategy** | Electronic databases searched for articles satisfying inclusion criteria. Google searching supplemented database searching. |
| **Type of Studies** | Studies investigating intra or interexaminer reliability of PSIS palpation. |
| **Approaches** | "Related articles" function used following successful retrieval. Secondary search used to reach a point of data saturation (i.e., no new references could be identified). |
| **Range of Years** | No restrictions. |
| **Limits:** | Only English-language articles were included. |
| **Inclusions/Exclusions** | Included only English language primary reliability studies. Excluded theses, validity studies, and review articles. |
| **Terms Used** | PSIS reliability, posterior superior iliac spine reliability, PSIS agreement, posterior superior iliac spine agreement; PSIS palpation; posterior superior iliac spine palpation. This strategy was repeated substituting the words "sacroiliac" and "pelvic" and "landmark" for the acronym PSIS. |
| **Electronic Sources** | PubMed, ICL, CINAHL, AMED, Osteopathic Research Web, OstMed, MANTIS |

were excluded from further consideration, leaving 42 abstracts to be read for consideration of possible inclusion. This resulted in the retrieval of 17 full text articles. Three of the retrieved full text articles were excluded because they did not involve PSIS palpation[13,15,16] and one because it involved radiological rather than manual assessment[17]. This resulted in a total of 13 articles published between 1985 and 2008 that met the inclusion/exclusion criteria. The literature retrieval flow process is depicted in Figure 2.

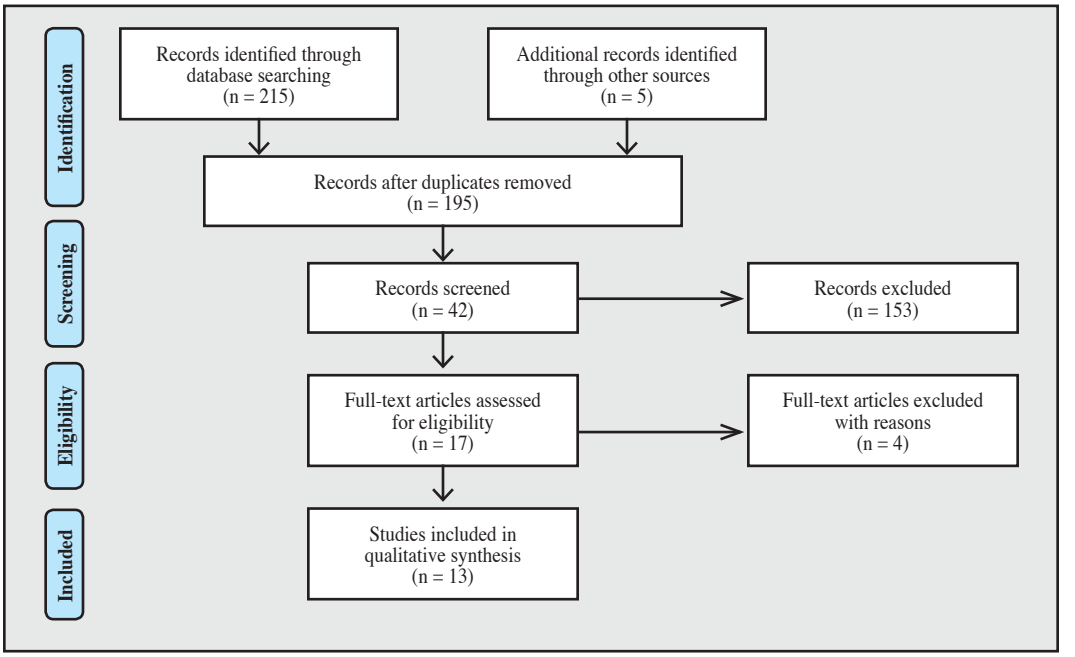


Figure 2.
*Literature retrieval flow diagram*

Three studies utilized seated PSIS palpation only[10,18,19]; 6 utilized prone palpation only[4,20-24]; 3 used standing palpation only[25-27]; and one include seated and standing palpation[8]. Ten of the included studies[8,10,18,19,21-25,27] asked assessors to examine the PSISs bilaterally to determine if they were symmetric or displaced on the superior-inferior axis; 2 studies[20,28] asked examiners to locate one of the PSISs, reporting their agreement in terms of the distance between the sites identified by the assessors, making no attempt to analyze their continuous data by calculating their Intraclass Correlation Coefficient (ICC); and 1 study[4] assessed agreement as the midline distance between lines examiners drew between the bilateral PSISs. Of the 10 studies that involved bilateral palpation, all but one used inferential statistics to report their data, the exception being Potter *et al*.[8] who reported percent agreement only. Only 1 study reported data using an inferential statistic other than kappa: Kim[4] used the Wilcoxon signed rank test statistic as a surrogate measure of reliability[4], basing calculations on the distance between lines that 2 examiners drew between the PSISs, as measured where these lines intersected a midline ruler. (The Wilcoxon test may be used to assess reliability when paired data are not normally distributed, in order to test the hypothesis that the median difference between the pairs is significantly different from zero.) None of the studies included in this review attained kappa levels for interexaminer reliability that would be considered to reflect "substantial" agreement according to the widely accepted Landis and Koch scale.[29] The 5 studies[10,20,22-24] that included intraexaminer reliability modules found intraexaminer reliability to exceed interexaminer reliability. In the 8 studies that reported interexaminer agreement using the kappa statistic, the mean value, weighted by sample size, was $\kappa$=0.27. One study[25] did not provide exact kappa results, reporting only that $\kappa$<0.40, and thus could not be included in this mean calculation. The data are abstracted in Table 3, and the QAREL ratings in Table 4. There was a non-significant trend for moderate correlation between the reported kappa values and study quality (Pearson's product moment correlation r = 0.43, p = 0.28), suggesting that the higher quality studies demonstrated higher interexaminer reliability.

An established categorical hierarchy of scores has not been established for the QAREL instrument. That stated, the authors established the following arbitrary categorical hierarchy of scores to interpret the QAREL quality assessments (1-4: low; 5-8: moderate; 9-11: high) also supports this trend. The results were: $\kappa$=0.03 for the 2 low quality studies, $\kappa$=0.33 for the 5 moderate quality studies, and $\kappa$=0.37 for the 1 high quality study.

An intra-examiner reliability study was conducted in which 3 final year osteopathic students served as examiners attempting to reliably identify the location of a single PSIS on repeated examinations.[30] Although the full text of the thesis was not available to us, precluding including it in our review, we may point out that the investigators reported "low to moderate intra-rater reliability" and recommended "cautious presentation of palpation in osteopathic curricula."

## Discussion

Most manual therapists perform tests for both joint fixation and misalignment. The term "joint fixation" may refer either to an examiner's sense of a hard endfeel on palpatory digital pressure, or restriction in or a specific direction during palpation for joint excursion.[31] The authors are not aware of evidence supporting the view that either type of finding is more important than the other, nor definitive evidence that the information supplied by either test has an important impact upon the outcome of care. Beyond the interexaminer reliability being demonstrably wanting, the validity has hardly been studied. Kmita[24] calls attention to the fact that "the field of diagnostic accuracy has been labelled in the British Medical Journal as the 'new frontier'"[32]. Despite the lack of evidentiary support, a typical manual therapy examination involves finding asymmetry (*e.g*., pelvic torsion), then determining the clinically relevant side through motion palpation and other examination procedures.[33] The sequence could be reversed, so the clinician would identify a fixated or restricted joint, then determine via static palpation if there is positional asymmetry that might inform the vector of correction. Asymmetric PSIS locations may imply opposed rotations of the innominate bones, wherein the bone on the side of the inferior PSIS has rotated posteriorly in relation to the other side, which in turn is judged to have rotated anteriorly.[34]

There are basic science threats to the feasibility of using PSIS palpation to derive clinically useful information, beyond the demonstrable low reliability of the procedure. Congenital and/or acquired asymmetry of the pel-

Table 3.
*Reliability studies, PSIS palpation*

| Author, date | Palpatory method (bilateral unless unilateral noted) | Examiners/ participants (E/P) | Reliability (κ, % agreement, or other statistic) | Quality. score (n/11) | Study conclusions |
|---|---|---|---|---|---|
| Potter, 1985[8] | Seated and standing, cadual aspect | E: 8 PTs<br>P: 17 buttock pain | %=35.29 seated<br>%=35.29 standing<br>(interexaminer only) | 4 | Need for improved methods for SI palpation; PSIS palpation under the conditions of this study was unreliable. |
| Byfield, 1992[28] | Standing position, aspect of PSIS not specified | E: 10 DCs & 10 students<br>P: 2 patients, clinical status unspecified | "Horizontal spread" for DCs 1.1 (0.7) cm, for students 2.0 (0.1) cm<br>"Vertical spread" for DCs 1.4 (0.7) cm, for students 4.5 (2.2) cm students | 4 | The DC's skin marks for PSIS location were more "concentrated" than students' marks; DCs were "reasonably" reliable. |
| Simmonds, 1992[20] | Prone, not further specified | E: 20 PTs<br>P: 20 asymp. | Intraexaminer: mean distance between UV skin marks= 8 ±5 mm<br>Interexaminer: mean distance between UV skin marks= 20 ±13 mm | 5 | PSIS palpation was associated with a statistically significant low within-rater but high between-rater error. |
| Paydar, 1994[10] | Seated, caudal aspect | E: 2 DC students<br>P: 32 asymp. | κ=.25 (intraexaminer)<br>%=51.6<br>κ=.15 (interexaminer)<br>%=46.8 | 2 | The clinical decision on which sacroiliac joint to treat should not be based on palpatory findings alone. |
| Lindsay, 1995[21] | Prone, not further specified | E: 2 experienced manual therapists<br>P: 8 skiers (unknown symptom status)<br>Apparently dichotomous protocol | κ= -.10<br>%=50<br>(interexaminer only) | 3 | PSIS palpation failed to meet a predetermined agreement criterion of 70%; sacroiliac very unreliable. |
| O'Haire, 2000[23] | Prone, caudal aspect | E: 10 DO students<br>P: 10 asymp. | κ=.07 to .58, mean .33<br>%=43-94 (intraexaminer)<br>κ=.04, %=51<br>(interexaminer only) | 6 | Only slight inter-examiner reliability; efforts should be made to improve levels of agreement. |
| Riddle, 2002[18] | Seated | E: 34, pairwise<br>P: 65 pain | κ:=.37<br>%=55.6<br>(interexaminer only) | 5 | Pain provocation tests appear to have more support for identifying sacroiliac problems than sacroiliac alignment or movement tests. |
| Fryer, 2005[22] | Prone, caudal aspect | E: 10 final year osteopathic students (5 trained)<br>P: 10 asymp. female volunteers | κ=0.49 untrained, .54 trained (intraexaminer)<br>κ=0.15 untrained; .08 trained<br>%=53 trained, %=34 untrained (interexaminer) | 7 | Training did not improve reliability |
| Kim, 2007[4] | Prone, caudal aspect | E: 4, experienced<br>P: 60 patients | Wilcoxon statistic: mean PSIS delta = .60(.60) mm<br>(interexaminer only) | 6 | Palpating the PSIS with accuracy might be difficult. |

| Author, date | Palpatory method (bilateral unless unilateral noted) | Examiners/ participants (E/P) | Reliability ($\kappa$, % agreement, or other statistic) | Quality. score (n/11) | Study conclusions |
|---|---|---|---|---|---|
| Kimita, 2008[24] | Prone, caudal aspect | E: 2 students, 2 experienced DOs<br>P: 5 symptomatic, 4 asymp. | $\kappa$= -.29 to 0.39 (intraexaminer)<br>%=11-67<br>$\kappa$= .38 to 0.35 (interexaminer)<br>%=11-56 | 10 | Inter-examiner reliability was low, irrespective of examiners' years of experience. |
| van Kessel-Cobelens, 2008[19] | Seated, caudal aspect | E: 2 PTs<br>P: Total 60<br>20 Control<br>22 w/pelvic pain, 20 wks pregnant<br>20 no pelvic pain, 20 weeks pregnant<br>(interexaminer only) | Total group: $\kappa$=0.26, %=63<br>Control: $\kappa$=0.47, %=75<br>Pain: $\kappa$=.20, %=60<br>Non-pain: $\kappa$=0.10, %=55 | 7 | Poor interexaminer reliability for palpation, should not be used for diagnostic purposes. |
| Sutton, 2012[27] | Standing, caudal aspect, unilateral | E: 15 final year osteopathy students, 15 3rd year, 10 exp. osteopaths<br>P: 1 asymp. model; 5mm wedge inserted 2/3 trials<br>(interexaminer only) | 3rd year students $\kappa$=.025; 4th year $\kappa$=.065; DOs $\kappa$=.058; all combined $\kappa$=.063 | 6 | Inter-reliability of palpation to locate PSISs and assess levels is poor in both students and experienced osteopaths. |
| Suwanasri, 2014[25] | Standing, aspect unspecified | E: PTs, number unclear<br>P: 10 PT students | $\kappa$<.40 | 2 | Inter-reliability of palpation to locate PSISs is poor. |

Abbreviations: *DO=Osteopath, DC=Chiropractor, PT=Physiotherapist, E=Examiner, P=Patient, $\kappa$=Kappa, mm=millimeter, asymp.= asymptomatic patient*

vis may confound the interpretation of palpable or visible misalignment. That stated, there is evidence that although there may be substantial left-right asymmetry of the innominate bones in any one individual, on average such differences are usually small and average only 2mm.[35-37] Roentgen Stereophotogrammetric Analysis (RSA) poses another challenge to the clinical utility of PSIS palpation. RSA technology, which involves 3-D digitizing of metallic markers implanted in the skeleton, is generally considered the most accurate method for measuring 3-D motions of the sacroiliac joints.[38] Motions of the sacroiliac joint in stressed positions, such as one-legged stance and straddle position, have been found to be much smaller than those reported by most other measuring technologies; Goode[38] concludes that "the limited movements may not support a clinician's ability to palpate selected movements." Small sacroiliac movements notwithstanding, it must be emphasized that RSA measures movement, not position. Therefore this technology does not refute the possibility of asymmetric positions, if not movements, of the innominate bones, in principle detectable by means of manual palpation. Likewise, RSA technology does not rule out that findings of asymmetry could suggest vectors for manual therapy that are more optimal than contrary vectors, even were it found that such vectors had not resulted in measurable repositioning of the innominate bones.

Although the interexaminer reliability of most palpatory pelvic positional tests (PSIS levels, ASIS levels, sacral sulcus depth) has been poor[39], instrumented measurements of innominate positions suggest these do in fact occur[2]. Since many studies of clinical interventions that

Table 4.
*QAREL ratings*[14]

| Item # | Criterion |
|---|---|
| 1 | Was the test evaluated in a sample of subjects who were representative of those to whom the authors intended the results to be applied? |
| 2 | Was the test performed by raters who were representative of those to whom the authors intended the results to be applied? |
| 3 | Were raters blinded to the findings of other raters during the study? |
| 4 | Were raters blinded to their own prior findings of the test under evaluation? |
| 5 | Were raters blinded to the subjects' disease status or the results of the accepted reference standard for the target disorder (or variable) being evaluated? |
| 6 | Were raters blinded to clinical information that was not intended to form part of the study design or testing procedure? |
| 7 | Were raters blinded to additional cues that were not part of the test? |
| 8 | Was the order of examination varied? |
| 9 | Was the stability (or theoretical stability) of the variable being measured taken into account when determining the suitability of the time interval between repeated measures? |
| 10 | Was the test applied correctly and interpreted appropriately? |
| 11 | Were appropriate statistical measures of agreement used? |

QAREL assessments for articles in review

| Item # | Byfield | Fryer | Kim | Kmita | Lindsay | O'Haire | Paydar | Potter | Riddle | Sim-monds | Sutton | Van Kessel | Suwan-asri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Y | | Y | Y | | | | Y | Y | Y | | Y | |
| 2 | Y | | Y | Y | Y | | | Y | Y | Y | Y | Y | Y |
| 3 | Y | Y | Y | Y | | Y | | Y | Y | Y | Y | Y | |
| 4 | | Y | | Y | | | | | | | | | |
| 5 | | Y | | Y | | | | | | | | Y | |
| 6 | | Y | | Y | | Y | | | | | Y | | |
| 7 | | Y | | Y | | Y | | | | | | | |
| 8 | | | Y | Y | | Y | | | | | Y | Y | |
| 9 | | | | | | | | | | | | | |
| 10 | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | |
| 11 | | Y | Y | Y | Y | Y | Y | | Y | Y | Y | Y | Y |
| **Total Y** | 4 | 7 | 6 | 10 | 3 | 6 | 2 | 4 | 5 | 5 | 6 | 7 | 2 |

attempt to improve symmetry confirm clinical improvement in both pain reduction and functional measures, it may be hypothesized that these interventions normalize neuromusculoskeletal function, if not bone positions. It remains to be seen whether interventions using vectors contrary to those intended to improve symmetry would get equivalent results, but there is some evidence that they may not. Long *et al*.[40] showed that the direction of prescribed McKenzie exercises did make a clinical difference, while another author showed that patients preferred being blocked in positions that reversed their palpable pelvic torsion pattern[41].

Manipulative strategies for pelvic structures should involve reliable and valid assessment procedures. However, none of the studies included in this review that reported their data using kappa calculations obtained the $\varkappa \geq .60$ level that is considered to reflect "substantial" agreement and identify a clinically useful procedure.[42] In fact, none achieved the $\varkappa \geq .40$ level that defines "moderate" agreement. Fryer *et al* found that training did not improve reliability[22], similar to findings reported in other studies[43]. In a review, Seffinger *et al*.[44] found that neither examiners' discipline, experience level, agreement on procedure used, nor use of symptomatic participants increased reli-

ability. Since palpation of the PSISs is the starting point for other pelvic examination procedures, examiner inability to agree on the location of the PSIS may negatively impact their ability to perform, interpret, and agree upon the results of other manual pelvic examination procedures.[23]

The articles in this review that specified the aspect of the PSIS with which the examiners made contact specified either the inferior aspect or the most posterior point. Since the PSIS in some individuals has a rather blade-like (rather than protuberant) anatomy, it is unlikely that attempting to locate the most posterior aspect would result in consistent findings – in effect, there would be no "most posterior" aspect. Palpating the inferior aspect of the PSIS, on the other hand, is not likely to yield consistent results because this method precludes easily using the index fingers to serve as stabilizing anchors on an adjacent anatomical structure. The first author of this study routinely anchors his index fingers on the lateral iliac crests while using his thumbs to probe an area somewhat superolateral to the *superior* aspect of the PSISs, in order to make better use of tactile sense. Figure 3 illustrates seated PSIS palpation using this method.[45] The authors are unaware of any published evidence regarding the reproducibility of this method, contacting the superior aspect of the PSISs.

Figure 3.
*PSIS palpation at superior aspect*

The fact that examiners may not agree with each other on the location of landmarks, but may manifest internal consistency in their individual palpatory efforts, may explain why intraexaminer generally exceeds interexaminer reliability in the included studies, as in many other manual therapy studies. One of the authors included in this review wrote: "No attempt was made to rigidly standardize each test as this would have interfered with each therapist's normal assessments".[21] Although we recognize this author's effort to increase the external validity of the study, the resulting lack of methodological standardization may have contributed to poor examiner agreement. The present authors think it more appropriate that examiners develop reproducible patient examination methods, refining and standardizing methods as required. Demonstrating reliability alone does not establish an examination method as clinically useful; but without reliability, there would be no point in proceeding to validity studies, nor reason to think the method may remain clinically useful.

### *Limitations of the study*

By excluding studies not in the English language, and also studies written to fulfill a thesis requirement, relevant information may not have been included. None of the authors who reported kappa values for interexaminer reliability provided the standard deviation, thus precluding meta-analysis using the method described by Goldman.[46] Among the included studies, the data were reported using dissimilar methods, although most did use the kappa statistic. Given there were some differences in the aspect of the PSIS that was palpated among the included studies, it should not be assumed that the palpatory methods gathered entirely equivalent data, which warrants caution in interpreting the mean kappa levels reported. Combining data from studies with very different quality scores also warrants cautious interpretation, especially given the statistical tendency for the higher quality studies to show more reliability. None of the included studies reported a palpatory method involving the superior aspect of the PSIS, the first author's preferred method. The authors are unaware of any published evidence regarding the reproducibility of this method. Unless and until this method undergoes reliability assessment, it would be premature to entirely reject the possible clinical utility of PSIS palpation.

## Conclusion

Although claims have been made that palpatory procedures can detect subtle misalignments, fixations, and soft

tissue changes in patients with neuromusculoskeletal disorders, and that the requisite skills take a considerable amount of time to acquire, there is little evidence at this time in support of these contentions with regard to PSIS palpation. Although the evidence available at the present time does not support clinical utility of manual PSIS palpation as a self-contained assessment nor as a component of other pelvic examination methods, it remains to be seen whether an alternative method or improvements in standardizing the methods can increase examiner reliability and thus clinical utility.

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## References:

1. Bergmann T, Peterson DH. Chiropractic Technique. St. Louis: Elsevier; 2011. p. 35-83.
2. Levangie PK. The association between static pelvic asymmetry and low back pain. Spine. 1999;24(12):1234-1242.
3. Levangie PK. Four clinical tests of sacroiliac joint dysfunction: the association of test results with innominate torsion among patients with and without low back pain. Phys Ther. 1999;79(11):1043-1057.
4. Kim HW, Ko YJ, Rhee WI, Lee JS, Lim JE, Lee SJ, et al. Interexaminer reliability and accuracy of posterior superior iliac spine and iliac crest palpation for spinal level estimations. J Manipulative Physiol Ther. 2007;30(5):386-389.
5. Chakraverty R, Pynsent P, Isaacs K. Which spinal levels are identified by palpation of the iliac crests and the posterior superior iliac spines? J Anat. 2007;210(2):232-236.
6. Bourdillon J, Day E. Spinal Manipulation. 4th ed. Over Wallop, New Hamphsire, England: BAS Printers, Limited; 1987. 250 p.
7. Cooperstein R. Assessment of sitting-standing pelvic landmarks for anatomical LLI: Or Darwin's finches and leg checking. J Am Chiropr Assoc. 2006;43(2):12-14.
8. Potter NA, Rothstein JM. Intertester reliability for selected clinical tests of the sacroiliac joint. Phys Ther. 1985;65(11):1671-1675.
9. Peterson DH, Bergmann T. Chiropractic Technique. 2 ed. Saint Louis, MI: Churchill Livingstone Inc.; 2002. 532 p.
10. Paydar D, Thiel H, Gemmell H. Intra- and Interexaminer reliability of certain pelvic palpatory procedures and the sitting flexion test for sacroiliac joint mobility and dysfunction. J Neuromusculoskel Sys. 1994;2(2):65-69.
11. Meijne W, van Neerbos K, Aufdemkampe G, van der Wurff P. Intraexaminer and interexaminer reliability of the Gillet test. J Manipulative Physiol Ther. 1999;22(1):4-9.
12. Forst SL, Wheeler MT, Fortin JD, Vilensky JA. The sacroiliac joint: anatomy, physiology and clinical significance. Pain Physician. 2006;9(1):61-67.
13. Holmgren U, Waling K. Inter-examiner reliability of four static palpation tests used for assessing pelvic dysfunction. Man Ther. 2008;13(1):50-56.
14. Lucas NP, Macaskill P, Irwig L, Bogduk N. The development of a quality appraisal tool for studies of diagnostic reliability (QAREL). J Clin Epidemiol. 2010;63(8).
15. Tong HC, Heyman OG, Lado DA, Isser MM. Interexaminer reliability of three methods of combining test results to determine side of sacral restriction, sacral base position, and innominate bone position. J Am Osteopath Assoc. 2006;106(8):464-468.
16. Moriguchi CS, Carnaz L, Silva LC, Salasar LE, Carregaro RL, Sato Tde O, et al. Reliability of intra- and inter-rater palpation discrepancy and estimation of its effects on joint angle measurements. Man Ther. 2009;14(3):299-305.
17. McGaugh JM, Brismee JM, Dedrick GS, Jones EA, Sizer PS. Comparing the anatomical consistency of the posterior superior iliac spine to the iliac crest as reference landmarks for the lumbopelvic spine: a retrospective radiological study. Clin Anat. 2007;20(7):819-825.
18. Riddle DL, Freburger JK. Evaluation of the presence of sacroiliac joint region dysfunction using a combination of tests: a multicenter intertester reliability study. Phys Ther. 2002;82(8):772-781.
19. van Kessel-Cobelens AM, Verhagen AP, Mens JM, Snijders CJ, Koes BW. Pregnancy-related pelvic girdle pain: intertester reliability of 3 tests to determine asymmetric mobility of the sacroiliac joints. J Manipulative Physiol Ther. 2008;31(2):130-136.
20. Simmonds MJ, Kumar S. Health care ergonomics Part II: Location of body structures by palpation - A reliability study. In J Indust Ergon. 1993;11:145-151.
21. Lindsay D, Meeuwisse W, Mooney M, Summersides J. Interrater reliability of manual therapy assessment techniques. Physiother Canada. 1995;47(3):173-180.
22. Fryer G, McPherson HC, O'Keefe P. The effect of training on the inter-examiner and intra-examiner reliability of the seated flexion test and assessment of pelvic anatomical landmarks with palpation. Int J Osteopath Med. 2005;8(4):131.
23. O'Haire C, Gibbons P. Inter-examiner and intra-examiner agreement for assessing sacroiliac anatomical landmarks using palpation and observation: pilot study. Man Ther. 2000;5(1):13-20.

24. Kmita A, Lucas N. Reliability of physical examination to assess asymmetry of anatomical landmarks indicative of pelvic somatic dysfunction in subjects with and without low back pain. Int J Osteopath Med. 2008;11:16-25.
25. Suwanasri C, Sakullertphasuk W, Tosiriphattana M, Sangounsak T, Ekabutr W. Inter- and intra-rater reliability of postural assessment for scoliosis. J Med Assoc Thai. 2014;97 Suppl 7:S1-5.
26. Byfield DC, Kinsigner S. A manual therapists guide to surface anatomy & palpation skills. Oxford: Butterworth Heinemann; 2002. 173 p.
27. Sutton C, Nono L, Johnston RG, Thomson OP. The effects of experience on the inter-reliability of osteopaths to detect changes in posterior superior iliac spine levels using a hidden heel wedge. J Bodywork Movement Ther. 2013;17(2):143-150.
28. Byfield DC, Mathiasen J, Sangren C. The reliability of osseous landmark palpation in the lumbar spine and pelvis. Eur J Chiro. 1992;40:83-88.
29. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33(1):159-174.
30. Cossart E. Statistic palpation of posterior superior iliac spines: An intra-examiner reliability study of final-year undergraduate osteopathic students. United Kingdom: European School of Osteopathy; 2013.
31. Cooperstein R. Two types of motion palpation: The excursion and tne end-feel methods. JACA Online. 2008;45(5):Online access only p 25-26.
32. Delamothe T. Diagnosis - The next frontier. Br Med J. 2006;333.
33. Cooperstein R. A shortish treatise on determining the optimum place to adjust. J Amer Chiropr Assoc. 2010;47(9):12-17.
34. Cooperstein R, Lisi A. Pelvic torsion: anatomical considerations, construct validity, and chiropractic examination procedures. Topics Clin Chiro. 2000;7(3):38-49.
35. Thompson DM, Vrugtman R. Biometric comparison of the heights and widths of paired innominates. J Chirop Educ. 2003;17(1):39-40.
36. Badii M, Shin S, Torreggiani WC, Jankovic B, Gustafson P, Munk PL, et al. Pelvic Bone Asymmetry in 323 Study Participants Receiving Abdominal CT Scans. Spine. 2003;28(12):1335-1339.
37. Preece SJ, Willan P, Nester CJ, Graham-Smith P, Herrington L, Bowker P. Variation in pelvic morphology may prevent the identification of anterior pelvic tilt. J Man Manip Ther. 2008;16(2):113-117.
38. Goode A, Hegedus EJ, Sizer P, Brismee JM, Linberg A, Cook CE. Three-dimensional movements of the sacroiliac joint: a systematic review of the literature and assessment of clinical utility. J Man Manip Ther. 2008;16(1):25-38.
39. Stovall BA, Kumar S. Reliability of bony anatomic landmark asymmetry assessment in the lumbopelvic region: application to osteopathic medical education. J Am Osteopath Assoc. 2010;110(11):667-674.
40. Long A, Donelson R, Fung T. Does it matter which exercise? A randomized control trial of exercise for low back pain. Spine. 2004;29(23):2593-602.
41. Lisi AJ, Cooperstein R, Morschhauser E. A pilot study of provocation testing with pelvic wedges: Can prone blocking demonstrate a directional preference? J Chirop Educ. 2002;16(1):30-31.
42. Landis JR, Koch GG. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. Biometrics. 1977;33(2):363-374.
43. Mior SA, Kopansky-Giles DR, Crowther ER, Wright JG. A comparison of radiographic and electrogoniometric angles in adolescent idiopathic scoliosis. Spine. 1996;21(13):1549-1555.
44. Seffinger MA, Najm WI, Mishra SI, Adams A, Dickerson VM, Murphy LS, et al. Reliability of spinal palpation for diagnosis of back and neck pain: a systematic review of the literature. Spine. 2004;29(19):E413-425.
45. Cooperstein R. Palpating the pelvis for torsion. J Am Chiropractic Assoc. 2004;41(9):48-50.
46. Goldman RL. The reliability of peer assessments. A meta-analysis. Eval Health Prof. 1994;17(1):3-21.

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# Extra-articular hip impingement: a narrative review of the literature

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*There is growing subgroup of patients with poor outcomes after hip arthroscopy for intra-articular pathology suggesting unrecognized cause(s) of impingement may exist. Extra-articular hip impingement (EHI) is an emerging group of conditions that have been associated with intra-articular causes of impingement and may be an unrecognized source of pain. EHI is caused by abnormal contact between the extra-articular regions of the proximal femur and pelvis. This review discusses the most common forms for EHI including: central iliopsoas impingement, subspine impingement, ischiofemoral impingement, and greater trochanteric-pelvic impingement. The clinical presentation of each pathology will be discussed since EHI conditions share similar clinical features as the intra-articular pathology but also contain some unique characteristics.*

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KEY WORDS: hip pain, extra-articular, impingement, diagnosis, review

*Un nombre croissant de patients ont des résultats négatifs après l'arthroscopie de la hanche pour la pathologie intra-articulaire, ce qui indique l'existence de causes non reconnues de pincement. Le pincement extra-articulaire de la hanche est un groupe émergent d'états qui ont été associés à des causes intra-articulaires de pincement et peuvent constituer une source méconnue de douleurs. Le pincement extra-articulaire de la hanche est causé par un contact anormal entre les régions extra-articulaires du fémur proximal et le bassin. Cette étude examine les formes les plus courantes du pincement extra-articulaire de la hanche, y compris : le pincement central psoas-iliaque, le pincement sous-vertébral, le pincement ischio-fémoral et un pincement trochantérien-pelvien plus important. La présentation clinique de chaque pathologie sera discutée puisque les conditions du pincement extra-articulaire de la hanche ont des caractéristiques cliniques similaires à celles de la pathologie intra-articulaire, tout en contenant des caractéristiques uniques.*

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MOTS CLÉS : douleurs de hanche, extra-articulaire, pincement, diagnostic, étude

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## Introduction

Intra-articular causes of impingement such as femoral acetabular impingement (FAI) and acetabular labral tears have become well known causes of hip pain and impingement in younger non-arthritic individuals. Arthroscopic and open surgical procedures are often indicated and have shown good outcomes with returning individuals back to pre-injury levels of function and sports activity.[1-3] However, there is growing subgroup of patients with poor outcomes after surgery suggesting unrecognized cause(s) of impingement may exist.[4-6]

More recently, an emerging body of literature has identified extra-articular causes of hip impingement that are associated with patients who have poor outcomes to intra-articular surgical procedures.[5,6] Extra-articular hip impingement (EHI) is caused by abnormal contact between the extra-articular regions of the proximal femur and pelvis and may coexist with intra-articular FAI.[7] Regions of abnormal contact may exist between the greater trochanter, lesser trochanter, extracapsular femoral neck and the ilium or ischium.[4,5] The causes of EHI have been further classified into specific conditions: central iliopsoas impingement, subspine impingement, ischiofemoral impingement, and greater trochanteric-pelvic impingement.[3,8]

The research on these specific conditions is still emerging. A recent systematic review by de Sa et al[5] appraised the literature on surgical interventions for these conditions. The authors found only 14 qualifying studies that varied in methodology and overall quality. The authors concluded that a small amount of evidence does exist supporting the surgical interventions for these conditions and that further research is necessary. The lack of evidence leaves a gap in our understanding of the pathophysiology of these conditions and how they relate to intra-articular pathology. Moreover, there is a need to determine the best diagnostic criteria for identifying these conditions and determining which interventions influence recovery.

Extra-articular conditions share similar clinical features as the intra-articular pathologies but also contain some unique characteristics. Clinicians must have a working knowledge of the clinical presentation of these conditions in order to enhance accuracy during the examination and differential diagnosis process. This manuscript will review common extra-articular conditions with a focus on clinical presentation.

## Prevalence

The epidemiological data on EHI is still emerging and the available research has revealed some preliminary trends in patient demographics. Riccardi et al[4] conducted a retrospective review of 1765 patients (2075 hips) who underwent hip preservation surgery (hip arthroscopy, periacetabular osteotomy, femoral osteotomy, and surgical hip dislocation) between 2010 and 2013. The authors analyzed two cohort groups: (1) EHI group and (2) intra-articular FAI group. The diagnosis of EHI was made preoperatively based on history, clinical examination, and radiographic studies. Seventy-five patients (86 hips) met the criteria for the EHI group and 1690 (1989 hips) patients for the FAI group. Patients in the EHI group were younger than the FAI group (24 ±7 years versus 30±11 years). The EHI group had an increased proportion of females than the FAI group (85% to 49%). The right hip was the most commonly affected side in both groups (57% in each group). EHI patients were more likely to have undergone prior hip surgery than the FAI group (44% to 10%) which consisted of hip arthroscopy (N = 24) and pelvic osteotomy (N = 6). The EHI group had lower preoperative outcome scores for the modified Harris hip score (mHHS) and Hip Outcome Scores activities of daily living (HOS ADL) (55 ± 15 versus 63 ± 15) after adjustments for age, sex, and type of revision surgery. Sixteen percent of the EHI patients were diagnosed with previous hip pathology which included: Leg Legg-Calve´-Perthes (N = 7), developmental dysplasia of the hip (N = 2), slipped capital femoral epiphysis (N = 1), Ehlers-Danlos (N = 1), and postinfectious deformity (N = 1).[4]

The research by Riccardi et al[4] suggested that EHI patients tend to be younger, female, and have undergone previous FAI surgery. Also, the presence of EHI was about 4% (75 of 1765) which is infrequent compared to the intra-articular pathology. The authors suspect that the diagnosis of EHI pathology may have been missed during the initial diagnosis. This hypothesis has been supported by other clinical trials investigating the outcomes of FAI revision surgery. [9-11]

## Central Iliopsoas Impingement

Central iliopsoas impingement (CII) is an emerging diagnosis of anterior hip pain that has been linked to acetabular labral tears.[12,13] This type of impingement causes a distinct pattern of anterior labral damage that does not

extend into the anterosuperior portion of the labrum (e.g. 1 to 2 o'clock position). The damage often occurs directly adjacent to the iliopsoas tendon at the 2 to 3 o'clock position of the anterior labrum and is often confirmed via magnetic resonance arthrography (MRA) (Figure 1).[5,12,13] It is postulated that the impingement is caused by a repetitive traction injury by the iliopsoas tendon that is scarred and adherent to the capsule-labrum complex of the hip or by a tight or inflamed iliopsoas tendon that causes impingement during hip extension.[5,8] Iliopsoas impingement has also been reported after total hip resurfacing and total hip arthroplasty when a larger femoral head component is used.[14-17]

The strongest available evidence on CII consists of retrospective case series from the United States with no randomized controlled trials.[5] The current research suggests that this condition may be more common in younger females (pooled age range 19 to 35 years) and individuals involved in regular sports activities.[5,12,18] Patients often report anterior hip pain with active flexion and may report a snapping sensation. The clinical examination may reveal non-specific focal tenderness over the iliopsoas tendon at the anterior joint line, positive hip impingement test (e.g. Flexion, Adduction, Internal Rotation (FADIR) test) (Figure 2), and pain or apprehension with resisted straight leg raise (Table 1).[12,18] Patients may report little or no relief after intraarticular injection of a local anesthetic. MRA is often ordered to further diagnose the condition. MRA has shown good diagnostic properties with strong intra-observer agreement.[13] A labral tear at the 3-o'clock position (immediately below the iliopsoas tendon) suggests the diagnosis of iliopsoas impingement; especially if it does not extend above the 2-o'clock position.[13]

Non-surgical intervention such as activity modification, rehabilitation, and therapeutic injections may be prescribed first. However; the efficacy of these interventions have not been investigated.[5] If conservative measures fail, then surgery may be an option. Often, patients will have concomitant labral injury with the iliopsoas pathology requiring arthroscopic resection or repair of the acetabu-

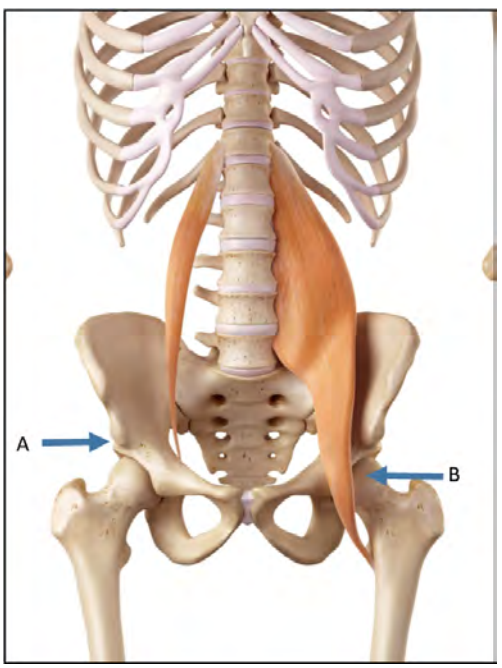


Figure 1.
*a) Region of subspine impingement, b) Region of central psoas impingement*


Figure 2.
*Flexion-Adduction-Internal Rotation Test. The patient is lying supine. The affected hip is passively moved into 90 degrees of hip and knee flexion. The hip is then passively adducted with internal rotation and overpressure in both directions. A positive test is reproduction of the patient's concordant pain.*

lar labrum and iliopsoas tenotomy at the level of the labrum.[12,18] Studies have shown good short-term outcomes at 1 year post-operative for return to sports activity, restored range of motion (ROM), decreased symptoms, and scores on the mHHS and HOS ADL and sport HOS (Table 2).[5,12,18,19] Further studies are needed to validate these findings and further develop diagnostic criteria for this pathology. To date, the clinical trials have primarily reported post-surgical outcomes and briefly described post-operative rehabilitation or did not mention if it was prescribed for these patients.[5,18,20] Lindner et al.[21] briefly outlined a post-surgical program. After surgery, the patient is partial weight bearing (e.g. 9.7kg (20lbs) flat-foot weight bearing) with crutches and a hip brace locked at 0 to 90 degrees for the first 2-weeks. Two weeks post-surgical, the brace and crutches are discontinued and the patient continues rehabilitation with an emphasis on regaining joint ROM, strengthening the gluteus medius and core muscles. The available details regarding the role of post-surgical rehabilitation is under reported. Further studies are needed to objectively assess the effects of post-operative rehabilitation for these individuals.

Figure 3.
*The Subspine Impingement Test. The patient is lying supine. The affected hip is passively moved into maximum hip flexion (neutral adduction and internal rotation). A positive test is reproduction of the patient's concordant anterior hip pain.*

## Subspine Impingement

Subspine impingement (SSI) is caused by a prominent anterior inferior iliac spine (AIIS) abnormally contacting the distal femoral neck during hip flexion (Figure 1).[5] SSI is thought to be caused by excessive muscular activity of the rectus femoris during repetitive knee flexion with hip extension resulting in an avulsion injury of the AIIS. Upon healing, the apophysis may be inferiorly displaced leading to a malunion which often results in an enlarged bony protrusion at the AIIS that abnormally abuts the femoral neck.[8,22] Avulsion injuries are common in adolescent athletes. This repetitive traction injury is common in running sports and sports involving rapid high energy kicking such as soccer.[5,22] Avulsion injuries to the AIIS are reported to be the second most common with ischial avulsions being the most common.[10] SSI has been related to CAM-type FAI and may be corrected with surgery.[8]

The strongest available evidence on SSI consists of case reports and series from the United States, United Kingdom, and China with no randomized controlled trials.[5] The current research suggests that this condition is more common in younger active males (age range 14 to 30 years).[5,8] Patients often report anterior hip or groin pain that is aggravated by active hip flexion and activities such as running or kicking. The clinical exam may reveal palpable AIIS pain and limited passive hip flexion with end range anterior hip pain. The patient may or may not have a positive hip impingement test (Table 1).[22] Poultsides et al[23] described the subspine impingement test that includes passively flexing the hip into maximum flexion (neutral adduction and internal rotation) (Figure 3). Reproduction of the patient's anterior pain is considered a positive test.[23] Currently, there are no studies that have assessed the clinimetric properties of this test. Patients may report little or no relief with hip flexion after intraarticular injection of a local anesthetic. Radiographs may reveal a prominent AIIS deformity that extends distally to the level of the anterior-superior acetabular rim.[22] The radiographs may also reveal sclerosis at the AIIS (inferior) and distal femoral neck junction. Computed tomographic (CT) scans have also been used with a classification system to categorize the type of SSI.[24] Researchers have also associated the ROM limits with each SSI classification (Table 3).[24] To date, the diagnostic properties of this imaging has not been reported in the literature.

Non-surgical intervention such as activity modifica-

Table 1.
*Common types of extra-articular hip impingement*

| Extra-Articular Condition | Patient Demographics | Pathological Characteristics | Clinical Presentation |
|---|---|---|---|
| Central iliopsoas impingement | Pooled age range: 19–35 years<br>Gender: Females more than males | The pathology may be caused by: (1) a repetitive traction injury by the iliopsoas tendon that is scarred and adherent to the capsule-labrum complex of the hip, (2) a tight or inflamed iliopsoas tendon that causes impingement during hip extension | Patients often report anterior hip pain with active hip flexion and may report a snapping sensation. Clinical findings include non-specific focal tenderness over the iliopsoas tendon at the anterior joint line, positive hip impingement test (e.g. FADIR test), and pain or apprehension with resisted straight leg raise. MRA is often used to further diagnose the condition. |
| Subspine impingement | Pooled age range: 14–30 years<br>Gender: Males more than females | The pathology is caused by a prominent AIIS abnormally contacting the distal femoral neck during hip flexion. This may be due to an avulsion injury to the AIIS due to excessive muscular activity of the rectus femoris during repetitive knee flexion and hip extension. | Patients typically report anterior hip or groin pain that is aggravated by active hip flexion and activities such as running or kicking. Clinical findings include palpable AIIS pain and limited passive hip flexion with end range anterior hip pain. The patient may or may not have a positive subspine hip impingement test. Plain radiographs and computed tomography are commonly used to further diagnose the condition. |
| Ischiofemoral impingement | Pooled age range: 14–30 years<br>Gender: Females more than males | The pathology is caused by a narrowed space between the ischial tuberosity and the lesser trochanter resulting in repetitive impingement of the quadratus femoris muscle. | Patients often report non-specific pain in the hip, groin, and buttocks with active adduction and external rotation. Pain is often increased with sports related activity such as gymnastics or dance or activities of daily living such as long-stride walking. Referral pain may occur down the lower extremity due to possible irritation of the adjacent sciatic nerve. Clinical findings include pain with active or passive hip extension, external rotation, and adduction. In some cases, snapping may occur during hip flexion or extension during weight bearing activities. Magnetic resonance imaging and plain radiographs are commonly used to further diagnose the condition. |
| Greater trochanteric-pelvic impingement | Pooled age range: 5 to 41 years<br>Gender: No predilection | The pathology is caused by a painful and pathological contact between the greater trochanter and ilium when the hip is actively or passively moved into abduction and extension. | Patients typically report both lateral hip and groin pain that is reproduced with active hip abduction and extension. A blocking of the joint may be felt at the end range of these combined motions. Clinical findings include limited and painful active or passive hip abduction and extension, a shortening of the involved leg, and a Trendelenburg gait pattern. Plain radiographs are commonly used to further diagnose the condition. |

Abbreviations: FADIR: flexion-adduction-internal rotation; AIIS: anterior inferior iliac spine; MRA: magnetic resonance arthrography

tion, rehabilitation, and therapeutic injections may be prescribed first but their efficacy have not been investigated.[5] Some patients may be recalcitrant to conservative treatment and require surgical interventions. An open AIIS decompression is commonly performed through the standard anterolateral and mid-anterior hip arthroscopy portals. At times, a concomitant arthroscopic procedure is conducted to address any intra-articular pathology.[22] Studies have shown good short-term outcomes at up to 2 years post-surgical follow-up for return to sports activity,

Table 2.
*Common non-arthritic patient reported outcome measures for the hip*

| Patient Related Outcome Measure | Type of Questions | Description |
|---|---|---|
| Hip Outcome Score | 24 questions measuring activities of daily living and physical function during sports activity. | Each subscale is scored separately. The highest potential score for the ADL scale is 68 and 38 for the sports subscale. The scores are converted to a percentage. A higher score represents a higher level of physical function. |
| modified Harris Hip Score | 2 rating scales and 8 items. The domains covered are pain, function, and functional activity. | Each item has a unique numerical scale. There are 100 total points. A higher score represents a higher level of physical function. |

Abbreviation: ADL: activities of daily living

Table 3.
*Classification of subspine impingement*

| Classification | Description | Range of Motion (mean) Limitations |
|---|---|---|
| Type I | Defined as a smooth ilium wall between the AIIS and the acetabular rim. | Hip flexion: 120 degrees<br>Hip internal rotation (in 90 degrees of flexion): 21 degrees |
| Type II | Defined as the AIIS extending to the level of the rim. | Hip flexion: 107 degrees<br>Hip internal rotation (in 90 degrees of flexion): 11 degrees |
| Type III | Defined as the AIIS extending distally to the acetabular rim. | Hip flexion: 93 degrees<br>Hip internal rotation (in 90 degrees of flexion): 8 degrees |

Abbreviation: AIIS: anterior inferior iliac spine

increased ROM, scores on the HHS, visual analog scale, and short form 12.[9,22,25] The post-surgical rehabilitation for SSI is poorly reported among the published surgical investigations. Hestroni et al[12] do recommend 2 to 4 weeks of protected weight bearing with crutches and ROM exercises until basic muscle strength is regained. Further strengthening and proprioception exercise should be prescribed as tolerated. Anti-inflammatory medications are also recommend for the first 3 to 4 weeks after surgery to help decrease the risk of heterotrophic ossification. [22] To date, post-surgical rehabilitation has not been objectively studied and its role in the post-operative period is poorly detailed in the literature.[5]

## Ischiofemoral Impingement

Ischiofemoral impingement (IFI) is characterized by a narrowed space between the ischial tuberosity and the lesser trochanter resulting in repetitive impingement of the quadratus femoris muscle (Figure 4).[5,7] The condition has been reported as primarily congenital but may also be acquired from a hip fracture, superior medial migration of the hip joint with osteoarthritis, or total hip arthroplasty when offset is not fully restored.[7,8]

The strongest available evidence consists of case reports and series outside the United States with no randomized controlled trials.[5] The research suggests that ischiofemoral impingement is more prevalent in females

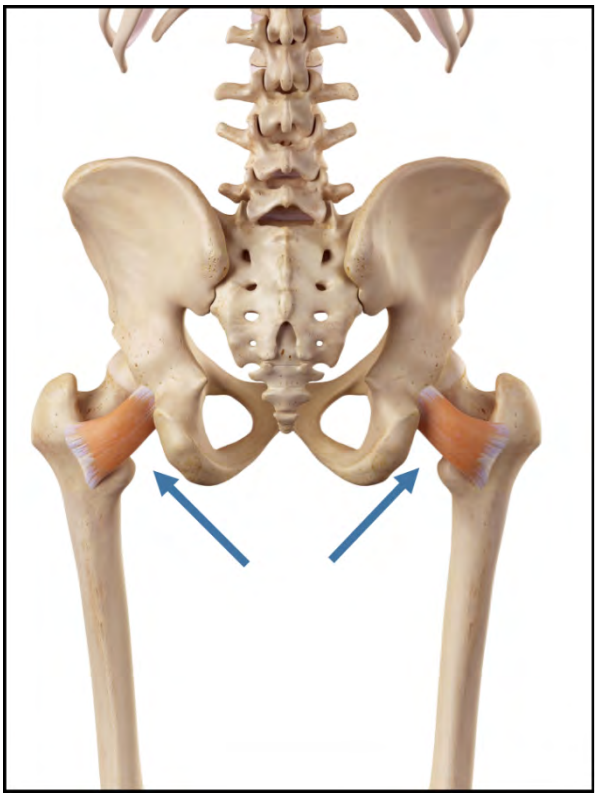

Figure 4.
*Region of ischiofemoral impingement*

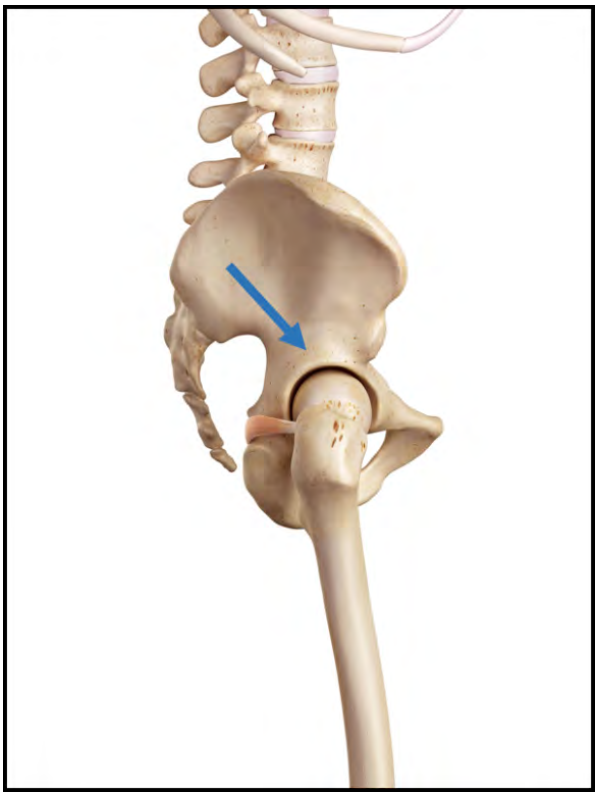

Figure 5.
*Region of Greater Trochanteric-Pelvic Impingement*

versus males and older individuals (mean age of 51-53 years, pooled age range 14-77 years).[5,7,8] Bilateral IFI is believed to occur in approximately 15 to 30% of cases of individuals diagnosed with IFI. There is an increased risk of IFI in patients who have suffered prior proximal hamstring avulsion fractures or multiple hereditary exostoses.[7] Patients often report non-specific pain in the hip, groin, and buttocks with active adduction and external rotation. Pain is often increased with sports related activity such as gymnastics or dance or activities of daily living such as long-stride walking.[7] Referral pain may occur down the lower extremity due to possible irritation of the adjacent sciatic nerve.[7,8]

The clinical examination may reveal pain with active or passive hip extension, external rotation, and adduction. In some cases, snapping may occur during hip flexion or extension during weight bearing activities (Table 1).[7] There are no specific special tests for IFI which is often mistaken for intra-articular pathology and is largely dependent on magnetic resonance imaging (MRI).[8] On MRI, decreased space between the ischium and lesser trochanter is often identified as a risk for IFI. Singer et al[26] conducted a meta-analysis of MRI studies (2005 to 2014) and determined that a cut-off threshold of ≤ 15 mm (ischio-femoral space) showed a sensitivity of 77%, specificity of 81%, and overall accuracy of 78.3% for diagnosing IFI (defined as the presence of quadratus femoris edema and/or atrophy, and ipsilateral pain). Edema of the quadratus femoris muscle may be visible in patients with IFI and some patients may present with fatty infiltration of the quadratus femoris muscle which is sometimes combined with muscle atrophy.[7,8]

Plain radiographs are often negative but may reveal sclerosis or cystic changes within the lesser trochanter or ischium, decreased femoral offset, or bony prominences from ischial avulsion injury or multiple hereditary exos-

toses.[7] Patients may report relief after intraarticular injection of a local anesthetic.[27]

Non-surgical management is often prescribed first with a focus on avoiding activities that involve combined hip adduction and external rotation. Rehabilitation should be directed towards strengthening the hip external rotators and abdominal core. Stretching of the hip adductors and external rotators should also be done in the presence of decreased muscle length.[7] Nonsteroidal anti-inflammatory (NSAID's) medication and therapeutic corticosteroid injections may also be beneficial. Investigations have reported good outcomes with the combination of activity modification, rehabilitation, NSAIDS, and therapeutic injections.[7,28,29]

If non-surgical interventions fail, then surgical management may be suggested. The objective of surgery is to widen the space by resecting the bone from the lesser trochanter or ischium or releasing the quadratus femoris muscle. The surgery is commonly done through the standard anterolateral arthroscopy portal. Psoas weakness is a potential complication. Resection of the lesser trochanter and release of the quadratus femoris creates a risk for disrupting the lateral circumflex artery and avascular necrosis of the femoral head.[7] The studies reporting outcomes from this surgery have mainly been case reports which make intra-study comparisons difficult due to the low level of evidence.[5] However; the published case reports have shown good outcomes up to a 3.5 year follow-up for decreased symptoms, increased ROM, and return to function.[5] To date, post-surgical rehabilitation for IFI has not been objectively studied and its role in the post-operative period is poorly detailed in the literature.

### Greater Trochanteric-Pelvic Impingement

Greater trochanteric-pelvic impingement (GTPI) is described as painful and pathological contact between the greater trochanter and ilium when the hip is actively or passively moved into abduction and extension (Figure 5).[7] During development an elongation of the greater trochanter occurs due to partial or complete arrest of the proximal femoral physis. With a complete arrest of the proximal femoral physis, the femoral neck becomes shortened, thickened, and develops a varus deformity. The trochanteric epiphysis may also be elongated further predisposing individuals to GTPI. GTPI is commonly associated with Legg–Calvé–Perthes disease but also may be related to the ischemia that occurs with the treatment of congenital hip dislocation, hip infection, traumatic injury, and infantile coxa vara.[5,7]

The strongest available evidence for GTPI consists of case series from the United States and Scotland with no randomized controlled trials.[5] The research suggests that GTPI is more prevalent in younger individuals (pooled age range 5 to 41 years) with no gender predilection.[5,7,30] GTPI alters the morphology of the proximal femur and acetabulum which may predispose individuals to intra-articular pathology.[7] Patients commonly report both lateral hip and groin pain that is reproduced with active hip abduction and extension. A blocking of the joint may be felt at the end range of these combined motions. Patients may report pain with exercise and limping due to hip abductor weakness.[7] The examination may reveal limited and painful active or passive hip abduction and extension, a shortening of the involved leg, and a Trendelenburg gait pattern (Table 1). Macnicol and Makris[31] describe a special test called the "gear-stick" sign which helps to differentiate between GTPI and other causes of hip impingement. The patient is side-lying with the affected side up. The hip is passively abducted in extension without excessive movement for the lumbopelvis (Figure 6). ROM restriction and reproduction of the patient's symptoms is a positive sign. The hip can also be passively abducted in flexion to further assess ROM. The hip should have more abduction ROM in flexion since the greater trochanter avoids contact with the ilium in this position.[31] To date, the clinimetric properties of this test have not been studied. This must be considered prior to integrating this test into clinical practice. Plain radiographs seem to be the "gold" standard for further diagnosing GTPI. The radiographs often reveal abnormal proximal femoral morphology and a prominent greater trochanter.[7] To date, the diagnostic properties of this imaging has not been reported in the literature.

Non-surgical intervention such as activity modification, rehabilitation, and therapeutic injections may be prescribed first but the efficacy of these interventions have not been investigated.[5] If conservative measures fail, then surgical interventions may be indicated. The surgical procedure is an open procedure which may include distal transfer of the greater trochanter and various reduction osteotomy procedures. The case studies reported favorable outcomes up to a 3 year follow-up with decreased pain, increase hip abduction and extension ROM, in-

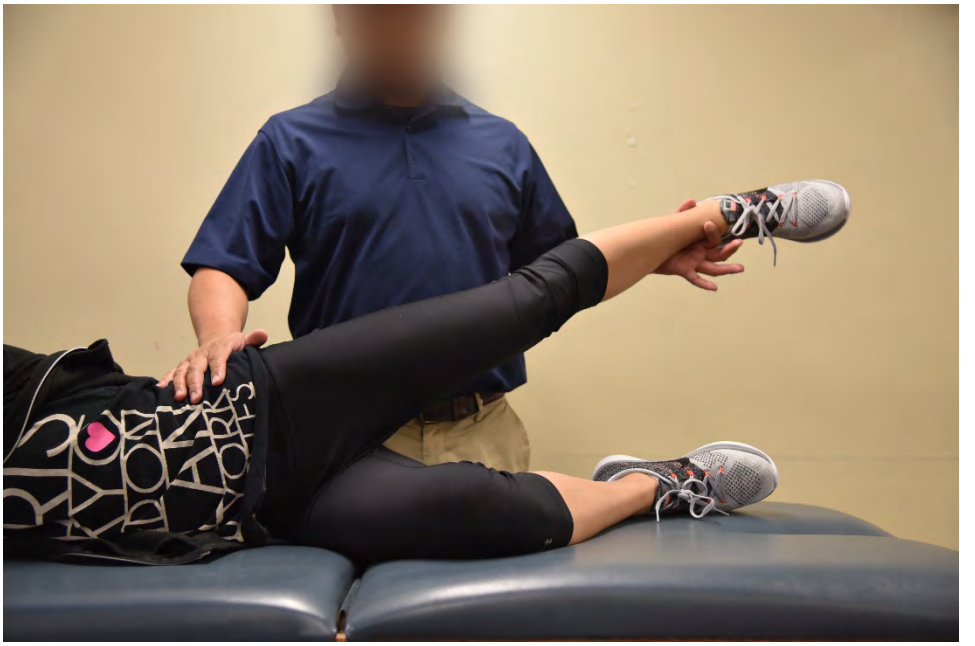

Figure 6.
The "Gear Stick" Sign. *The patient is sidelying with the affected side up. The hip is passively moved into abduction and extension without excessive lumbopelvic movement. A positive test is limited range of motion and reproduction of the patient's concordant symptoms.*

creased strength, and improved gait. No osteonecrosis events were reported.[5] Despite the favorable results, the weakness in the evidence must be considered when interpreting these findings. To date, post-surgical rehabilitation for GTPI has not been objectively studied and its role in the post-operative period is also poorly detailed in the case reports.

## Conclusion

Understanding the clinical presentation of common EHI conditions is vital to the hip differential diagnosis process. Currently, the evidence on EHI is weak but does present some preliminary insight into the clinical presentation of these conditions. The one related characteristic among all EHI pathologies is that they may co-exist with intra-articular causes of impingement and may be overlooked during the examination process. This must be considered during the examination and differential diagnosis process in order to accurately diagnosis all causes of hip impingement.

## References:


1. Kemp JL, Collins NJ, Makdissi M, et al. Hip arthroscopy for intra-articular pathology: a systematic review of outcomes with and without femoral osteoplasty. Br J Sports Med. 2012;46(9):632-643.
2. Papalia R, Del Buono A, Franceschi F, et al. Femoroacetabular impingement syndrome management: arthroscopy or open surgery? Int Orthop. 2012;36(5):903-914.
3. Clohisy JC, St John LC, Schutz AL. Surgical treatment of femoroacetabular impingement: a systematic review of the literature. Clin Orthop Relat Res. 2010;468(2):555-564.
4. Ricciardi BF, Fabricant PD, Fields KG, et al. What are the demographic and radiographic characteristics of patients with symptomatic extraarticular femoroacetabular impingement? Clin Orthop Relat Res. 2015;473(4):1299-1308.
5. de Sa D, Alradwan H, Cargnelli S, et al. Extra-articular hip impingement: a systematic review examining operative treatment of psoas, subspine, ischiofemoral, and greater trochanteric/pelvic impingement. Arthroscopy. 2014;30(8):1026-1041.

6. Cvetanovich GL, Harris JD, Erickson BJ, et al. Revision hip arthroscopy: a systematic review of diagnoses, operative findings, and outcomes. Arthroscopy. 2015;31(7):1382-1390.
7. Beckmann JT, Safran MR, Abrams GD. Extra-articular impingement: ischiofemoral impingement and trochanteric-pelvic. Oper Techniques in Sports Med.2015. [Published ahead of print]
8. Sutter R, Pfirrmann CWA. Atypical hip impingement. Am J Roentgenol. 2013;201(3):W437-W442.
9. Larson CM, Kelly BT, Stone RM. Making a case for anterior inferior iliac spine/subspine hip impingement: three representative case reports and proposed concept. Arthroscopy. 2011;27(12):1732-1737.
10. Ross JR, Stone RM, Larson CM. Subspine Impingement. Operative Techniques in Sports Medicine.
11. Sardana V, Philippon MJ, de Sa D, et al. Revision hip arthroscopy indications and outcomes: a systematic review. Arthroscopy. 2015.[Published ahead of print]
12. Domb BG, Shindle MK, McArthur B, et al. Iliopsoas impingement: a newly identified cause of labral pathology in the hip. HSS J. 2011;7(2):145-150.
13. Blankenbaker DG, Tuite MJ, Keene JS, et al. Labral injuries due to iliopsoas impingement: can they be diagnosed on MR arthrography? Am J Roentgenol. 2012;199(4):894-900.
14. Cobb JP, Davda K, Ahmad A, et al. Why large-head metal-on-metal hip replacements are painful: the anatomical basis of psoas impingement on the femoral head-neck junction. J Bone Joint Surg Br. 2011;93(7):881-885.
15. Browne JA, Polga DJ, Sierra RJ, et al. Failure of larger-diameter metal-on-metal total hip arthroplasty resulting from anterior iliopsoas impingement. J Arthroplasty. 2011;26(6):978.e975-978.
16. Piggott RP, Doody O, Quinlan JF. Iliopsoas tendon rupture: a new differential for atraumatic groin pain post-total hip arthroplasty. BMJ Case Rep. 2015. [Published ahead of print].
17. Jerosch J, Neuhauser C, Sokkar SM. Arthroscopic treatment of iliopsoas impingement (IPI) after total hip replacement. Arch Orthop Trauma Surg. 2013;133(10):1447-1454.
18. Cascio BM, King D, Yen YM. Psoas impingement causing labrum tear: a series from three tertiary hip arthroscopy centers. J La State Med Soc. 2013;165(2):88-93.
19. Nelson IR, Keene JS. Results of labral-level arthroscopic iliopsoas tenotomies for the treatment of labral impingement. Arthroscopy. 2014;30(6):688-694.
20. Jerosch J, Neuhäuser C, Sokkar S. Arthroscopic treatment of iliopsoas impingement (IPI) after total hip replacement. Arch Orthop and Trauma Surg. 2013;133(10):1447-1454.
21. Lindner D, Stake CE, El Bitar YF, et al. Endoscopic iliopsoas tenotomy for iliopsoas impingement on a collared femoral prosthesis. Arthrosc Tech. 2013;2(3):e205-208.
22. Hetsroni I, Larson CM, Dela Torre K, et al. Anterior inferior iliac spine deformity as an extra-articular source for hip impingement: a series of 10 patients treated with arthroscopic decompression. Arthroscopy. 2012;28(11):1644-1653.
23. Poultsides LA, Bedi A, Kelly BT. An algorithmic approach to mechanical hip pain. HSS J. 2012;8(3):213-224.
24. Hetsroni I, Poultsides L, Bedi A, et al. Anterior inferior iliac spine morphology correlates with hip range of motion: a classification system and dynamic model. Clin Orthop Rel Res. 2013;471(8):2497-2503.
25. Hapa O, Bedi A, Gursan O, et al. Anatomic footprint of the direct head of the rectus femoris origin: cadaveric study and clinical series of hips after arthroscopic anterior inferior iliac spine/subspine decompression. Arthroscopy. 2013;29(12):1932-1940.
26. Singer A, Subhawong T, Jose J, et al. Ischiofemoral impingement syndrome: a meta-analysis. Skel Radiol. 2015;44(6):831-837.
27. Backer MW, Lee KS, Blankenbaker DG, et al. Correlation of ultrasound-guided corticosteroid injection of the quadratus femoris with MRI findings of ischiofemoral impingement. Am J Roentgenol. 2014;203(3):589-593.
28. Lee S, Kim I, Lee SM, et al. Ischiofemoral impingement syndrome. Ann Rehabil Med. 2013;37(1):143-146.
29. Safran M, Ryu J. Ischiofemoral impingement of the hip: a novel approach to treatment. Knee Surg Sports Traumatol Arthrosc. 2014;22(4):781-785.
30. Stevens P, Anderson L, Gililland J, et al. Guided growth of the trochanteric apophysis combined with soft tissue release for Legg–Calve–Perthes disease. Strat Trauma Limb Reconstr. 2014;9(1):37-43.
31. Macnicol MF, Makris D. Distal transfer of the greater trochanter. J Bone Joint Surg Br. 1991;73(5):838-841.

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# Differentiating giant cell tumor of bone from patellofemoral syndrome: a case study

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*Balancing the assessment of musculoskeletal dysfunctions with a high level of suspicion for non-mechanical origins can be a challenge for the clinician examining a sports injury. Without timely diagnosis, non-mechanical complaints could result in surgery or loss of limb. This case describes the discovery of a Giant Cell Tumor of Bone (GCTB) following the re-evaluation of an athlete who had undergone five years of conservative management for patellofemoral pain syndrome (PFPS). Knee injuries account for 32.6% of sports injuries with PFPS being the most common and most likely diagnosis for anterior knee pain. GCTB is a benign aggressive bone tumor with a predilection for the juxta-articular region of the knee, comprising up to 23% of all benign bone tumors, and commonly occurs in the second to fourth decades. This case report illustrates the difficulty in accurately diagnosing healthy athletes, reviews common differentials for knee complaints and explores helpful diagnostic procedures.*

*Trouver le bon équilibre entre l'évaluation des dysfonctionnements musculo-squelettiques et un niveau élevé de suspicion d'origines non mécaniques peut présenter un défi pour un clinicien qui examine une blessure sportive. Sans un diagnostic rapide, les plaintes non mécaniques pourraient nécessiter la chirurgie ou aboutir à la perte d'un membre. Ce cas décrit la découverte d'une tumeur à cellules géantes (TCG) de l'os à la suite de la réévaluation d'un athlète qui avait subi cinq ans de traitement conservateur du syndrome fémoro-rotulien douloureux (SFP). Les blessures au genou représentent 32,6 % des blessures sportives, et le SFP est le diagnostic le plus fréquent et le plus probable pour la douleur de la partie antérieure du genou. La TCG est une tumeur osseuse bénigne agressive avec une prédilection pour la région juxta-articulaire du genou, comprenant jusqu'à 23 % de toutes les tumeurs osseuses bénignes et généralement se produisant au cours de la deuxième, troisième et quatrième décennie. Cette étude*

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*Informed consent was obtained from the patient for the preparation and publication of this manuscript.

*de cas montre la difficulté du diagnostic précis des athlètes en bonne santé, examine les écarts communs pour les plaintes liées au genou et explore les procédures utiles de diagnostic.*

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KEY WORDS: chiropractic, patellofemoral pain syndrome, bone neoplasms, sports medicine, diagnostic errors

(JCCA. 2016;60(1):57-65)

MOTS CLÉS : chiropratique, syndrome fémoro-rotulien douloureux, tumeurs des os, médecine sportive, erreurs de diagnostic

## Introduction

Differentiating between mechanical and non-mechanical pain is one of the most important steps in the assessment of a patient; although this can be challenging with athletes. Mechanism of injury, associated symptoms, red flags and risk factors picked up in the medical history can lead clinicians toward potential non-mechanical origins of a complaint. However, aspects of the history can also distract clinicians initially. Once management begins, poor compliance and re-aggravation can also skew prognosis for the working diagnosis. We present the case of a recreational soccer player who was originally diagnosed and treated for mechanical knee pain. Re-evaluation of the case resulted in a potentially limb sparing discovery of a locally aggressive benign bone tumor. This case stresses the importance of maintaining a high level of suspicion, even when faced with seemingly healthy athletes. The following report will highlight how athletic injuries may mask pathology, while discussing common sources of anterior knee pain and detailing tumors of the knee.

## Case Presentation

An otherwise healthy 30-year-old female presented to a chiropractor with a complaint of right knee pain. She reported that this condition began approximately five years ago and attributes it to playing soccer. Past impressions have included an irritated meniscus and patellofemoral pain syndrome. The symptoms have recently become progressive, although she did get relief from icing.

Examination of the patellofemoral joint and muscles of the knee were unremarkable. There was positive medial joint line tenderness on palpation. Orthopedic tests for ligamentous stability were negative for excessive motion; however, Slocum test, anterior-posterior glide with external rotation of the shin reproduced the knee pain. Functional examination found single leg standing and squat aggravated the chief complaint and McMurray's test produced pain, without click. Duck walk was found to be non-painful at the hip, but reproduced medial joint line tenderness of the right knee. The patient was referred to her family doctor for a second opinion and imaging. A plain film series and MRI scan of the knee were then requisitioned to rule out meniscal injury and the patient was referred to physiotherapy for assessment and treatment.

When assessed by the physiotherapist, the patient reiterated her history of chronic, intermittent right medial knee pain with recent increase in intensity and frequency. A recreational soccer and ultimate Frisbee participant, she had discontinued playing due to an abdominal muscle pull. Aggravating activities for her knee pain included ascending and descending stairs, running, playing sports, sit to stand movements and prolonged sitting or jumping. Her knee pain was eased by ice only. Her pain intensity, as rated by a Numeric Pain Rating Scale, varied between 0-5/10. She did not report symptoms of inflammation. She denied any locking or giving way of the knee. Her history included a red flag of previous melanoma, which was removed surgically several years prior. No medications were prescribed or being taken for her knee pain.

On physical examination, dynamic valgus of the right knee was noted with single and double leg squatting while reproducing medial joint line pain. This pain could be modified with correction of the dynamic valgus pattern.

Thessely's test was negative, while McMurray's test was painful without click. Manual muscle testing was rated using the Oxford scale with left gluteus medius rated 4, 4- on the right, hamstrings 4+ bilaterally, and gluteus maximus 4 bilaterally. She was diagnosed with patellofemoral pain syndrome (PFPS) with a differential diagnosis of right medial meniscal injury.

Plain radiographs were taken and demonstrated a multiseptated "soap bubbly" lytic lesion in the medial femoral condyle (Figure 1). Differentials suggested by the radiologist included giant cell tumor (GCTB), aneurysmal bone cyst (ABC), osteoblastoma, or chronic osteomyelitis and advanced imaging was recommended. The MRI scan provided a more detailed description of the nature and size of the lesion and helped rule out malignancy (Figures 2 and 3). A well-circumscribed multi-septated lesion with a sclerotic border measuring 4.5 x 2.9 cm with several fluid-fluid levels was visualized. There was no cortical disruption, periosteal reaction or expansion of the medial femoral condyle; also no soft tissue mass was visualized and there was no bone marrow edema.

The patient was referred to an orthopedic oncologist for assessment. Due to patient symptomatology and the locally aggressive but benign behavior of the lesion on imaging, surgical management was the best option for this patient. During the surgical procedure, first a biopsy was perform which revealed benign multinucleated giant


Figure 1.
*Right knee, anterior-posterior view plain film radiograph. This pre-surgical image demonstrates a multiseptated "soap bubbly" lytic lesion in the medial femoral condyle. Differentials suggested by the radiologist included giant cell tumor (GCTB), aneurysmal bone cyst (ABC), osteoblastoma, or chronic osteomyelitis.*

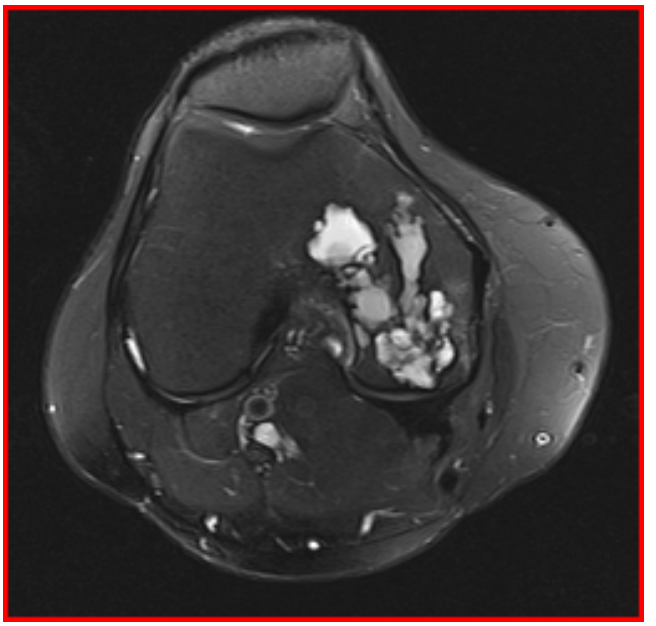

Figure 2.
*Right knee magnetic resonance imaging (T2 weighted fat-saturated) axial view. This pre-surgical image demonstrates a lesion in the medial femoral condyle projecting anterior-posterior 4.5 x 2.9 cm with the visualization of several fluid-fluid levels.*

cells in a mononuclear stroma, while the mononuclear cells showed moderate atypia and extensive hemosiderin deposition, suggestive of GCTB. Based on this benign diagnoisis, aggressive curettage and high speed burring were performed to remove the tumor. During surgery both solid tumor and blood filled cystic areas were identified. The final pathology revealed a GCTB with a secondary ABC. A portion of the distal femoral medial condyle was removed until only normal appearing bone remained. A periarticular plate and screws were used to support the morcellized cancellous allograft bone (Figure 4 and 5).

## Discussion

This case highlights an example where an underlying pathological condition went clinically unnoticed for a number of years. Considering the good health of the patient and the fact that the only symptom was knee pain, this should not be a surprise. In fact, we are trained knowing that serious pathology comprises a very small percentage of complaints presenting to a musculoskeletal practitioner. Therefore, the point of this case presentation is to emphasize the importance of the re-evaluation, a thorough work up and a second opinion in cases with persistent symptoms. Further, it is an excellent starting point for a review of the differential diagnosis of persistent knee pain (Table 1).

In retrospect, the patient could have been asked more pointed questions regarding red flags (in this case the re-evaluation history only included general questions about health status and whether or not there were any changes in the health history). Red flag symptoms including night sweats, weight loss, malaise etc. could be present in tumours of metastatic origin, but none were present in this case aside from history of melanoma and unremitting pain. The reproduction of pain during the orthopaedic tests could have been due to compressive forces on the

Figure 3.
*Right knee magnetic resonance imaging (T2 weighted fat-saturated) coronal view. This pre-surgical image demonstrates a well-circumscribed multi-septated lesion with no signs of malignant characteristics.*

Figure 4.
*Right knee, anterior-posterior view plain film radiograph. This post-surgical image demonstrates the hardware (A periarticular plate and screws) utilized post-curettage to cover and support the site of morcellized cancellous allograft bone used for reconstruction.*


Figure 5.
*Right knee, lateral view plain film radiograph. This post-surgical image demonstrates the side view of the periarticular plate and screws used to cover and support the allograft reconstruction post-curettage.*

bone itself. Regardless of the exact mechanism of pain, the decision to refer the patient for a second opinion and imaging was largely based on a lack of specific findings from the physical examination and the history of unresolved symptoms with no past imaging.

### *Differential Diagnosis of Knee Pain*

Roughly 33% of all sports injuries involve the knee (Table 1).[1] PFPS is the most commonly diagnosed clinical condition in athletes with non-traumatic anterior knee pain.[1-2] In a military population, with comparable incidence rates, females were found to suffer from PFPS 2.23 times more frequently than males.[3-4] At a specialty center dealing with musculoskeletal trauma, meniscal injury was the most common knee injury with an incidence of 23.8/100,000 per year.[5] Recent investigations found strong evidence that participation in soccer, rugby, downhill skiing and squash were strong risk factors for acute meniscal tears.[6] It is difficult to truly estimate the incidence of meniscal injuries. Incidental findings of meniscal tears on MRI and during arthroscopic procedures have been widely documented, with some reports observing meniscal tears on MRI in 61% of asymptomatic subjects.[7] However, it can still be considered a highly probable differential diagnosis for traumatic mechanical knee pain in active individuals.

The earlier popular, but controversial, rationales for the mechanism of PFPS is that of mal-alignment of patellar tracking. It is with more recent kinematic research that

Table 1.
*Common sources of knee pain.*

| **Common Pathologies Leading to Anterior Knee Pain (AKP)** | |
|---|---|
| Articular Cartilage Injury | Patellar Tendinopathy |
| Bone Tumors | Patellofemoral Arthritis |
| Chondromalacia Patellae | Patellofemoral Pain Syndrome |
| Hoffa's Disease | Pes Anserine Bursitis |
| Iliotibial Band Syndrome | Plica Synovialis |
| Loose Bodies | Prepatellar Bursitis Previous Surgery |
| Neuromas | Quadriceps Tendinopathy |
| Osgood-Schlatter Disease | Referred from L/S or Hip Joint Pathology |
| Osteochondritis Dissecans | Saphenous Neuritis |
| Patellar Instability/Subluxation | Sinding-Larsen-Johansson Syndrome |
| Patellar Stress Fracture | Symptomatic Bipartite Patella |

Table 2.
*Common bone tumors and conditions by age of incidence. Asterisks (*) indicate tumors commonly affecting the femur or tibia around the knee.*

| **Age** | | |
|---|---|---|
| 0-20 years | 20-50 years | >50 year |
| Osteoblastoma | Non-Hodgkin's Lymphoma* | Paget's Disease |
| Osteoid Osteoma* | Osteosarcoma | Lymphoma |
| Fibrous dysplasia | Giant Cell Tumor* | metastatic carcinoma |
| Hodgkins Lymphoma | Aneurysmal Bone Cyst | Multiple Myeloma |
| Osteochondroma* | Chondroblastoma | Chondrosarcoma |
| Ewing sarcoma | Spindle cell sarcoma (eg Fibrosarcoma)* | |
| Osteosarcoma | | |
| Osteomyelitis | | |
| Aneurysmal Bone Cyst | | |
| Chondroblastoma | | |

the proximal links in the lower extremity are more significantly associated with the dysfunction noted in PFPS.[8] Positive risk factors for the development of PFPS identified in the literature include: muscular weakness around the knee and/or hip; single leg stance strength deficits; decreased trunk proprioception; tight illiotibial band; general ligament laxity; large Q-angle; patellar compression or tilting.[9-10] Abnormal vastus medialis oblique/vastus lateralis reflex timing has also been considered; however this is proving to be less significant than first theorized according to recent systematic reviews.[11] The female athlete is in a high risk category due to relatively larger Q-angles, potential ligamentous laxity, differences in muscular girth, and even effects of hormone fluctuations throughout the menstrual cycle.[3,12-13] One weakness to the patellar tracking theory is the poor correlation with expected lateral tilt or displacement of the patella on radiographs and symptomatology.[14] More recent observational trials have demonstrated significantly lower cross-sectional girth and diameter of the quadriceps musculature as measured

on MRI; however a significant difference in the ratio of vastus lateralis and vastus medialis was not demonstrated.[14] Further research using MRI paired with kinematic analysis revealed that what is more important is abnormal femur motion and not that of the patella.[15] This abnormal femur motion in PFPS is suggested to be the result of reduced hip torque into abduction and external rotation noted on a step down task.[16] Similarly, decreased hip abduction force and associated increased hip adduction angle at the end of a run of variable distances was measured in PFPS subjects.[17]

Investigations on the natural history of PFPS have been poor, making it difficult to know when to consider alternative differential diagnoses. Two studies have attempted long-term follow-up of patients with PFPS. The group found that 27% of athletes recovered within an average of 8 months, while the remaining patients continued to have pain at 5 years.[4] Of the unrecovered population, half reported being able to cope with the pain, and only 20% of athletes were forced to completely cease sport participation, and 6% reporting time off work.[4] Variables strongly associated with poorer prognosis include: female gender, pain severity on visual analog scale, Anterior Knee Pain score, patellar hypermobility, and a sedentary lifestyle.[4, 18]

### *Misdiagnosis in Athletes*

Misdiagnosis, specifically tumors about the knee in athletes is an important issue looked at in the literature.[19] One report from a large orthopedic hospital helped illustrate the incidence of misdiagnosed knee pathology in athletic populations.[20] The investigators reviewed 667 cases and found 25 tumor patients which were originally misdiagnosed as an athletic injury, and resulted in inappropriate invasive procedures.[20] The authors concluded that 15 patients had suffered significant detrimental effects to their final clinical outcomes due to misdiagnosis, 3 of which resulted in limb amputation.[20] While the incidence of these cases was found to be relatively low, the results are potentially devastating to the patient. The most common cause for misdiagnosis reported by the authors was poor quality radiographs and refusal to consider alternative diagnoses in the absence of clinical improvement.[20]

### *Tumors Around the Knee*

Although GCTB is an uncommon cause of knee pain, it has been reported to accounts for 13.7% (8–23%) of all benign primary bone tumors.[21] GCTB is considered to be "quasi-malignant" or a "borderline" malignancy making up a 5-8% of all primary malignant bone tumors.[21-22] It is associated with a very low risk of lung metastasis, even in the absence of histologic malignancy, although it is treated locally as a benign tumor.[21] The vast majority of patients with GCTB are between 20–50 years of age.[22-23] GCTB has a predilection for juxta-articular locations (i.e. metaphysis and epiphysis) and is located most commonly around the knee.[23]

ABC is also an uncommon cause of knee pain, 6% of benign bone tumors, which occurs typically in the first two decades of life.[22] ABC frequently causes bone destruction and cortical expansion prior to their discovery.[23] In adults ABC can also form secondary to an underlying GCTB or other benign bone tumor. [21, 25-25] In the case presented above, pathological analysis of the excised tissue found evidence of both GCTB and secondary ABC. There are other bone tumors that fit this case presentation based on location and demographic information (Table 2).

Patients with benign aggressive bone tumors usually present with rapid onset of symptoms and functional disability, unlike the patient in this case report who had persistent, but slowly worsening symptoms over a course of 5 years. The typical management of benign aggressive lesions including GCTB and ABC is tumor resection by aggressive curettage and high speed burring followed by reconstruction with either bone graft or cement, or less commonly by en bloc resection.[26-27] A retrospective review of 621 patients at a Chinese hospital specializing in musculoskeletal oncology reported a local recurrence rate of 8.6% after extensive curettage and burring.[20]

### *Imaging*

Most guidelines prefer a conservative approach to imaging; however, when considering athletes imaging utilization tends to increase. Indications for knee imaging includes traumatic injury with inability to fully extend the knee, severe ecchymosis with anterior cruciate ligament tear suspected, and persistent unexplained knee pain, to rule out surgical pathology and neoplasms.[28] To evaluate these structures, MRI is preferable, however, it is up to the clinician to know if the structures are just as easily demonstrated on US. Plain radiographs or MRI can identify previously undiagnosed bone tumors prior to any surgical intervention including arthroscopy, thus avoid-

ing inadvertent tumor rupture, spread of lesion and sometimes amputation.[20]

## Summary

We have presented a case of underlying knee pathology that had remained undiagnosed for a number of years. The important feature to note during the evolution of this case was the re-evaluating clinician's willingness to engage in collaborative care when faced with progressive or unresolving symptoms. On a subsequent evaluation, the patient's presentation still appeared mechanical on physical exam; however, symptoms were increasing in severity making the clinical progression appear more urgent, warranting imaging. While MRI remains a sensitive imaging modality for early diagnosis, radiographs may be a logical first step.

One challenge with this case is the self-limiting nature of PFPS in the absence of ligamentous instability or intra-articular injury. This allows patient to continue to access pain management over a period of time, often seeking out various health care providers due to frustration, while allowing serious pathology to go unsuspected. This case illustrates the importance of a thorough re-evaluation, consideration of differentials and follow-up for persistent self-limiting complaints. Maintaining a high level of suspicion in athletic or active populations should be exercised early so as to avoid delayed diagnosis and hasten recovery.

## References:


1. Steinbrück K. Epidemiology of sports injuries—25-year analysis of sports orthopedic-traumatologie ambulatory care. Sportverletz Sportschaden. 1999;13(2): 38 – 52.
2. Kransdorf M. Malignant soft-tissue tumors in a large referral population: distribution of diagnoses by age, sex, and location. Am J Roentgen. 1995; 164(1): 129-134.
3. Boling M, Padua D, Marshall S, Guskiewicz K, Pyne S, Beutler A. Gender differences in the incidence and prevalence of patellofemoral pain syndrome. Scand J Med Sci Sports. 2010; 20(5): 725–730.
4. Blønd L, Hansen L. Patellofemoral pain syndrome in athletes: a 5-7-year retrospective follow-up study of 250 athletes. Acta Orthop Belg. 1998; 64(4): 393–400.
5. Clayton R, Brown C. The epidemiology of musculoskeletal tendinous and ligamentous injuries. Injury. 2008; 39(12): 1338-1344.
6. Snoeker B, Bakker E, Kegel C, Lucas C. Risk factors for meniscal tears: a systematic review including meta-analysis. J Orthop Sports Phys Ther. 2013; 43(6): 352-367.
7. Englund M, Guermazi A, Gale D, Hunter D, Aliabadi P, Clancy M, Felson D. Incidental meniscal findings on knee MRI in middle-aged and elderly persons. N Engl J Med. 2008; 359: 1108-1115.
8. Powers C. The influence of abnormal hip mechanics on knee injury: a biomechanical perspective. J Orthop Sports Phys Ther. 2010;40(2):42-51.
9. Boling MC, Padua DA, Marshall SW, Guskiewicz K, Pyne S, Beutler A. A prospective investigation of biomechanical risk factors for patellofemoral pain syndrome: the Joint Undertaking to Monitor and Prevent ACL Injury (JUMP-ACL) cohort. Am J Sports Med. 2009; 37: 2108–2116.
10. Witvrouw E, Lysens R, Bellemans J, Cambier D, Vanderstraeten G. Intrinsic risk factors for the development of anterior knee pain in an athletic population. a two-year prospective study. Am J Sports Med. 2000; 28(4): 480-489.
11. Chester R, Smith TO, Sweeting D, Dixon J, Wood S, Song F. The relative timing of VMO and VL in the aetiology of anterior knee pain: a systematic review and meta-analysis. BMC Musculoskelet Disord. 2008; 9: 64.
12. Wojtys, Edward M et al. Association between the menstrual cycle and anterior cruciate ligament injuries in female athletes. Am J Sports Med. 1998; 614-619.
13. Slauterbeck, James R et al. The menstrual cycle, sex hormones, and anterior cruciate ligament injury. J Athl Train. 2002: 275.
14. Giles, Lachlan S et al. Does quadriceps atrophy exist in individuals with patellofemoral pain? A systematic literature review with meta-analysis. J Orthop Sports Phys Ther. 2013: 766-776.
15. Souza R, Draper C, Fredericson M, Powers C. Femur rotation and patellofemoral joint kinematics: a weight-bearing magnetic resonance imaging analysis. J Orthop Sports Phys Ther. 2010; 40(5): 277-285.
16. Bolgla, L, Malone T, Umberger B,Uhl T. Hip strength and hip and knee kinematics during stair descent in females with and without patellofemoral pain syndrome. J Orthop Sports Phys Ther. 2008;38(1):12–18.
17. Dierks T, Manal K , Hamil J, Davis I. Proximal and distal influences on hip and knee kinematics in runners with patellofemoral pain during a prolonged run. Orthop Sports Phys Ther. 2008;38(8):448–456.
18. Kujala UM, Jaakkola LH, Koskinen SK, et al. Scoring of patellofemoral disorders. Arthroscopy. 1993; 9: 159–163.
19. Muscolo DL, Ayerza MA, Makino A, Costa-Paz M, Aponte-Tinao LA. Tumors about the knee diagnosed as athletic injuries. J Bone Joint Surg. 2003; 85(7): 1209–1214.
20. Niu X, Zhang Q, Hao L, Ding Y, Li Y, Xu H, Liu W. Giant cell tumor of the extremity: retrospective analysis of 621 Chinese patients from one institution. J Bone Joint Surg Am. 2012; 94(5): 461-467.
21. Kransdorf M, Murphey M. Giant Cell Tumor. Imaging

Of Bone Tumors And Tumor-Like Lesions Medical Radiology. Springer Berlin Heidelberg; 2009. p. 321-336.
22. Yochum TR, Rowe LJ. Essentials of Skeletal Radiology. 3rd. ed. Philadelphia: Lippincott Williams & Wilkins; 2005.
23. Taylor JAM, Hughes TH, Resnick DL. Skeletal Imaging: Atlas of the spine and extremities. Elsevier Health Sciences; 2009.
24. Chakarun CJ, Forrester DM, Gottsegen CJ, Patel DB, White EA, Matcuk GR Jr. Giant cell tumor of bone: review, mimics, and new developments in treatment. Radiographics. 2013; 33(1): 197-211.
25. Low SF, Hanafiah M, Nurismah MI, Suraya A. Challenges in imaging and histopathological assessment of a giant cell tumour with secondary aneurysmal cyst in the patella. BMJ Case Rep. 2013; 20.
26. Turcotte RE, Wunder JS, Isler MH, Bell RS, Schachar N, Masri BA, Moreau G, Davis AM; Canadian Sarcoma Group. Giant cell tumor of long bone: a Canadian Sarcoma Group study. Clin Orthop Relat Res. 2002; 397: 248-258.
27. Blackley HR, Wunder JS, Davis AM, White LM, Kandel R, Bell RS. Treatment of giant-cell tumors of long bones with curettage and bone-grafting. J Bone Joint Surg Am. 1999; 81(6): 811-820.
28. Parker L, Nazarian L, Carrino J, Morrison W, Grimaldi G, Frangos A, Levin D, Rao V. Musculoskeletal imaging: Medicare use, costs, and potential for cost substitution. J Am Coll Radiol Art. 2008; 5(3): 182-188.

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# Primary spontaneous pneumothorax presenting to a chiropractic clinic as undifferentiated thoracic spine pain: a case report

Ryan Larson, BSc, DC[1]

Objective: *To present a case of primary spontaneous pneumothorax presenting to a chiropractic clinic as undifferentiated thoracic spine pain.*

Clinical Features: *A tall thin 25-year-old male anxiously presented to a chiropractic clinic with six days of sudden unexplained left thorax pain. His breathing was laboured and his dry cough aggravating. After assessment a high clinical suspicion of primary spontaneous pneumothorax prevailed.*

Intervention and Outcome: *The patient was referred to hospital for further investigation and primary spontaneous pneumothorax was confirmed on chest radiograph. He underwent immediate tube thoracostomy to drain the air from his pleural space and to re-inflate his lung. After three days the tube was removed. By two weeks the lung had returned to full size. No recurrences have occurred to date.*

Conclusions*: Primary spontaneous pneumothorax is a medical emergency in the presence of shortness of breath. The focus of treatment is to drain air from the pleural linings and to prevent recurrences. In less severe cases, patients may believe they have thoracic spine pain and seek manual therapy care. This case highlights the*

Objectif : *Présenter un cas de pneumothorax spontané primaire présenté à une clinique chiropratique comme douleur de la colonne thoracique indifférenciée.*

Caractéristiques cliniques : *Un homme grand et mince de 25 ans s'est présenté anxieusement à une clinique de chiropratique en se plaignant d'une douleur soudaine inexpliquée dans le thorax gauche pendant six jours. Sa respiration était laborieuse et sa toux sèche s'aggravait. Après l'examen, une forte suspicion clinique de pneumothorax spontané primaire s'est imposée.*

Intervention et résultats : *Le patient a été orienté à l'hôpital pour des examens supplémentaires, et le pneumothorax spontané primaire a été confirmé à la suite de la radiographie thoracique. Il a immédiatement subi une insertion du drain thoracique afin de drainer l'air à partir de sa cavité pleurale et de regonfler son poumon. Au bout de trois jours, le drain a été retiré. En deux semaines, le poumon a retrouvé sa taille normale. Pas de récidive à ce jour.*

Conclusions : *Le pneumothorax spontané primaire est une urgence médicale en cas d'essoufflement. L'objectif du traitement est de vider l'air des doublures pleurales et de prévenir les récidives. Dans les cas moins graves,*

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Written consent to participate in this case study was provided.

*important role chiropractors have as primary contact health care providers.*

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KEY WORDS: chiropractic, pneumothorax, chest

*les patients peuvent croire qu'ils ont une douleur à la colonne thoracique et chercher des soins de thérapie manuelle. Ce cas met en évidence le rôle important des chiropraticiens en tant que fournisseurs de soins de santé primaires.*

(JCCA. 2016;60(1):66-72)

MOTS CLÉS : chiropratique, pneumothorax, poitrine

## Introduction

Primary spontaneous pneumothorax remains a significant health problem.[1,2] It ranks high on the list of common medical conditions, especially in the emergency department. A pneumothorax is defined as the presence of air in the pleural cavity which leads to a collapsed lung.

There are several types of pneumothoraces. Over half pneumothoraces are traumatic, either accidental or iatrogenic; the remaining occur without any preceding trauma and are labelled spontaneous pneumothorax (SP). SP can be divided into two types – primary and secondary. Primary Spontaneous Pneumothorax (PSP) is the idiopathic variety which occurs in the otherwise healthy person. In Secondary Spontaneous Pneumothorax (SSP) an underlying disease state responsible for the pneumothorax can be identified. SSP is associated with underlying lung diseases such as cystic fibrosis, Chronic Obstructive Pulmonary Disease, Acquired Immune Deficiency Syndrome and tuberculosis, with peak incidence with those aged >55 yrs.[1] The consequences of pneumothorax in patients with pre-existing lung disease are significantly greater and management is potentially more difficult. The development of a one-way air valve leads to tension pneumothorax and can occur in either traumatic or spontaneous cases. Unless reversed by effective treatment, this situation can progress and cause death.[3]

The most likely pneumothorax presenting to chiropractic clinic is SP. SP remains a significant health problem, with an annual incidence of 18-28 per 100,000 population in males and 1.2-6.0 per 100,000 population in females.[2] Mortality rates of 1.26/million for men and 0.62/million for women per annum have been reported.[1] The mortality of SP can be high, especially in older subjects and those with SSP.[4] The course of SP remains unpredictable, with a recurrence rate ranging from 25-54%.[5] Smoking is an important risk factor for PSP. The lifetime risk of developing pneumothorax in smoking males is 12%, compared with 0.1% in non-smoking males.[6,7] Patients with PSP tend to be taller than control patients.[5,8] The gradient of negative pleural pressure increases from the lung base to the apex, so that alveoli at the lung apex in tall individuals are subject to significantly greater distending pressure than those at the base of the lung, and the vectors in theory, predispose to the development of apical subpleural blebs.[9] Although it is to some extent counterintuitive, there is no evidence that a relationship exists between the onset of pneumothorax and physical activity, the onset being as likely to occur during sedentary activity.[10] Clinical signs and symptoms of SP include sudden sharp chest pain worse with breathing and coughing, chest tightness, dyspnea, easily fatigued, nasal flaring, anxiety, reduced lung expansion, hyper-resonance and diminished breath sounds on the side of the pneumothorax, cyanosis, sweating, sever tachypnea and hypotension.[3,11]

Non-specific mechanical Thoracic Spine Spain (TSP) is a common presentation in both clinical practice and in the general population with a high prevalence among healthy individuals, thus contributing to a significant personal and community burden.[12-14] Thoracic facet[15] and costotransverse joint pain patterns are well demonstrated as contributing to TSP[16]. Thoracic spinal manipulative therapy in the care of TSP is often utilized by many professional health disciplines and is demonstrated to have a reasonable degree of efficacy verses placebo in preliminary studies.[17] Although patients may present clinically with what they believe is TSP the following case dem-

onstrates the importance of thorough history taking and assessment.

## Case Presentation

Believing that he had spine pain and that chiropractic manipulation would be helpful, a 25-year-old active male cabinetmaker, presented with sudden sharp progressing chest and rib pain of 6 days duration. This gentleman was very tall and thin (6'9"/205.7 cm and 180lbs/81.6 kg). Onset was insidious and his symptoms were localized to the left chest, rib cage, thoracolumbar spine and posterior shoulder. His breathing was laboured, painful and short. A dry cough was present and aggravated his symptoms. Over-the-counter ibuprofen was not helping. He reported smoking one pack per week. Due to his symptoms, he was unusually anxious. His sleep was significantly disturbed and limited. Auscultation did not reveal obvious abnormality; the clinician admits to limited experience with lung auscultation and therefore considered this as a possible false negative. Global chest compression and thoracic joint palpation were aggravating. Global active/passive/resisted thoracic ranges of motion were severely limited and painful. Based on the history and physical findings a high clinical suspicion of primary spontaneous pneumothorax prevailed and the patient was referred to hospital for chest radiography and further investigation.

At the hospital, chest radiographs were performed and a 40% spontaneous pneumothorax was confirmed in the left lung (Figure 1A). Immediate tube thoracostomy was performed to drain the trapped air in the pleural linings and to allow for the lung to re-inflate. Shortly after tube insertion, additional radiographs were taken demonstrating an immediate decrease in the size of the pneumothorax to 15% (Figure 1B). The patient remained in hospital one day under supervision and then was released with chest tube still inserted. The tube was removed on the third day and follow up radiographs were taken, which still demonstrated the presence of a small pneumothorax.

1A. 1B.

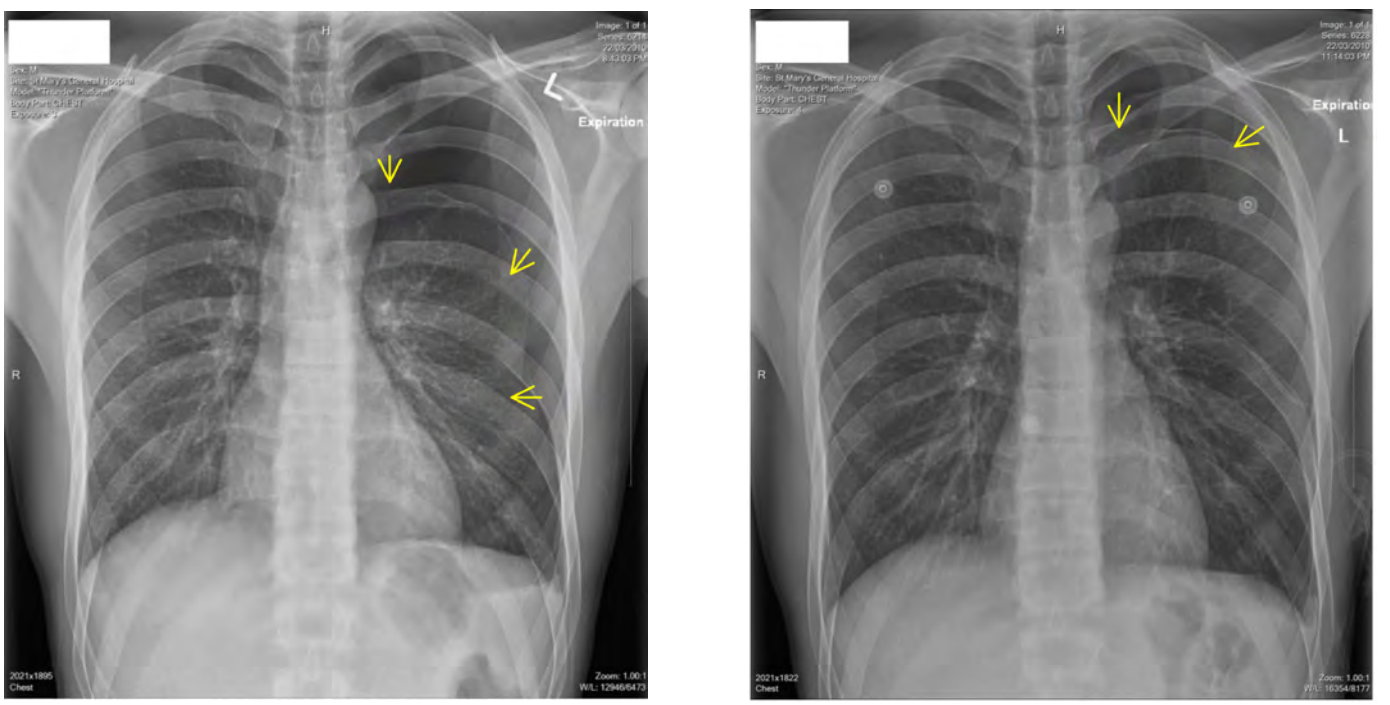


Figure 1.

*Expiration chest radiographs taken at hospital day of presentation. 1A. Demonstrating 40% left lung pneumothorax (arrows). 1B. Same day, chest tube inserted and pneumothorax decreased to 15% (arrows).*

At two weeks follow up radiographs revealed complete resolution of the pneumothorax (Figure 2). The patient has had no recurrences.

## Discussion

The pathophysiology of pneumothorax remains unknown. Subpleural blebs and bullae are found at the lung apices at thoracoscopy and on CT scan in up to 90% of cases of PSP, and are thought to play a role.[18,19] Pulmonary blebs are small subpleural thin walled air containing spaces, not larger than 1-2cm in diameter; their walls being less than 1 mm think. It's thought if a bleb ruptures it can allow air to escape into the pleural space. Blebs are also observed in cell apoptosis[20] which is a cells self-execution plan to guided rupture. It is theorized that the pleural lining cells are committing apoptosis leading to the creation of spontaneous pneumothorax. Pulmonary bullae are focal regions of emphysema measuring more than 1cm in diameter with very thin cell walls.[21] The location of the unique or diffuse sites of air leakage leading to PSP is usually unknown. Distal airway inflammation due to cigarette smoking seems to play a key role. No clinician should miss the opportunity, especially in young people, to encourage smoking cessation. Most young patients continue to smoke after their first episode of PSP, showing that clinical strategies need to be improved in order to better address the needs of this particular age group.[22]

Tension pneumothorax can develop in any type of pneumothorax, traumatic, PSP, or SSP. The development of a tension pneumothorax is a medical emergency requiring heightened awareness in a specific range of clinical situations. Patients are to be referred immediately for emergency care. Treatment is with oxygen and emergency decompression. A tension pneumothorax arises as a result of the development of a one-way valve system at the site of the breach in the pleural membrane, permitting air to enter the pleural cavity during inspiration but preventing egress of air during expiration, with consequent

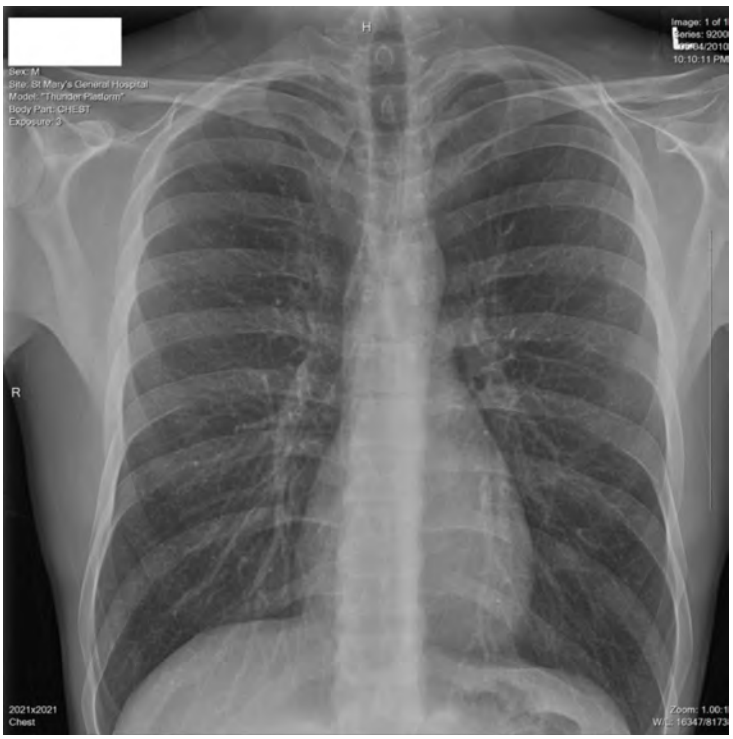


Figure 2.
*Two weeks after tube inserted there is a complete resolution of pneumothorax.*

increase in the intrapleural pressure such that it exceeds atmospheric pressure for much of the respiratory cycle. As a result, impaired venous return and reduced cardiac output results in the typical features of hypoxaema and haemodynamic compromise.[23,24]

Any clinical suspicion of pneumothorax must be assessed with a stethoscope specifically listening for decreased or absent breathing sounds on the affected side. A diagnosis of PSP is usually made by expiration chest radiography. Standing erect PA and lateral chest radiographs are the mainstay. CT scan is the gold standard in the detection of small pneumothoraces and in size estimation.[25] It is important to always check for associated rib fracture in all cases of pneumothorax. It is not unusual for patients with PSP to present several days after onset of symptoms because of the relatively minor severity.[26]

There are two main aims when treating pneumothorax; first, insure the trapped air is evacuated and that the lung is re-expanded; secondly, prevent recurrence. In first episodes of PSP observation and simple needle aspiration are established first-line therapies.[27] If the PSP is small without significant breathlessness, observation is the treatment of choice. Adequate analgesia and high concentration oxygen therapy without any interventional therapy are usually enough to relieve the patients' symptoms.[11] Observation is the guideline recommendation from the British Thoracic Society for first line treatment of patients with small closed PSP (<15% of lung size) with minimal symptoms. A 70-80% resolution rate can be achieved in these patients in about 7 weeks.[29] Observation alone is inappropriate for breathless patients who require active intervention, needle aspiration or chest tube drainage. If observation is unwarranted, needle aspiration is a more conservative second choice. However, in the case of failed aspiration, a chest tube should be inserted. Within 24hrs of admission patients should be referred to a respiratory specialist since intercostal tube placement can lead to serious complications, even death.[30] Patients should be hospitalized while a tube is in chest, at least until stable. Video-assisted Thoracosopic Surgery (VATS) is a newer alternative to chest tube drainage and has been shown to be more cost-effective[31] with similar result.

Recurrences are common and prevention is therapeutically challenging.[32] The risk of recurrence of PSP is as high as 54% within the first four years, with isolated risk factors including smoking, height and age >60 years.[5,9,33] After a first recurrence, the likelihood of subsequent recurrences increases progressively, up to 62% for a second recurrence and 83% for a third.[34] Patients should avoid air travel until full resolution of pneumothorax has been confirmed by chest radiograph. The consequence of a recurrence during air travel may be serious.[35] After a pneumothorax scuba diving should be permanently avoided.[36] There is no evidence to link recurrence with physical exertion.[10] The patient can be advised to return to work and resume normal physical activities once all symptoms have resolved, although it is reasonable to advise that sports that involve extreme exertion and physical contact should be avoided until full resolution.[11]

To prevent recurrences of SP pleurodesis should be considered.[18] Pleurodesis is a medical procedure performed surgically or chemically in which the space between the parietal and visceral pleural is artificially obliterated. It involves the adhesion of the two pleurae producing a diffuse pleural symphysis.

If the PSP is small without significant breathlessness, the patients' chief complaint can be misrepresented as unspecific Thoracic Spine Pain (TSP). This presentation can lead patients to seek chiropractic care for non-specific mechanical TSP as this is a common presentation in clinical chiropractic practice. It is necessary to be clinically aware of differentials when an undifferentiated thoracic spine condition is present, as serious cases, such as pneumothorax, cancer and heart and lung disease may require emergency medical care.

In summary, a young tall and thin male who was a smoker, presented to a chiropractor with insidious left sided thorax pain thinking he required manual therapy for a thoracic spine complaint. He was experiencing Primary Spontaneous Pneumothorax. It is imperative that when pneumothorax is suspected that immediate referral be made to the hospital for further investigation and possibly acute emergency management.

This case highlights an example of an emergency care situation of thoracic pain presenting to a chiropractic clinician. Chiropractors are primary contact health care providers, and future research on the their role and involvement in emergency care encounters is warranted in order to demonstrate the value of integrating chiropractors into interdisciplinary collaborative models such as hospital or multidisciplinary health teams. There is a growth in chiro-

practic researchers focusing on less traditional chiropractic research pursuits, including innovative collaborative research efforts in undifferentiated chest pain.[37] Therefore, it appears that an initiative of this nature would be in align with the efforts to move beyond simply the spine and into other primary contact musculoskeletal areas that benefit both the patient and the profession. Successful management of emergency care cases can only emphasize the role the chiropractic profession has in the health care system.

## References:


1. Gupta DJ, *et al*. Epidemiology of pneumothorax in England. Thorax. 2000; 55:666-671.
2. Melton LJ, Hepper NCG, Offord KP. Incidence of spontaneous pneumothorax in Olmsted County, Minnesota: 1950-1974. Am Rev Respir Dis. 1987; 29: 1379-1382.
3. Zarogoulidis P, *et al*. Pneumothorax from definition to diagnosis and treatment. J Thorac Dis 2014; 69(S4): S372-376.
4. Wait MA, Estrera A. Changing clinical spectrum of spontaneous pneumothorax. Am J Surg. 1992; 164(5): 528-531.
5. Sadikot RT *et al*. Recurrence of primary spontaneous pneumothorax. Thorax. 1997; 52(9): 805-809.
6. Bense L *et al*. Smoking and the increased risk of contracting spontaneous pneumothorax. Chest. 1987;92(6):1009-1112.
7. Jansveld CA, Dijkman JH. Primary spontaneous pneumothorax and smoking. BMJ. 1975; 4:559-560.
8. Withers JN *et al*. Spontaneous pneumothorax. Suggested etiology and comparison of treatment methods. Am J Surg.1964; 108:772-776.
9. West JB. Distribution of mechanical stress in the lung, a possible factor in localisation of pulmonary disease. Lancet. 1971; 1:839-841
10. Bense L, Wiman LG, Hedenstierna G. Onset of symptoms in spontaneous pneumothorax: correlations to physical activity. Eur J Respir Dis. 1987; 71(3):181-186.
11. MacDuff A *et al*. Management of spontaneous pneumothorax: British Thoracic Society Pleural Guideline 2010. Thorax 2010; 65 Suppl 2:ii18-ii31.
12. Dionne CE *et al*. Determinants of "return to work in good health" among workers with back pain who consult in primary care settings: a 2-year prospective study. Eur Spine J. 2007(5); 16:641-655.
13. Briggs AM *et al*. Thoracic spine pain in the general population: Prevalence, incidence and associated factors in children, adolescents and adults. A systematic review. BMC Musculoskeletal Disorders. 2009; 10:77.
14. Edmondston SJ, Singer KP. Thoracic spine: anatomical and biomechanical considerations for manual therapy. Man Ther. 1997;2(3):132-143.
15. Manchikanti L *et al*. Prevalence of facet joint pain in chronic spinal pain of cervical, thoracic and lumbar regions. BMC Musculoskeletal Disorders. 2004; 5:15.
16. Young BA *et al*. Thoracic costotransverse joint pain patterns: a study in normal volunteers. BMC Musculoskeletal Disorders. 2008; 9:140.
17. Schiller L. Effectiveness of spinal manipulative therapy in the treatment of mechanical thoracic spine pain: a pilot randomized clinical trial. JMPT. 2001;24(6):394-401.
18. Donahue DM *et al*. Resection of pulmonary blebs and pleurodesis for spontaneous pneumothorax. Chest. 1993; 104:1767-1769.
19. Lesur O *et al*. Computed tomography in the etiologic assessment of idiopathic spontaneous pneumothorax. Chest. 1990; 98:341-347.
20. Mills JC *et al*. Apoptotic membrane blebbing is regulated by myosin light chain phosphorylation. J Cell Biol. 1998; 140(3): 627-636.
21. Stern EJ, Frank MS. CT of the lung in patients with pulmonary emphysema: diagnosis, quantification, and correlation with pathologic and physiologic findings. Am J Roentgenol. 1994; 162(4): 791-798.
22. Smith HJM, Chatrou M, Pstmus PE. The impact of spontaneous pneumothorax and its treatment on the smoking behaviour of young adult smokers. Respir Med. 1998; 91:1132-1136.
23. Light RW. Tension pneumothorax. Intensive Care Med. 1994; 20:468-469.
24. Baumann MH, Sahn SA. Tension pneumothorax: diagnostic and therapeutic pitfalls. Crit Care Med. 1993; 21:177-179.
25. Kelly AM *et al*. Comparison between two methods for estimating pneumothorax size from chest X-rays. Respir Med. 2006; 100:1356-1359.
26. O'Hara VS. Spontaneous pneumothorax. Milt Med. 1978; 143(1):32-35.
27. Andrivet P *et al*. Spontaneous pneumothorax. Comparison of thoracic drainage vs immediate or delayed needle aspiration. Chest. 1995; 108(2):335-340.
28. Noppen M *et al*. Manual aspiration versus chest tube drainage in first episodes of primary spontaneous pneumothorax: a multicenter, prospective, randomized pilot study. Am J Respir Crit Care Med. 2002; 16599):1240-1244.
29. Stradling P, Poole G. Conservative management of spontaneous pneumothorax. Thorax 1966; 21(2):145-149.
30. Chan L *et al*. Complication rates of tube thoracostomy. Am J Emerg Med. 1997; 15(4):368-370.
31. Schramel FM *et al*. Cost-effectiveness of video-assisted thoracoscopic surgery versus conservative treatment for first time of recurrent spontaneous pneumothorax. Eur Respir J. 1996; 9(9):1821-1825.

32. Schramel FM, Postmus PE, Vanderschueren RG. Current aspects of spontaneous pneumothorax. Eur Respir J 1997; 10(6):1372-1379.
33. Lippert HL *et* al. Independent risk factors for cumulative recurrence rate after first spontaneous pneumothorax. Eur Respir J. 1991; 4(3): 324-331.
34. Gobbel W *et al*. Spontaneous pneumothorax. J Thorac Cardiovasc Surg. 1963; 46:331-345.
35. British Thoracic Society Standards of Care Committee. Managing passengers with respiratory disease planning air travel: British Thoracic Society recommendations. Thorax. 2002; 57(4): 289-304.
36. Ziser A, Väänänen A, Melamed Y. Diving and chronic spontaneous pneumothorax. Chest 1985;87(2):264-265.
37. Donovan J *et al*. Beyond the spine: A new clinical research priority. JCCA. 2015; 59(1): 6-12.

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# A jurisdictional review of the legislation governing informed consent by chiropractors across Canada

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*The objective of this jurisdictional review is to provide summary information pertaining to the regulation of chiropractors in Canadian provinces and territories on the topic of informed consent. Our review shows that two provinces have legislated for all healthcare professions: Ontario and Prince Edward Island. Two chiropractic regulatory bodies (New Brunswick and, Newfoundland and Labrador) have adopted the Canadian Chiropractic Association Code of Conduct. All chiropractic regulatory bodies of the other provinces and Yukon have adopted their own specific dispositions regarding informed consent. Chiropractors in Prince Edward Island, Saskatchewan and Québec must obtain informed consent in writing.*

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KEY WORDS: chiropractic, informed consent, Canada

*L'objectif de cette étude juridictionnelle est de fournir des informations sommaires portant sur la réglementation des chiropraticiens dans les provinces et territoires canadiens en ce qui concerne le consentement éclairé. Notre étude montre que deux provinces (l'Ontario et l'Île-du-Prince-Édouard) ont légiféré sur toutes les professions de la santé. Deux organismes de réglementation chiropratique (le Nouveau-Brunswick et, Terre-Neuve-et-Labrador) ont adopté le Code de conduite de l'Association chiropratique canadienne. Tous les organismes de réglementation de chiropratique des autres provinces et le Yukon ont adopté leurs propres dispositions spécifiques concernant le consentement éclairé. Les chiropraticiens de l'Île-du-Prince-Édouard, de la Saskatchewan et du Québec doivent obtenir le consentement éclairé par écrit.*

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MOTS CLÉS : chiropratique, consentement éclairé, Canada

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## Introduction

In a large telephone survey, Caspi[1] found that only 57% of U.S.-based complementary and alternative medicine (CAM) organizations have any informed consent (IC) policy and that only 16% mandate their members to obtain IC from their patients. They also found "no consistent standards with respect to the IC process across a broad range of CAM practices." In a more recent study, the same authors[2] reported "CAM practitioners seem to represent their own opinions or preferences and not profession-based standards, perhaps because there are none."

It is a truism that levels of training and regulation of CAM practices vary greatly but contrary to the opinion of the above mentioned authors, established CAM practices such as chiropractic are well regulated and implement profession-based standards. The objective of this jurisdictional review is to provide summary information relative to the regulation of chiropractors in Canadian provinces and territories on the topic of informed consent.

## Methods

A review of current legislations and regulations pertaining to chiropractors in all Canadian provinces and territories was conducted. Research was conducted through the CANLII database and websites for each jurisdiction's regulatory body and professional association. Missing information was completed by telephone interviews with representatives of regulatory bodies and associations.

## Results

Chiropractors are regulated in all Canadian provinces and in the Territory of Yukon. There is no regulation of chiropractic in the North West Territories and in the Territory of Nunavut.

We present here the key findings of our review:

- British-Columbia: Authority comes from the *Health Professions Act*[3] which authorizes a board to make bylaws that may include standards of professional practice.[4] Provision and information on informed consent is provided in *The Professional Conduct Handbook* adopted by the College of Chiropractors of British-Columbia.[5]
- Alberta: Authority comes from the *Health Professions Act*[6] which lays down that a regulated profession must establish, maintain and enforce a Code of Ethics. Provision and information on informed consent is provided in *The Standards of Practice*[8] and in *The Code of Ethics* adopted by the Alberta College and Association of Chiropractors.[9]
- Saskatchewan: Authority comes from the *Chiropractic Act*[10], which authorizes the Chiropractors' Association of Saskatchewan (CAS) to make standards of practice and professional ethics. The CAS requires its members to use the Canadian Chiropractic Protective Association patient informed consent form.[11]
- Manitoba: Authority comes from *The Chiropractic Act*[12], which authorizes the Manitoba Chiropractors Association "to make regulations to develop, establish and maintain standards for the practice of chiropractic". Provision and information on informed consent are provided in the *Code of Ethics* adopted by the Manitoba Chiropractors Association.[13]
- Ontario: Authority comes from the *Regulated Health Professions Act*[14] where the College has to "develop, establish and maintain" standards of practice and professional ethics and where members must follow a *uniform set of rules for consent to treatment created by* the *Health Care Consent Act*.[15] Provision and information on informed consent are provided in the *Standards of Practice S-002 (Record Keeping), S-005 (Manipulation/Adjustment), S-008 (Diagnosis/Clinical Impression) and S-013 (Consent)* adopted by the College of Chiropractors of Ontario.[17] Also, the Ontario Chiropractic Association, the largest advocacy group in the province, recommends its members to practice in accordance with the laws and regulations of the Province of Ontario.[18]
- Québec: Authority comes from the *Professional Code* [20] where the Québec Board of Chiropractors must make, by regulation, a code of ethics. Provision and information on informed consent is provided in the *Code of ethics of chiropractors*.[22] In Québec, the Québec Chiropractors Association published the Chiropractor's Manual[23], adopted by the Québec Board of Chiropractors. This Manual is a summary of accepted standards of practice, and procedures and services performed in the daily practice of clinical chiropractic. Authority also comes from the Civil Code of Québec[19] in harmony with the Charter of Human Rights and Freedoms and the general principles of law.

- New-Brunswick: Authority comes from *An Act to Incorporate the New- Brunswick Chiropractors Association*[24] which authorizes the Association "to establish, maintain, develop and enforce standards of professional ethics." Provision and information on informed consent are provided in the *Code of Ethics* adopted by the New-Brunswick Chiropractors Association.[26] The Association has also adopted through its bylaws the *Code of Ethics* and the *Clinical Guidelines for Chiropractic Practice In Canada* by the Canadian Chiropractic Association.[25]
- Nova Scotia: Authority comes from the *Chiropractic Act*.[27] The *Act* authorizes the College to "establish, maintain and develop" standards of professional ethics and practice. Provision and information on informed consent are provided in *The Standards of Practice on Informed Consent* [29] and in *The Code of Ethics* adopted by the Nova Scotia College of Chiropractors[28].
- Prince-Edward-Island: Authority comes from to the *Consent to Treatment and Health Care Directives Act*[30] which *creates a uniform set of rules for consent to treatment for all health care providers*. *Besides, t*he Prince Edward Island Chiropractic Association, which is the regulatory body in Prince Edward Island, requires Canadian Chiropractic Protective Association (CCPA) membership for liability coverage.[32] CCPA strongly recommends use of their informed consent form.
- Newfoundland and Labrador: Authority comes from the *Chiropractors Act 2009*.[33] By regulation[34], improper professional conduct includes conduct contrary to the *Code of Ethics* set by the Canadian Chiropractic Association (CCA).[35] This Code of Ethics recommends that CCA members "share the responsibility of the health care decision making process with a patient." Furthermore, the CCA has a specific position statement on informed consent.[36]
- Yukon: Authority comes from the *Chiropractors Act*.[37] Provision and information on informed consent are those published by the Canadian Chiropractic Association.

Two provinces have enacted omnibus legislation with respect to informed consent: Ontario (*Health Care Consent Act*[15]) and Prince Edward Island (Consent to Treatment and Health Care Directives Act[30]). Two provinces (New Brunswick and Newfoundland and Labrador) have adopted the Canadian Chiropractic Association Code of Conduct.[25,34] All other provinces and Yukon have adopted their own specific dispositions regarding informed consent (see Table).

Two provinces have made it mandatory to obtain consent in writing and chiropractors in Saskatchewan must use the Canadian Chiropractic Protective Association form.[11] In Québec, chiropractors must obtain consent in writing but do not have the obligation to follow any specific format although the regulatory board recommends to its members to use either the Canadian Chiropractic Protective Association form or a provincial form (which itself has information, based on the CCPA form), that is made available to the members of the Québec Board of Chiropractors.

Details are provided in the Table below.[a]

[a] Modifications to legislation, standards/codes, and guidelines are often ongoing. Chiropractors are encouraged to consult their regulatory bodies to keep current with the most recent information.

Table 1.
*Laws and regulations*

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| **British-Columbia: Health Profession Act** [3]<br>http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_96183_01<br><br>**a.15.1** (1) The British Columbia College of Chiropractors continued under the *Chiropractors Act* is continued as a college under this Act under the name College of Chiropractors of British Columbia.<br><br>16 Duty and objects of a college<br>(1) It is the duty of a college at all times: […]<br>(i) to inform individuals of their rights under this Act and the *Freedom of Information and Protection of Privacy Act*;<br><br>Bylaws for college<br><br>**19** (1) A board may make bylaws, consistent with the duties and objects of a college under section 16, that it considers necessary or advisable, including bylaws to do the following: (…)<br><br>(k) establish standards, limits or conditions for the practice of the designated health profession by registrants;<br><br>(l) establish standards of professional ethics for registrants, including standards for the avoidance of conflicts of interest; | **College of Chiropractors of British-Columbia: Bylaws** [4]<br>http://www.chirobc.com/standards-and-legislation/bylaws/<br><br>Standards of professional ethics and practice<br><br>a.82.<br><br>(1) The board must publish, on the college website or in another manner accessible to registrants and the public, all standards, limits and conditions established by the board in accordance with the authority set out in section 19 (1)(k), (l) and (z) and (1.1) of the Act.<br><br>(2) Registrants must at all times conduct their practice in a manner that is in keeping with the standards, limits or conditions published by the board under subsection (1).<br><br>Under section 82 of the Bylaws, the College published **The Professional Conduct Handbook** for the guidance of registrants. [5]<br>http://www.chirobc.com/standards-and-legislation/professional-conduct-handbook/ |
| **Alberta**<br><br>**1- Health Profession Act** (subjects all health care practitioners). [6]<br>http://www.qp.alberta.ca/documents/acts/h07.pdf<br><br>a. 3 (1) A College (…)<br><br>(c) must establish, maintain and enforce standards for registration and of continuing competence and standards of practice of the regulated profession<br><br>(d) must establish, maintain and enforce a code of ethics<br><br>**2- Chiropractic Profession Act** [7]<br>https://www.canlii.org/en/ab/laws/stat/rsa-2000-c-c-13/latest/rsa-2000-c-c-13.html<br><br>a. 7 (1) The Alberta Chiropractic Association is continued as a corporation under the name "The College of Chiropractors of Alberta" | **Alberta College and Association of Chiropractors**<br><br>**1- Standards of Practice** [8]<br>http://www.albertachiro.com/ieadmin/files/ACAC_Standards_of_Practice.pdf<br><br>a.3.1 Informed Consent (Adopted 06/2004, Revised and Effective 01/2014)<br><br>**2- Code of Ethics** [9]<br>http://www.albertachiro.com/ieadmin/files/Code_of_Ethics.pdf<br><br>a. A5 and A6 |
| **Saskatchewan**: **The Chiropractic Act** [10]<br>http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/C10-1.pdf<br><br>a.3 The Chiropractors' Association of Saskatchewan, continued pursuant to The Chiropractic Act, is continued as a corporation.<br><br>a.14 (2) The board may (a) make bylaws for any purpose set out in section 15<br><br>a.15 (h) setting standards regarding the manner and method of practice of members; (i) providing for a code of professional ethics; | **Chiropractors' Association of Saskatchewan**[11]<br><br>**Policy on informed consent**: The CAS adopts the CCPA patient informed consent form as a mandatory part of the patient records (Unit V- K.1).<br>http://www.saskchiropractic.ca/doc/BLK%20book/PolicyA_II_Jan_2014%281%29.pdf |

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| **Manitoba: The Chiropractic Act** [12]<br>http://web2.gov.mb.ca/laws/statutes/ccsm/c100e.php<br><br>a.3 The Manitoba Chiropractors Association is continued as a body corporate<br><br>a.25 (2) The board may make by-laws respecting: (e) a code of ethics for the practise of chiropractic<br><br>a.26 (b) the board may make regulations to develop, establish and maintain standards for the practice of chiropractic;<br><br>Under legislation enacted in 2009 (RHPA) the College of Chiropractors of Manitoba will be the regulatory body established for the health profession of chiropractic. Every doctor of chiropractic practicing in Manitoba will be required to become a registered member of the College. According to the Manitoba Chiropractors Association, transition to the new legislation in under way.<br>http://www.mbchiro.org/ | **Manitoba Chiropractors Association**: **Code of Ethics** [13]<br>http://www.mbchiro.org/docs/Approved-Code-of-Ethics.pdf<br><br>II Principles<br><br>1. Patient autonomy and informed consent (…) A chiropractor shall respect the patient's right to participate in treatment decisions, to be informed of the potential risks and benefits of treatment options and venue, and to accept or refuse such treatment.<br><br>III. Responsibilities and Accountability<br><br>A. RESPONSIBILITY TO PATIENTS<br><br>Article 4 Informed Consent to Treatment<br><br>(a) Chiropractors must discuss with patients treatment recommendations including benefits, prognosis and significant risks, as well as reasonable alternatives and associated costs to enable patients to make an informed decision with regard to any proposed chiropractic care. |
| **Québec**<br><br>**1- Civil Code** [19] (subjects all citizens)<br>a. 3, 10, 11 (establish the right to the inviolability, integrity and privacy of his person).<br>https://www.canlii.org/en/qc/laws/stat/cqlr-c-c-1991/latest/cqlr-c-c-1991.html?autocompleteStr=civil%20code&autocompletePos=1<br><br>**2- Professional Code** [20] (subjects members of all orders)<br>a. 87**:** The board of directors (of the professional order) must make, by regulation, a code of ethics governing the general and special duties of the professional towards the public, his clients and his profession.<br>https://www.canlii.org/en/qc/laws/stat/cqlr-c-c-26/latest/cqlr-c-c-26.html?autocompleteStr=professional%20code&autocompletePos=1<br><br>**3- Chiropractic Act** [21]<br>http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=2&file=/C_16/C16_A.html<br><br>2. All persons qualified to practise chiropractic in Québec constitute a professional order called the "Ordre professionnel des chiropraticiens du Québec" or the "Ordre des chiropraticiens du Québec".<br>1973, c. 56, s. 2; 1977, c. 5, s. 229; 1994, c. 40, s. 284.<br><br>3. Subject to the provisions of this Act, the Order and its members shall be governed by the Professional Code (chapter C-26).<br>1973, c. 56, s. 3 | **Quebec Board of Chiropractors: Code of Ethics of Chiropractors** [22]<br>http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=3&file=/C_16/C16R5_1_A.HTM<br><br>**a. 43** Prior to the examination or treatment proposed, chiropractors must obtain from the patient a written, free and enlightened consent after having informed the patient of the nature of the problem to be treated, the treatment procedure and the potential benefits and risks. Chiropractors must also inform their patient that their consent may be revoked at any time and that any material change in the treatment plan agreed to requires a separate consent.<br><br>**Association des chiropraticiens du Québec : Chiropractors' Manual (adopted by the Québec Board of Chiropractors)** [23]<br><br>Since the Manual is a summary of accepted standards of practice, and procedures and services performed in the daily practice of clinical chiropractic, it must be used in accordance with the laws and regulations which govern chiropractic in their resident province or state. |
| **Nova Scotia: Chiropractic Act** [27]<br>http://nslegislature.ca/legc/statutes/chiropractic.pdf<br><br>4 (1) The Nova Scotia College of Chiropractors is hereby created and established as a body corporate and is composed of the members on the register created under the former Act.<br><br>(3) In order that the public interest may be served and protected, the objects of the College are to<br>(b) establish, maintain and develop standards of knowledge and skill among its members;<br>(c) establish, maintain and develop standards of qualification and practice for the practice of chiropractic;<br>(d) establish, maintain and develop standards of professional ethics among its members; | **Nova Scotia College of Chiropractors**<br><br>**1- Code of Ethics** [28] (approved by the Board of the NSCC; effective June 2002)<br>http://www.chiropractors.ns.ca/images/stories/NSCC_Members/NSCC_Code_of_Ethics.pdf<br><br>a. 4: The ethical chiropractor will show concern and care for his/her patients, and will share information, whenever possible, so that his/her patients can make appropriate decisions regarding his or her care.<br><br>**2- Standards of practice on informed consent** [29] (approved by the Board of the NSCC April 20 2002)<br>http://www.chiropractors.ns.ca/images/stories/NSCC_Members/Standards_of_Practice/05__Standards_of_Practice__Informed_Consent.pdf |

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|---|---|
| **Prince Edward Island**<br><br>**1- Consent to Treatment and Health Care Directives Act** [30] (subjects all health care providers)<br>http://www.gov.pe.ca/law/statutes/pdf/c-17_2.pdf<br><br>This act *creates a uniform set of rules for consent to treatment*.<br><br>**2- Chiropractic Act** [31]<br>https://www.canlii.org/en/pe/laws/stat/rspei-1988-c-c-7.1/latest/rspei-1988-c-c-7.1.html?searchUrlHash=AAAAAQAlcHJpbmNlLWVkd2FyZC1pc2xhbmQgY2hpcm9wcmFjdGljIGFjdAAAAAAB<br><br>3. (1) The Prince Edward Island Chiropractic Association is continued as a body corporate<br><br>5. (1) There is established a council to be known as the Council of the Prince Edward Island Chiropractic Association (2) The functions of the Council are to Council (…) (d) establish, or adopt from another regulating body in another jurisdiction, professional ethical guidelines and standards of practice respecting the practice of chiropractic; | **Prince Edward Island Chiropractic Association**<br><br>**By-law: 2004-1: Memberships** [32]<br><br>By-law passed membership vote at Annual General Meeting on January 14, 2004<br>By-law in effect as of date vote: January 30, 2004:<br><br>All registered chiropractors of the PEICA must be members of CFCRB (the Canadian Federation of Chiropractic Regulatory Board), the CCA (the Canadian Chiropractic Association) and retain mal-practice insurance with CCPA (the Canadian Chiropractic Protective Association). |
| **Newfoundland and Labrador**<br><br>**1- Chiropractors Act 2009** [33]<br>https://www.canlii.org/en/nl/laws/stat/snl-2009-c-c-14.01/latest/snl-2009-c-c-14.01.html<br><br>**2- Chiropractors regulation** [34]<br>Under the authority of section 15 of the *Chiropractors Act* and the *Subordinate Legislation Revision and Consolidation Act* : Improper conduct shall include a. 10 (t) : conduct contrary to the Code of Ethics set by the Canadian Chiropractic Association (CCA) http://www.assembly.nl.ca/legislation/sr/regulations/rc961101.htm | **Newfoundland and Labrador Chiropractic Association**<br><br>All chiropractors' obligations are set by the *Chiropractors Act* and the Chiropractors Regulations. |
| | |
| **Yukon: Chiropractors Act** [37]<br>http://www.gov.yk.ca/legislation/acts/chiropractors.pdf<br><br>a. 5 : The Code of Ethics and guidelines of the Canadian Chiropractic Association shall be the code of ethics and guidelines to be followed by chiropractors. S.Y. 1999, c.11, s.12. | All chiropractors' obligations are set by the *Chiropractors Act*. |
| **North West Territories**<br><br>Nil | Nil |
| **Nunavut**<br><br>Nil | Nil |

## Discussion

First, in this review, we have highlighted the fact that several Canadian provinces have enacted informed consent legislations that apply to all health care professionals. Second, all chiropractic licensing bodies have adopted regulations and codes of ethics that specifically address the issue of informed consent in the health care context. Generally speaking, all of these statutes have an objective to organize the common law rules regarding informed consent as enunciated in *Reibl v. Hughes*.[38] This decision of the Supreme Court of Canada is of considerable importance because it recognizes that informed consent requires health care practitioners to inform their patients of risks that the "reasonable person in the position of the patient" would want to know and to ensure that their patients have understood the information that has been disclosed. This

represents a significant change from a paternalistic perspective to informed consent toward a more patient-centered approach.

Chiropractic licensing bodies ensure the patients' right to be informed and the need for the health practitioner to know how to fully comply with his or her duty of disclosure. In sum, the basic principles of Canadian chiropractic informed consent procedures and policies do not differ from allopathy and cover the essentials of the Supreme Court of Canada decision.[38]

However, with 13 different jurisdictions (10 provinces and 3 territories), the format of those statutes may vary greatly from one region to another since health regulation is a provincial/territorial responsibility. This heterogeneity in statutes may lead to large variations in the day-to-day implementation of sound informed consent procedures. In Canada, approximately 87%[b] of chiropractors have professional liability protection from the Canadian Chiropractic Protective Association, a mutual defence association which is governed by a council of chiropractors. For the benefit of its members, this association has published in October 2015 a revised version of its informed consent form.

This form reflects actual knowledge regarding chiropractic informed consent and represents what patients should know regarding their chiropractic care. The most significant change from the last version is a statement that patients should not sign the consent form before they have had an opportunity to speak to their chiropractor first. In other words, the consent form should never be signed during patient intake since obtaining informed consent requires that the patient understands the diagnosis, proposed treatment, alternatives and plan management. It is important to remember that informed consent is a process and not just a one-time event.

We suggest that chiropractic regulatory bodies and associations encourage chiropractors to use the documentation created by the Canadian Chiropractic Protective Association (CCPA) whether or not they get their professional liability coverage from this provider. However, Canadian chiropractors must ensure that the documentation complies with the nuances of their province/territory regulations. Also, they must ensure the understanding of these documents by their patients and cannot be content to provide information without explanation.

Chiropractic care remains unregulated in the Northwest Territories and Nunavut. According to our respondents, only a handful of chiropractors are practicing in those areas but patients receiving chiropractic care in those two regions are entitled to the same protection as those in the rest of Canada. We suggest that the Canadian chiropractic profession makes an in-depth analysis of this issue in order to ensure that patients in those regions are covered by the same standards of care than in the rest of Canada.

## Conclusion

Chiropractic is a well-organized profession in Canada. In terms of informed consent, provincial and territorial regulations and profession-based standards ensure that chiropractic patients receive and understand all pertinent information related to their care. However little data exists on how chiropractors implement those procedures. Studies should be conducted to measure the compliance of chiropractors to informed consent standards.

## References:


1. Caspi O, Holexa J. Lack of standards in informed consent in complementary and alternative medicine. Complement Ther Med. 2005; *13*(2), 123-130.
2. Caspi O, Shalom T, Holexa J. Informed consent in complementary and alternative medicine. Evid Based Complement Alt Med. 2011. 170793. doi:10.1093/ecam/nep032.
3. British-Columbia, *Health Professions Act*, RSBC 1996, c 183.
4. College of Chiropractors of British-Columbia Bylaws.
5. College of Chiropractors of British-Columbia. *The Professional Conduct Handbook*.
6. Alberta, *Health Professions Act*, RSA 2000, c H-7.
7. Alberta *Chiropractic Profession Act*, RSA 2000, c C-13.
8. Alberta College and Association of Chiropractors, Standards of Practice 2014.
9. Alberta College and Association of Chiropractors, Code of Ethics 2012.
10. Saskatchewan, *The Chiropractic Act*, 1994, SS 1994, c C-10.1.
11. Chiropractors' Association of Saskatchewan, Policy on Informed Consent 2014.
12. Manitoba, *The Chiropractic Act*, 2008, CCSM c C100.
13. Manitoba Chiropractors' Association Code of Ethics 2008.


[b] Estimation of percentage. CCPA membership = 7 300 (CCPA website, members section, as of July 2015). Total number of Canadian chiropractors = 8 400 (Canadian Chiropractic Association website as of July 2015, http://www.chiropractic.ca/blog/social-media/)

14. Ontario, *Regulated Health Professions Act,* 1991, SO 1991, c 18.
15. Ontario, *Health Care Consent Act*, 1996, SO 1996, c 2, Sch A.
16. Ontario, *Chiropractic Act*, 1991, SO 1991, c 21.
17. College of Chiropractors of Ontario, Standards of Practice 2009.
18. Ontario Chiropractic Association Code of Ethics 2013.
19. *Civil Code of Québec*, CQLR c C-1991.
20. Québec, *Professional Code*, CQLR c C-26.
21. Québec, *Chiropractic Act*, CQLR- c C-16.
22. Québec Board of Chiropractors, Code of Ethics of Chiropractors.
23. Chiropractors' Manual. Ville d'Anjou, Association des chiropraticiens du Québec 1990.
24. New-Brunswick, *An Act to Incorporate the New-Brunswick Chiropractors Association*, 1997, c C-69.
25. New-Brunswick Chiropractors' Association, Bylaws 2009.
26. New-Brunswick Chiropractors' Association, Code of Ethics 2010.
27. Nova Scotia, *Chiropractic Act*, SNS 1999, c 4.
28. Nova Scotia College of Chiropractors, Code of Ethics 2002.
29. Nova Scotia College of Chiropractors, Standards of Practice on Informed Consent 2002.
30. Prince Edward Island, *Consent to Treatment and Health Care Directives Act*, C-17.2.
31. Prince Edward Island, *Chiropractic Act*, RSPEI 1988, c C-7.1.
32. Prince Edward Island Chiropractic Association, personal communication.
33. Newfoundland and Labrador, *Chiropractors Act*, SNL 2009, c C-14.01.
34. Newfoundland and Labrador, Chiropractors Regulations.
35. Canadian Chiropractic Association, Code of Ethics.
36. Canadian Chiropractic Association, Position Statement on Patient-centred Practices, para. 4.
37. Yukon, *Chiropractors Act*, RSY 2002, c 32.
38. *Reibl v. Hughes*, [1980] 2 SCR 880, 1980 CanLII 23 (SCC).

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# Pathological burst fracture in the cervical spine with negative red flags: a case report

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Objective: *To report on a case of a pathological burst fracture in the cervical spine where typical core red flag tests failed to identify a significant lesion, and to remind chiropractors to be vigilant in the recognition of subtle signs and symptoms of disease processes.*

Clinical Features: *A 61-year-old man presented to a chiropractic clinic with neck pain that began earlier that morning. After a physical exam that was relatively unremarkable, imaging identified a burst fracture in the cervical spine.*

Intervention & Outcomes: *The patient was sent by ambulance to the hospital where he was diagnosed with multiple myeloma. No medical intervention was performed on the fracture.*

Summary: *The patient's initial physical examination was largely unremarkable, with an absence of clinical red flags. The screening tools were non-diagnostic. Pain with traction and the sudden onset of symptoms*

Objectif : *Présenter un cas de fracture-éclatement pathologique dans la colonne cervicale où les tests de base pour révéler des signes alarmants n'ont pas réussi à identifier une lésion significative, et rappeler les chiropraticiens à être vigilants dans la reconnaissance des signes et symptômes subtils des processus pathologiques.*

Caractéristiques cliniques : *Un homme âgé de 61 ans s'est présenté à une clinique de chiropratique avec une douleur cervicale qui a commencé tôt le matin. Après un examen physique relativement banal, l'imagerie a révélé une fracture-éclatement du rachis cervical.*

Intervention et résultats : *L'ambulance a transporté le patient à l'hôpital où il a reçu un diagnostic de myélome multiple. Aucune intervention médicale n'a été effectuée sur la fracture.*

Résumé *L'examen physique initial du patient était banal et sans signes alarmants cliniques. Les outils de*

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*prompted further investigation with plain film imaging of the cervical spine. This identified a pathological burst fracture in the C4 vertebrae.*

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KEY WORDS: chiropractic, burst fracture, red flags

*dépistage n'ont pas pu diagnostiquer. La douleur avec la traction et l'apparition soudaine de symptômes ont incité un examen plus approfondi avec l'imagerie par radiographie du rachis cervical. Cela a révélé une fracture-éclatement pathologique dans la vertèbre C4.*

(JCCA. 2016;60(1):81-87)

MOTS CLÉS : chiropratique, fracture-éclatement, signes alarmants

## Introduction

Chiropractors are manual therapists trained in the diagnosis and treatment of musculoskeletal conditions. In order to elicit an appropriate diagnosis, chiropractors rely heavily on the history the patient provides. This includes the mechanism of injury, temporal onset, aggravating and relieving factors, and psychosocial influences. The presence of serious pathology includes, but is not limited to: (1) pain that is worse during rest versus activity, (2) pain that is worsened at night or not relieved by any position, (3) a poor response to conservative care including a lack of pain relief with prescribed bed rest, or (4) poor success with comparable treatments.[1] It is well documented[2,3] that in chronic conditions patient self-reporting is accurate, as care is a habitual part of their daily lives. The history accounts for 82% of the diagnosis, with the physical exam used to help verify the anticipated diagnosis.[3] A physical exam that follows an adequate history is usually confirmatory rather than exploratory.[4]

Specific historical considerations should include the patient's history, the report of the present complaint, and additional work-up such as imaging and blood work.[1] When the physical exam does not confirm the suspected diagnosis, further investigation is required. For chiropractors, radiological plain film imaging is used to assess bone health and to screen for underlying pathology. If there is any indication for further work-up, such as blood work or advanced imaging, inter-professional collaboration with other health care professionals is crucial.

The objective of this case report is two-fold. The first is to highlight the need to be vigilant in recognizing and responding to subtle signs and symptoms of disease processes. The second is to remind clinicians to rely on all of their assessment tools, including radiographic imaging, if orthopaedic tests are of limited value.

## Case Presentation

A 61-year-old retired male presented to a chiropractic clinic in the mid-morning, complaining of dull, achy cervicothoracic discomfort in the left upper scapular area. He came to the clinic wearing a soft cervical collar. The pain began early that morning when the patient sat up in bed from a supine position, turned to step out and heard what he described as a "crunch-like" sound. There was an immediate reaction including sweating and dizziness, lasting five minutes. Slight pain relief was achieved by taking two Tylenol 3s and pressing his occiput against the edge of the bed. The patient described an inability to find a comfortable position for his neck, and rated his pain at 7/10 on the VAS that was constant. Coughing aggravated the pain in the mid-cervical spine. Slight weakness was reported when picking up a glass of water with his left hand; however, this was not consistent throughout the morning. Otherwise, there were no neurological symptoms described in the upper limb, lower limb, or cranium.

His past health history was unremarkable. The patient described having a cold for approximately three weeks in advance of the date of presentation, but felt well on that day. Approximately fifteen years previously, he had a mole removed from his nose that was determined to be pre-cancerous. The patient had an active lifestyle including a healthy diet, regular exercise, no smoking, and social alcohol consumption. He was pre-diabetic and overweight. This was his first chiropractic visit.

A post-history differential list included compression fracture, grade two mechanical neck pain, and strain of

the cervicothoracic musculature. Prior to the physical examination, the patient removed the collar himself and went through active ranges of motion that was painless with only a mild limitation at end range globally. A full neurological examination of the upper and lower limb was intact, and bilaterally symmetrical. Plantar reflexes were down going, and Hoffman's test was negative. Valsalva and spinal percussion tests were negative. There was mild muscle spasm in the trapezius and cervical paraspinals bilaterally. Axial compression of 2-3 lbs of pressure did not contribute to or alleviate his symptoms. Cervical traction was painful. The examination was tiring for the patient, however, no motor weakness was found. The physical exam was unable to rule out compression fracture.

The patient replaced his collar and was sent for cervical spine films to a chiropractic radiologist. While the anterior-posterior open mouth image (Figure 1) was read as normal except for general osteopenia, a burst fracture of C4 vertebrae was visualized on the remaining images (Figures 2 & 3). The chiropractic radiologist conferred with the referring chiropractor, and emergency measures were taken including re-collaring the patient and having him transferred by ambulance to the hospital. The chiropractic radiologist then conferred with the radiologist at the hospital and was able to provide collaborated evaluation.

Following advanced imaging it was determined the patient had multiple myeloma in his cervical spine, thoracic spine and ribs. At the hospital he was put into a hard collar and developed hard radicular signs and pneumonia by nightfall. Due to the complexity of the lesion and the pneumonia, the burst vertebra was unable to be managed operatively at that time.

## Discussion

This patient presented with acute neck pain without radiation after waking up that morning. The physical exam was surprisingly non-conducive, given the diagnosis. The significant physical exam findings were increased pain with traction despite painless range of motion, negative spinous percussion test, and a normal neurological exam. It is pertinent to recognize there is limited strength in many of the tests that are presented, including differentiating a fracture of the cervical spine.

Hoffman's sign is an indication of an upper motor neuron lesion. However, Hoffman's sign may be positive in patients who have hyperthyroidism, anxiety, and patients who have had previous cervical spine surgery.[5] Further studies have indicated that Hoffman's sign, in absence of other clinical signs and indications, is not a reliable test[6], with a sensitivity range of 33-58% and a specificity of 59-78%[7]. Spinal percussion has no evidence for use in the cervical spine. In the lumbar spine, there are mixed reviews as to whether spinal percussion has diagnostic significance. In one study by Langdon in 2010, spinal percussion was found to be diagnostic for upper lumbar osteoporotic compression fractures with a sensitivity of 87.5% and a specificity of 90%.[8] Another study, however, suggested spinal percussion may not be diagnostic as previously thought.[9] Downie *et al*.[9] in 2013 found it is more likely that a fracture will be present if the patient is older than 65 years, has a history of prolonged corticosteroid use, had significant trauma or visible con-

Figure 1.
*Anterior-Posterior Open Mouth Plain Film Image: Read as osteopenic, otherwise normal.*

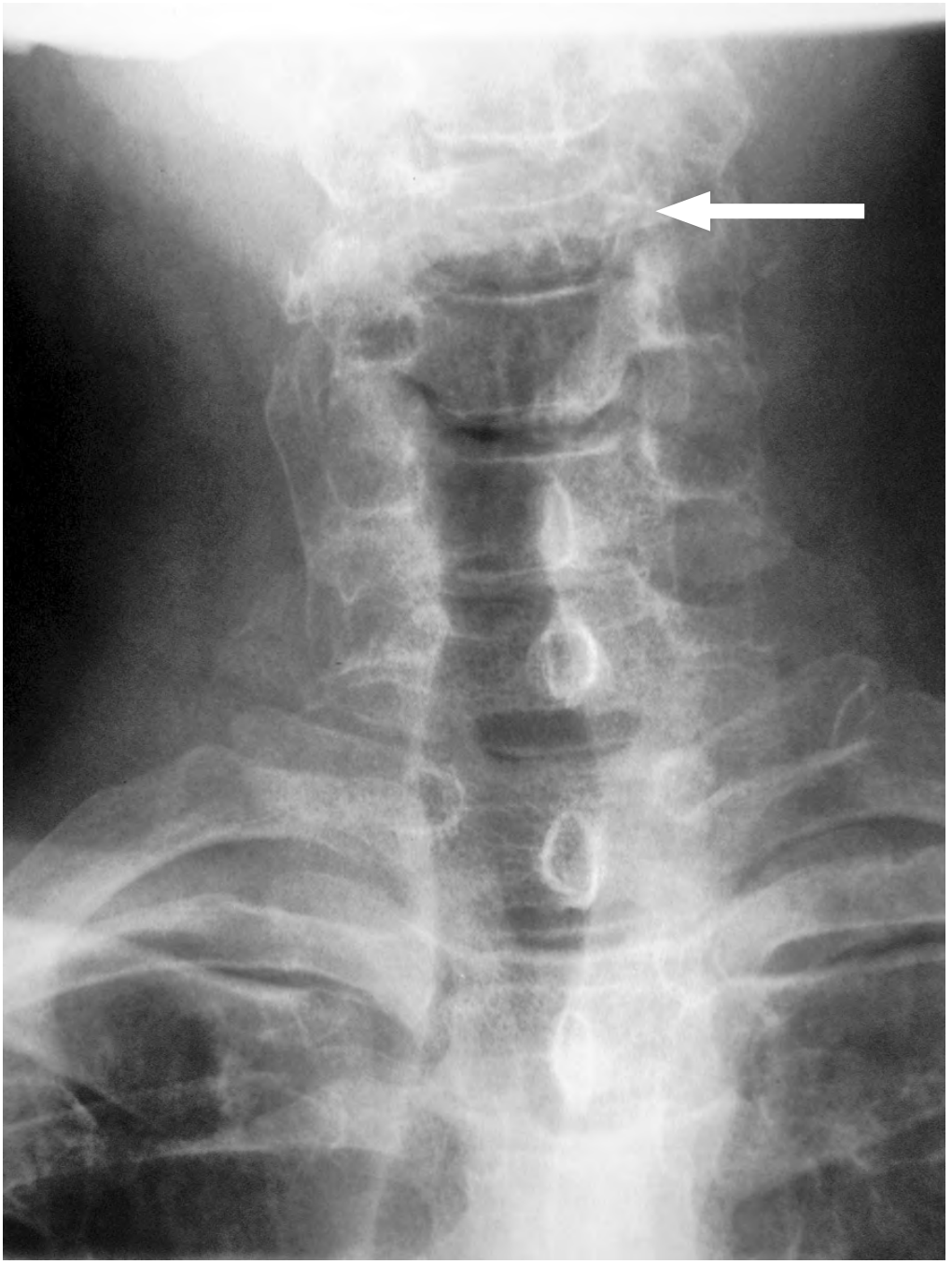

Figure 2.
*Anterior Posterior Cervical Spine: Decreased vertebral body height of C4(arrow), moderate degenerative joint disease of the Lushka and facet joints at C4-5, C5-6, and generalized osteopenia, deviation of the tracheal air shadow to the right.*

tusions. Additional tests used in this case were valsalva, axial distraction, and axial compression. These tests are used primarily to differentiate radiculopathy from a central cord pressure (whether from space occupying lesion or disc herniation). The valsalva test has been found to have 22% sensitivity and 95% specificity.[7] Axial distraction has 44% sensitivity, and 90% specificity[7], and axial compression has a sensitivity of 25-50% and a specificity

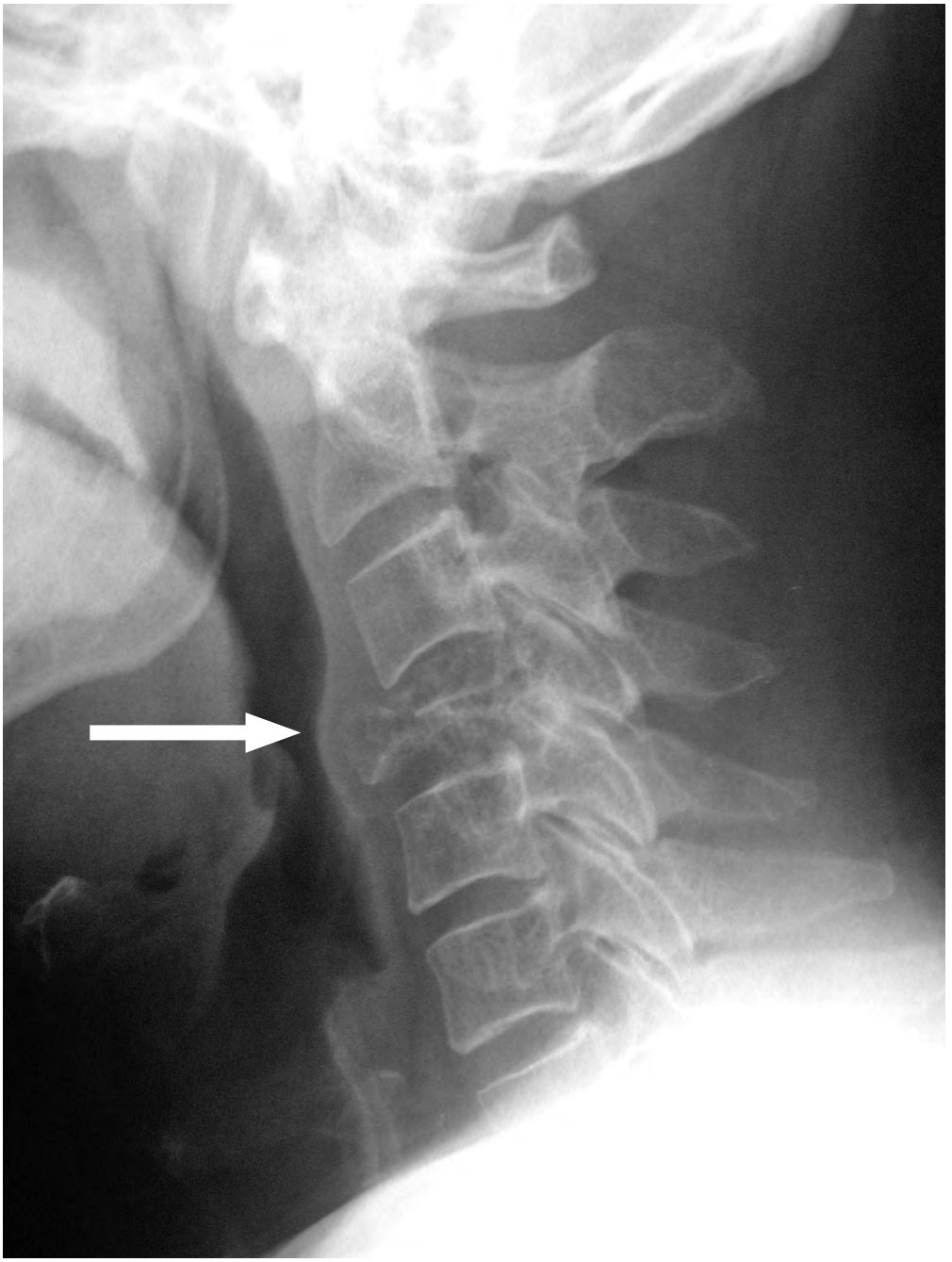

Figure 3.
*Lateral Cervical Spine Plain Film Image: Severe pathologic compression fracture of C4 vertebral body, increase in the AP dimension (arrow) with focal anterior displacement of the retropharyngeal soft tissue, posterior displacement of the posterior wall of the vertebral body compromising the spinal canal, moderate to severe generalized osteopenia, with a decrease in cervical lordosis.*

of 40-64%[10]. Overall, the tests applied in this case tend to have low sensitivity, and moderate to high specificity when testing for cord compression to the cervical spine.

A burst fracture is a specific form of compression fracture that requires considerable forces of axial compression and flexion in healthy bone.[11] Due to the amount of force required, a comminution of the vertebral body occurs with fragments migrating centrifugally.[11] Poster-

iorly displaced fragments of bone may create extrinsic pressure on the ventral surface of the spinal cord, causing significant neuropathy.[11] Up to 50% of burst fractures can cause neurological injury depending on the diameter of the fracture, and how much it occludes the spinal canal[11], however, this patient had a normal neurological exam.

In some cases with variable history or unclear mechanisms of injury, it is difficult to discern whether or not imaging is indicated for the patient. Screening tools and guidelines have been developed to determine whether or not radiographic imaging is required. The Canadian C-Spine Rules (CCSR) and the National Emergency X-Radiography Utilization Group (NEXUS) have been designed to help establish whether or not low-risk patients require cervical spine imaging.[12] The CCSR has been found to be superior to the NEXUS Guideline in a population of over 8000 patients.[13] It had a higher sensitivity and specificity, and only missed one patient when used by physicians compared to sixteen patients missed when using the NEXUS. The CCSR is an algorithm that asks three 'yes/no' questions (See Figure 4). One study indicated that doctors were able to effectively use this screen 83% of the time, and were able to reduce emergency room cervical spine imaging by 13% without adverse event.[13]

Multiple myeloma (MM) is the most common primary malignant spinal tumour in adults.[14] It is twice as common in males and typically onsets in the sixth decade.[15] MM makes up 15-20% of all haematological cancers with an average 5-year survival rate of 15-20%.[16] The classic presentation of a patient with MM is severe bone pain that is aggravated by activity and relieved by rest, though according to one study, this is only seen in 67%.[17] Other symptoms, though less common, include dyspnea, fatigue, asthenia, and weight loss.[17] This patient's presentation did not indicate how advanced the disease was.

Blood work tends to have a serum M-protein spike of IgG, Bence Jones proteinuria, hypercalcemia and hyperuricemia.[18] On imaging, a classic case of multiple myeloma would have multiple, permeative lesions, osteopenia, and sharply circumscribed osteolytic defects.[11] In the spine, multiple myeloma will affect any region of the spine appearing as osteopenic vertebrae early in the process, with inevitable progression to pathological vertebral collapse.[11] Multiple myeloma can be identified from an insufficiency fracture by the loss of posterior vertebral body height.[11] The prognosis of MM was very poor ten

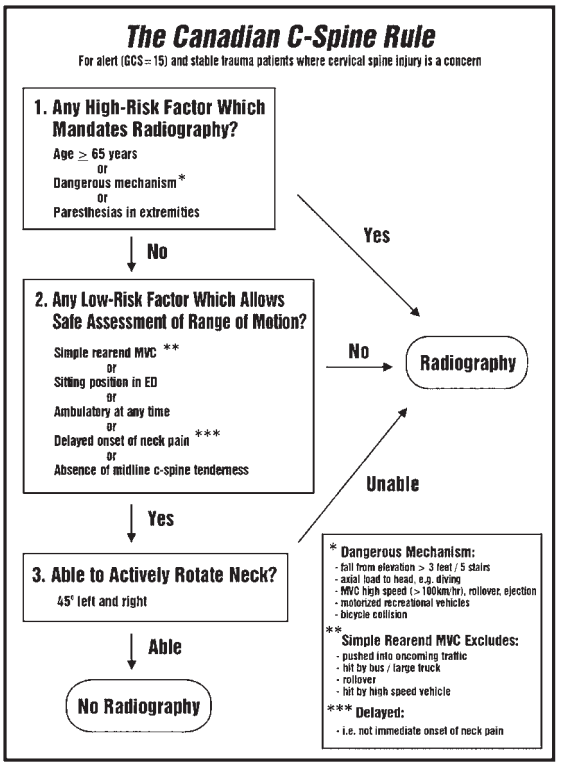


Figure 4.
*The Canadian C-Spine Rules Algorithm (Stiell, 2009)*[13]

years ago, with <10% surviving past 3 years[11] however, recent advances have improved survival rates to a median value of 10 years[19].

Two additional case reports in the last decade describe the presence of cervical spine pathological burst fracture in a medical setting by specialists.[20,21] However, the authors of this paper believe the presented case to be the first description of an initial presentation of a pathological burst fracture to a primary-contact conservative care facility. This should affect the decision making of all manual therapy practitioners when considering differentials of rare but serious pathology as they may not possess traditional history red flags, nor possible signs on examination.

## Summary

A 61-year-old male presented to a chiropractic clinic for management of acute neck pain. The history revealed a

'crunch' sound when getting out of bed that morning. There were no red flags in the history. The physical exam identified traction was aggravating, but was otherwise non-conducive. This case should serve as a reminder that in some circumstances, orthopaedic tests may be of limited clinical value. Practitioners need to be diligent in their clinical assessment of patients to be aware of subtle signs of disease processes. It also serves as a reminder to clinicians that these rare cases do present to our offices and radiographic intervention is still the diagnostic tool of choice to confirm a pathological fracture diagnosis.

## References:


1. Sizer, PS, Brismée J, Cook, C. Medical screening for red flags in the diagnosis and management of musculoskeletal spine pain. Pain Practice. 2007; 1: 53-71.
2. Hampton JR et al. Relative contributions of history-taking, physical examination, and laboratory investigation to diagnosis and management of medical outpatients. BMJ. 1975; 2(5969): 486-489.
3. Kehoe R et al. Comparing self-reported and physician-reported medical history. Am J Epidemiol . 1994; 139(8): 813-818.
4. Keitz SA. The rational clinical examination: Evidence-based clinical diagnosis. New York: McGraw-Hill Medical, eBook Collection, 2009. 1-16.
5. Barman B. Clinical signs revisited. Ind J Med Spec.. 2010; 1(1): 44-45.
6. Glaser JA et al. Cervical spinal cord compression and the Hoffman sign. Iowa Orthop J. 2001; 21: 49.
7. Simpson R, Gemmell H. Accuracy of spinal orthopaedic tests: a systematic review. Chiropr Man Ther. 2006; 14(1): 26.
8. Langdon J et al. Vertebral compression fractures–new clinical signs to aid diagnosis. Ann Royal Coll Surg Engl. 2012; 92(2): 163.
9. Downie A et al. Red flags to screen for malignancy and fracture in patients with low back pain: systematic review. BMJ. 2013; 347: f7095.
10. Viikari-Juntura E, Porras M, Laasonen EM. Validity of clinical tests in the diagnosis of root compression in cervical disc disease. Spine. 1989; 14(3): 253-257.
11. Yochum TR, Rowe LJ. Essentials of skeletal radiology. 3rd ed. Baltimore: Lippincott Williams & Wilkins, 1987. 1168-1177.
12. Stiell IG et al. The Canadian C-spine rule versus the NEXUS low-risk criteria in patients with trauma. New Engl J Med. 2003; 349(26): 2510-2518.
13. Stiell IG et al. Implementation of the Canadian C-spine rule: prospective 12 centre cluster randomised trial. BMJ. 2009; 339: b4146.
14. Southerst D, Dufton J, Stern P. Multiple Myeloma presenting as sacroiliac joint pain: a case report. J Can Chiropr Assoc. 2012; 56(2): 94.
15. Kyle RA. Multiple myeloma: review of 869 cases. Mayo Clin Proc. 1975; 50(1): 29-40.
16. Becker N. Epidemiology of multiple myeloma. Multiple Myeloma. Springer Berlin Heidelberg. 2011: 25-35.
17. Kariyawasan CC et al. Multiple myeloma: causes and consequences of delay in diagnosis. QJM. 2007; 100(10): 635-640.
18. Kyle RA, Rajkumar SV. Criteria for diagnosis, staging, risk stratification and response assessment of multiple myeloma. Leukemia. 2009; 23(1): 3-9.
19. Rajkumar SV, Gahrton G, Bergsagel PL. Approach to the treatment of multiple myeloma: a clash of philosophies. Blood. 2011; 12: 3205-3211.
20. Wegener, et al. Cervical spine metastasis of multiple myeloma: a case report with 16 years of follow-up. Spine. 2004 29(17): 368-72.
21. Berg AJ. Complete C4 vertebral body destruction: a dramatic finding in a patient with a new diagnosis of myeloma. BMJ Case Rep. 2014; bcr2013203108

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# A single cohort prospective trial of the immediate effects of spinal manipulation on visual acuity

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Introduction: *There is no high quality evidence on which to judge the generalizability of isolated reports of improvement in vision following manipulation. The current paucity of research results also precludes the thoughtful design of a controlled, prospective clinical study. Hence, the purpose of the current study was to test the feasibility of conducting a clinical trial of the acute effects of spinal manipulation on visual acuity.*

Methods: *New adult patients presenting to a community based chiropractic clinic were recruited into a single cohort prospective trial to determine the immediate effects of cervical spinal manipulation on visual acuity.*

Results: *The experimental protocol was well accepted by patients and caused minimal or no disruption of the clinic routine. By some measures, chiropractic treatment was accompanied by statistically significant improvements in visual acuity.*

Introduction : *Il n'y a pas de preuves de grande qualité permettant d'évaluer la généralisation de quelques rapports d'amélioration de la vision après la manipulation. La rareté actuelle des résultats de recherche empêche également la conception réfléchie d'une étude clinique éventuelle contrôlée. Par conséquent, l'objectif de la présente étude était de tester la faisabilité d'un essai clinique sur les effets aigus de la manipulation vertébrale sur l'acuité visuelle.*

Méthodologie : *De nouveaux patients adultes qui s'étaient adressés à une clinique chiropratique communautaire ont été recrutés dans une étude de cohorte prospective afin de déterminer les effets immédiats de la manipulation vertébrale cervicale sur l'acuité visuelle.*

Résultats : *Le protocole expérimental a été bien accepté par les patients et n'a pas du tout perturbé la routine de la clinique. Selon certaines mesures, le traitement chiropratique a été accompagné par une amélioration statistiquement significative de l'acuité visuelle.*

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Discussion: *The results of this study indicate that it is quite feasible to conduct a prospective, community based clinical study of the acute effects of spinal manipulation on visual acuity.*

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KEY WORDS: chiropractic; feasibility; pilot study; visual acuity; spinal manipulation

Discussion : *Les résultats de cette étude montrent qu'il est tout à fait possible de mener dans une communauté une étude clinique prospective des effets aigus de la manipulation vertébrale sur l'acuité visuelle.*

(JCCA. 2016;60(1):88-92)

MOTS CLÉS : chiropratique; faisabilité; étude pilote; acuité visuelle; manipulation vertébrale

## Introduction

A number of intriguing case studies have reported instances of visual disorders which apparently commenced at the time of a spinal injury and/or were relieved following manual treatment of a spinal disorder. The particular disorders have been diverse and include glaucoma or otherwise restricted visual fields[1-8], scotoma[9,10], diminished visual acuity[6,11] and diplopia[12]. In some instances it is unclear whether recovery was promoted by or merely coincident with treatment. In other cases, the temporality of events strongly suggests that the treatment contributed to relief of the visual complaint.[1,2,5,8,12] Nonetheless, it is uncertain whether the lessons learned from these interesting cases are generalizable to the wider population. Are responders to spinal manipulation highly prevalent in the general population or are they quite rare?

The generalizability of treatment effects is best determined by prospective studies employing relatively large sample sizes.[13] To date, there has been only one prospective cohort study examining the effects of spinal manipulation on visual acuity.[14] While that study did report some improvement with spinal manipulation, the outcome measure which the authors used was novel and did not take into account the logarithmic scaling of the Snellen eye chart used to measure acuity. Additionally, there was no statistical correction for the multiple comparisons that the authors used, and there was no control cohort. Thus, to date, there is little clinical evidence on which to advocate the consideration of spinal manipulation as an intervention in patients with visual disorders.

The most convincing primary research design in support of a therapeutic intervention is, of course, a randomized controlled trial. Randomization to treatment and control cohorts substantially reduces the influence of bias, and corrects for non-specific effects and natural variability.[13,15] However, randomized controlled clinical trials are complex to manage and expensive to conduct. It would be challenging to justify this expense on the basis of the meager clinical evidence currently available, and without estimates of treatment effects it would be difficult to determine appropriate cohort sizes.[16]

Hence, the purpose of the current study was to test the feasibility of conducting a clinical trial of the acute effects of spinal manipulation on visual acuity, to obtain estimates of treatment effect size, and to determine the effects of small changes in methods of data analysis.

## Methods

### *Patient recruitment*

This study was approved by the Research Ethics Board of Canadian Memorial Chiropractic College. Between September 2012 and February 2013, consecutive new patients presenting to a community based chiropractic clinic in Toronto, Canada were recruited by the clinic receptionist into a single cohort prospective trial to determine the immediate effects of cervical spinal manipulation on visual acuity. Patients were required to be 18 years of age or older, and to have not received cervical spinal manipulation in the previous 3 months. Patients with frank eye disease, other than diminished visual acuity, were excluded. No other exclusion criteria were applied. Twenty-three patients who elected to participate in the study provided written informed consent.

### *Experimental procedure*

Immediately prior to chiropractic examination and treatment, visual acuity was assessed by one of two investiga-

Table 1.
*Visual acuity pre- and post-treatment.*

| | Outcome Measure | Pre-treatment Mean +(S.D.) | Post-treatment Mean +(S.D.) | p-value |
|---|---|---|---|---|
| 1. Right eye | Snellen fraction | 61 (63) | 52 (56) | 0.059 (t-test) |
| | Snellen line | 5.6 (3.1) | 6.2 (3.3) | 0.006 (t-test) |
| | ETDRS | 70 (20) | 74 (20) | 0.005 (t-test)<br>0.013 (Wilcoxon) |
| 2. Left eye | Snellen fraction | 52 (55) | 54 (54) | 0.075 (t-test) |
| | Snellen line | 6.1 (3.2) | 5.8 (3.2) | 0.110 (t-test) |
| | ETDRS | 74 (20) | 72 (19) | 0.085 (t-test)<br>0.075 (Wilcoxon) |
| 3. Pooled results | ETDRS | 62(16) | 64(18) | 0.024 (Wilcoxon) |

Legend: *Segregated outcomes for the (1.) right and (2.) left eyes were Snellen fraction, Snellen line and Early Treatment Diabetes Retinopathy Study (ETDRS) score. P values were generated using paired, two-tailed t-tests and the Wilcoxon signed rank test. For the (3.) pooled results of right and left eyes with pre-treatment EDTRS score of 80 or less, data were analyzed only with the Wilcoxon signed rank test.*

tors, both chiropractic interns, using a Snellen eye chart. Patients were requested to remove eye glasses before testing, and to stand 20 feet away from a wall-mounted eye chart. With one eye covered, they were then instructed to read the letters on the Snellen chart beginning from the top and largest letter and proceeding to the smallest line they could read. This process was then repeated for the other eye. The visual acuity and Snellen line values for each eye were recorded as the smallest line for which more than half of the letters were read correctly.

Patients were then escorted to the treatment room where they received chiropractic treatment according to their individualized treatment plans and including, but not limited to, cervical spinal manipulation. The treating doctor was unaware of the results of the visual exam. Immediately following treatment, visual acuity was measured again and the patients were released.

### *Data analysis*

Two analyses of the data were performed. First, visual acuity scores for the left and right eyes prior to and following treatment, were compared using the paired, two-tailed t-test and the Wilcoxon signed rank test, where a p-value of 0.05 or less was considered statistically significant. Subsequently, data for patients with an initial Snellen fraction of 20/20 or better were deleted, and the remaining pooled data for the two eyes were compared, pre- and post-treatment, with the Wilcoxon signed rank test. Cohen's d was calculated as a measure of treatment effect size.

## Results

Within the recruitment period, 23 subjects were enrolled and completed the study. There were no drop-outs. The process of vision testing apparently caused minimal or no disruption of the normal clinic routine and was well accepted by patients. In this study, there was no attempt to record adverse events, and none were spontaneously reported by patients. The subjects consisted of 6 males and 17 females aged 22- to 71-years old (mean 43 years, S.D. 17 years). Thirteen subjects routinely wore eyeglasses which were removed prior to testing. One subject wore contact lenses which were not removed. Fifteen of the subjects were naïve to spinal manipulation.

Raw visual acuity data are attached as supplementary file #1. Table 1 shows the summary results for right and left eyes (mean ± standard deviation) in terms of Snellen visual acuity fractions, Snellen line scores and ETDRS

(Early Treatment Diabetic Retinopathy Study) scores. There were no statistically significant changes in any measure of visual acuity in the left eye using either the paired, two-tailed t-test or the Wilcoxon signed rank test (Cohen's d = -0.10). For the right eye, there were statistically significant changes in the Snellen line score and the ETDRS score (Cohen's d = 0.21), but not in the Snellen fraction score.

When data were removed for eyes with an initial Snellen fraction score of 20/20 or better, and the remaining data for the 2 eyes were pooled ('Pooled results,' Table 1), there was a significant improvement (p=0.018 per Wilcoxon signed rank test) in visual acuity for the ETDRS score (Cohen's d = 0.11). There were insufficient remaining data for separate statistical analyses of the left and right eyes.

## Discussion

This study measured immediate changes in visual acuity following chiropractic treatment which included cervical manipulation. Perhaps due to the convenience of the testing process and the fact that pre- and post-treatment measures were taken in a single visit, there were no dropouts and no incomplete data sets. By some measures, with the caveats discussed below, there were immediate improvements in visual acuity following treatment.

A number of previous studies of spinal manipulation and visual acuity have employed eye charts as evaluation tools.[6,11,14] However, caution must be exercised when interpreting the data.[17] The Snellen fraction represents acuity based on the distance at which the subject can resolve a symbol. On the other hand, the physiological basis for acuity is the ability to resolve two points within the visual field (or more precisely on the spherically shaped retina) and hence could more properly be described in terms of angles rather than distance. Thus, Snellen fractions and line scores are logarithmic and cannot be directly interpreted using conventional statistical methods, so that our apparent finding of an improvement in Snellen line score for the right eye (Table 1) is in fact spurious. The same considerations would affect the conclusions of the previous study by Kessinger and Boneva[14] and those case studies which reported raw eye chart data.

In order to apply conventional statistical analyses, such as a t-test or Wilcoxon signed rank test, Snellen data must first be converted to values on a scale which reflects the arc subtended by a line joining two points in the visual field. One such scale is the Early Treatment Diabetic Retinopathy Study (ETDRS) scale.[18] In the current study, when Snellen data were converted to ETDRS scores, there remained a convincing improvement in visual acuity in the right eye according to the paired, two-tailed t-test (p=0.005) or the Wilcoxon signed rank test (p=0.013). Based on a Cohen's d = 0.21, this would be considered a small effect. Given the small number of subjects in this pilot study, it is not possible to determine whether or not the data were truly normally distributed, and so the Wilcoxon test, which is more parsimonious, provides a more rigorous test of statistical significance. Analyzing the data from the two eyes separately is also appealing in terms of statistical rigour, as it allows for a laterality to the clinical phenomena. This would occur in the unlikely event that all left eyes were, on average, inherently different in some regard from right eyes. Analyzing the eyes separately also allows for the less unlikely possibility that eyes respond differently to contralateral versus ipsilateral adjustment and the clinician had a bias (in the scientific sense) for adjusting on one side versus the other.

In our second statistical analysis, we pooled data for the two eyes as if the response of one eye would be independent of the response of its contralateral mate. This may or may not be true in any given patient depending in part upon the cause of their visual deficit. It may, nonetheless, be the preferred practical approach since in everyday life functional visual acuity is essentially determined by the acuity of the 'best' eye.[19] In the second analysis, we used only ETDRS values, and we removed data for eyes with an initial Snellen fraction of 20/20 or better. This step was taken in order to minimize any 'ceiling effect' – if visual acuity was already very good, then there would not be much room for it to improve following any treatment. This selective removal of data necessarily creates a non-Gaussian distribution which requires non-parametric analysis – the Wilcoxon signed rank test. The analysis was based on 30 eyes with pre-treatment ETDRS scores (mean $\pm$ S.D.) of 62 $\pm$ 16 and post-treatment scores of 64 $\pm$ 18. Thus in our second analysis, which we believe to be both more rigorous and realistic, treatment was associated with a statistically significant improvement in visual acuity (p=0.024) which was quite small in terms of treatment effect size (Cohen's d =0.11).

## Conclusions

In summary, this study suggests that it is feasible to measure acute responses to chiropractic treatment in a community-based clinic. Furthermore, a small but statistically significant treatment effect may be achieved with a relatively small number of subjects. In this instance, the treatment effect was quite small, and is of uncertain clinical significance. These results do not speak to long term effects. Additionally, there was no control group in this study and so it is not possible to determine the contribution of a non-specific treatment effect. Overall, however, given the promising pilot data, it would appear reasonable to conduct a larger controlled study of the effects of spinal manipulation on visual acuity and to anticipate convincing acute results, either negative or positive, with a manageable number of subjects. The outcome measure should be a linear measure of visual acuity, such as the ETDRS score, and consideration should be given to the influence of a ceiling effect and to the appropriateness of a non-parametric statistical analysis.

## Competing interests:

All authors declare that they have no competing interests.

## Authors' contributions:

MA, CR and BB all contributed to the design of this study. MA and CR conducted data collection. BB conducted data analysis. MA, CR and BB all contributed to and approved the final manuscript.

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## References:

1. Gorman R, Anderson R, Bilton D, Favoloro R, AJ. P. Case report: spinal strain and visual perception deficit. Chiropr J Aust. 1994;24:131-134.
2. Gorman R. Monocular visual loss after closed head trauma: immediate resolution associated with spinal manipulation. J Manip Physiol Ther. 1995;18(5):308-314.
3. Stephens D. A chiropractor validates the 'tunnel vision information': a report on three patients. The Ophthalmic Research Institute of Australia Meeting; December 1995.
4. Stephens D, Gorman F. The prospective treatment of visual perception deficit by chiropractic spinal manipulation: a report on two juvenile patients. Chiropr J Aust. 1996; 26:82-88.
5. Stephens D, Gorman F. The association between visual incompetence and spinal derangement: an instructive case history. J Manip Physiol Ther. 1997;20(5):343-350.
6. Stephens D, Gorman F, Bilton D. The step phenomenon in the recovery of vision with spinal manipulation: a report on two 13-yr-olds treated together. J Manip Physiol Ther. 1997;20(9):628-633.
7. Conway C. Chiropractic care of a pediatric glaucoma patient: a case study. J Clin Chiropr Ped. 1997;2(2):155-156.
8. Wingfield B, Gorman R. Treatment of severe glaucomatous visual field deficit by chiropractic spinal manipulative therapy: a prospective case study and discussion. J Manip Physiol Ther. 2000;23:428-434.
9. Gorman R. Monocular scotomata and spinal manipulation: the step phenomenon. J Manip Physiol Ther. 1996;19(5):344-349.
10. Gorman R. The treatment of presumptive optic nerve ischemia by spinal manipulation. J Manip Physiol Ther. 1995;18(3):172-177.
11. Stephens D, Pollard H, Bilton D, Thomson P, Gorman F. Bilateral simultaneous optic nerve dysfunction after periorbital trauma: recovery of vision in association with chiropractic spinal manipulation therapy. J Manip Physiol Ther. 1999;22(9):615-621.
12. Tymms G. Visual recovery from diplopia in a 13-year-old following chiropractic intervention. J Clin Chiropr Ped. 2011;12(1):876-878.
13. Papageorgiou S, Antonoglou G, Tsiranidou E, Jepsen S, Jager A. Bias and small-study effects influence treatment effect estimates: a meta-epidemiological study in oral medicine. J Clin Epidemiol. 2014;67:984-992.
14. Kessinger R, Boneva D. Changes in visual acuity in patients receiving upper cervical specific chiropractic care. J Vertebral Subluxation Res. 1998;2(1):43-49.
15. Zhao W. Selection bias, allocation concealment and randomization design in clinical trials. Contemp Clin Trials. 2013;36:263-265.
16. Whitehead A, Sully B, Campbell M. Pilot and feasibility studies: Is there a difference from each other and from a randomized controlled trial. Contemp Clin Trials. 2014;38:130-133.
17. Kaiser P. Prospective evaluation of visual acuity assessment: a comparison of Snellen versus ETDRS charts in clinical practice (an AOS thesis). Trans Am Ophthalmol Soc. 2009;107:311-324.
18. Gregori N, Feuer W, Rosenfeld P. Novel method for analyzing Snellen visual acuity measurements. Retina. 2010;30:1046-1050.
19. Rubin G, Munoz B, BAndeen-Roche K, West S. Monocular versus binocular visual acuity as measures of vision impairment and predictors of visual disability. Invest Ophthalmol Vis Sci. 2000;41(11):3327-3334.

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# Evaluating the feasibility of using online software to collect patient information in a chiropractic practice-based research network

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Background: *Practice based research networks (PBRNs) are increasingly used as a tool for evidence based practice. We developed and tested the feasibility of using software to enable online collection of patient data within a chiropractic PBRN to support clinical decision making and research in participating clinics.*

Purpose: *To assess the feasibility of using online software to collect quality patient information.*

Methods: *The study consisted of two phases: 1) Assessment of the quality of information provided, using a standardized form; and 2) Exploration of patients' perspectives and experiences regarding online information provision through semi-structured interviews. Data analysis was descriptive.*

Contexte : *Les réseaux de recherche basés sur la pratique (RRBP) sont de plus en plus utilisés comme un outil pour la pratique fondée sur des preuves. Nous avons mis en place et évalué la faisabilité de l'utilisation de logiciels pour permettre la collecte en ligne de données de patients dans un RRBP chiropratique à l'appui de la prise de décision clinique et de la recherche dans les cliniques participantes.*

Objectif : *Évaluer la faisabilité d'utiliser des logiciels en ligne pour recueillir des renseignements de qualité sur les patients.*

Méthodologie : *L'étude a consisté en deux phases : 1) l'évaluation de la qualité des renseignements fournis en utilisant un formulaire standardisé; et 2) l'exploration des points de vue et des expériences des patients en ce qui concerne les renseignements fournis en ligne, à l'aide d'entretiens semi-structurés. L'analyse des données était descriptive.*

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Results: *Forty-five new patients were recruited. Thirty-six completed online forms, which were submitted by an appropriate person 100% of the time, with an error rate of less than 1%, and submitted in a timely manner 83% of the time. Twenty-one participants were interviewed. Overall, online forms were preferred given perceived security, ease of use, and enabling provision of more accurate information.*

Conclusions: *Use of online software is feasible, provides high quality information, and is preferred by most participants. A pen-and-paper format should be available for patients with this preference and in case of technical difficulties.*

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key words: chiropractic, practice-based research network, feasibility, upper cervical

Résultats : *Quarante-cinq nouveaux patients ont été recrutés. Trente-six formulaires ont été remplis en ligne et soumis par une personne compétente (100 % du temps), avec un taux d'erreur de moins de 1 %, et soumis dans les délais (83 % du temps). Vingt et un participants ont été interrogés. Dans l'ensemble, les formulaires en ligne étaient privilégiés, compte tenu de la sécurité perçue, la facilité d'utilisation et la disposition des gens permettant de donner des renseignements plus précis.*

Conclusions : *L'utilisation d'un logiciel en ligne est possible. Cela permet de fournir des renseignements de grande qualité et est privilégié par la plupart des participants. Un stylo et une feuille de papier doivent être mis à la disposition des patients qui préfèrent cette forme d'interaction ou en cas de difficultés techniques.*

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MOTS CLÉS : chiropratique, réseau de recherche basé sur la pratique, faisabilité, vertèbre cervicale supérieure

## Introduction

Chiropractors are regulated health professionals in Canada with expertise in the assessment, diagnosis, treatment and prevention of dysfunctions in the structures or functions of the spine, nervous system, and joints.[1] Chiropractors are increasingly playing an important role in the health of Canadians as primary health care providers and are accessed by approximately 11% of the Canadian population annually.[2] As such, provision of evidence based care is of great importance. Practice based research networks (PBRNs) are increasingly recognized as a useful approach in promoting health care quality[3-5] and enabling an evidence-based approach within clinical settings.

A PBRN is a group of independent health care clinicians providing care in community settings that are networked for the purpose of examining and evaluating the health care processes and outcomes that occur within these clinics.[5-7] A PBRN therefore provides a "real world" setting where patients are the study participants, patient outcomes are directly applicable to patient concerns and can be explored and/or measured within the context of their lived experiences.

The development of the one chiropractic PBRN in Canada was initiated in 2009. Founded by two chiropractors, JS and MR (co-authors) based in Alberta and Quebec, respectively, its primary purpose is to facilitate evidence-based practice within participating clinics. The patient information collected through the PBRN will be used to inform clinical decision-making and conduct practice-based research. To date, several clinics have expressed interest in joining the PBRN, indicating its significant potential to collect large amounts of data and create an evidence base directly from practices where it would then be applied.

In order to produce meaningful and useful results, a PBRN requires several key components, including but not limited to: data collection, analysis and management infrastructure; membership of clinics or practices; communication strategies; support staff; and, establishment of collaborative relations between practitioners and researchers.[5,8-10] One of the first steps in establishing this PBRN has been the development and testing of a customized online data collection software to facilitate systematic collection of patient information that is effectively

streamlined into clinical operations. It therefore allows data collected to simultaneously inform clinical decision-making as well as specific analyses aimed at generating a higher level evaluation of clinical outcomes of a practice or group of practices.

Electronic methods of collecting and storing patient data/information are applied in and recommended specifically for PBRNs[11-13] and are increasingly widespread within the health care system[14-17]. Several advantages of electronic data collection are reported in the literature, such as improved data quality, convenience of data collection, potential real time data collection, efficiency of data entry, and expedient transmission and/or access to data across multiple sites.[4,11,13,14,18] Further, the equivalence of computer and pen-and-paper administration of patient reported outcome (PRO) measures has also been demonstrated in context of clinical trials.[17,19,20] Despite the advantages, there are also potential negative impacts of computerization on data quality. For example, small devices may result in the data entry process being slow.[14] There is also potential for measurement error due to factors such poor visibility due to screen size or low contrast, not scrolling down and missing questions, and fast reading or scanning more likely used by internet users .[14,18] Technical challenges may also impede data collection or analysis processes.[4,11]

While research supports the potential usefulness of using electronic devices for data collection, we determined it necessary to assess the quality of the patient information collected with the online software as it was custom built specifically for this PBRN. Information quality is a multi-dimensional construct and directly related to the perceived utility of information for the intended users and for their intended purposes.[14,21] Those aspects of information quality that relate to how the data collection software was coded (i.e., comprehensive, relevant, secure, accessible, reliable, valid and value-added)[22] were accounted for during software development; what has not been determined is whether those aspects of information quality that relate to how information is provided by patients using the software (i.e., complete, timely, provided by an appropriate source and free of error)[22] are sufficient. As such, for clinical and research purposes, there was a need to assess whether it is feasible to use the online software to collect data that is complete, timely, provided by an appropriate source and error free.

Another important aspect that also requires consideration is the patient perspective, specifically, whether patients perceive provision of their own health and personal information through the online software to be appropriate and acceptable. Clinicians and researchers generally perceive electronic modes of data collection as an enabler of PBRN activity[3,4,23], yet there is limited evidence on this issue from the perspective of the patient in the context of PBRNs. While studies in the broader health context suggest that patients are satisfied with an internet-based approach and find it acceptable in completing self-report questionnaires using electronic or online devices[18,24,25], given broader concerns regarding internet security, the accuracy of the information provided is unclear.

The purpose of this study was to assess the feasibility of using the online software to collect patient information for clinical decision-making and practice-based research. The objectives were to:

1) Assess whether information provided by new patients of a PBRN clinic using the online data collection software is timely, provided by an appropriate source, and free of error.
2) Explore and describe experiences and perspectives of new patients of a PBRN clinic using the online data collection software to provide their health information.

## Methods

### *Study design*

We conducted a descriptive feasibility study consisting of two phases. In Phase 1, we aimed to assess in a standardized manner the quality of information provided using the online software. In Phase 2 we aimed to qualitatively describe the perspectives and experiences of patients regarding provision of personal and health information through the online software. Ethics approval was obtained from the Conjoint Research Ethics Board at the University of Calgary (Ethics ID: E24885).

### *Setting*

The study was conducted at one clinic (study site), which is also a launch sites for the PBRN. The study site is a private clinic in Calgary AB, with a team of three chiropractors supported by an administrative team of five chiropractic assistants.

### The online software

The online software was created by a professional developer based in Quebec, Canada, using Wordpress (version 4.2.4) and Gravity Forms (version 1.9). The software functionality, layout, and content was developed in consultation with MR and JS. Two versions of the software were beta tested internally within the private practices of the PBRN founders prior to this study to assess applicability within the practices. The software programming allows for secure collection of demographic, health history, and initial assessment information (i.e. primary complaints, symptoms). There is also built in functionality that allows for the administration of PRO measures, enabling prospective collection of treatment outcomes data. The security of the website is based on password protection for the interface and database and includes HTTPS protocol with encryption.

The content was developed by completing a critical review of the type of information, forms, and questionnaires used in the two clinics. Patient charts were audited to identify response categories to certain questions (for example, reason for seeking care). Through an iterative process engaging the developers, clinicians, and administrative staff, information relevant to practice and useful outcomes measures were determined for inclusion. A list of the forms included in the online software is provided in Table 1.

Table 1.
*Forms and questionnaires collected using the online software*

- Personal information questionnaire (ex. Name, address)
- General health history questionnaire (current and past)
- Specific health history
  - OPQRST (onset, provocation, quality, radiation, severity and time) – neck, headaches, hips, jaw, lower extremities, low back shoulders, mid-back, upper extremities
- RAND SF-36
- Oswestry Low Back Disability Questionnaire
- Neck Disability Index

### Recruitment

Using a convenience sampling strategy, all new patients were approached regarding study participation over five consecutive months (Dec 2013 to May 2014). In Phase 1, our recruitment strategy targeted new patients who used the online forms, were 18 years of age or older, and completed the full initial 8-week course of care. In Phase 2, we expanded our inclusion criteria to also include new patients who completed paper forms.

### Data collection and analysis – Phase 1

Data collection for the study was integrated into the established treatment protocol for new patients and clinical data collection time points. The treatment protocol for new patients involves an initial assessment followed by 10 clinic visits over an eight-week period. Baseline data are collected prior to the first visit and follow up data (outcomes measures only) are collected prior to visit 2, 4 and 10 (see Figure 1). For each study participant, research data was gathered at these 4 time points. As such, there were a total of 144 time points when information was submitted by all participants.

Patients who opted to complete their forms using the pen-and-paper method did so at the office prior to their consultations. Patients who chose to complete their forms online were requested by office administrative staff to do so before a visit (up to 24 hours prior). Administrative staff provided written instructions as to where the online forms could be accessed (website) and how to set up a user account to login. Brief verbal communication was used to provide additional information or answer patients' questions. Patients could use a personal computer device of their choice to access the online forms (e.g. home/work desk top, laptop, tablet etc.). Although preference was for patients to complete the online forms prior to arriving at the office, for those who did not, a tablet with access to the forms was available at the office.

Patients did not receive any training to use the online forms. It was determined training was not necessary for several reasons. First, the content of the on-line forms was based on information previously collected successfully using paper forms. As such the comprehension level was considered acceptable. Further, the forms were based on a basic format of clicking with a mouse to select the most suitable response to a given question. As such, the level of computer literacy was minimal and not beyond what the average user would need to use email.

We assessed three aspects of information quality for data collected using the online forms: timeliness, provision by an appropriate source, and whether it was error

Figure 1.
*Data collection integrated with the standard treatment schedule for new patients*

| | **Treatment Schedule** | **Integration of data collection points** |
|---|---|---|
| | | Pre-consultation (within 24 hrs prior to visit 1):<br>Baseline: demographic info; baseline outcome data collection(Oswestry and RAND SF 36) |
| **Visit 1** | Assessment | |
| | | Within 24 hrs prior to visit 2:<br>Outcomes data collection (Oswestry and RAND SF-36) |
| **Visit 2** | Adjustment 1 | |
| | | |
| **Visit 3** | Re-assessment<br>and<br>adjustment 2 (if needed) | |
| | | Within 24 hrs prior to visit 4<br>Outcomes data collection (Oswestry and RAND SF-36) |
| **Visit 4** | Re-assessment<br>and<br>adjustment 3 (if needed) | |
| | | |
| **Visit 5** | Re-assessment<br>and<br>adjustment 4 (if needed) | |
| | | |
| **Visit 9** | Re-assessment<br>and<br>adjustment 8 (if needed) | |
| | | Within 24 hrs prior to visit 10:<br>Outcomes data collection (Oswestry and RAND SF-36) |
| **Visit 10** | Re-assessment<br>and<br>adjustment 9 (if needed) | |
| | | |
| **Visit 11** | Progress report and future recommendations provided | |

free. We initially included completeness as a fourth criterion; however, as all of the fields in the online form were programmed to be required, assessment of this aspect was not useful. We did not assess information quality for the pen-and-paper forms, as our goal was not to compare information quality across the two methods, but rather asses the quality of information using the online method, in line with the intentions for the PBRN. Timeliness and whether the information source was appropriate (i.e. was the patient the source?) were assessed by administrative staff before a patient visit. Identification of any errors was completed by a treating clinician during the patient visit, by asking the patient random questions to determine whether there were any discrepancies or mistakes between what was indicated on the forms and what the patient reported during the office visit. Data for the three

criteria were recorded on a standardized form developed for this study (the Information Quality Assessment Form (IQAF) - see Appendix 1) and later input into a Microsoft Excel database for analysis. Data analysis was descriptive, reporting on the means and ranges, as indicated.

### *Data collection and analysis – Phase 2*

In the second phase, we iteratively conducted and analyzed semi-structured telephone interviews with the goal to explore patients' perceptions and experiences of providing personal and health information using the online software. In the sample of patients who agreed to study participation, we aimed for a purposive sample with maximum variation in characteristics related to user experiences with the software (to include those who did and did not use the software), internet use, and with a range in age, sex and conditions or symptoms for which treatment was being sought. Each was contacted up to three times by the researcher conducting the interviews (AKR) to schedule a telephone interview. Questions addressed

Appendix 1:
*Information Quality Assessment Form (IQAF)*

Unique Patient Identifier: _____

SECTION 1: COMPLETED AT THE CHIROPRACTIC OFFICE BY ADMINISTRATIVE STAFF BEFORE A PATIENT VISIT

Timeliness: Quality patient information is provided according to the schedule outlined in figure 1

1. Was the demographic information input into the online system by visit 1 (initial assessment appointment)?
   - ☐ Yes
   - ☐ No
2. Was the health history information input into the online system by visit 1 (initial assessment)?
   - ☐ Yes
   - ☐ No
3. Was the initial assessment (i.e. symptoms) information provided by visit 1 (initial assessment)?
   - ☐ Yes
   - ☐ No
4. Was the 2-week outcomes assessment information provided before visit 5 (2 weeks)?
   - ☐ Yes
   - ☐ No
5. Was the 6-week outcomes assessment information provided before visit 10 (7 weeks)?
   - ☐ Yes
   - ☐ No

Appropriateness of information source: Quality information originates from an appropriate source (i.e. the patient)

6. Did the patient input the information on his or her own?
   - ☐ Yes
   - ☐ No. If No, who input the information on behalf of the new patient?

Please record any other comments regarding quality of the information provided by the new patient that you feel has not been captured by this form:

SECTION 2: COMPLETED BY RESEARCH ASSOCIATE OUTSIDE OF A PATIENT VISIT

Completeness: Quality patient information does not include blank values indicating skipped or missed questions.

Specify the number of blanks within each of the following categories:

1. Demographic: _____
2. Health History: _____
3. Initial Assessment: _____
4. Oswestry (week 2): _____
5. Oswestry (week 6): _____
6. RAND SF-36 (week 2): _____
7. RAND SF-36 (week 6): _____
8. Total Blanks (add 1-7 above): _____

Free of error: Quality information is free of spelling and other errors (e.g., incorrect characters) that would prevent interpretation for either clinical decision-making or practice-based research.

Specify the number of responses within each of the following categories that would prevent interpretation for either clinical decision-making or practice-based research:

1. Demographic: _____
2. Health History: _____
3. Initial Assessment: _____
4. Oswestry (week 2): _____
5. Oswestry (week 6): _____
6. RAND SF-36 (week 2): _____
7. RAND SF-36 (week 6): _____
8. Total number of errors (add 15-21 above): _____

Please record any other comments regarding quality of the information provided by the new patient that you feel has not been captured by this form:_____

_____

_____

_____

topics such as: how comfortable people were providing personal and health information online, and why or why not. For people who completed the forms online, we asked whether they experienced any difficulty, whether they perceived instructions and questions as clear, and what people liked and did not like about completing the forms online. For people who did not complete the forms online, we asked about their reasons and/or preferences for using paper forms and what, if anything, would make them comfortable to use online forms. Interviews lasted between 5 to 15 minutes, and were digitally recorded with participant consent.

A descriptive content analysis approach was used to analyze the interview data. This involved independent reading of interview transcripts by two researchers (LW and AKR) and initiating coding with a pre-conceptualized list of topics derived from the study objective. Through an iterative process, transcripts were read and re-read, and categories emerged that captured issues, concerns, suggestions and experiences of the participants. The re-

Table 2.
*Participant Characteristics*

| | All participants (n=45) | Phase 1: Information Quality (n=36) | Phase 2: Perspectives and Experiences (n=21) |
|---|---|---|---|
| **Sex: n (%)** | | | |
| Male | 17 (38%) | 12 (33%) | 5 (24%) |
| Female | 28 (62%) | 24 (67%) | 16 (76%) |
| **Age: mean (range)** | | | |
| Male | 49 (21-85) years | 47 years (28-71) years | 55 (27-85) years |
| Female | 42 (19-65) years | 40 years (19-65 years) | 41 (19-65) years |
| **Condition/symptoms treated:** | | | |
| Neck pain or stiffness | 25 | 23 | 9 |
| Headache | 19 | 18 | 7 |
| Low back pain | 12 | 10 | 4 |
| Jaw pain or dysfunction | 10 | 9 | 5 |
| Other (upper/mid back pain; should pain; hip pain; ear pain; migraine; numbness (arm, shin, foot); poor posture, tinnitus; | 21 | 19 | 7 |
| **Completed forms online** | | | |
| Yes | 36 | 36 | 17 |
| No | 9 | 0 | 4 |

searchers met regularly to discuss their coding, finalizing a coding structure that was then applied to all transcripts.

## RESULTS

During the recruitment period, 161 new patients were registered at the clinic. Online forms were selected by 137 patients and 101 of these patients completed the initial 8-weeks of care. Pen-and-paper forms were selected by 24 patients, 17 of whom completed the initial 8-weeks of care.

Of all new patients who completed the full course of initial care (n=118), 45 consented to participate in the study (overall response rate: 38%). Twenty-eight (62%) of the participants were female. The age range was between 19 and 85 years, with an average age of 42 years for female and 49 years for male participants. Participants were receiving care to address various health related issues, including but not limited to: headaches, jaw pain or dysfunction, neck pain and stiffness, low back pain. Descriptive characteristics of participants are presented in Table 2.

Of the 45 participants, 36 selected to completed the online forms and agreed to study participation (Phase 1 and Phase 2). Nine completed the pen-and-paper forms and agreed to study participation (Phase 2 only).

### *Phase I*

The following provides a descriptive summary of the quality of information collected online from 36 participants who completed the online forms.

### *Appropriateness*

Information was submitted online by an appropriate source-the patient who was capable of providing such information 100% of the time.

### *Free of error*

A total of 18 errors were identified, which results in an error rate of less than 1% (each participant answered 144 questions during the four data collection points). Three errors were specific to patient's personal information (e.g. birth date, address). Five errors were identified specific

Table 3.
*Phase 2 – Summary of themes*

| Theme | Details |
|---|---|
| Format preferences | Preference for online format (majority – 19/21 participants)<br>• All participants who completed the online forms and 2/4 participants who completed paper forms<br>Preference for paper form (minority – 2/21 participants)<br>• Limited computer experience<br>• Low computer literacy<br>• Reservation about providing personal information on the internet |
| Comfort providing information online | All participants were comfortable providing the information requested online. Reasons:<br>• Info requested was not sensitive<br>• The context for providing the information (receiving chiropractic care)<br>• Trust in the chiropractic clinic<br>• Perceived security<br>• Use of internet for personal activities (banking, shopping etc) |
| Understanding and Ease of Completion | • Various electronic devices were used to complete the forms (desk top computers, laptops, tablets)<br>• Completing the forms was perceived as easy<br>• Questions and response options were clear<br>• Completion of forms took between 5 to 30 minutes<br>• Challenges with limited response options and required fields |
| Suggestions for changes | • Ability to provide individualized responses<br>• Relevance of forms to the patient<br>• Better flow between forms<br>• Statement on website describing security features |

to health history (e.g. onset of symptoms; rating of pain levels). Ten errors were identified in PROs. Clarification comments by the assessing clinician indicate that errors resulted from unintentional mistakes or omissions made by the participant during entry.

### *Timeliness*

Timely submission of online forms occurred 83% of the time. Of the 36 participants, 16 submitted forms late 25 times (17%). Late submissions were highest (10 participants) at visit 5, midway through the 8-week treatment protocol. For the other three data collection time points, forms were submitted late by five participants. Of the 16 participants, 11 did not complete the forms in a timely fashion once and one participant was late every time.

### *Phase 2*

The following describes the main themes that emerged through the qualitative analysis of the semi-structured interviews with 21 participants; 17 used the online forms and four used paper forms. A summary of the qualitative findings is provided in Table 3.

### *Preference for online forms*

Most participants interviewed expressed a preference for the online format. Reasons provided included being able to complete the forms on their own time and not wasting time at their appointment filling out forms. Participants also note that this was conducive to providing more reliable responses as at home they had access to information such as medications, contact details for other health care providers, and medical reports. Interestingly, of the four participants who used paper forms, two also expressed a preference for the online format but experienced technical difficulties (i.e. inability to login for access) that precluded them from completing the forms online. Two participants

expressed reluctance providing their information online due to limited experience with computers, low computer literacy, and reservations about providing personal and health information online.

*Comfort providing information online*

With few exceptions, all who completed the forms online were comfortable providing the information requested through the online format. Most felt the information requested was not of a sensitive nature. Information that was identified as sensitive and would not be provided online included: social insurance number, banking information, and health conditions considered to be highly sensitive (mental health, cancer). The context for questions appeared to guide most participants' overall comfort in providing personal information online. If the request for information appears relevant to the situation (e.g. receiving chiropractic care), most stated they would not hesitate to provide that information. Participants' overall comfort levels with the online forms was reinforced by their trust in the clinic and perceived security of the website (password protected access) where the online forms were accessed. Lastly, several participants commented that their comfort with using the online forms was linked to an overall preference for using the internet for conducting various types of personal activities online such as banking and shopping.

### *Understanding and Ease of Completion*

All participants described the process as easy and straightforward. Most described the questions and instructions as clear and easy to understand and were satisfied with the format and layout. The forms took between five and 30 minutes to complete, which everyone felt was an appropriate duration. The first time completing the forms took the longest, but once familiar with the process of completing the forms, subsequent times were faster. Two participants expressed discontent with the volume of forms and information requested.

The majority also identified no difficulty with accessing the forms or transitioning between web pages and forms. However, a few problems in completing the online forms were identified. Three participants were unable to access specific forms due to technical difficulties (with the forms or the browser used), which elicited frustration. Specific to the forms, the issues appeared to be related to question and answer formats rather than the online process itself. A key issues perceived by participants as a problem was the lack of fit between questions and/or response options and participants' situation in standardized questionnaires or patient reported outcomes (PROs). The challenge in answering the questions was exacerbated by the fact that a response was required due to all being set as mandatory fields. As such these participants felt they had to make a response selection even if they perceived it to be inaccurate. One participant found the lack of ability to access previous questionnaires problematic.

### *Suggestions for Change*

Overall, participants reported they were satisfied or very satisfied with their experience of completing the online forms; however, a few suggestions or recommendations to further improve online data collection were provided. The most frequent suggestions related to enabling an individualized response through a text or comment box. Other suggestions included: ensure requested forms being completed are relevant to the patient; allow access to the next form without having to return to the home page; and provision of a statement on the home page to describe the security features of the website and forms, and who is able to access the information.

## Discussion

In this study we aimed to assess the feasibility of using an online software developed for the purpose of collecting patient health and personal information to support the clinical and research activities of a chiropractic PBRN. We sought to assess the quality of information collected using this online software and to investigate patients' experience and perceptions of the online forms and provision of personal and health through an online format. To our knowledge, this study is one of the first to report on patient perspectives regarding online data collection in the context of a PBRN.

Overall, the information provided using the online forms was assessed to be provided in a timely manner, submitted by an appropriate individual (representative of the patient) and the error rate was low. The accuracy of information provided was considered acceptable for the purposes of research and clinical decision-making. Although relatively infrequent, potential sources and types of errors require attention. Anticipating errors and incor-

porating processes that will allow for cross-referencing of the information provided online to ensure accuracy is recommended.

From the patient perspective, an important factor impacting the accuracy of information provided was linked to the restricted fields in the questionnaires and PROs. Although this approach was used to prevent occurrence of missing data, this forced a response choice even if none of the options were suitable. The perception that less accurate information was provided was also linked to the difficulty of personalizing responses and providing additional information that may better capture the individual's situation or context within the structure of standardized questionnaires. It is important to stress that the potential for less accurate information is related to the standardized nature of the questionnaires rather than the online format. Yet, the results of our assessment resulted in recognition that other response options need to be incorporated into the online forms, for example a "not applicable" or "other" option.

Our findings of a clear preference for online forms by most patients are supported by results of prior studies reporting on patient preferences for online or electronic methods for providing information in the context of health care. For example, Richter et al. (2008)[26] report that 62.1% of study participants who completed self-administered questionnaires as part of routine patient management expressed preference for remote data entry, using devices such as PC or MAC, tablet PCs, and smart phones. Similarly, in assessing the acceptability, feasibility, reliability and score agreement of PROs using a touch screen computer system, Salaffi et al (2009)[27] found that the majority of study subjects (86%) expressed preference for the computer format compared to the pen-and-paper format. However, as patients' continue to adapt to online functions and processes for providing their personal information online, due diligence in developing and managing online or web-based methods of collecting such data in the health care context to ensure the security of the information and safety of the person is protected is imperative.

This study was an important experience that benefited the clinicians, founders of the PBRN, and administrative staff, as it was their first direct involvement in research within this PBRN. Engagement of the clinical and administrative staff resulted in a better understanding of expectations related to the PBRN. A number of discussions took place, formally and informally, working out how to integrate research processes into established procedures and routines at the clinic.

There are limitations of this study that require consideration in the interpretation of the results. We did not gather data on previous computer experience, computer skills, education or vocation, although such data may be informative to our understanding of how the online forms and software were used and perceived. Another potential limitation is the relatively low response rate to the study (38%). We did not gather data to determine reasons why patients declined participation, however, this is something useful to explore in the context of the developing PBRN where research recruitment will be important. The number of participants interviewed who opted to complete paper forms was low (n=4). Although the number of patients eligible for the study who opted to use paper forms was low (14%), it is difficult to ascertain if a greater number of interviews with these patients may have provided additional insights regarding a preference (or lack thereof) for paper forms and their potential consideration as a data collection method for the PBRN.

## Conclusion

In conclusion, the online software tested is feasible for collecting quality information from patients for the purposes of the PBRN. The findings also indicate that the collection of personal and health information using this software is the preferred approach and considered to be appropriate from the patient perspective. However, the pen-and-paper method should remain as a possible option to accommodate for patient preference and to ensure for timely data collection when technical issues arise.

## Author contributions

The study was conceptualized by AKR, LW and JS and designed by AKR and LW. The online software development was led by JS and MR. Data collection in phase 1 was completed using a standardized quality of information form developed by LW. Data (Phase 1) was collected by administrative staff at the study site and by AKR for (Phase 2). Data analysis was completed by AKR and LW. The manuscript was drafted by AKR and LW and edited by JS and MR. All authors read and approved the final manuscript.

## Conflict of interest

The authors declare no conflict of interest with this article.

## Acknowledgments

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## References:

1. College of Chiropractors of Ontario. Scope of Practice and Authorized Act. Available at: http://www.cco.on.ca/english/Members-of-the-Public/How-CCO-Protects-the-Public%20Interest/Scope-of-Practice-and-Authorized-Acts/ (accessed November 16, 2014)
2. McManus E, Mior S. Impact of provincial subsidy changes on chiropractic utilization in Canada. J Chiropr Educ. 2013; 27:73.
3. Bakken S, Lantigua R, Busacca L, Bigger JT. Barriers, enablers, and incentive for research participation: A report from the ambulatory care research network (ACRN). J Am Board Fam Med. 2009; 22:436-445.
4. Cole A, Stephens K, Keppel G, Lin C, Baldwin L. Implementation of a health data sharing infrastructure across diverse primary care organizations. J Ambul Care Manage. 2014; 37:164-170.
5. Bussieres A, Cote P, French S, Goodwin M, Gotlib A, Graham I, Grondin D, Hawk C, Leboeuf-Yde C, Mior S. Creating a chiropratic practice based research network (PBRN): Enhancing the management of musculoskeltal care. J Can Chiropr Assoc. 2014; 58:8-15.
6. Nyiendo J, Lloyd C, Haas M. Practice-based research: the Oregon experience. J Manipulative Physiol Ther. 2001; 24:25-34.
7. Mold JW, Pasternak A, McCaulay A, Manca, D, Rubin G, Westfall J, Beasley J, Hankey T. Definitions of common terms relevant to primary care research. Ann Fam Med. 2008; 6:570 –571.
8. Gilbert G, Williams O, Rindal D, Pihlstrom D, Benjamin P, Wallace M. The creation and development of the dental practice-based research network. J Am Dent Assoc. 2008; 139:74-81.
9. Green L, White L, Barry H, Nease D, Hudson B. Infrastructure Requirements for a Practice Based Research Network. Ann Fam Med. 2005; 3(Supple1):S5-S11.
10. Hawk C, Long CR, Boulanger K. Development of a practice-based research program. J Manipulative Physiol Ther. 1998; 2:149–156.
11. Peterson KA, Delaney BR, Arvanitis TN, Sandberg EA, Speedie S, Hobbs FDR. A model for the electronic support of practice-based research networks. Ann Fam Med. 2012; 10:560-567.
12. Kho A, Zafar A, Tierney W. Information technology in PBRNs: the Indiana University Medical Group Research Network (IUMG ResNet) experience. J Am Board Fam Med. 2007; 20:196-203.
13. Sauers E, Valovich McLeod T, Curtis Bay R. 2012 Practice Based Research Networks, Part 1: Clinical laboratories to generate and translate research findings into effective patient care. J Athl Train. 2012; 47:549-556.
14. Haller G, Haller DM, Courvoisier DS, Lovis C. Handheld vs laptop computer for electronic data collection in clinical research: A crossover randomized trial. J Am Med Inform Assoc. 2009: Sep-Oct;16(5):651-659.
15. Galliher J, Steward T, Pathak P, Werner J, Dickinson L, Hickner J. Data collection outcomes comparing paper forms with PDA forms in an office based patient survey. Ann Fam Med. 2008; 6:154-160.
16. Holzinger A, Kosec P, Schwantzer G, Debevc M, Hofmann-Wellenhof, Fruhauf J. Design and development of a mobile computer application to reengineer workflows in the hospital and the methodology to evaluate its effectiveness. J Biomed Inform. 2011; 44:968-977.
17. Gwaltney C, Shields A, Shiffman S. Equivalence of electronic and paper-and-pencil administration of patient reported outcome measures: A meta-analytic review. Value Health. 2008; 11:322-333.
18. van Gelder M, Bretveld R, Roeleveld N. Web-based questionnaires: The future in epidemiology? Am. J. Epidemiol. 2010; 172:1292-1298.
19. Lane S, Heddle N, Arnold E, Walker I. A review of randomized controlled trials comparing the effectiveness of hand held computers with paper methods for data collection. BMC Med Inform Decis Mak. 2006; 6.
20. Beasley JM, Davis A, Riley WT. Evaluation of a web-based, pictorial diet history questionnaire. Public Health Nutr. 2009;12:651–659.
21. Juran J. & Godfrey AB. Juran's quality control handbook. 5th. ed. Toronto, Canada: McGraw-Hill Ryerson Ltd., 1999.
22. Pipino LL, Lee YW, Wang RY. Data quality assessment. Communications of the ACM. 2002; 45:211-218.
23. Pace WD, Staton EW. Electronic data collection options for practice-based research networks. Ann Fam Med. 2005; Suppl 1:S21-S29.
24. Aktas A, Hullihen B, Shrotriya S, Thomas S, Walsh D, Estfan B. Connected Health: Cancer symptom and quality of life assessment using a tablet computer – A pilot study. Am J Hosp Palliat Care. 2013; 32:189-197.

25. Hunter J, Leeder S, Phelps K. Is it time to abandon paper? The use of emails and the Internet for health services research – a cost-effectiveness and qualitative study. J Eval Clin Pract. . 2012; 19:855-861.
26. Richter JG, Becker A, Koch T, Nixdorf M, Willers R, Mosner R, Schacher B, Alten R, Specker C, Schneider M. Self-assessments of patients via tablet PC in routine patient care: comparison with standardized paper questionnaires. Ann Rheum Dis. 2008; 67:1739-1741.
27. Salaffi F, Gasparini S, Grassi W. The use of computer touch-screen technology for the collection of patient-reported outcome data in rheumatoid arthritis: comparison with standardized paper questionnaires. Clin Exp Rheumatol. 2009; 27:459-648.

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# Allan C. Gotlib, DC, CM: A worthy Member of the Order of Canada

Douglas M. Brown, DC[1]

*On June 29, 2012, His Excellency the Right Honourable David Johnston, Governor General of Canada, announced 70 new appointments to the Order of Canada. Among them was Dr. Allan Gotlib, who was subsequently installed as a Member of the Order of Canada, in recognition of his contributions to advancing research in the chiropractic profession and its inter-professional integration. This paper attempts an objective view of his career, to substantiate the accomplishments that led to Dr. Gotlib receiving Canada's highest civilian honour.*

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KEY WORDS: chiropractic, history, Allan Gotlib

*Le 29 juin 2012, Son Excellence le très honorable David Johnston, gouverneur général du Canada, a annoncé 70 nouvelles nominations à l'Ordre du Canada. Parmi eux, le Dr Allan Gotlib qui a ensuite été nommé membre de l'Ordre du Canada en reconnaissance de sa contribution au développement des recherches dans la profession chiropratique et de sa grande collaboration interprofessionnelle. Cet article essaie de présenter une vue objective de sa carrière et d'étayer les réalisations qui ont permis à Dr Gotlib de mériter la plus haute distinction honorifique civile du Canada.*

(JCCA. 2016;60(1):106-122)

MOTS CLÉS : chiropratique, histoire, Allan Gotlib

## Scholastics

Allan Gotlib was born October 5, 1949, in Toronto, ON. He attended Wilmington Avenue Public School, Dufferin Heights Junior High School and obtained a Senior Matriculation diploma from William Lyon MacKenzie Collegiate Institute, before entering the University of Toronto (U of T) Scarborough Campus and earning an Honours Bachelor of Science degree (BSc) in 1972. Allan's family wanted him to be a dentist or medical doctor. Allan desired neither so approached Queens University's Faculty of Medicine, knowing it only accepted 35 students and as a B+ applicant he would not be chosen. Then he applied to the U of T Faculty of Dentistry where one of the admission tests was to carve a piece of chalk to certain

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specifications. Allan deliberately broke his chalk in half, ensuring he would fail to qualify.

Gotlib's parents had close friends whose son, Marshall Ross, was in his senior year at the Canadian Memorial Chiropractic College (CMCC). Marshall gave Allan a tour of CMCC and he was accepted for the September 1972 class without being interviewed. On opening day, Allan was pleased to see Irving Pisarek and Charles Goldman, two friends from his studies at high school, in the freshman class. Allan had a number of university credits and a lot of spare periods. He sat at the back of the room and dozed, but maintained a B+ average. By his junior year, he and Rena, nee Eisenberg, whom he had married in August that first year, began raising their family in a small, one bedroom apartment on Bathurst Street, where the parents slept on the floor. In due course, Rena and Allan produced three bright, well-educated offspring: two daughters and a son; Erin, Lesley and Stephen.

## Professional Practice and Pedagogy

Graduating in May 1976, Dr. Gotlib attempted twice to join with other chiropractors before opening his own office in 1980, on Mount Pleasant Road at Eglinton Avenue. Here he stayed until 1985 when he joined a busy, multidisciplinary clinic in Thornhill. This 8,000 sq ft facility accommodated six partners, 10 associates and 30,000 patient files. In 1997 Gotlib left this location and retired from private practise. [Interview, Gotlib by the author, Feb 21, 2012]

Figure 1.
*Allan and Rena Gotlib*

Figure 2.
*Dr. Allan Gotlib, C.M., DC*

In 1977, Terry Watkins (CMCC 1969) hired Allan as a College tutor in technique. Two years later he was a clinical supervisor, spending a lot of hours with Zoltan Szaraz (CMCC 1974). Over the next decade he rose to the level of Associate Clinical Professor and his duties were limited to clinical research. By1997, Dr. Gotlib was list-

ed as a full Professor, Division of Graduate Studies and Research but left CMCC, to return in 2010 as an Adjunct Professor, lecturing the student body on scholarly matters at the direction of the Academic Dean.[1]

## Journal of the Canadian Chiropractic Association (JCCA)

No Canadian chiropractic journals seemed to exist prior to the short-lived, "un-official" version penned by Walter Sturdy (PSC 1919) in 1934. The "official" Journal, edited by Donald Sutherland (CMCC 1950), commenced in 1957. It was a vehicle for transmitting current events throughout the land along with voluminous documentation regarding the "Decade of Royal Commissions," which occurred in the 1960s and 70s.[2]

In 1980 the CCA formed a Publications Committee headed by Dr. Watkins to revamp the JCCA. Its primary goal was to have the Journal accepted as part of the international indexing system. With that in mind, Allan Gotlib was picked as Associate Editor, Scientific Affairs.[3] Dr. Gotlib had been connected to the JCCA since 1979. By 1981 it had started to mature into the "peer reviewed, quarterly research publication of the CCA," although when Gotlib became Chief Editor in 1984, in some respects it could be described as a professional trade magazine. Allan was innovative. Choosing the five leading medical journals (British Medical Journal, The Lancet, Journal of the American Medical Association, New England Journal of Medicine and Canadian Medical Association Journal) as templates, he raised the JCCA's standards to a higher level. As well, he used the Editor's Page as a pulpit to discuss issues such as: The importance of gaining acceptance for our Journal within a database system such as Index Medicus;[4] accessing biomedical literature;[5] the economics of a scientific journal;[6] the manuscript review process;[7] and Guidelines for referees.[8] It took several years for the Journal to evolve into a publication whose purposes are: To publish scientific articles and papers…To cultivate professional dialogue and awareness…To enhance the continuing education of the practising chiropractor." By 2007, its 50th anniversary, the Journal was finally part of the PubMed database system, digitally archived in the United States National Institutes of Health (NIH) and available in the libraries of 120 leading health sciences universities. "This brought tremendous credibility to our profession. The Journal had become the vehicle to document the clinical evidence we as clinicians experience everyday in our practice, facilitating a true research culture in the profession."[9]

Granted its core is research, but the JCCA's editorials, commentaries, correspondence and obituaries make it a rich source of anecdotal lore, while "Historical Reviews" help preserve and disseminate our chiropractic heritage. As of the March 2012 issue, the JCCA has gone online and no longer produces hard copies, making it affordable and universally accessible.[10]

## Chiropractic Research Journal Editors Council (CRJEC)

The idea of a number of editors in similar disciplines meeting to discuss issues and set policy came from the International Committee of Medical Journal Editors who met in Vancouver, BC, in January 1978 and formatted "Uniform Requirements for Manuscripts Submitted to Biomedical Journals.[11] In May 1989, the Foundation for Chiropractic Education and Research (FCER) organized a roundtable discussion by a group of chiropractic journal editors, subsequently approved its concept and offered financial support. In May 1990, Silvano Mior (CMCC 1980) represented the JCCA when the CRJEC convened its first annual meeting. The itinerary included: Consideration of uniform requirements for manuscripts; standards for peer review; standardized chiropractic indexing terms; responsibilities of a chiropractic journal editor; and applying for indexing status.

In May 1992, Dr. Mior chaired the third meeting where the Council began wrestling with the ethics of fraudulent advertising in the journals, versus the urgent need for money to keep them afloat. By September 1997 Dr. Gotlib was attending on behalf of the JCCA and was named Chair for 1998-99. In July 1999, at the 10th Annual Meeting, Gotlib was happy to report that Dr. Paul Carey (CMCC 1967) had arranged for the Canadian Chiropractic Protective Association (CCPA) to supply a $10,000 grant for travel expenses so the members could continue to meet annually and administrate the CRJEC's mandate. "The CCPA has taken a leadership role in supporting the chiropractic *milieu*, by promoting the awareness of scholarship, as well as safe, effective, competent practice through responsible journalism. This cannot be accomplished any other way than through peer reviewed

publications"[12] Though commendable, the CCPA's generosity did not revive the Editors Council.

In 1991, membership in the Council was limited to editors from "primary source, peer-reviewed journals, publishing scientific information that contributes new knowledge" and there were 14 periodicals that met those standards. No CRJEC minutes are available after 2001 and by then just eight of those journals were still in print, reinforcing Gotlib's contention that "Science literature is very fragile and along with clinical and historical literature it must be documented before it disappears."

## College of Chiropractors of Ontario (CCO)

Prior to 1925, no effective regulation of chiropractic existed in Ontario. That year umbrella legislation was passed under the Drugless Practitioners Act (DPA) and a Board of Regents chosen, with jurisdiction over chiropractors, osteopaths, drugless therapists, masseurs and chiropodists.[13] In 1952, chiropractors got new legislation when the Ontario Government replaced the Board of Regents with separate boards for the various drugless disciplines. This provided chiropractors with an independent regulatory board but the five members of the Board of Directors of Chiropractic (BDC) remained political designates, the DPA regulations were unchanged and the profession resented having little control over its destiny.[14]

In1966 the Committee on the Healing Arts (CHA) to study all Ontario health care was formed and in 1974, the first six parts of the Health Disciplines Act (HDA) covering dentistry, medicine, nursing, optometry and pharmacy, were passed into law. The Ministry of Health (MOH) then struck a committee to make recommendations for professions not yet included: chiropractors, optometrists, chiropodists and osteopaths. In 1975 a chiropractic liaison committee, consisting of BDC, Ontario Chiropractic Association (OCA), and CMCC representatives, worked long and hard with senior MOH authorities to discuss the chiropractic portion of the HDA. Negotiations were difficult, because the chiropractors were determined that their scope of practice would embrace diagnosis, the right to use x-ray and treatment of the nervous system. They were complex because in 1982 the MOH had established the Health Professions Legislative Review (HPLR) to examine all 21 of the health professions not within the HDA legislation of 1974, rather than the original four. And they were protracted. By 1988, Stephen E. West (CMCC 1950), who was a major force within the BDC for two decades "believed passage of the Regulated Health Professions Act (RHPA) was imminent."[15] However, it was not until November 25, 1991, that the portion of the RHPA containing the new Chiropractic Act gained Royal Assent and 1994 became the inaugural year of the CCO. At its initial meeting on March 24, the BDC as it existed was replaced by the CCO.

1988 was the year of Allan Gotlib's first assignment to the BDC. By 1994 he had been elected as a CCO Council Member and moved on to positions as Secretary-Treasurer and Chair of the Discipline Committee. In 1999 he assumed the role of President for two years, followed by Vice-Chair for one year and in 2002 he took on a second two year term as President, before retiring from the CCO in 2005.

The CCO is more complicated, pervasive and demanding than the BDC. As the body established by the provincial government to regulate chiropractors in Ontario, its statutory mandate is to protect the public interest.[16] This privilege of self-governance, as determined by the RHPA, 1991, allows for the enforcement of various statutory duties by the CCO.[17] Its main responsibilities are: Developing standards of admission; establishing rules for members' conduct; developing means of improving members' skills and knowledge; examining complaints; and disciplining members whose behaviour is deemed below acceptable standards. The CCO's policy-making Council consists of nine chiropractors elected by their peers and seven public members chosen by the government, who serve on seven statutory and one non-statutory committee. The largest of these is the Discipline Committee, comprising seven individuals and for which all Council members are potential members of a Discipline panel.

Unfortunate members who find themselves embroiled in disciplinary matters soon discover dispute resolution is expensive. Should allegations of professional misconduct or incompetence come before a panel of the Discipline Committee and the panel finds for the prosecution, it may direct the Registrar to impose sanctions, fine the miscreant up to $35,000 and pay part or all of the College's legal expenses. In addition, the price of defending oneself is huge. Costs at the investigative and complaints levels can be $10,000; lengthy hearings can exceed $50,000 for each party involved.[18]

The time to disposition of a disciplinary matter before the CCO can be onerous. The review referred to here was conducted by Gotlib. It consists of a retrospective analysis of 27 case files that met the criteria of being referred by the Complaints or Executive Committee and disposed of by the Discipline Committee from 1994 through 2001, excluding time related to the penalty phase or appeals process of any proceeding. The starting point for most of these files was defined as the date of approval of the inquiry, whereas the end point was the day the defendant was informed of the Discipline Committee's decision. Over the eight years since the RHPA was proclaimed, the average period for a case to complete the disciplinary process and be disposed, was 19.5 months, with a range of 6 to 45 months.

> *This study sought to quantify the time it took for a discipline matter to be disposed. In exercising statutory authority, administrative tribunals must clearly understand due process and procedural fairness. Parties to discipline proceedings have their respective rights including the right to natural justice and these rights must be weighed fairly, and balanced with respect to societal rights. Delayed proceedings may challenge an individual's Charter rights and may also offend the administrative legal duties imposed by statute.*[19]

## Judicially Related Activities

### *Member, Deputy Judges Council of Ontario*

From 2002 to 2003 Dr. Gotlib was appointed by the Lieutenant Governor in Council on the Attorney General's recommendation, as one of three lay persons, to serve along with the Chief Justice of the Ontario Superior Court, the Honourable Heather Forster Smith, and other justices, on the Ontario Deputy Judges Council. Its mandate is to review and approve plans for the continuing education of deputy judges.[20] Four hundred of these part-time magistrates ease congestion in Ontario courts by handling things such as bail hearings. To obtain such a post you must apply, and meet eligibility requirements.

### *Bencher, Law Society of Upper Canada*

Benchers are governors of the Law Society of Upper Canada, the members of its board of directors. There are two main categories; elected and appointed. At the time, there were 40 benchers elected by the Society's members, every four years. Appointed benchers are also known as "lay" members because they are not lawyers. Eight in number, they are chosen "by the Lieutenant Governor in Council of the Ontario Government, to represent the public interest."[21] Gotlib was an appointed bencher from 2003 to 2007. He got this job because his 18 years on the BDC and CCO had given him the skills needed to conduct discipline inquiries. Gotlib sat on a very large number of hearings regarding lawyer disciplinary proceedings.

### *Transitional Council College of Naturopaths of Ontario*

In September, 2009, Ontario spawned a transitional council of Ontario naturopaths to establish rules governing the registration of qualified practitioners. All 17 members were appointed by the Lieutenant Governor In Council, charged with the specific duty of protecting the public interest and made responsible to the Minister of Health and Long-Term Care.[22] This marked a major step toward the regulation of naturopathy within the RHPA, 1991 and the Naturopathic Act, 2007. As the sole chiropractor, Dr. Gotlib was chosen for a two year term, primarily for his background in professional regulation and experience with the DPA, the HPLR and the RHPA.

## Canadian Chiropractic Research Foundation (CCRF)

The CCRF, Canada's oldest and most established chiropractic funding body, was initiated in 1976. Its founders were Drs. Ron Collett (CMCC 1958), Al Hawkins (CMCC 1965), Terry Watkins, John Bloomer (PSC 1957) and Walter Savickey (PSC 1959). Terry Watkins chaired the CCRF Organizing Committee in Winnipeg, MB, before moving to Toronto, to become CMCC's Academic Dean in 1978.[23] Dr. Watkins left the College, returning to Winnipeg in 1980. This was the year Dr. Collett succeeded in obtaining letters patent from the Federal Department of Consumer and Corporate Affairs, and a charitable registration number for the Foundation, from Revenue Canada. Now the CCRF was able to issue tax-deductible receipts which helped in raising money to bolster a variety of projects. Watkins resumed his role as chair until 1990, when he and Collette resigned. Soon "the CCRF became too difficult to manage and control

for those who were left in charge." [Email, Watkins to the author, Oct 20, 2013] Gotlib remembers it as enduring a long struggle. "In its best year it was worth about $30,000 before moving its head office from Winnipeg to Toronto in 1998. It now has $1.3 million in assets and recently received an anonymous donation of $500,000. This is all restricted money which must be used for specific purposes." [Interview, Gotlib by the author, Feb 21, 2012]

## CCRF Allies

### *Canadian Institutes of Health Research (CIHR)*

In 1997 Dr. Gotlib became the CCA's Director of Research Programs and in 1999 was named Executive Vice-President, Research and University Affairs of the CCRF.

Once more he was self-reliant, teaching himself the university system, developing relationships with university officials and affiliations with the Canadian Institutes of Health Research (CIHR). Announced by the Government in 1998, the CIHR became operational in April 2000, giving Gotlib an early start within Canada's independent health research agency. Its mission is to contrive new scientific knowledge which is translated into a strengthened Canadian health care system. Its research is integrated through 13 "virtual" institutes, bringing networks of researchers together to focus on important health problems. Some of these are: Aging, genetics, health services, musculoskeletal (MSK) health, addiction and nutrition.[24] Gotlib has found the CIHR Small Health Organizations Partnership Program (SHOPP) tremendously successful in providing extraordinary opportunities to small, historically under-represented professions such as chiropractic to foster true research cultures and furnishes a mechanism for new knowledge to be integrated into the health research and health care systems.

In 2003, Alan Bernstein, PhD, President of the CIHR, invited Gotlib to sit on his President's Voluntary Health Sector Committee until 2007. The Committee's first meeting was in Ottawa, November 3, 2004. Members included the Canadian Cancer Society, Heart and Stroke, Health Charities Council of Canada, Cystic Fibrosis Foundation, the CIHR Vice-President and four Scientific Directors.[25]

Allan recognized that the Voluntary Sector Committee was "an important venue to strengthen and build relationships between the CIHR and voluntary sector partnerships, including the Health Charities Coalition of Canada (HCCC) to address issues of common interest." In 2009-2010 the CIHR's budget was slightly over $1 billion and it was supporting more than 11,000 researchers and researchers in training.

### *Cochrane Collaboration*

Established in the United Kingdom in 1993, "The Cochrane Collaboration is an international network of more than 28,000 individuals from over 100 countries that aim to help people make well-informed decisions about health care by preparing, maintaining and promoting the accessibility of systematic reviews of the effects of healthcare interventions.[26] The CCA is an affiliate member of Cochrane Canada and from 2001 to 2010 Dr. Gotlib was on its Executive Committee, encouraging the formation of strong ties between Cochrane and the chiropractic profession. Gotlib explains that among this global sphere are 10,000 to 12,000 researchers who extract, coordinate and synthesize investigative studies into systemized reviews. There are 5,000 reviews in their library that Cochrane is constantly updating. If a politician wants information on a condition such as back pain, he can get evidence about the best care from the scanning of thousands of journals, creating reliability for us.

Fifty groups of researchers exist around the world. Six of these are in Canada; the two most important for chiropractors are in Ontario. The group for back pain is located at the U of T; the one for MSK problems is at the University of Ottawa. The Federal Government relies heavily on these databases for making health care policy decisions. All trials are subject to bio-statistical analysis and research protocols. This requires knowledge of research and trial methodology, biostatistics and epidemiology. Allan has organized a lot of workshops to train chiropractors how to extract fair, valid and unbiased conclusions and he has a good relationship with the Director of Cochrane Canada. In fact, we are the only health profession that supports Cochrane in this country.

### *Canadian Memorial Chiropractic College*

CMCC is a fully accredited, degree granting institution, recognized as one of the most rigorous and innovative chiropractic programs in North America. The College's focus is on education, research and patient satisfaction related to neuromusculoskeletal (NMSK) interactions and

the study of chiropractic's role in an integrated system. Its research agenda includes three on- site centres. First is the Centre for the Study of Mechanobiology, Injury and Health, exploring the mechanics of treatment and their end results. Second is our Centre for Interprofessional Health Dynamics, regarding the profession's role in integrated care and its promotion. Third is the University of Ontario Institute of Technology (UOIT) - CMCC Centre for the Study of Disability Prevention and Rehabilitation. Opened in July 2012, the latest acquisition has enhanced scientific exchange between our institutions and brought physical therapists, psychologists, orthopaedic surgeons and general practitioners along with chiropractors, into the mix. Resources for the centre include a $2.8 million grant from the Ontario Ministry of Finance, Financial Services Commission, to develop a Minor Injury Treatment Protocol.[27]

CMCC's research agenda is geared toward contributing to the body of chiropractic knowledge, thereby elevating the quality of education and improving patient outcomes. A variety of campus laboratories support this research culture exploring: Biomechanics and elastography; materials fabrication; neurophysiology; cellular and molecular biology; and histology. In 2010, CMCC established the McMorland Family Research Chair in Mechanobiology, a first for any chiropractic institution and in 2013 the promise of more groundbreaking research was made possible by successfully applying for a grant through the United States National Institutes of Health (NIH), to support a study of spinal manipulation. This endowment, which is slightly less than $1 million, is the highest level of award made by the NIH.

## Developing a Research Agenda for Chiropractic in Canada

In 1995 the CCA framed a *Task Force* on Chiropractic Research in Canada[28] and in March 1997, the CCA commissioned the construction of a *Consortium of Canadian Chiropractic Research Centres (CCCRC)*.[29] Its purpose is to develop new chiropractic knowledge through multidisciplinary collaboration and integrate that knowledge into the Canadian health care system.

The original consortium consisted of CMCC, the CIHR, L' Université du Québec à Trois Rivières (UQTR), and the Universities of Calgary, Saskatchewan and Waterloo. The first CCA/CCRF supported *Canadian Chiropractic Scientific Symposium (CCSS)* was formed in Calgary, November 14-15, 1998. Over 150 registrants heard presentations by member institutions and Heritage Lectures from leading chiropractic researchers of the 1980s. October 21-22, 2000, 200 people attended the second CCSS in Toronto. During this symposium *Workshop I* was conducted. Its purpose was for chiropractic and biomedical researchers to integrate their individual agendas into a comprehensive framework related to spinal pain and disability.

*Workshop II* was convened in October 2002, immediately prior to the third CCSS in Montréal, PQ. Sponsored by the CIHR, it was designed to assist chiropractors set an agenda congruent with CIHR goals. Gotlib was present at both meetings to help identify and prioritize questions to be addressed by CCCRC members. Although symposia have been held biannually since their inception, it was not until 2009 that *Workshop III* occurred in Montréal. In 2008, Drs. Gotlib, André Bussières and Kent Stuber, won a non-renewable grant of $25,000 from the CIHR. This was first prize in the MSK Health and Arthritis Competition and was delivered in Montrèal, during the CIHR/CCRF Research Consortium Workshop III to advance the Chiropractic Research Agenda.[30] This year, 23 members representing CMCC and universities across Canada, met with five invited Topic Speakers, to identify priority areas and gaps for future research activities.

## CCRF Goals

Allan Gotlib was added to the CCA Task Force in 1996 and impacted the CCRF's strategy of "investing in people" and fashioning its goals.

### *CCRF Goal 1: To establish and fund university-based Chiropractic Research Chairs for each province in Canada*

Dr. Gotlib envisioned these chairs as portals of entry into the university system and saw them coalescing into a network of chiropractic research activity across the country. The reality of spawning them was another matter. Allan quickly learned the procedure was "burdened with satisfying committee after committee, by-law approvals, faculty union collective agreements, senate and board of governors acceptance, and on and on. The process easily stretches beyond four years; the avalanche of expectations and crushing disappointments can be overwhelm-

ing." After due diligence, the final decision was made by a university search committee that chose the best candidate for both the university and faculty.[31]

Gotlib began his bold journey into this vast, unknown territory in the mid 1990s. As of December 31, 2013, Allan and the CCRF had sparked 15 Chiropractic Research Chair/Professorships and another was in the works for Memorial University of Newfoundland/Labrador. The remaining provincial jurisdictions were the University of New Brunswick (Canada's oldest English speaking University) and the University of Prince Edward Island.

### *CCRF Goal 2: To increase the profession's research capacity*

Although by 2008 the CCRF strategy of "investing in people" had produced some trans Canada momentum, Dr. Gotlib sensed we lacked enough researchers to meet the profession's needs and set out with Drs. Kent Stuber and André Bussières to answer two key questions: What percentage of the chiropractic profession is engaged in full-time research; and what strategies should be employed to increase the profession's capacity to undertake research in Canada?[32]

This investigation was divided into three phases. Phase I involved mailing a twelve question survey to all provincial associations, regulatory colleges and the CCA, for distribution to their membership. Of the over 6,000 chiropractors who were invited to complete the analysis, little more than ten percent responded. Of these, 94 had or were in the process of obtaining master's degrees while 30 possessed or were completing PhDs. The majority were located in Ontario and Québec. Phase II comprised mailing a 19 question survey to 198 individuals, made up of those with post graduate training who answered the first questionnaire, or who indicated they were currently conducting research. One hundred and twenty-three (62%) completed the second survey. Forty-eight said they did no research, 20 were full-time and 55 part-time.

The "key message" is that 0.3% of the profession has been conducting most of the research to substantiate what the rest of us do clinically. "To achieve a level of 1% of the profession doing research on a full-time basis would require an additional 40 chiropractors."[33] Three major approaches for consideration are: Supporting and expanding the University Based Research Chair /Professorship program; increasing opportunities for our part-time researchers; and augmenting inter-disciplinary research through alternative disciplines.

### *CCRF Goal 3: To access the millions of federal and provincial Canadian dollars available for health research*

Goal 3 ties into Phase III of the Stuber, Busssières, Gotlib surveys.[34]

Their final assessment focussed on "financial aspects," to determine the amount of funding which supports chiropractic research in Canada. The Phase III sample population consisted of Phase II respondents plus known researchers and graduate students who had not replied to Phases I and II. Professors and chiropractors in research training positions were asked to name all external sources of income. Ninety individuals received this survey and 88 (98%) replied. Of these, 32 were not involved with research in 2008, 18 researchers including 12 of the 35 graduate students had no external funding, while 38 had some funding.[35]

In 2008 it was reported that Canadian chiropractic research activity was supported by approximately $4 million in competitive funding. While this sounds promising, 75% of those grants were controlled by just four researchers. Canadian researchers as a whole are poorly paid and many are self-funded. "Finding new ways to secure funding for chiropractic researchers is imperative and an urgent need to continue to build chiropractic research capacity."

In 2008, Stuber, Bussières and Gotlib determined that CMCC and UQTR were producing capable researchers and quality research. A majority of the faculty members who responded to their surveys were alumni of those two institutions and most were engaged in part- time research.[36] CMCC still qualifies. January 20, 2014, College faculty and clinicians, including adjunct faculty and excluding graduate students, totalled 154 employees. Of these 130 had DC degrees, 22 Masters and 17 PhDs. Just three of the DCs came from schools other than CMCC. Out of the 24 who were not chiropractors, 20 had Masters, Medical and/or PhD diplomas.[37] During the two year period, 2012-13, CMCC's three research centres presented and published over 100 articles in an array of journals. "The global community has recognized these efforts and in the past 24 months alone, 14 awards and honours were presented to CMCC researchers, students and graduates."[38]

## Progress

### *CCRF Research Consortia*

As noted earlier, in 1998 the first Consortium of Chiropractic Research Centres consisted of six institutions. September 27-28, 2013, the CCA hosted its biennial Research Consortium in Toronto. This gathering attracted 50 world-class chiropractic researchers from 16 Canadian universities and was funded by 15 sponsors, including every provincial CCA division. Its aim was to "facilitate trans-disciplinary chiropractic research," and its participants agreed that, "This research is essential to leading our profession to the next chapter of its evolution as an integrated member of the health care team, caring for all Canadians."[39] Allan Gotlib promises that, "Plans are already underway for the next Research Symposium in 2015 and it will be riveting!"

### *Research Capacity*

Although by the end of 2013 there were approximately 50 active full-time chiropractic researchers, this was merely 0.7% of our professional population because now there were 7,000 chiropractors serving 35 million Canadians. Don't despair; help is on the way. By February 2014, there were 30 Masters and 20 PhD candidates in the system. Within a couple of years we should be up to 1.4% and on our way to a respectable 2%.

### *CCRF Research Chair/ Professorships*

In December 1999, Greg Kawchuk (CMCC 1990) received his PhD from the University of Calgary and September 1, 2001, Dr. Gotlib facilitated Dr. Kawchuk's installation as Canada's first Chiropractic Research Chair, in Spinal Function, within the university's Faculty of Civil Engineering. It was for a three year period with capital of $430,000 to start. In 2004 this became a 10 year Canada Research Chair and Kawchuk received competitive funding of several million dollars from the Canada Foundation for Innovation (CFI), University of Alberta, CIHR, Natural Sciences and Engineering Research Council of Canada (NSERC), College of Chiropractors of Alberta, OCA and CCRF. In 2009 the Canadian Government renewed Kawchuk's Chair for $500,000 at the University of Alberta and in June 2012, he initiated the International Chiropractic Research Network (ICRN). Hosted by Linkedin, it aims to develop a global resource for those interested in research related to our profession. In September 2013, Greg was one of three Principal Investigators (PIs) on a team that won $750,000 in a Partnership for Research and Innovation in the Health Care System (PRIHS) competition, in the Bone & Joint category.

When Mark Erwin (CMCC 1984), PhD, assumed the second Research Chair in June 2005, his co-funding by the OCA, CIHR and CCRF, amounted to $300,000. In 2007 his designation became CCRF/University of Toronto, Scientist in Disc Biology and monies from the profession, the University Health Network and corporations totalled $510,000. March 2012 he was supplied with an independent laboratory by the Toronto General Hospital, to support his quest to unravel a leading cause of spine-related neurological disability and in December, the CCRF entered into a direct agreement with the U of T to conceive and fund the position of CCRF Professorship in Disc Biology. Dr. Erwin is the recipient of this new, three year appointment, supported by the CCRF, U of T, OCA and University Health Network, in Toronto. This arrangement provides another $300,000 investment in the plausibility of our profession and follows earlier transactions with the Universities of BC and Alberta. At the CCA Chair Affair, November 29, 2013, Mark received the Medal of Merit, the CCA's highest honour, for outstanding, long-term service to the Association.

April 1, 2006, Jean-Sébastien Blouin's (UQTR 1999), PhD, five year CCRF/University of BC Professorship in Spine Mechanics and Human Neurophysiology began with an investment of $500,000 from the CCRF, UBC, BC Chiropractic Association (BCCA) and BC College of Chiropractors (BCCC). The following year he won an operating grant of $320,000. Paid by the Canada Foundation for Innovation (CFI), UBC and BC Knowledge and Development Fund, the project is titled: Neurophysiology of the Cervical Spine: Application of Robotics and Electroencephalography to Injury Prevention, Assessment and Rehabilitation. By 2011, Dr. Blouin had been promoted to Associated Professor and was tenured at the UBC School of Kinesiology.

Martin Descarreaux's (UQTR 1998), PhD, August 2006 Chair at the UQTR came with a $250,000 operating grant and $230,000 for equipment. In 2007 the FCER and National Board of Chiropractic Examiners (NBCE) granted him $33,000 for a comparative study of spinal manipulation and his research team at UQTR achieved

"Groupe de Recherche" status, ensuring recurrent internal funding of $17,000 to $25,000 per year. In 2010, the Fonds de la Recherche en Santé du Québec (FRSQ) presented Dr. Descarreaux a Research Scholar Award, providing $60,000 a year for the 2010-2014 period. In 2011 Martin's $150,000 stipend was renewed for a three year term by the Fondation de Recherche Chiropratique du Québec (FRCQ) and in 2013 he obtained $175,000 from the Research Institute of Robert Sauvé, for his efforts in workplace health and safety. Now his team collaborates with other disciplines and universities in Québec as well as chiropractic colleges in Canada, the United States and Europe.

In 2007, Jill Hayden (CMCC 1996), successfully defended her PhD in Clinical Epidemiology at the U of T and July 1, she became the CCRF/CIHR Chair at the Toronto Western Research Institute, received the New Investigator five year Award of $525,000 and worked on a pair of ventures funded with $130,000. 2010 was the year Dr. Hayden relocated to Canada's east coast where she and her colleagues established the Nova Scotia Cochrane Resource Centre and acquired two new research grants totalling $207,000. On July 1, 2011, Dalhousie University, NS, declared that the CCRF Professorship in Epidemiology had been presented to Hayden and in 2012 the Nova Scotia Health Research Foundation (NCHRF) donated an Establishment Grant of $150,000 to assist in building its research capacity. Jill has also earned several training and achievement awards and in 2013 the CIHR contributed $94,000 to explore the relationship between individual recovery expectations and outcomes, in adults experiencing low back pain.

September 1, 2008, it was declared that John Srbely (CMCC 1992), PhD, had been handed a five year CCRF/University of Guelph Professorship in Spine Mechanics and Human Neurophysiology. Financed by the OCA, University of Guelph and the CCRF, the professorship is housed in the College of Biological Sciences, with access to modern lab facilities in neurophysiology and spine biomechanics. Dr. Srbely is the only chiropractic researcher holding the distinction of "Canadian Arthritis Network Investigator." Supported by the OCA, CCRF and University of Guelph, he was given $48,000 to investigate mechanisms of pain in osteoarthritis.

Jason Busse (CMCC 1999), PhD, became the CCRF/CIHR McMaster University Research Chair for five years on March 1, 2009. He is involved with projects through the CCRF, CIHR, McMaster University and the Institute for Work and Health, worth approximately $5 million and in March 2012, the CIHR handed Dr. Busse two additional operating grants totalling $193,000. Jason has authored over 80 peer-reviewed articles focusing on medically unexplained syndromes, orthopaedic trauma and the integration of chiropractic into mainstream health care.

July 1, 2010, the University of Manitoba granted Steven Passmore (NYCC 2006), PhD, the CCRF Professorship in Spine Biomechanics and Neurophysiology for five years. This demonstrated the Manitoba Government's commitment to supporting chiropractic research within its system of higher education. In 2012 the Manitoba Medical Service Foundation rewarded Dr. Passmore with a $20,000 bursary. The same year, he and Bernadette Murphy (CMCC 1989), PhD, received a $199,000 grant from the Manitoba Workers Compensation Board. Steven is also an Adjunct Professor in the research department at the New York Chiropractic College.

From 2004 to 2010, Paul Bruno (CMCC 2004), PhD, was a research fellow and lecturer at the Anglo-European College of Chiropractic in the UK, earning his PhD from the University of Portsmouth (2008) and winning post graduate research prizes. July 1, 2010, Dr. Bruno acquired a five year term as CCRF Research Chair in NMSK Health in the Faculty of Health Studies at the University of Regina, SK. He was awarded an Establishment Grant of $95,000 from the Saskatchewan Health Research Foundation (SHRF), which is funded 50:50 by the SHRF and CCRF. Paul's research concentrates on rehab exercise to target the specific needs of individual patients with low back pain. In 2012 he obtained an operating grant to purchase a "Vicon Motion Capture System" to calculate the relative motion of multiple spine segments.

Mathieu Piché (UQTR 2002), secured his PhD in Neurological Sciences from L' Université de Montréal in 2009. January 1, 2011, Dr. Piché was named to a five year position as Research Chair in Pain Neurophysiology at the UQTR and is a co-researcher for the FRCQ Research Chair held by Dr. Descarreaux. He also collaborates with the Tokyo Metropolitan Institute of Gerontology and the Université de Montréal. Dr. Piché's interests include the physiology and pathology of endogenous pain modulation and the impact of pain on the autonomic nervous system.

Sam Howarth, PhD, was named holder of the McMorland Family Research Chair in Mechanobiology at CMCC, June 20, 2011. A graduate of the University of Waterloo, ON, the hub of his former research was identifying mechanisms of injury within the vertebral joint. At the College, Dr. Howarth has been exploring methods of controlling spinal movements and low back rehabilitation programs to improve motion patterns. His perspective on stability stems from his expertise in biomechanics, which he applies to mechanobiology. This is a field at the intersection of biology and engineering which looks at the mechanism through which cells communicate, thereby enabling a useful paradigm for the study of chiropractic.

Endowed with a partnered investment of $500,000 between the U of T and CCRF, on July 1, 2012, the U of T bestowed the Professorship in Spine upon Carlo Ammendolia (CMCC 1982), PhD. Although occupied within the Faculty of Medicine at the U of T, Dr. Ammendolia also directs the Spinal Stenosis Program at the Toronto Mount Sinai Hospital. For 2013-2016, Ammendolia was awarded a $1.7 million grant from the Patient-Centred Outcomes Research Institute and $23,000, by the National Chiropractic Insurance Mutual Company (NCIMC) Foundation, Supporting Research and Education for 2013-2014. For the same period, he was named PI of a $360,000 award from the Arthritis Society, in the Strategic Operating Grant Competition. Carlo has incorporated clinical practice with research in applying non-operative treatments for mechanical, degenerative and inflammatory spinal disorders.

In July 2012, Pierre Côté (CMCC 1989), PhD, reaped the benefits of the previously mentioned $2.8 million grant issued by the Ontario Ministry of Finance, to develop treatment protocol for minor injuries based on best scientific and medical practices. Dr. Côté also received the new Tier 2 Canada Research Chair (CRC) in Disability Prevention and Rehabilitation at the UOIT. The CRC is valued at $500,000 over five years. Dr. Côté says its "primary objective is to develop and test interventions aimed at reducing MSK pain in Canadians…MSK conditions are responsible for nearly half of all disabilities in Canada and related health-care costs continue to skyrocket."[40] He also holds appointments at the Dalla Lana School of Public Health and at the Institute of Health Policy Management and Evaluation, at the U of T.

On September 26, 2012, André Bussières (CMCC 1991), PhD, earned the CCRF Professorship in Rehabilitation Epidemiology, at McGill University, Montrèal, PQ. Capitalized by a joint $500,000 investment between the CCRF and McGill, this established a university-based research position that converged on a scientifically sound approach to the development of Clinical Practice Guidelines. Dr. Bussières serves on the JCCA editorial board and has written over 20 scientific and clinical articles and three book chapters.

2013 was another year of firsts for the CCRF. September 12, there was a Recognition Event at Queen's University, Kingston, ON, to declare that it had assigned Simon French, BAppSc (Chiropractic), PhD, to the CCRF Professorship in Rehabilitation Therapy. Dr. French hails from the University of Melbourne, Australia, where he was a Senior Research Fellow in the School of Heath Sciences. At Queen's he concentrates on knowledge translation in primary care with an emphasis on MSK conditions. He also conducts randomized trials of interventions relevant to primary care settings and is an Associate Editor of the Journal, "Chiropractic & Manual Therapies."

Drew Potter (CMCC 1970), CCRF President, was present on this occasion and was "struck by the manner in which we were received at the University. Their Dean and Vice-Dean welcomed us as colleagues, expressing their genuine respect for Dr. French and our profession."[41] This reception was in stark contrast to some Allan Gotlib endured back in the 1990s, when cap in hand, he pioneered knocking on doors of academia.

## Continuing Education and Publications

Dr. Gotlib is a proponent of life-long learning. The period of 2000 through 2011 was one of intense activity for Allan, yet he was an energetic participant in 32 separate events, lasting two to three days and was a prime mover in fathering at least 20 of these conferences. Besides stimulating (and occasionally exhausting) our leader, these conventions, symposia, workshops, colloquia, training sessions and congresses broadened the perspectives of thousands of our peers concerning the advantages of systematized research and inter-professional collegiality.

During his career, Dr. Gotlib has authored or co-authored 27 scholarly papers in peer-reviewed journals. Eleven of them have been referenced in this paper. Many of the others address controversial issues facing our vocation. For instance: In 1984 Gotlib wrote about the neces-

sity for chiropractors to obtain informed consent[42] and third party access to confidential patient records;[43] in 1985 Gotlib and Haymo Thiel (CMCC 1985), selected an annotated bibliography of core medical literature pertaining to stroke and cervical spine manipulation;[44] in 1997 Gotlib, Stephen Injeyan (CMCC 1984) and John Crawford (CMCC 1975), recorded the need for reform relative to the use of lab diagnosis by chiropractors in Ontario;[45] and in 2005, Gotlib and Ronald Rupert (Research Director, Parker University), assessed the evidence for chiropractic manipulation in pediatric health conditions.[46]

Between March 1998 and December 2013, the CCA distributed 38 Research Bulletins to its members, running from 12 to 20 pages. Ninety percent of the information they contain was collected and collated by Dr. Gotlib.

## Accolades

The CMCC "Cornerstone" yearbooks, 1973-76, offer no clues as to the heights Dr. Gotlib would reach, however shortly after graduation, his talents began to emerge.
Dr. Terry Watkins' interaction with our champion stretches back 37 years.

> *From my experience dealing with Dr. Gotlib, it is amazing how much one dedicated individual can contribute to the development of our profession in ways most others could not envision. From my time spent discussing our profession at our CMCC Friday afternoon faculty sessions, to the development of the JCCA and the extraordinary vision to provide an opportunity for suitable chiropractic research candidates to occupy funded research chairs at major universities. What a remarkable and determined colleague Dr. Allan Gotlib has been. I have great respect for him and am privileged to have watched his growth.*[Email, T. Watkins to the author, Oct 1, 2013]

Dr. Igor Steiman (CMCC 1981), was accepted into the College in 1977, right after completing his MSc program at the U of T. His first encounter with Dr. Gotlib was as a second year technique instructor in 1978. He gave them an assignment to photograph vertebrae placed on grid paper to measure anatomical irregularities. "The objective was to have us realize that just because we might palpate or observe segmental asymmetries in a patient's spine, it didn't necessarily mean we had detected a subluxation." Dr. Steiman's second encounter was in a third year technique lab, where he describes himself as "quite incompetent and lacking confidence." Allan observed Igor's "hesitant, half-hearted attempt" to adjust a classmate's C2 subluxation and told him to repeat the move "with more speed and force." This produced a "loud crack" that startled Igor but pleased both Allan and the classmate. Steiman credits Gotlib with sparking his evolution into a competent adjuster and says, "Allan always struck me as being calm, reasonable, but perseverant in driving towards his goals." [Email, I. Steiman to the author, Oct 15, 2013].

Dr. Keith Thomson (CMCC 1978), served on the CCO in a variety of capacities from 1994 to 2007 and still acts as a Peer Assessor.

> *One of the first things I noticed about Allan was his encyclopaedic knowledge of the CCO Regulations and Standards, which he could recite at will. When Allan felt strongly about an issue, he was forceful, eloquent and did not back down. What impressed me most were the two years (1994-96) we spent together on the Discipline Committee. No matter the subject before us, Allan was the fairest, most compassionate person on the panel. I never saw him want a 'pound of flesh' from members who made poor professional choices. A humorous bit of advice Allan gave me was to take a brief case into discipline hearings. He said, 'There may be times you need it to open up and laugh behind – on other occasions to cry behind.' Allan was a great mentor to me. I will always appreciate his thoughtfulness and kindness.* [Email, K. Thomson to the author, Oct 15, 2013]

*Dr. Brian Budgell* (CMCC 1986), PhD, has been Director of the Neurophysiology Laboratory at the College since 2009.

> *Among Dr. Gotlib's feats, the one that impressed me most was the erection and fortification of our research chairs. This strategy benefits the individual and provides the entire profession with a research base which illuminates the discipline of chiropractic. In the past, chiropractic was essentially a 'folk practice,' meaning techniques were passed down*

> *from one generation to the next, but there was scant understanding of how they worked and no thoughtful strategy for improvement. Current research vindicates certain practices, allowing us to dissect what we do, so as to identify those components of total care which are either more or less effective. This way, we can discard the ineffective and build on our strengths. Beyond research findings from specific projects, the presence of chiropractors in the university system enables us to interact with the 'thought leaders' of other health professions. Our researchers are wonderful ambassadors for chiropractic and will open doors for us in other arenas.* [Email, B. Budgell to the author, Feb 12, 2014]

Dr. Chris Martin (CMCC 1978), worked in several executive capacities for the CCA and CCRF between 1998 and 2013.

> *When I began my relationship with the CCRF many years ago, we were on the doorstep, entering into our first Chiropractic Research Chair at the University of Calgary. Today, we have chairs in almost every province. Our researchers are world class, building strong, collaborative relations with leading scientists throughout Canada and around the world. We are fortunate to have been lead by dedicated boards but more importantly, we have benefitted from the skill, expertise and devotion of Dr. Allan Gotlib. Our achievements lie squarely with this individual's never-say-quit approach and for that we are most grateful.*[47]

## Trophies

Between 1984 and 2013, Dr. Gotlib has received 18 laurels. Several of them: The *OCA Chiropractor of the Year*; CCA *Medal of Merit*; and *CMCC Homewood Professorships*, are the highest awards given by these chiropractic institutions. Among his highly-prized citations is one he received from the Government of Canada in 2012, when it was announced that Allan Gotlib had been appointment to the Order of Canada. Prior to that, Gotlib's name was familiar to members of the Canadian chiropractic community in general and its scientists in particular. After the notice appeared in the newspapers, Gotlib became an overnight research celebrity.

Figure 3.
*Dr. Gotlib receiving the OCA Chiropractor of the Year Award*

*CMCC's President, Dr. Jean Moss*, was tremendously proud to see one of her graduates recognized for such a prestigious honour as the Order of Canada.

> *Dr. Gotlib has created a heightened interest in research which plays a pivotal role in the development of the chiropractic profession. This is an inspiration to our students and assists in fostering an interest in scientific inquiry among them. In fact, Dr. Gotlib's work stimulated CMCC to create its own Research Chair in Mechanobiology…The research being conducted in Canada is the envy of the world and has the potential to create advances in the care and quality of life for patients everywhere. Dr. Gotlib is fundamental to this success and is to be congratulated.*[48]

Drs. Jill Hayden and Greg Kawchuk agree they owe their status within the university health care system to Dr. Gotlib's diligence and devotion. By identifying areas where one could "do a lot with a little" and applying effort and intellect, Allan brought these opportunities to fruition. "His idea of constructing a critical mass of chiropractic


Figure 4.
*Dr. Allan Gotlib was invested Member of the Order of Canada by His Excellency the Right Honourable David Johnston, Governor General of Canada, at a ceremony at Rideau Hall on May 3, 2013.*

scientists touched the careers of almost every Canadian chiropractic investigator."[49]

Allan M. Freedman, LLB, first met Allan Gotlib in 1963, while attending junior high school. " In the early years, Allan appeared polite, studious and reserved to the outside world, although he had a mischievous streak that fell short of getting him into real trouble." One of Gotlib's harmless pranks was skipping class with a group of his chums to have their photo taken with Santa Claus, at Yorkdale Plaza. After their senior matriculations, Gotlib and Freedman's academic paths parted with Gotlib ending up at CMCC and Freedman studying law at the University of Western Ontario, in London.

In 1975-76, Gotlib was in his clinical year at the Col-

Figure 5.
*Dr. Allan Gotlib, C.M., DC*

lege and Freedman was articling in Toronto. Because he was taking Valium for "neck pain which medical doctors had diagnosed as tension," Freedman consulted Gotlib at the CMCC clinic who told him he had a subluxation that "could be managed by spinal manipulation and would take nine treatments." Freedman asked if he "could get all nine treatments at once, to which the reply was a brusque no."

Almost four decades later, Freedman still requires maintenance care and the two remain close companions as they deal with the vicissitudes of life. "Allan Gotlib is an unique human being with an unusual amount of common sense and quiet determination. His level of patience when dealing with issues is remarkable. Above all, his commitment to the validity of the chiropractic profession is above repute and ultimately led to his being rewarded with the Order of Canada." [Email, Freedman to the author, March 24, 2014]

Naturally, Dr. Gotlib has expressed his own viewpoint. June 29, 2012, Toronto Star columnist Jim Coyle wrote: "Along with the identification, this week's recipients had to deal with the trying circumstances of being thrilled with the news from Rideau Hall but sworn to secrecy until after the announcement." When Gotlib, who is known for a "quiet and diligent manner," was invited to a Star photo shoot, "there was pride and playfulness in him" when he replied he would be there. "I'll be the old guy with a gorgeous lady on my arm. It will be my bride of 40 years."

Allan is both gracious and grateful in expressing his "heartfelt thanks to Canada," for giving "its citizens one of the world's most precious gifts, freedom." Allan finds this freedom inspirational and "fires" his passion. "To be recognized in this special way for contributions made not only to my profession but to Canadian society, is beyond belief."

It also puts chiropractors in the spotlight and affords them "a wonderful opportunity to grow arm in arm with Canada and to engage all Canadians in the future."

May 3, 2013, Allan Gotlib was among 44 worthy civilians who gathered in the Ballroom of Rideau Hall for their Investiture by the Right Honourable David Johnston, Governor General of Canada.

> *I am so pleased to invest you into the Order of Canada, the centerpiece of our country's honours system. DESIDERANTES MELIOREM PATRIAM. They desire a better country. That is why you are here today, and why I am so grateful for your contributions that shape our ongoing experiment called Canada. Congratulations on your achievements and on behalf of all Canadians, thank you.*

On October 1, 2013, Dr. Gotlib had to be surprised, if not shocked to receive another letter, from our Governor General of Canada.

> *On behalf of Her Majesty Queen Elizabeth II, I am pleased to award you the Queen Elizabeth II Diamond Jubilee Medal, created to mark the 60th anniversary of Her Majesty's accession to the Throne. In granting you this honour, I thank you for your dedicated service to your peers, to your community and to Canada. The contributions you have made to our nation are most commendable and deserve our praise and admiration.*

## Allan Gotlib's Dreams

When asked by the press in 2012, what piece of advice he had for young Canadians, Dr. Gotlib's response was, "Don't let anyone tell you it can't be done. Dream to succeed – then work hard!" Dr. Gotlib is still dreaming and says he cannot visualize where we would be today without the Research Chair/Professorship program.

> *This program has been a catalyst for our profession and brought believability and trust but it is limited by the funding available, which is small compared to other professions. The current Chairs and Professorships give our researchers and clinicians access to millions and millions of dollars in infrastructure which the profession could never afford. Creating the evidence our profession needs to satisfy the public and policy makers requires highly sophisticated technologies and equipment. In order for our profession to grow, this program must grow.* [Email, A. Gotlib to the author, Mar 19, 2014]

Lately Dr. Gotlib's dreams have become even more vivid and expansive.

> *The future is evidence-based! We have a growing research culture and collective intellectual capacity. Our foot is in the door and we are courting university integration, but most important to our continued success is the current strength of our momentum. There are unprecedented pressures now, but building on the critical relationships established with university officials will bring tremendous credibility and expertise to our profession… Canada has 100 world-class universities. Imagine a chiropractic research chair in each one of those universities. Just imagine!!![50]*

## References:


1. CMCC Calendars 1978-2010. CMCC Archives.
2. Sutherland DC. Decade of the 70s. JCCA. 1969; 13(6): 3-5.
3. Watkins TA. Your CCA publications. JCCA. 1983; 27(2): 49.
4. Gotlib A. Index Medicus. JCCA. 1984; 28(2): 245.
5. Gotlib A. Accessing the biomedical literature. JCCA. 1984; 28(3): 303.
6. Gotlib A. Economics and the scientific journal. JCCA. 1985; 29(3): 125.
7. Gotlib A. The manuscript review process. JCCA. 1985; 29(4): 181.
8. Gotlib A. Guidelines for referees. JCCA. 1986; 30(2): 65.
9. Gotlib A. Turning 50 – look at what we have become! JCCA. 2007; 51(4): 197.
10. http://www.jcca-online.org.
11. International Committee of Medical Journal Editors. Uniform requirements for manuscripts submitted to biomedical journals. Ann Intern Med. 1989;108: 258-265.
12. Canadian Chiropractic Protective Association. Chiropractic Journal of Australia 2000; 30(2): 43.
13. Chiropractic self-regulation timeline. CCO, June 2000.
14. Sutherland DC. Chiropractic: From rejection to acceptance. JCCA. 1998; 42(3): 167.
15. Brown DM. The West family chiropractic dynasty: celebrating a century of accomplishment in Canada. JCCA. 2010; 54(3): 198.
16. http://www.cco.on.ca.
17. Regulated Health Professions Act, 1991, S.O., 1991 c. 18, as amended.
18. Gotlib A. The disciplinary process for chiropractors in the province of Ontario: a review. JCCA. 1998; 42(1): 52-54.
19. Gotlib A. The time to disposition of a disciplinary matter before the College of Chiropractors of Ontario. JCCA. 2002; 46(2): 111.
20. http://www.pas.gov.on.ca/scripts.
21. http://www.lsuc.on.ca.
22. http://www.health.gov.on.ca/newsbulletin/2009.
23. Terry A. Watkins. Curriculum Vitae. Undated: P. 4. CMCC Archives.
24. http://cihr-irsc.gc.ca.
25. http://www.cihr.gc.ca/e20177.html.
26. http://www.cochrane.org/organisational-policy-manual.
27. CMCC Research Report, 2012-13: 2-3. CMCC President's Office.
28. Grier A, et al. Report of the task force on chiropractic research in Canada. JCCA. 1997; 41(1): 36-61.
29. Vernon H. The development of a research agenda for the Canadian chiropractic profession: Report of the consortium of Canadian chiropractic research centres, November 2000. JCCA. 2002; 46(2): 86-92.
30. Gotlib A, Stuber K, Bussières A. Research consortium workshop III to advance the Canadian chiropractic research agenda. JCCA. 2009; 53(1): 7-13.
31. Gotlib A. Investing in people. CCA Back Matters, Winter 2014: 10.
32. Stuber K, Bussières A, Gotlib A. Chiropractic research capacity in Canada in 2008. JCCA. 2009; 53(2): 78-86.
33. Ibid: 79.
34. Stuber K, Bussières A, Gotlib A. Chiropractic research capacity in Canada in 2008 – Phase 3. JCCA. 2009; 53(4); 227-230.
35. Ibid: 228.
36. Stuber K, Bussières A, Gotlib A. Chiropractic research in Canada in 2008. JCCA. 2009; 53(2): 83.
37. CMCC faculty and clinicians. Accessed Jan 27, 2014, from http://www.cmcc.ca.
38. CMCC Research report 2012-13: 2. President's Office.
39. CCRF Bulletin, December 2013: 10.
40. UOIT's new Canada research chair. Accessed Feb 24, 2014 from http://news.uoit.ca/archives/2013.
41. Potter RA. President's message. CCRF Research Bulletin, December 2013: 1.

42. Gotlib A. The nature of the informed consent doctrine and the chiropractor. JCCA. 1984; 28(2): 272-274.
43. Gotlib A. The chiropractor and third party access to confidential patient health records. JCCA. 1984: 28(3): 327-330.
44. Gotlib A, Thiel H. A selected annotated bibliography of the core biomedical literature pertaining to stroke, cervical spine, manipulation and head/neck movement. JCCA. 1985; 29(2): 80-89.
45. Gotlib A, Injeyan HS, Crawford J. Laboratory diagnosis in Ontario: the need for reform relative to the profession of chiropractic. JCCA. 1997; 41(4): 205-220.
46. Gotlib A, Rupert R. Assessing the evidence for chiropractic manipulation in pediatric health conditions – a systematic review. Pediatr Child Health. 2005; 10(3): 157-161.
47. Martin CL. Chair's message. CCRF Research Bulletin, August 2013: 11.
48. Canadian Chiropractor, September 2012: 9-10.
49. Ibid: 10.
50. CCA Back Matters, Winter 2014: 10.

# Book Review

*Fascia in Sport and Movement*
*Robert Schleip, Editor and Amanda Baker, Assistant Editor*
*Handspring Publishing, Scotland, UK, 2015, 274 pp.,*
*Paperback Price: $76.90*
*ISBN: 978-1-909141-07-0*

Editor Robert Schleip is a researcher and international authority on fascia. In his book, *Fascia in Sport and Movement,* he, co-author Amanda Baker and twenty-six contributing authors provide a sound evidence-based framework for fascial therapy by applying the current histological research to clinical practice. The book contains contributions from a wide-variety of health professions, who all provide refreshing and diverse positions on this newly emerging topic.

*Fascia in Sport and Movement* is divided into two well laid out sections. The first section discusses the research and theories of fascia as they pertain to force transmission, biochemistry, elastic storage, recoil dynamics, stretching, etc. The second section addresses the clinical applications of fascia training. This section is broad and covers numerous movement practices, assessment technologies and manual techniques. The book does an exceptional job fitting fascial training principles into already established movement practices such as Pilates, Gyrotronics and martial arts. Though the book fails to apply fascial training principles and methods to a large number of mainstream sports, it is something the authors may consider expanding upon in future editions.

The information cited within the text is current and well referenced. Many chapters within and between the two sections also reference each other, providing a fluid read with easy navigation of the text. *Fascia in Sport and Movement* is an excellent addition to the bookshelf of any manual health care practitioner or student. It is the first book of its kind and I believe it is a resource that will be referenced for many years.

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*Fascial Dysfunction - Manual Therapy Approaches*
*Leon Chaitow, Editor*
*Handspring Publishing, Scotland, UK, 2014, 266 pp.,*
*Paperback Price: $62.50*
*ISBN: 978-1-909141-10-0*

Fascia is a trending topic of discussion among many health disciplines. Many professions are beginning to understand and acknowledge fascia's contribution to dysfunction as the body of research on fascia continues to grow. Leon Chaitow is a renowned Osteopath and Naturopath who has authored numerous papers and books on various manual medicine topics. He and nineteen others have put together an exceptional book called *Fascial Dysfunction - Manual Therapy Approaches*. The book is a great resource for fascia research and provides information on various methods to clinically assess and treat fascial dysfunction.

*Fascial Dysfunction - Manual Therapy Approaches* is divided into two sections. The first section provides a detailed groundwork for understanding the many roles fascia plays in the body. It also provides valuable information on what can happen when the fascial tissues are not performing as they should.

Section two provides the reader with various techniques used to treat fascial dysfunction. This section is particularly worthwhile for those interested in exploring and practicing different fascial treatment methods. The largely European contribution in section two suggests that that the fascial treatment techniques provided may not be representative of the treatment methods practitioners are using in other parts of the world and is therefore something that the authors may consider expanding upon in a future edition. The contributors in this section provide a treatment rationale based on both anecdotal evidence and scientific research and acknowledge limitations when necessary.

I would recommend *Fascial Dysfunction - Manual Therapy Approaches* to all manual medicine practitioners who are interested in expanding their knowledge of fascia and fascia treatment techniques.

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*Faster, Higher, Stronger - How Sports Science is Creating a New Generation of Superathletes - and What We Can Learn from Them*
*Mark McClusky*
*Hudson Street Press, New York, 2014, 274 pp.,*
*Hardcover Price: $18.14*
*ISBN: 978-1-59463-153-5*

Competitive and elite sport is a multi-billion dollar industry, which has seen numerous advancements in sport technology, training principles and nutrition over the last few decades. These improvements have created a new generation of athletes that are stronger, faster and more skilled than ever before. Mark McClusky is a veteran journalist, editor and author of the book *Faster, Higher, Stronger - How Sport Science is Creating a New Generation of Superathletes - and What We Can Learn from Them*. In his book, McClusky dives into the world of elite sports to find out what it really takes to become a top athlete in the 21st century.

*Faster, Higher, Stronger - How Sport Science is Creating a New Generation of Superathletes - and What We Can Learn from Them* details how athletes and coaches are using science and technology to achieve new levels of human performance. McClusky explains that raw talent; hard work and good coaching are no longer enough to achieve elite level status because these advancements are changing the way that athletes eat, train and recover. Improvements that have been made in the fields of sport supplements, sport analysis, recovery, and exercise physiology are detailed in the book and McClusky emphasizes that it is the synergistic interplay between them that provides top athletes with a competitive edge.

Through a combination of scientific literature, interviews, and occasional reflection of personal experience, McClusky has put together a strong and convincing basis for how teams of coaches, trainers, nutritionist, and scientists, influence an athlete's performance in their sport. The scientific literature that is referenced appears to come from credible sources and the conversations that he narrates come from top product engineers, athletes, coaches, and sport analysts from a wide variety of sports.

I would recommend *Faster, Higher, Stronger - How Sport Science is Creating a New Generation of Superathletes - and What We Can Learn from Them* to any sport and performance enthusiast. It is both an entertaining and educational read and compliments books such as The Sport Gene and The Talent Code, which also provide insight into the evolution of elite sport and athletics.

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*Fatigue in Sport and Exercise*
*Shaun Phillips*
*Routledge, New York, 2015, 288 pp.,*
*Hardcover Price: $179.55*
*ISBN: 978-0-415-74222-1*

Fatigue in sport has become a topic of interest among athletes, coaches and sport scientists because it affects athletic performance across a wide range of sports. Shaun Phillips is a sport physiology professor at the University of Edinburgh and has studied how peripheral and central mechanisms may impact fatigue. His text; *Fatigue in Sport and Exercise*, is the first book of its kind. Shaun synthesized a great deal of fatigue research into a go-to resource for those in the sport and exercise physiology field. Though his book does not provide "all the answers", he presents the information and research in a way that's easy to read and understand.

*Fatigue in Sport and Exercise* is broken into four parts. Part 1 sheds light on the difficulty in defining fatigue and some of the ways in which fatigue is measured. Part 2 discusses many potential mechanisms of fatigue including metabolic acidosis, dehydration and hyperthermia, etc. Part 3 complements Part 2 by pulling together the information across all previously discussed fatigue mechanisms based on different types of exercise (i.e. short distance vs. middle distance sports). The book concludes in Part 4 with some thoughts on the direction of fatigue research, the interpretation of this research, and some recommendations with respect to keeping abreast the fatigue literature.

Shaded "Key Point" boxes are littered throughout the test, which summarize the most important concepts of each chapter. This provides the reader with a great review and easy reference in the future. Although this book is the first of its kind, the current list price may be a barrier for some interested in the material. Irrespective of the price, I would recommend *Fatigue in Sport and Exercise* to all those working with an athletic population.

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# ERRATUM

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

In several instances (see below) in the article by Passmore et al. (2015)[1] "Manitoba Health Family Services", "Manitoba Health", or "healthcare" are mentioned as being an interested and supporting party. This should be corrected to "Family Services" in all instances.

- Page 365, paragraph 5
- Page 365, paragraph 8
- Page 370, paragraph 3
- Page 370, paragraph 5 (2 instances)

We sincerely apologize for these errors.

## Reference:

1. Passmore SR, Toth A, Kanovsky J, Olin G. Initial integration of chiropractic services into a provincially funded inner city community health centre: a program description. J Can Chiropr Assoc. 2015; 59(4): 363-372.