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Profile – Dr. Jean-Alexandre Boucher, DC

Dr. Jean-Alexandre Boucher, DC
PhD Candidate
Université du Québec à Trois-Rivières

Dr. Jean-Alexandre Boucher obtained his Chiropractic degree in June 2010 from Université du Québec à Trois-Rivières (UQTR) and immediately undertook part-time practice in Trois-Rivières, his native town. During his studies, he served as a research assistant for Dr. Martin C. Normand, DC, PhD. They developed functional assessment tools and specific exercise programs using the RedCord™ workstation. They also decided to introduce a vibration component to the protocol. Dr. Boucher enrolled in a PhD program at UQTR in September 2010, under the supervision of Dr. Normand and co-supervision of Dr. Martin Descarreaux, DC, PhD. His thesis will focus on lumbar pain rehabilitation and the influence of vibration on its evolution. The aim of the first part of the study will be to confirm the specific role of vibration as a therapeutic modality and to determine whether the application of paraspinal muscle vibration will alter the control of isometric force production of the trunk. The validation of the use of three physical tasks to categorize non-specific chronic low back pain and to create specific exercise programs for rehabilitation will also be undertaken in the later stages of the project.

Dr. Boucher is an active member of the UQTR GRAN « Groupe de recherche sur les affections neuro-musculo-squelettiques », a research group with interest in health issues related to neuro-musculo-skeletal disorders. Dr. Boucher also benefits from financial support awarded by the « Fondation de Recherche Chiropratique du Québec » to pursue his PhD. He will be presenting his research at the WFC Congress in Rio this April.

Profile – Dr. Maja Stupar, DC

Dr. Maja Stupar, DC
PhD Candidate
University of Toronto

Dr. Maja Stupar graduated from the Canadian Memorial Chiropractic College (CMCC) in 2003 and completed the Clinical Sciences Residency in 2005. She is currently a doctoral candidate in Clinical Epidemiology at the Department of Health Policy, Management and Evaluation, Faculty of Medicine, University of Toronto. Dr. Stupar's thesis addresses measurement of outcomes in musculoskeletal injuries. Specifically, it is evaluating psychometric properties of an outcome measure developed for assessing whiplash-related disability. Her doctoral thesis supervisor is Dr. Pierre Côté.

Dr. Stupar is a Vanier Canada Scholar. Vanier Canada Scholarships are funded by the Canadian Institutes of Health Research (CIHR) in the amount of $150 000 to support doctoral education. Dr. Stupar ranked within the top 2% among the review committee that evaluated her application for the Vanier Canada Scholarship competition. Furthermore, she was the recipient of the Michael Smith Foreign Study Supplement through the CIHR for a six-month international collaboration project completed in November 2010 with researchers from Karolinska Institute in Stockholm, Sweden. Dr. Stupar's work in Sweden assessed an outcome measure in the Swedish adult population with back and neck pain. While there, Dr. Stupar collaborated with researchers from different clinical professions and gave a presentation about the chiropractic profession in Canada at the Scandinavian College of Naprapathic Manual Medicine. Prior to her work abroad and during her doctoral studies, Dr. Stupar collaborated with other clinical groups locally. Her collaboration with Dr. Gillan Hawker, a rheumatologist and Chief of Medicine at Women's College Hospital, resulted in a publication in the JMPT in 2010. This paper "The Association Between Low Back Pain and Osteoarthritis of the Hip and Knee: A Population-Based Cohort Study" was awarded the 2nd place World Federation of Chiropractic (WFC) research prize sponsored by NCMIC group. Dr. Stupar continues to work (part-time) as a clinical research coordinator for the UHN Whiplash Intervention Trial. This RCT focuses on identifying the program of care most effective for acute whiplash associated disorders.

Dr. Stupar started her outstanding research career while studying at CMCC. Her 4th year research project was chosen for presentation at the Canadian Chiropractic Association Research Day and her graduate research project was awarded the ACC Research Scholarship. This gave her the opportunity to present her project at the WFC Congress in Sydney, Australia. Dr. Stupar has been presenting her work extensively at international and interdisciplinary conferences.

Profile – Dr. Connie D'Astolfo DC

Dr. Connie D'Astolfo DC
PhD candidate
York University

Dr. Connie D'Astolfo graduated with her Hons BA from the University of Toronto in 1996 followed by a BSc in Human Biology (summa cum laude) in 1999 and her Doctor of Chiropractic degree in 2001, both from the National University of Health Sciences in Chicago IL. In 2008, she received her Graduate Diploma in Health Administration from the Faculty of Medicine at the University of Toronto in clinical epidemiology and outcomes evaluation.

Dr. D'Astolfo is the president of SPINEgroup®, a clinical-research-consulting firm in Vaughan, ON. Currently Dr. D'Astolfo is a PhD candidate in Health Informatics and Decision Making in the Faculty of Health at York University. Her research interests are focused on health services research specifically related to chronic disease prevention and management, spinal disorders and clinical program evaluation, management and outcome evaluation.

The topic of her PhD thesis is: "Spine Care Program Model and Implementation in the Ontario Long Term Care System."

This program initiative is novel in its inclusion and study of the chiropractor in a mainstream interdisciplinary clinical team in the long term care sector. This program is expected to enable long term care institutions, the Ministry of Health and Long Term Care (MOHLTC) and other stakeholders to effectively address several urgent issues including:

- understanding the impact of spinal disorders on quality of life in the senior LTC population,
- recognizing the complex dynamics of the interdisciplinary clinical team that underlies effectiveness and impact on quality of care,
- identifying at risk seniors, reducing pain and impairment and increasing their quality of life, and
- evaluating the clinical and economic impact (cost-effectiveness analysis) of interdisciplinary teams compared to usual care in the prevention, diagnosis and management of spinal disease/disorders in the geriatric population.

Dr. D'Astolfo's PhD thesis supervisor is Dr. Peter Tsasis MBA, PhD, CHE, an Associate Professor in the School of Health Management at York University. His expertise is in health management and his research interests lie in organizational change, performance evaluation and quality improvement.

Profile – Dr. Mohsen Kazemi RN, DC, FCCSS(C), FCCRS(C), DACRB, MSc

Dr. Mohsen Kazemi RN, DC, FCCSS(C), FCCRS(C), DACRB, MSc
Associate Professor
Canadian Memorial Chiropractic College

Dr. Kazemi recently completed his Master of Science in Advanced Chiropractic Practice through Bournemouth University/AECC. His thesis was titled "Relationships between injury and performance in elite Taekwondo athletes." This retrospective case-series study examined the relationships between pre competition and during competition injuries and success in terms of gaining medals among Canadian National Taekwondo athletes over a 10 year time period. The study has been accepted for presentation at 2011 ACC-RAC.

Dr. Kazemi graduated from Shahid Beheshti University in Tehran-Iran with a Nursing Diploma in 1986. He graduated from CMCC in 1996 and went on to become the first clinician to successfully complete the Sports Residency at CMCC. In 2004, he also completed the Chiropractic Rehabilitation Sciences Fellowship program.

As an Associate Professor at CMCC, he teaches Clinical Education to fourth year students and Sports Specific Subjects to first and second year Sports Sciences Residents. He has published several scientific papers in peer-reviewed journals, presented his research in Taekwondo and chiropractic around the world and is the author of the first complete book on vibration plate exercise programs, "Vibration Plate Exercise." Dr. Kazemi is the inventor of the VMTX Vibromax Therapeutics soft tissue technique and Kazemizer, a portable exercise device and method of preventing lactic-acid build-up.

Dr. Kazemi holds a 6th degree black belt in WTF Taekwondo and has been Canadian Taekwondo Poomse Champion in 2006, 2008 and 2010. He won gold at the 2008 World Hanmadang Taekwondo in 5th degree Masters individual poomse.

In addition, Dr. Kazemi has been the Medical Chair person for Ontario Taekwondo Association since 2003 and also served as the WTF Taekwondo Canada Medical Chair (2009–2010). He was the appointed Alternate Chiropractor for the Core Canadian Health Care Team for the Salt Lake City 2002 Winter Olympic Games, Manchester 2002 Commonwealth Games, Rio 2007 Pan American Games and the Beijing 2008 Olympic Games. He served as the Core Canadian Medical Team Chiropractor at the Santa Domingo 2003 Pan American Games and Canadian Taekwondo team Chiropractor at the Beijing 2008 Olympic Games. He was the appointed Chiropractor to Mount Cypress at the 2010 Winter Olympic Games. He was the only Canadian Chiropractor at the first Youth Olympic Games, Singapore, 2010.

Profile – Dr. Walter Herzog PhD

Dr. Walter Herzog PhD
Professor
Faculties of Kinesiology, Engineering and Medicine
Director, Human Performance Laboratory
Canada Research Chair in Molecular and Cellular Mechanics
University of Calgary

In 2010 alone, Dr. Herzog published 15 scholarly papers with 9 more accepted or in press and 13 submitted. His research involves understanding molecular transport and tissue adaptation in a wide range of musculoskeletal injuries and diseases. His research is relevant to furthering nanotechnology research and development while providing the basis for medical breakthroughs in treating diseases such as osteoarthritis, which is expected to affect 20 to 25 per cent of Canadians by 2025. Dr. Herzog hopes to discover new ways to detect, prevent and treat diseases like osteoarthritis, osteoporosis, and fibromyalgia.

Three very timely papers include:

- Austin N, DiFrancesco L, Herzog W (2010). Microstructural damage in arterial tissue exposed to repeated tensile strains. Journal of Manipulative and Physiological Therapeutics 33:14–19.
- Herzog W (2010). The biomechanics of spinal manipulation. Journal of Bodywork and Movement Therapies 14:280–286.
- Wuest S, Symons B, Leonard TR, Herzog W (2010). Preliminary report: biomechanics of vertebral artery segments c1-c6 during cervical spinal manipulation. Journal of Manipulative and Physiological Therapeutics 33:273–278.

As the PI in 10 research projects, Dr. Herzog currently carries over $1.8 million in operating grants from agencies such as CIHR, CCRF, Canada Council for the Arts, CCPA, Natural Sciences and Engineering Research Council, and the Alberta Heritage Foundation for Medical Research.

In 2010, he organized the 6th World Congress on Biomechanics in Singapore and in 2011 he is organizing the 5th International Conference on Biomedical Engineering in Kuala Lumpur.

This past year has been very successful in terms of chiropractic research. He has established a core group of interested local chiropractors who meet regularly and help with ongoing research problems. These include Drs. Bruce Symons, Sarah Wuest, Ron Carter and Phil Conway. In addition, Dr. Herzog is supervising a MSc level graduate student and chiropractor, Dr. Conrad Tang.

This past year his focus was on three primary projects:

(i) the first project was aimed at investigating the potential for vertebral arteries to adapt positively or negatively to multiple stretching cycles as they occur during spinal manipulation; (ii) the second project was aimed at quantifying the stresses and strains of human vertebral artery segments C1-C6 during diagnostic, range of motion and spinal manipulative treatment testing; (iii) the third project was aimed at studying the efficacy of ART techniques to release pain and improve function of patients with anterior knee pain.

New JCCA Editorial Board Appointments

The JCCA is delighted to announce the appointments of three Editorial Board members effective January 1, 2011 for a two year term.

Dr. Mohsen Kazemi RN, DC, FCCSS(C), FCCRS(C), MSc
Associate Professor, Faculty of Clinical Education
Sports Sciences Residency Program Co-ordinator
Canadian Memorial Chiropractic College

Dr. Steven Passmore DC, MS
CCRF Professorship in Spine Biomechanics and Neurophysiology
Assistant Professor, School of Medical Rehabilitation
Faculty of Medicine
University of Manitoba

Dr. Paul Bruno DC, PhD
CCRF Research Chair in Neuromusculoskeletal Health
Assistant Professor
Faculty of Kinesiology and Health Studies
University of Regina

What does the concept of "non-organic signs/symptoms" mean to chiropractic MSK specialists?

Dr. Howard Vernon DC, PhD, FCCS*

Dr. Howard Vernon DC, PhD, FCCS

Introduction

Non-organic signs and symptoms (NOS) have been included in assessments of spine pain patients for decades, originating with Waddell et al.'s seminal 1980 study.[1] In that and other early work, high NOS scores were thought to indicate the need for further psychological assessment of the spine pain patient.[2] In a more recent work, Main and Waddell have clarified that, all along, they considered NOSS to be associated with higher levels of distress and illness behaviour.[3] They noted that other interpretations of high NOS scores had entered the literature and the general discourse on spine pain patients, including considerations of malingering or insincere effort. They cautioned that these interpretations were not part of the original considerations for NOS.

Numerous studies have appeared since 1980 on the use of NOS in low back pain patients, many of which confirm the association of NOS with certain psychological variables and with poorer prognosis.[4–15] NOS have also been applied in the cervical spine.[16–18] However, critical reviews have emerged which challenge some popular assertions about NOS.[19] Most important among these critiques is the work of Fishbain et al.[20,21] whose systematic reviews of the literature find very little empirical support for many of the psychological associations with NOSS and almost no support for the correlation between NOSS and malingering.

In light of these controversies, it seemed appropriate to inquire as to the meaning of NOSS among some of those practitioners who specialize in spine pain assessments. Chiropractors in general, and chiropractic MSK specialists and third-party assessors in particular, may have implicit attitudes about NOSS which may not have been explicitly explored by themselves and which have never been explicitly examined or analyzed for their consistency with others in similar roles. As well, these implicit attitudes may be predicated on faulty justifications that are not evidenced-based. In order to identify if this is the case, a small survey of these attitudes was undertaken.

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Methods

A sample of 70 chiropractic MSK specialists and those who conduct third-party assessments in Ontario was created on the basis of ease of electronic access. A small questionnaire was developed which inquired into the terms which chiropractic spine pain specialists associated with the concept of NOS. Respondents were sent the questionnaire by e-mail. The questionnaire consisted of a single prompting paragraph which asked respondents to consider the following questions: What are NOS all about? What do they really test? What interpretation do you give them?

Respondents were then asked to offer up to 5 words or phrases which they associated with NOS. All responses were tabulated for frequency amongst respondents. Qualitative review of the total word list was conducted to develop any synonyms and any related themes.

Results

Questionnaires were sent to 70 chiropractic specialists. Sixteen responses were obtained (23%). Given the large number of terms generated and the degree of redundancy identified in the later responses, it was decided that this sample was sufficient.

The total number of distinct terms submitted by these respondents was 35 (see below: 4 themes contain all 35 words or phrases). Five (5) terms were endorsed by 3 or more respondents with scores as follows: "inconsistent" (endorsed by 6), "self-limiting" (endorsed by 3), "malingering" (endorsed by 4), "exaggerating" (endorsed by 8) and "somatization" (endorsed by 5).

Of these terms, 4 synonyms for "exaggeration" were noted: "symptom magnification," "amplification," "over-reaction" and "embellishing." From the remaining 30 terms, 7 similar terms (not necessarily synonyms) were noted for the concept of "deliberate deception:" "misleading," "falsify," "faking," "malingering," "deceiving," "artificial response" and "improper response."

Taking these two sets of words into account, the frequency counts for response terms was as follows:

1. Exaggeration: 15
2. Deception: 12
3. Inconsistent: 6
4. Somatization: 5
5. Pain Focus: 4
6. Self-limiting: 3
7. All other terms: 1

Upon review of these terms, four themes emerged, as shown in Table 1 (# in bracket = # of respondents selecting this term):

Discussion

This survey must be interpreted with caution due to the small sample size of respondents. However, even from this small sample, it appears that there is a strong endorsement of the nexus of concepts around "exaggeration", "malingering" and "inconsistency" which would indicate that the chiropractic assessors take the attitude that NOS reflect consciously motivated behaviour. The respondents did endorse 8 terms that appear to provide a more psychological (non-deliberate / sub-conscious) interpretation of the motivational set of patients demonstrating high NOS (see Psychological Factors); however, no single one of these terms was endorsed by more than 2 respondents. Given that a maximum of 70 responses was possible with this sample, the total number included in the "psychological factors" theme was 11 (16%); this appears to be only a modest endorsement of these factors as critical to the interpretation of NOS.

The concept of "over-reaction" provides a test case for the problem: when a non-organic sign of "over-reaction" is observed, does this originate in the patient's psychological or even "neurological" hypersensitivity?, or does it originate in a conscious motivation to mislead? Proponents of the former interpretation would likely justify it by appeals to the well-known manifestations of distress or anxiety (i.e., hypervigilance, fear avoidance attitudes, negative affect, negative response bias, etc.[22–28]) and/or to the increasingly accepted concept of chronic pain-induced central sensitization, with clinical manifestations of hyperalgesia or allodynia underlying the over-reactivity observed clinically.[29,30] Proponents of the latter interpretation appear to downplay these "psychological" interpretations and emphasize those that arise from deliberate attempts to obtain secondary gain.[31–33]

Perhaps these respondents were placing greater emphasis on the non-organic simulation signs (lumbar and cervical) as opposed to the non-organic symptoms. The former are distinguished from the latter as they clearly involve the patient's verbal response to whether the "test"

Table 1 *Four themes arising from responses*

1. Deception:
   - malingering (4)
   - falsify (2)
   - faking (2)
   - deceiving (1)
   - misleading (1)
   - artificial response (1)
   - improper response (1)

2. Psychological factors:
   - fear avoidance (2)
   - pain anxiety (2)
   - frustrated (2)
   - catastrophizing (1)
   - apprehension (1)
   - anxiety (1)
   - urgency (1)
   - hopelessness (1)

3. Clinical Behaviours:
   - exaggerating (8: single highest item)
   - inconsistent (6)
   - pain-focus (4)
   - self-limiting (3)
   - symptom magnification (2)
   - amplification (1)
   - embellishment (2)
   - over-reaction (2)
   - attention-centred (1)

4. Miscellaneous / Clinician-focused concepts:
   - somatization (5)
   - co-morbidity (1)
   - passive coping (1)
   - non-anatomical (1)
   - prolonged disability (1)
   - high pain level (1)
   - psychological factors (1)
   - biopsychosocial issues (1)
   - caution (1)

provokes pain. These respondents may have taken the attitude that an examiner "knows" that these tests should not be painful, but, if the patient responds that they are, this can't be due to anything other than a deliberate falsehood.

If the findings of an emphasis on the conscious motivation of the patient to deceive are at all generalizable to the larger chiropractic world, then this is somewhat at odds with current important reviews in the literature and may not be an evidence-based attitude. Ferrari[27,28] has consistently indicated that "symptom magnification" is likely due to psychological factors such as depression, negative response bias, distress and the like. Fishbein and colleagues[20,21]have consistently shown poor correlations between NOS and distress,[20] non-organicity,[20] secondary gain[20] and tests of malingering.[21] They have shown evidence that NOS do correlate with higher pain scores and with poorer prognosis, but the mechanism of this association is unclear.

One important consideration is that the issue of the distinction between non-organic symptoms, non-organic clinical signs and non-organic simulation signs has not been well-addressed in the literature. More work is needed to clarify the meanings and interpretations of NOS.

Conclusion

This is only a brief report. Its findings should be viewed with caution as to the nature of the sample (only chiropractic MSK specialists) and of the small proportion of respondents from this sample. The findings reported here are not generalizable beyond these limitations; however, readers are challenged to consider their own attitudes to NOS in light of those expressed by the respondents in this study and those identified in the relevant literature.

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PROMIS: a new tool for the clinician scientist

Dr. Douglas M. Lawson DC, MSc*

Dr. Douglas M. Lawson DC, MSc

The Patient-Reported Objective Measurement Information System (PROMIS) holds great potential for supporting the clinical scientist. That potential includes: better surveys, better outcome measures, easier obtained outcome measures, better comparators, easier collaboration, and greater support for the clinician who wishes to engage in research in his/her clinical setting.

In the past, conducting research from within a clinical practice has been fraught with many challenges. Unless the clinician was located close to an educational institution, little support has been available. If patients were to be surveyed, which survey should be used? Which of the available surveys (patient reported measures) has been validated for the population of interest to the clinician? If the clinician was to make up his/her own survey, which rating scales should be used and how was the survey to be validated? Was the survey reliable? Were the survey outcomes valuable? If the survey was delivered by paper, how were the data to be entered electronically, and who would help analyze the data? How did the clinician's sample compare to a normal population, or to a sample of similar health challenges? If a single clinician's office held insufficient sample size for clinical research, how could collaboration with other offices be coordinated? Once the research was completed, who else could benefit from access to the data? How could the data be shared? There were many barriers to the clinician who wished to contribute to the scientific evidence within his/her field.

Starting in 2004, the National Institutes of Health (NIH) created a process to deal with the critical research challenges of clinical research.[1] The Patient-Reported Outcomes Measurement Information System (PROMIS; www.nihpromis.org) was one of the first initiatives. This initiative brought the focus of many experts in research and psychometrics to the problems of clinical research and patient reported outcomes. Patient reported outcomes include quality of life surveys, pain questionnaires, functional surveys, and satisfaction with care surveys. Advanced psychometric techniques were used to validate available survey instruments and to create better instruments for

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Table 1

Domain	Adult		Pediatric	
	# Items in Bank	# Items in Short Form(s)	# Items in Bank	# Items in Short Form
Emotional Distress – Anger	29	8		6
Emotional Distress – Anxiety	29	4, 6, 7, 8		8
Emotional Distress – Depression	28	4, 6, 8		8
Fatique	95	4, 6, 7, 8		10
Pain – Behavior	39	7		
Pain – Interference	41	4, 6, 8		8
Sleep Disturbance	27	4, 6, 8		
Sleep Related Impairment	16	8		
Physical Function	124	4, 6, 8, 10, 20		
– Mobility			23	8
– Upper Extremity			29	8
Asthma			17	8
Satisfaction with Participation in Discretionary Social Activities	12	7		
Satisfaction with Participation in Social Roles	14	4, 6, 7, 8		
Peer Relationships			15	8
Global Health		10		
Profile (4-, 6-, or 8-items short forms of Anxiety, Depression, Fatique, Pain-Interference, Sleep Disturbance, Physical Function, and Satisfaction with Participation in Social Roles)		29, 43, 57		

the clinician. The PROMIS research sites gathered data on both the general population and diseased populations in 2006 and 2007: normal subjects approximately 7,500, cancer approximately 1,000, heart disease approximately 500, rheumatoid arthritis approximately 500, osteoarthritis approximately 500, etc.[2] The general population was constructed to ensure adequate representation with respect to: sex, age, ethnicity and education (for a US population). Currently, the Assessment Center website (www.assessmentcenter.net) states that there has been adult testing in over 20,000 individuals in the US and child and youth testing in over 4,000 individuals in the US.

Both traditional (classical test theory) and modern (item response theory) analytic methods were applied to the data. The analysis allowed the validation of surveys, development and selection of appropriate rating scales and

of individual items. For example in the area I am currently working (sleep disorders), the literature search revealed over 100 surveys with almost 3,000 items.[3] As well as the analysis, all surveys were subjected to qualitative focus groups research. As a result of the considerable investment of time, financial resources, and expert analysis, the PROMIS web site now lists 17 surveys. Table 1 lists the surveys available as of July 2010 (from the Assessment Center Instrument Library).

Table 1 lists the psychometric domain that each survey measures, the number of items in the bank, and the number of items on the short form (which can be printed and delivered by paper), for both adult and pediatric populations. The Assessment Center Instrument Library is the research arm of PROMIS. At the Assessment Center, researchers can register and engage in the research process by creating surveys on the Assessment Center web site. Any of the surveys/instruments listed above can be added to a researcher's study. Demographic information as well as unique questions can be added to the survey. Welcome pages, individual logos, and on-line consent forms can be added to a study. The Assessment Center allows a clinician scientist to create a study, administer the study, and download the data from the study for analysis. The researcher can compare the results of his/her study to the general population data from PROMIS, or to disease specific populations.

As PROMIS has applied modern psychometric analysis to the data, survey participants do not have to respond to the entire items in any bank in order for stable estimates. As few as 4-items might be needed to estimate the participant's measure. This means that multiple measures can be gathered without fatiguing the participants. PROMIS has a demonstration of the computer adaptive testing (CAT) of surveys on its web page, and it is worthwhile to visit that site and visit the Assessment Center and the CAT demonstration (www.nihpromis.org).

For those wishing to utilize the short-forms of the surveys and to distribute them as paper surveys within the clinical setting, paper versions have been created. The short-forms are available to registered researchers who agree to a quite reasonable copyright. The short-forms include a scoring format so that each clinician can score a participant's form and arrive at a stable measure for that participant that compares him/her to a normal population. In order to be able to score the short forms in the clinical setting, participants must respond to all questions in the form. The short forms are a great opportunity for those who might wish to compare their daily patients to a larger population. New patients could, for example, fill out an 8- to 10-item form on pain, disability, or fatigue and the researcher would have some evidence as to how they compare to a normal population.

For both the short-form and CAT forms of the surveys, participant's measures are reported as a transformed scale (or T-score). The mean of the transformed scale is set at 50 and the standard deviation is set at 10. Due to the large size of the population data gathered by PROMIS, a normal table can be utilized to determine how the participant's measure fits within a normal curve. Any introductory statistical text will provide a table for conversion as will Dr. Rollin Brand's web page (www.stat.ubc.ca/~rollin/stats/ref/tables.html). For example, a participant measure of 60 would indicate that he/she was one standard deviation above the mean and that about 84% of the general population would have a lower measure. A participant measure of 70 would indicate two standard deviations above the mean, and that about 98% of the general population would have a lower measure.[4]

For the purpose of collaboration, the Assessment Center of PROMIS allows for teams of researchers to be involved. Each team member can be provided specific access to the site (e.g., from full access to data, to only being able to view the surveys being used). Researchers from anywhere in the world can be provided access to the site and methods for each researcher's participants to access the site. In this way, participants from multiple sites can easily be analyzed separately or in combination to increase a study's sample size.

As with every research study, the study leader still is responsible for agreements with PROMIS, appropriate consent forms and proper ethics board approval. The PROMIS site has the means for participants to consent online, and for privacy information to be held confidential.

On the plus side, PROMIS has provided researchers with an amazing study administration tool (did I mention free of charge, and available throughout the world). The surveys have been validated for a general population and specific disease groups. The results are provided in a manner that the clinician's sample can be compared to the general population. Many of the barriers have been addressed and overcome by the previous research, analysis,

validation and publication. For those wishing to develop their own surveys, the articles published by the PROMIS researchers provide a road-map of how this should be done. Here's the catch: once a year the researcher must provide demographic information to the PROMIS administrators. If the demographic and data prove to be of interest, they might be added to the PROMIS databases. Again, the researcher had control and this is an excellent opportunity to add information from a small research project to a larger study. It is quite possible that your study doesn't die when completed, but continues on as part of a larger research project.

If there is a negative, it is that the data are centered on a US population. This might be less of a problem for Canada than for other countries. Another issue is that a researcher's sample might be at the extreme end of the normal population dynamic (think breast cancer survivors dragon boat racing teams) and the PROMIS survey might not be applicable for such an extreme group.

PROMIS appears to hold the potential for providing the support needed to remove the barriers to most individuals wishing to practice as clinician scientists. I hope the reader will take the time to review the excellent work that has been done by PROMIS to date, and to consider the application of the Assessment Centers instruments in clinical research.

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The politics of chiropractic research

Dr. David J. Brunarski DC, MSc, FCCS(C)

Dr. David J. Brunarski DC, MSc, FCCS(C)
President
Ontario Chiropractic Association

The number of chiropractors involved in full time research in Canada is very limited and the infrastructure and financial resources for conducting clinical chiropractic research is insufficient.[1]

The current deficiency is not only a reflection of the down turn in the economy but a devaluation of the profession in terms of the delisting of provincial government funding, few opportunities for inter-professional collaboration, the absence of university affiliation and no new growth in public utilization.

Chiropractors have been excluded or marginalized by mainstream health care through the lack of a cohesive role identity, regulatory restrictions and limited spheres of competence. There are significant barriers to professional interaction and access to patient files, referral networks and diagnostic tests.

On the other hand, increased consumer demand for health care services has encouraged more insurers and hospitals to incorporate Complementary and Alternative Medicine (CAM) providers into their plans.[2] This change in institutional behaviour may increase chiropractic utilization and opportunities for collaborative research.The CAM modalities that seem to be the most recommended are the ones that appear regularly in the popular media and suggest that increased media exposure may influence policy makers choices.[3]

Many may not agree with the label but the mainstream health care system considers chiropractic under the umbrella of CAM and all Canadian provincial chiropractic associations agreed at the 2009 Chiropractic Leadership Summit, to strive for "mainstream" status. This approach seems timely and appropriate given a recent U.S. National survey of rheumatologists that revealed: "the historical antagonism between CAM practitioners and mainstream rheumatology physicians seems weakened."[4]

This may be considered a breakthrough because we know that when clinicians have entrenched views that are either in favour or opposed to a specific therapeutic approach, it is extremely difficult for new evidence to alter their preconceived ideas.[5,6]

The underlying cause of these opinions point to a

major credibility and communication problem in inter-professional relationships with Doctors of Chiropractic. The lack of any direct, formalized referral relationship between primary care physicians and chiropractors may contribute to some very serious negative implications for health care efficiency, quality, continuity of care and safety in the delivery of patient-centered care.[7,8]

On the positive side, the past decade has witnessed encouraging momentum and increased research capacity in key clinical areas of interaction between chiropractic and the health sciences. The Canadian Institutes of Health Research (CIHR) is the major federal agency responsible for funding health research in Canada. It was established by Act of Parliament in April 2000. It replaced the Medical Research Council of Canada. The 2011 budget is just over one billion dollars.[9]

The Board of Directors of the Ontario Chiropractic Association (OCA) approved a research policy that is aligned with it's strategic plan to prioritize support of chiropractic research chairs/professorships in Canadian Universities particularly if that research includes the evaluation of the value of chiropractic services to patients, payers and other stakeholders. The OCA's current description of the chiropractic paradigm of health is visualized as full integration into the primary health care system characterized by positive inter-professional relations, free of rivalry. The goal is ensure that chiropractic will be accepted as mainstream and an integral part of the health care system.

The OCA is credited with negotiating a fund for chiropractic research with the Ontario Ministry of Health and Long Term Care. Dr. Greg Kawchuk became our first University-based chiropractic researcher and has gone on to be awarded with a Canada Research Chair in spinal function at the University of Alberta in Edmonton.

Over the past decade the OCA has carefully managed the MOHLTC funds and leveraged the proceeds of the funds to maximize returns on interest and matching funds with other funding agencies; most notably, the Canadian Chiropractic Research Foundation (CCRF).

This mutually beneficial relationship has served as a successful template for matching funding with government and chiropractic associations in other jurisdictions as we now have nearly a dozen research chair/professorships in place across the country.

But what has been the impact of the research effort on the chiropractic profession in Canada to date?

- Is chiropractic research translating into clinical practice?
- Have Canadian chiropractors applied their knowledge and skills?
- Have they provided evidence of practical and clinical effectiveness?
- Are the research approaches addressing the strengths, weaknesses, gaps and opportunities in chiropractic clinical practice and basic science?
- Is there a more skilled cadre of researchers?
- Are they managing projects better over time?

Metrics to measure success could include:

- Comparisons between numbers of external grants and fellowships applied for and awarded, as sole or co-applicant
- Publication records
- Awards
- Training engagement levels and employability
- Translational endeavours that enhance or increase the public understanding of the research

Research funding agencies are forever trying to balance two opposing forces: scientist's desire to be left alone to do their research and society's demand to see a return on its investment.

But who is ultimately responsible for supporting and promoting our chiropractic research endeavour? The historical reluctance of the scientific community to actively engage in self-advocacy is attributable to a range of explanations that often include the following:

- I don't have time
- I am a scientist not a communications person
- I am not allowed to advocate, that's lobbying
- No one will listen to me
- My professional society does the advocacy for me
- There is no career track incentive for this

Leaving advocacy for research funding and recognition to someone else is a short-sighted strategy and ends up leaving the funding for a researchers work in someone else's hands.[10,11] There is ample opportunity for researchers and clinicians alike to get more politically active in knowledge translation and dissemination of the recent

advances in chiropractic evidence through advocacy and a consistent grassroots political presence. Chiropractic research remains a key priority because it informs the care we provide to our patients, informs health policy decisions and demonstrates the value of chiropractic care to our stakeholders, including other health care providers.

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CCRF President's Message – Investing in our researchers means investing in our profession!

Dr. Drew Potter DC
President, CCRF
Glen Morris, Ontario

Dear Colleagues

In 2010, CCRF operated with a Board approved total budget of $877,000 in revenues and supported $765,000 in restricted programming alone. CCRF funding commitments are primarily allocated to supporting the Research Chair and Professorships program across Canada.

In 2010, CCRF had financial commitments to fund the following chiropractic researchers:

1. Dr. Walter Herzog PhD, a Canada Research Chair at the University of Calgary.
2. Dr. Mark Erwin DC, PhD, the CCRF Scientist in Disc Biology at the University of Toronto.
3. Dr. Jill Hayden DC, PhD, the CIHR/CCRF Chiropractic Research Chair at Dalhousie University.
4. Dr. Jean-Sebastien Blouin DC, PhD, the CIHR/CCRF Chiropractic Research Chair at the University of British Columbia and the CCRF/UBC Professorship in Spine Biomechanics and Human Neurophysiology.
5. Dr. Jason Busse DC, PhD, the CIHR/CCRF Chiropractic Research Chair at McMaster University.
6. Dr. Steven Passmore DC, the CCRF Professorship in Spine Biomechanics and Neurophysiology at the University of Manitoba.
7. Dr. John Srbely DC, PhD, the CCRF Professorship in Spine Mechanics and Neurophysiology at the University of Guelph.
8. Dr. Paul Bruno DC, PhD, the CCRF Research Chair in Neuromusculoskeltal Health at the University of Regina.
9. Dr. Carlo Ammendolia DC, PhD, at Mount Sinai Hospital and the University of Toronto.
10. Dr. Greg Kawchuk DC, PhD, a Canada Research Chair at the University of Alberta.

Provincial/National donations

In 2010, the Provincial/National donations to CCRF included the following:

British Columbia	$100,000
Alberta	$ 90,000
Saskatchewan	$ 63,700
Manitoba	$ 57,500
Ontario	$170,000

Nova Scotia	$ 14,250
New Brunswick	$ 7,375
Newfoundland/Labrador	$ 6,750
Prince Edward Island	$ 1,000
CCA	$330,500

Foundation memberships

The membership in CCRF now totals over 1600 chiropractors. The CCRF goal is to have all Canadian chiropractors become annual members of CCRF. At $125 per year that represents the best investment anyone can make in our profession.

I want to thank The CCA, and all of those provinces and individuals that provide funding support to the CCRF. Without their donations and leadership, we cannot realize our vision and goals. In addition I want to thank the CCRF Board members and Officers for their tremendous support and insight.

Membership in the CCRF costs $125.00. This tax deductible contribution helps the CCRF oversee and coordinate this extensive research program. If you agree that we must maintain our efforts, you can very easily join those who have demonstrated their commitment. Contact your CCRF provincial representative or Dr. Allan Gotlib (AGotlib@chiropracticcanada.ca) to make a tax-deductible contribution to CCRF.

Make an investment in your profession!

CCRF Appointment

Dr. Frank Mangoni DC
New Brunswick

The Canadian Chiropractic Research Foundation is delighted to announce that Dr. Frank Mangoni DC has been appointed to the CCRF as a Vice-President.

Dr. Mangoni received his Bachelor of Science Degree in Biochemistry in 1991 from the University of Toronto. In 1995 he graduated from the Canadian Memorial Chiropractic College and has since been in clinical practice. In the past 15 years of service to the profession, Dr. Mangoni has made exemplary contributions to the chiropractic community.

He has served on countless committees during his career, including:

- Vice President, NBCA: 1997–1998
- President, NBCA: 1998–2004
- CCA Governor for NB: 2004–Present
- Chair, NBCA Complaints Committee: 1997–1998
- Chair, NBCA Board: 2004–Present
- Chair, CCA Research Committee: 2006–Present
- Chair, CCA Relocation Committee: 2009

Dr. Mangoni is the immediate past Chair of the CCA Research Committee and is the recipient of the distinguished CCRF President's Citation Award.

CCRF Directors & Officers

Dr. Drew Potter DC
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Dr. Frank Mangoni DC
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Invest in your profession!

Make a donation to support chiropractic research.

Dr. Allan Gotlib DC
Executive Vice-President
Toronto, Ontario

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Conservative management of a case of medial epicondylosis in a recreational squash player

Karen Hudes, BSc, BS, DC*

Objective: *This case study was conducted to evaluate the treatment and management of a patient presenting with medial elbow pain diagnosed as medial epicondylosis.*

Case: *A 35 year old male presented with medial elbow pain of 4–6 weeks duration that worsened after playing squash.*

Treatment: *A course of fascial stripping techniques was initiated, including: cross friction massage, instrument assisted fascial stripping to the medial epicondyle area and over the belly of the pronator teres muscle, ischemic compression of a trigger point in the pronator teres, active assisted compressions to the trigger point noted in the pronator teres, and mobilizations of the carpals, specifically the scaphoid. Instructions were given to the patient regarding icing the elbow and daily eccentric exercises. At a one year follow up, the patient reported complete resolution of symptoms with no recurrence.*

Conclusion: *Conservative management, including eccentric exercises, mobilizations, and fascial stripping appear to be beneficial in the treatment of medial epicondylosis.*
(JCCA 2011; 55(1):26–31)

KEY WORDS: epicondylosis, elbow, pain

Objectif : *La présente étude de cas a été réalisée afin d'évaluer le traitement et la gestion d'un patient souffrant de douleurs à la face interne du coude diagnostiquées en tant qu'épicondylite médiale.*

Cas : *Homme de 35 ans souffrant de douleurs à la face interne du coude depuis 4 à 6 semaines et qui se sont aggravées en jouant au squash.*

Traitement : *Un traitement basé sur des techniques de crochetage des fascias a été mis en place, avec notamment : des massages transversaux, crochetage des fascias à l'aide d'instruments dans la zone de l'épicondyle médial et à la surface du muscle rond pronateur, compression ischémique d'un point de déclenchement dans le muscle rond pronateur, compressions actives assistées du point de déclenchement observé dans le muscle rond pronateur, et mobilisations des os carpiens, plus particulièrement le scaphoïde. Il a été demandé au patient de déposer de la glace sur le coude et d'effectuer des exercices excentriques. Lors du suivi après un an, le patient a indiqué que les symptômes avaient complètement disparu et qu'aucune récurrence n'était à signaler.*

Conclusion : *Les traitements conservateurs, comprenant notamment des exercices excentriques, des mobilisations et le crochetage des fascias semblent être bénéfiques en vue du traitement de l'épicondylite médiale.*
(JCCA 2011; 55(1):26–31)

MOTS CLÉS : épicondylite, coude, douleur

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Introduction

A search of the literature for "epicondylitis" yields a plethora of information mainly regarding lateral elbow pain. There is much less information regarding pain of the medial elbow. This outcome is likely due to the fact that lateral epicondylitis is diagnosed between three and ten times more frequently than the medial version.[1,2,3] One review reports that of all diagnoses of epicondylitis, medial epicondylitis makes up 9.8% to 20% of all cases.[2] In general, lateral epicondylitis is thought to be due to repetitive trauma injuries whereas medial epicondylitis occurs due to valgus stress placed on the elbow as well as forceful work.[4,5] The term "epicondylitis" has been abandoned by many researchers as it implies an ongoing inflammatory process. Studies of the histological nature of these conditions have shown that the condition on the lateral side of the elbow, and likely the medial side as well, is actually "a degenerative or failed healing tendon response characterized by the increased presence of fibroblasts, vascular hyperplasia, and disorganized collagen."[1,6] The term epicondylosis, which is a more appropriate term in light of these findings, will therefore be used for the remainder of this paper, although a search of the literature using the term "medial epicondylosis" does not yield many articles.

The incidence of presentation of peripheral conditions to chiropractors is reported as 17.1% of chief complaints.[7] According to the National Board of Chiropractic Examiners 2005 Job Analysis of Chiropractic, the chief presenting complaint on initial visit of 8.3% of chiropractic patients in 2003 was in an upper extremity. The prevalence of medial epicondylosis is 0.4% according to the literature.[8] Studies have noted that the dominant arm is involved in 82% of cases, the mean age was 45 years, and 51% of sufferers are female.[9,10] Gender association in medial epicondylosis remains controversial with some studies reporting a gender bias towards females and another refuting it.[8,9] Prevalence seems to be higher in the following categories: age range of 45–65, current and former smokers, high body mass index, larger waist circumference, higher waist to hip ratio, and type 2 diabetes.[8] Despite the common name of "golfers elbow" it is reported in one study that 90–95% of those affected were not atheletes.[1] Grip strength measures, which are generally negatively affected with lateral epicondylosis, do not seem to be as reliable a measure of pain or disability in medial epicondylosis.[11] The prognosis for medial epicondylosis is reported as an 81% resolution over a three year period.[4]

Medial epicondylosis exhibits characteristic pain along the medial aspect of the elbow, which is exacerbated by resisted wrist flexion and/or forearm pronation.[5] The vast majority of cases of medial epicondylosis can be treated using conservative methods, although severe cases of prolonged duration (over 6 to 12 months) may require a surgical consultation regarding release of the common flexor origin.[9] The purpose of this paper is to present a case of medial epicondylosis in a 35 year old male recreational squash player that was managed using conservative methods.

Case report

A 35 year old male presented with a complaint of right forearm pain that had been worsening gradually over the past month. He is right hand dominant and explained that he had been living overseas in a secluded camp in the desert as he works in the oil industry. While in camp, he reported that he did not have access to therapy or medical attention unless an emergency occurs. The job rotation he worked was seven weeks in camp and 3 weeks off, during which time he returned to Canada and elected to seek care for his right elbow pain. As his time was very limited, he requested a rapid series of treatments and an exercise program that he could do at home when he returned overseas. He reported that his forearm pain began 4–6 weeks prior to his initial visit, and that he was an avid amateur squash player. He had been playing approximately 5–6 times per week for over one year. He report that although he has had pain and has noted some weakness in his grip, he has continued to play squash and notices that forearm pain increases after playing squash. He also notes that it takes a longer period to warm up to play a game than was previously the case but does not have pain during a squash game. When not playing squash, he reports that reaching and gripping increases his pain. He has been unable to identify anything that relieves the pain. He reports that this pain has been worsening, and that he elected to rest for two weeks and avoid playing squash prior to his consultation with the chiropractor but has not noted any improvement in pain. The pain is described as dull and achy in nature and he rates the pain as a 3/10 in intensity on a verbal analog scale where 0 is no pain and 10 is the worst pain he has ever experienced. He indicates that the

pain is specifically in his medial right ventral forearm just inferior to the elbow and described it as being "in between the bones." The patient denies pain referral and the presence of any parathesias in the arm or hand. He reports that he has never had this pain before.

On examination, visual inspection did not reveal any bruising, redness or edema in the area. Palpation revealed tenderness and a tender point in the pronator teres muscle. Palpation over the medial epicondyle revealed pain and reproduced symptoms described by the patient. Neurological testing was found to be unremarkable with respect to sensation, motor and reflex testing bilaterally over all dermatomes tested for the upper extremities. The following orthopaedic tests were performed and were found to be negative: Pronator teres test (resisted pronation of the forearm), Mills test for lateral epicondylitis (with the elbow extended and the shoulder relaxed the wrist is passively stretched in flexion and pronation). The following tests were found to be positive: Passive test (with an extended elbow and relaxed shoulder the wrist is passively extended and supinated) and active resistive medial epicondylitis test (with the upper extremity relaxed and the elbow flexed slightly the patient is instructed to actively resist wrist flexion and pronation). From testing, reported symptoms and history, the patient was diagnosed with medial epicondylosis.

The patient began a series of four treatments that occurred within one week as he was at the end of his vacation time and would be returning to his camp. A course of fascial stripping techniques was initiated, including: cross friction massage, instrument assisted fascial stripping to the medial epicondyle area and over the belly of the pronator teres muscle using gua sha tools, ischemic compression of the trigger point found in the pronator teres, active assisted compressions to the trigger point noted in the pronator teres, and general mobilizations of the carpals, specifically the scaphoid as this carpal was noted to be restricted on motion palpation.[2,5,7,9,10,13–17,19–21] Similarly, joint play of the elbow was found to be unremarkable. The patient was instructed to ice his forearm and medial elbow daily for 10 minutes followed by a 20 minute break with an immediate repetition of this icing cycle four times for pain control. In addition he was given an eccentric exercise to do daily for his right arm that consisted of using a 1–2 pound weight supported in his right hand with his forearm flexed and supinated while supported on a table.[6,18] He was instructed to use his left hand to assist in moving his right to a flexed position of the wrist and then to allow the wrist to extend slowly and fully. In order to achieve full wrist extension, the wrist and hand must hang over the edge of the table, see figures A1 and A2.

Figures A1 and A2 *Eccentric Exercise given to Patient*

The patient was instructed to do three sets of 15 repetitions of this exercise three times per day. The patient verbally reported a 40–50% improvement after the fourth visit at which time he had to return overseas. The patient was followed up one and two weeks later via e-mail. At the one week follow up, he reported that he did not have access to ice but had continued to do the exercises daily. He reported that he continued to avoid playing squash and that there had been no change in symptoms since the previous visit. At the two week follow up he reported that he continued to participate in his exercise program almost daily and that he had attempted to play one game of squash which increased his symptoms slightly. The patient was again followed up at 8 and18 weeks after discontinuing treatment. At these junctures, he reported that he no longer had pain on a daily basis but reported that he was not playing squash as regularly as he had prior to his injury and that there was no change between week 8 and 18 in his symptoms. He continued his exercise program throughout this period. He reported that in the previous seven weeks he played squash twice per week and experienced minor symptoms for a day or two following each game. At a one year follow up, he reported that he no longer had any symptoms persisting and had no pain

while playing or after playing squash and had returned to his previous level and frequency of play. He was unable to recall when he discontinued his exercise program but reported that he had discontinued the program.

Discussion

Elbow pain may have numerous causes including those that are common such as medial or lateral epicondylosis, partial or full tearing of the medial or lateral collateral ligaments of the elbow, cubital tunnel syndrome, pronator quadratus syndrome, intra-articular injuries, epiphesial injuries, symptomatic osteophytes and anterior interosseous nerve entrapment.[7,12,13] Less commonly, elbow pain may be associated with radial head subluxation, infiltration by tumour, little league elbow and osetochondritis dessicans of the capitellum.[7,12,13] These conditions should remain on a practitioner's differential diagnosis list when presented with a case of elbow pain.

Medial epicondylosis is the most common diagnosis for complaints of medial elbow pain.[14] Medial epicondylosis is characterized by medial elbow pain that is worsened by resisted forearm pronation and wrist flexion and is usually of insidious onset.[5,11,14,15] Pain on palpation is usually found distal and lateral to the medial epicondyle, and may extend one to two centimeters distally, over one of the following muscles: pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, and/or the flexor carpi ulnaris[2,4,5,9,11,14,15] The pronator teres or the flexor carpi radialis are most often involved.[5,12–15] This condition commonly affects athletes, especially those placing a valgus stress on their elbow during play, but also may affect a non-athletic population for a similar biomechanical reason.[1,2,12,15,16] Range of motion, grip and generalized strength, and sensation are usually unaffected and radiographs of the elbow are usually unremarkable.[5] If the patient is a throwing athlete or the condition is chronic, radiographs may show calcification of the medial collateral ligament or traction spurs.[5,15] Ligamentous instability of the ulnar collateral ligament may be present in some cases but is not essential for diagnosis.[1,5,12] Several orthopaedic tests including Cozen's test, golfer's elbow test, Mill's test, Kaplan's test and Polk's test may be used to differentiate between medial and lateral epicondylitis.[1] The tests done to identify lateral epicondylosis include Cozen's test and Kaplan's sign. Polk's test may be used to diagnose either medial or lateral epicondylosis.[1] It is performed with a bent elbow in either variation. Pain produced while lifting an object such as a heavy text book with the forearm pronated (palm down) is indicative of lateral epicondylosis while pain produced while lifting the object with a supinated forearm (palm up) is indicative of medial epicondylosis.[1] Mills test and golfer's elbow test are used to identify medial epicondylosis.[17] A positive Mill's test is indicated with pain being reproduced at the medial elbow on resisted palmar flexion of the wrist with a straight elbow.[1] Golfer's elbow test is positive when resisted elbow and wrist flexion of a bent elbow and extended wrist cause pain at the medial elbow.[1] According to one Malanga and Nadler's text, none of the aforementioned elbow tests have reliability/validity tests reported.[26] In fact, this source reports that "there are no named tests for evaluating medial epicondylosis(sic)" and references the resisted wrist flexion and pronation test for this condition.[26] It was reported that "there are no studies evaluating the specificity and sensitivity of the above test."[26]

The muscles originating from the medial epicondyle include pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, and/or the flexor carpi ulnaris. These are illustrated in figure B (reprinted with permission).[18] All of these muscles, except for the palmaris longus which is an abductor, are active in flexion of the elbow, and flexion, adduction and pronation of the wrist.[4] The median and ulnar nerves lie in close proximity and underneath these structures and may get compressed in severe cases of medial epicondylosis. Tinel's sign or percussion over the cubital tunnel, and the local of these nerves, may therefore elicit symptoms.[1,6]

With the presence of only medial elbow pain in this case the following causes of elbow pain were eliminated as they generally present on the lateral side of the elbow: lateral epicondylosis, lateral collateral ligament injury, radial head subluxation and osteochondritis dessicans of the capitellum. Little league elbow, being a growth plate injury was eliminated due to the patient's age of 35 years. As no parathesia or other nerve symptoms were reported and the neurological assessment was unremarkable, cubital tunnel syndrome, pronator quadratus syndrome and anterior interosseous nerve entrapment were ruled out. If the patient did not respond to conservative management, radiographs and/or a bone scan could have been performed to help to rule out rheumatologic or other intra-articular

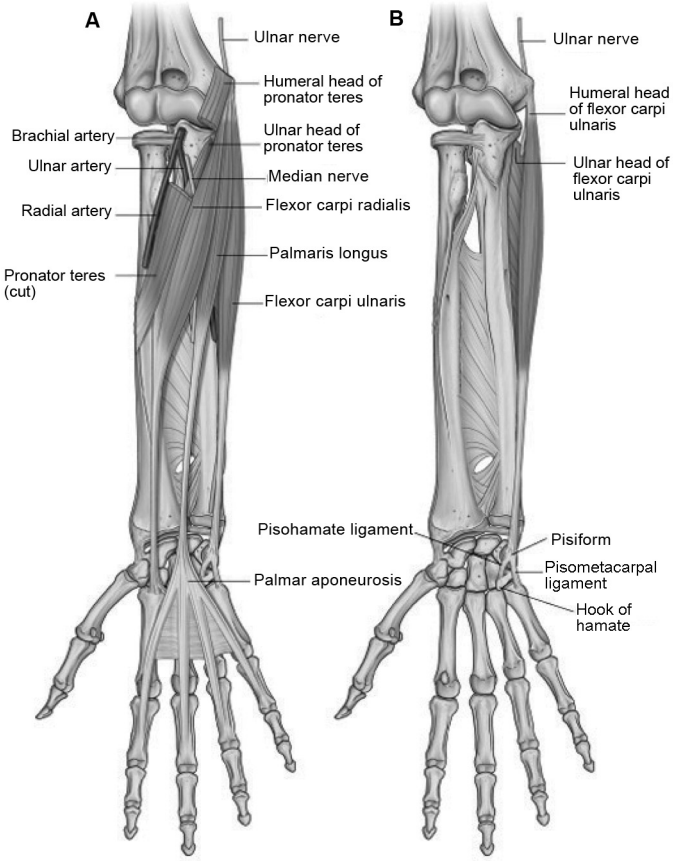

Figure B[18] *Musculature of the Medial Elbow*

causes as well as stress fracture and the rare possibility of infiltration by tumour. Unless there are signs of muscle atrophy or motor involvement, a conservative approach to treating medial epicondylosis should be attempted before considering a surgical referral.

Previous studies have reported the successful management of medial epicondylosis with relief of inflammation and include: cessation of the activity causing irritation, ice, oral anti-inflammatory medication, corticosteroid injection, physical therapy modalities including ultrasound, IFC, noxious level electrical stimulation and low intensity laser, myofascial trigger point therapy, range of motion and stretching exercises, and surgery to release the common flexion origin.[2,5,7,9,10,13–17,19–21] Cyriax physiotherapy consisting of deep transverse friction at the site of the lesion and Mill's manipulation, manipulation of the wrist, and eccentric strength exercises have been found to be possibly beneficial specifically for lateral epicondylosis, however their utility in medial epicondylosis has not been studied.[6,22,25] While some studies list extracorporeal shock wave therapy as useful in the treatment of lateral epicondylosis, research for this case uncovered a study concluding otherwise and reported that previously reported success may be due to inappropriate study designs.[23] Non-surgical conservative treatment is highly successful and should be explored thoroughly prior to consideration of surgery. Although this is the case, between 5 to 26% of patients may have a recurrence of symptoms and 40% may have prolonged minor discomfort following conservative treatment.[2] Surgical intervention should only be considered when persistent pain is experienced that limits activity after a failed conservative program of 3–6 months.[15]

There are several factors that may have influenced the favourable outcome of this case. Mobilizations of the bones of the wrist, specifically the scaphoid, as it was noted on motion palpation to have insufficient normal motion, were done to re-establish normal motion of the wrist articulations in an attempt to decrease pressure on the surrounding tendons which lead back to the medial and lateral elbow. The eccentric exercises were attempted due to the success of such programs seen for lateral epicondylosis with the hypothesis that this type of rehabilitation may prove beneficial if adapted for medial epicondylosis. Soft tissue techniques including fascial stripping were used to attempt to break down scar tissue that may have accumulated in the area.[24] With the onset of manual therapy, the patient seemed to have a rapid reduction of subjective symptoms, but it is important to note other factors that may have produced a favourable outcome in this case such as the cessation of playing squash and therefore rest to the affected elbow.

Further study is needed to identify other possible treatment avenues such as specific rehabilitative exercises including the eccentric exercise described in this case study. Exercises that influence the strength, stability and endurance of the muscles of the medial elbow may provide a useful tool in the treatment of medial epicondylosis. This research might take the form of other case reports or a small scale clinical trial to compare the effectiveness of treatment with and without specific exercise prescription.

Summary

Although favourable results were obtained, it is important to remember that the nature of this investigation was that of a case study, and therefore treatment was applied to only one patient. Limited as it may be, this case does demonstrate the conservative management of medial epicondylosis using fascial stripping, trigger point therapy, wrist mobilization and a home therapy program consisting of eccentric exercises geared towards strengthening of the wrist flexors. Conservative management of medial epicondylosis should be explored prior to more invasive procedures such as corticosteroid injections or surgery.

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Neuromusculoskeletal disorders following SARS: a case series

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Objective: *To detail the presentation of three health care workers diagnosed with sudden acute respiratory syndrome (SARS) who later presented to a CMCC teaching clinic with neuromusculoskeletal sequelae and underwent conservative treatments. This case series aims to inform practitioners of the potential pathogenesis of these neuromuscular complaints and describes their treatment in a chiropractic practice.*

Clinical Features: *Three patients presented with a variety of neurological, muscular and joint findings. Conservative treatment was aimed at decreasing hypertonic muscles, increasing joint mobility, and improving ability to perform activities of daily living.*

Intervention and Outcome: *The conservative treatment approach utilized in these cases involved spinal manipulative therapy, soft tissue therapy, modalities, and rehabilitation. Outcome measures included subjective pain ratings, disability indices, and return to work.*

Conclusion: *Three patients previously diagnosed with SARS presented with neuromusculoskeletal complaints and subjectively experienced intermittent relief of pain and improvement in disability status after conservative treatments.*
(JCCA 2011; 55(1):32–39)

KEY WORDS: SARS, neuromusculoskeletal, manipulative therapy

Objectif : *Présenter en détail le cas de trois travailleurs de la santé chez qui on a diagnostiqué un syndrome respiratoire aigu sévère (SRAS). Ils se sont ensuite présentés à la clinique d'enseignement du CMCC avec des séquelles neuromusculosquelettiques et ont suivi des traitements conservateurs. La présente série de cas a pour objectif d'informer les praticiens sur la pathogenèse potentielle de ces douleurs neuromusculaires et de décrire leur traitement dans le cadre de la pratique de la chiropractie.*

Caractéristiques cliniques : *Trois patients présentaient une variété de troubles neurologiques, musculaires et articulaires. Les traitements conservateurs avaient pour objectif de réduire l'hypertonicité musculaire, d'augmenter la mobilité articulaire, et d'améliorer la capacité à réaliser des activités de la vie quotidienne.*

Intervention et résultat : *Les traitements conservateurs utilisés dans ces cas comprennent : des manipulations rachidiennes, manipulations des tissus mous, modalités et rééducation. La mesure des résultats comprend : évaluations subjectives de la douleur, taux d'invalidité et retour au travail.*

Conclusion : *Trois patients chez qui on avait diagnostiqué le SRAS présentaient des douleurs neuromusculosquelettiques et ont connu un soulagement subjectif intermittent de la douleur ainsi qu'une amélioration de l'état d'invalidité après des traitements conservateurs.*
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MOTS CLÉS : SRAS, neuromusculosquelettique, thérapie manuelle

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Introduction

Severe acute respiratory syndrome (SARS) is an infectious disease caused by the novel SARS-corona virus (SARS-CoV) that caused a global outbreak in 2003 and resulted in serious mortality and morbidity.[1–3] As a novel virus presenting as an atypical pneumonia,[4] SARS created a diagnostic challenge. To aid in disease management, the World Health Organization defined suspected cases as: "disease in a person with a documented fever (temperature >38°C), lower respiratory tract symptoms, and contact with a person believed to have had SARS or a history of travel to a geographic area where there has been documented transmission of the illness."[4] Further, a suspected case involving findings of pneumonia on chest radiograph, acute respiratory distress syndrome, or unexplained respiratory illness resulting in death with autopsy results demonstrating the pathology of acute respiratory distress syndrome without an identifiable cause was considered a "probable case."[4]

From November 1, 2002 to July 31, 2003, 8098 probable cases and 916 deaths were reported internationally.[5,6] In Canada, there were 438 suspected and probable cases resulting in 44 deaths, with the majority identified in Toronto, ON.[7] During the SARS outbreak, 769 health care workers (HCW) at nine Toronto hospitals had treated patients with suspected or probable SARS. HCW were particularly vulnerable during the early weeks of the outbreak as viral loads peaked at 10 days following symptom onset.[5] During this time, many HCW were exposed to virus via direct patient contact, particularly prior to a diagnosis of suspected SARS.[5,7–9]

The clinical course of SARS was characterised by fever, myalgia, and other systemic symptoms that generally improved after a few days, followed by a second phase with recurrence of fever, oxygen desaturation, and radiological progression of pneumonia.[1,2] Due to this clinical picture, much of the literature to date has focused on the respiratory effects and long-term sequelae of infection,[1,4,5,7] however, little is known about myopathic or neurological complications.[5–8]

Muscle weakness and an elevated serum creatine kinase (CK) level occurred in more than 30% of the SARS-infected patients.[10] Elevation of CK is an enzymatic indication of muscle damage, thus, an increased level may have indicated myopathy in affected patients. It was suspected skeletal myopathy was primarily responsible for the elevation of serum CK as the levels of the cardiac enzyme were normal.[2] It has been suggested serum CK level may also be a reflection of the severity of the myopathy, as patients with higher CK levels demonstrated more substantial necrosis on autopsy.[2] In a prospective case series by Lee et al., elevated CK levels were also correlated with the requirement for intensive care or death; however, this finding did not reach statistical significance.[10] As greater than 60% of patients in their study initially presented with myalgia and objective muscle weakness, the authors suggested myopathy in SARS may be quite common.[10] In a post-mortem case series, Leung et al. examined specimens from the psoas or quadriceps femoris of eight subjects who experienced progressive myalgia and symmetrical (typically truncal) weakness, and identified a spectrum of myopathy.[2] To date, this small sample represents the only preliminary evidence reporting SARS-associated myopathy.

Neurologic manifestations have rarely been described, and the relationship, if any, between the SARS-CoV and neuromuscular problems is still relatively unknown.[11] In a case report by Chao et al., a female patient presented with objective lower limb weakness, absent Achilles deep tendon reflex and a stocking pattern of paraesthesia continued to have neuromuscular symptoms at two month follow-up.[11] Tsai et al. presented a case series of four patients (with no concurrent medical conditions, systemic illness or symptoms prior to the diagnosis of SARS) with varied neuromuscular disorders with onset of up to three weeks following the onset of SARS.[12] Similar to the case report by Chao et al., these symptoms persisted at follow-up (up to two months).[12] These cases highlight how little is known about the long-term sequelae of SARS and the potential need for ongoing care.[8]

As one of the largest primary contact health care professions in Canada, it is reasonable to expect a patient previously diagnosed with SARS or other serious viral infections may present to a chiropractor for diagnosis and treatment of neuromusculoskeletal complaints. Chiropractors should be aware of this possibility and the potential effects on prognosis, as the course of novel diseases like SARS and resultant sequelae are currently not well understood.

The purpose of this case series is to describe the presentation of three health care workers diagnosed with SARS who later presented to a CMCC chiropractic teaching

clinic with a variety of neuromusculoskeletal complaints. Further, it aims to inform practitioners of the potential pathogenesis of these neuromuscular complaints. It describes their treatment in a chiropractic practice and includes follow-up periods up to six years following the onset of SARS.

Case Series

Case 1

This case report involved a 38 year old female nurse diagnosed with SARS in March 2003. Following her diagnosis, she developed constant left hip pain of three-year duration. She had presented to a physiotherapist in 2005 and experienced short-term relief, and later presented to a CMCC teaching clinic on March 24, 2006. The pain developed insidiously and was described as dull and achy in character. The patient reported the intensity as three out of ten on a numeric pain rating scale (NPRS). It was aggravated by weight-bearing on the left (could not walk for greater than five minutes or sit for greater than 15 minutes) and relieved by traction mobilization and therapeutic exercise (physiotherapy), oxycodone (10mg twice daily, 5 days per week), Percocet (as needed (prn)) and diazepam (5mg, one-four per day). The patient reported the following as complications of SARS: respiratory difficulty (associated with chronic cough and diaphragmatic dysfunction), vision changes, bilateral peripheral neuropathy affecting her hands and feet, and easy bruising. The patient reported great difficulty maintaining her quality of life, and noted minimal sleep, poor appetite and diminished activity levels. At the time of presentation, she had not returned to work. Imaging revealed mild joint degeneration of the left hip on radiographs, and increased uptake in the sacroiliac joints bilaterally and left proximal tibiofibular joint on bone scan. On initial presentation, visual analog scale (VAS) was marked at 3/10 (9/10 at worst) and Oswestry Back Disability Index (OBDI) score was 58%.

On physical examination, the patient presented with a right antalgic list and excessive left hip flexion. During gait analysis, the patient favoured her right leg and was unable to perform a squat due to pain. A lumbar spine screen caused pain in the left low back and thoracic cage with active and passive right rotation. Active hip range of motion demonstrated reduced motion with pain in all ranges on the left (right side was full and pain-free) and passive testing was not tolerated due to pain. Orthopaedic testing of the hips could not be performed due to pain. Weakness with manual muscle testing was revealed in the left psoas major, quadriceps, adductors, gluteus maximus and bilateral hamstrings. Pain was elicited with palpation of the left psoas, proximal rectus femoris, piriformis and bilateral gluteus medius. Neurological examination findings were reported as unremarkable in the file.

The patient was diagnosed with left hip dysfunction with associated psoas contracture (differential diagnoses included symptomatic left hip degenerative joint disease and left hip capsular irritation). The plan of management consisted of treatment twice weekly for four weeks and included hip mobilizations, Active Release Techniques® (ART®) to affected muscles, therapeutic ultrasound (100% duty cycle, 3 MHz, 1 W/cm^2 for 7 minutes), sacroiliac and lumbar manipulations, and monitoring of exercises prescribed by the physiotherapist. Education regarding proper exercise technique and sleep hygiene was also provided.

Re-evaluation was performed after eight treatments and the patient reported positive effects with the prescribed treatment plan. No clinically relevant changes were noted on objective outcome measures; however, as VAS was recorded at 4/10 and OBDI score was 56%. Due to the reported subjective improvements and lack of evidence regarding the prognosis of musculoskeletal complaints, the patient requested to continue treatment. In the following years, periods of withdrawl of care were attempted with reported exacerbations of pain, and thus treatment plans with durations ranging between eight and 16 visits were carried out at the patient's continued requests. Prior to initiating each new treatment plan, a report of findings was provided; importantly, the patient was counselled on alternatives and the lack of evidence regarding her prognosis. In addition to the conservative treatments, numerous meetings and interprofessional communications with other members of the patient's health care team occurred to discuss appropriate referrals and ongoing management options. In total, 151 treatments using a variety of treatment approaches were provided for a number of conditions and complaints. At the last visit (April 2009), the patient reported to have stable symptoms, but had not returned to full-time employment. She was resigned to the fact she would not likely be able to work full-time or without modified duties in the future.

Case 2

This case report involved a 25 year old female paramedic diagnosed with SARS in March 2004. The patient was hospitalized in May 2003, however, had returned to work full-time by June 7 of that year. In January 2004, she was unable to perform essential job tasks due to a constant cough, and was later diagnosed with SARS in March 2004. She developed left hip pain in April 2004 and presented to a CMCC teaching clinic on June 29, 2005. The pain was rated as 7/10 (NPRS) and described as a deep, dull ache localized to the left hip. It became sharp with hip flexion and/or external rotation. It was aggravated by running and skating and partially relieved with naproxen (prn). The patient reported associated difficulties with gait (stumbling), and left lateral knee and foot pain. Relevant systems review included respiratory difficulties (perceived 'tight' sensation in chest), difficulty sleeping (due to pain) and easy bruising following her SARS diagnosis. Radiographic and magnetic resonance imaging of the involved regions were read as normal. On initial presentation, VAS was scored as 4/10 and OBDI as 26%.

On physical exam, the patient presented with decreased thoracic kyphosis and bilateral genu valgum. Gait revealed left foot lag with toeing in and weight-bearing on the lateral aspect of the left foot only. A lumbar spine range of motion screen was full and pain-free. Left active and passive hip flexion caused sharp pain at 90°, internal and external rotation were limited to 30° and painful, active abduction was limited to 40° due to pain, active adduction was extremely painful at 30°, and passive adduction was full but painful at end range. All other ranges were full and pain-free. Manual muscle testing demonstrated full strength (5/5) but intense pain during left hip flexion, adduction, internal and external rotation. Further, extension and abduction were graded 4/5 (compared to the right) without pain. Trendelenberg sign was observed on the left. Single and double leg squat caused pain in the left hip. Thomas and FABER tests recreated pain in the left hip; all other relevant orthopaedic tests were unremarkable. Pain was caused during palpation of the left pectineus, obturator externus, psoas and proximal rectus femoris. Neurological examination revealed normal sensation to light touch and sharp/dull testing in the L1-S1 dermatomes bilaterally, 5/5 strength in L4-S1 myotomes bilaterally, and 3+ patellar reflexes bilaterally, 3+ Achilles reflex on the right, 1+ Achilles reflex on the left.

The patient was diagnosed with left psoas contracture/tendinopathy and a plan of management including active and passive stretching of left psoas and rectus femoris, manual facilitation of gluteus maximus, ART® of psoas, rectus femoris, obturator externus, sartorius and pectineus was proposed. The patient was treated two times per week for four weeks.

Following eight treatments, the patient reported short-term subjective improvement and believed treatment to be important in maintaining her quality of life during re-evaluation; however, no clinically relevant improvements were observed via VAS (4/10) or OBDI (26%) scores. Improvement in gait was observed (the left foot was no longer lagging) and hip range of motion had improved such that she was able to put on shoes and socks without increased pain. Due to these improvements and lack of evidence regarding the prognosis of musculoskeletal complaints in patients previously diagnosed with SARS, the patient requested to continue with treatment. In the following years, treatment plans with durations ranging between eight and 16 visits were carried out to deal with the patient's presenting symptoms and incorporated a variety of treatment modalities, including spinal mobilizations. During this time, the patient's gait continued to improve, and communications with the patient's medical doctor and physical therapist to discuss appropriate shared management were an important component of the patient's care. Further, referral to a chiropodist was made for custom orthotics to assist with gait normalization. Periods of withdrawl of care were attempted, and though not tolerated completely, the patient did consent to (and tolerated) decreasing the frequency of treatments. Prior to initiating each new treatment plan, a report of findings was provided; importantly, the patient was counselled on alternatives and the lack of evidence regarding her prognosis. In total, 124 treatments using a variety of treatment approaches were provided for a number of conditions and complaints. The patient was discharged in November 2008. At that time, she had resumed skating and running, and had returned to full-time employment.

Case 3

This case report involved a 39 year old female respiratory therapist diagnosed with SARS in April 2003. Following a two-week isolation period in hospital and a two-week isolation period at home, she developed "constant pain all

over" and presented to a CMCC teaching clinic on June 6, 2007. On initial presentation, the patient reported burning, shooting, sharp and stabbing pain originating in the cervical and thoracic spine that radiated to the fourth and fifth fingers bilaterally. The pain was typically rated as four out of 10 (NPRS), but became 9/10 with light exercise, work activities, and stressful events. Short-term relief was obtained with massage therapy, heat and home exercises (as prescribed by a physiotherapist). She had returned to modified duties (two 12-hour shifts per week). The patient also reported difficulty sleeping, headaches, fatigue and difficulty concentrating, and her relevant systems review revealed respiratory sensitivity, heart palpitations and easy bruising. Medications included naproxen, nortriptyline, oral contraceptive pills, vitamin C and calcium. On initial presentation, VAS was marked at 5/10 and Neck Disability Index (NDI) score was 22/50.

On physical examination, the patient presented with anterior head carriage and lateral protraction of the right scapula without winging. Cervical and thoracic ranges of motion were full but caused local pain at end-range. Jackson's, Spurling's, and cervical compression tests all caused shooting pain to the ipsilateral lower thoracic spine, and bilateral Kemps tests caused ipsilateral facet pain without radiation. Bilateral cervical doorbell test referred pain to the left anterior thoracic cage; the left cervical doorbell test also referred pain to the left posterior thoracic cage. EAST manoeuvre demonstrated a gradual increase in pain and numbness with failure to maintain the test at 45 seconds. Bilaterally, Adson's, Reverse Adson's, Eden's and Wright's tests demonstrated decreased radial pulse amplitude and tingling of the involved forearm, medial hand and fourth and fifth fingers. Jump signs were elicited with thoracic spine palpation, and palpation of the trapezius, rhomboids, levator scapulae, scalenes and erector spinae (thoracic) bilaterally. Neurological examination revealed normal sensation to light touch and sharp/dull testing in the C5-T12 dermatomes, 5/5 strength in C5-T1 myotomes, and 2+ biceps, brachioradialis and triceps reflexes bilaterally.

The patient was diagnosed with cervicothoracic dysfunction and thoracic outlet syndrome, and a plan of management including mobilizations of the cervical, thoracic and costovertebral articulations, ART® to affected muscles and microcurrent (acupuncture point LI4, setting: 30/300) was proposed. The patient was treated twice per week for six weeks. Exercises prescribed by a physiotherapist were reviewed and monitored.

The patient did not attend a number of scheduled visits; therefore re-evaluation occurred after the eighth treatment. She reported short-term subjective improvement, and believed treatment to be important in maintaining her quality of life and allowing for return to modified duties. No clinically relevant improvements were observed via VAS (6/10) or NDI (23/50) scores. Due to the subjective improvements and lack of evidence regarding the prognosis of musculoskeletal complaints, a similar treatment plan was proposed at the patient's request. In the following years, withdrawl of care was attempted with reported exacerbations of pain, and thus treatment plans with durations ranging between eight and 16 visits were carried out at the patient's continued requests. Prior to initiating each new treatment plan, a report of findings was provided; importantly, the patient was counselled on alternatives and the lack of evidence regarding her prognosis. In total, 84 treatments using a variety of treatment modalities, including spinal mobilizations were provided for a number of conditions and complaints. In January 2009, the patient had returned to full duties and was placed on PRN (return at own request).

Discussion

The number of chiropractors treating patients previously diagnosed with SARS is unknown, however, with over 8000 cases reported during the global outbreak, it is certainly possible these patients may present in a chiropractic office. Readers should be aware of the limited body of knowledge regarding neuromusculoskeletal complaints associated with SARS and therefore, the difficulties in the determination of prognosis. Furthermore, other viral infections may present as neuromuscular disorders, and practitioners should be educated regarding the potential mechanisms of pathogenesis including direct action (viral myositis or neuritis), inflammatory reaction (immune mimicry), or via a systemic inflammatory response syndrome.[12]

Myopathy

Muscle weakness and an elevated serum CK level have been documented in patients infected by the SARS-CoV, however, little is understood about the mechanism of injury.[2,10] Though clinical trials to examine the pathogenesis

of SARS-associated myopathy are currently not available in the literature, the findings of case reports and series suggest it may be a common sequela of the infection.[2,10] A number of potential causes have been identified and warrant further investigation.

Cachetic myopathy has been suspected due to disuse following bed rest.[2,5,13] Patients commonly suffered from acute respiratory failure during the second phase of SARS and required bed rest which may have lead to deconditioning and muscle wasting.[5] While disuse is likely to play a role in muscle atrophy, it does not fully explain the necrosis and histochemical changes reported in the literature.

Due to the number of patients presenting with myalgia and an elevated serum CK level, a viral-induced myositis has been suggested.[10] During in situ hybridization and viral culture for SARS-CoV, the negative findings suggest the necrosis may be due to cytokine release which caused immune damage rather than viral infection of the skeletal muscles.[13] This theory was reinforced by the absence of viral particles observed during electron microscopy.[13]

The use of systemic corticosteroids as treatment for acute respiratory failure during the second phase of SARS has also been suggested as a potential contribution to the development of myopathy.[2,5] Corticosteroids have been purported to alter electrical excitability of muscle fibres, decrease the number of thick filaments, and/or inhibit protein synthesis.[5] Interestingly, patients who did not receive steroid therapy were not found to experience myofiber atrophy, further indicating the potential role of corticosteroid therapy in the development of myopathy.[2] It must be noted however, authors believe three to 10 days of steroid therapy (typical dose) alone was not adequate to explain the pathogenesis of myopathy, and stressed the need for investigation of other (or combined) causes.[2]

One such cause may be the development of critical illness myopathy (CIM), an acquired myopathy following acute or chronic disease. This disorder has frequently been observed in conditions requiring mechanical ventilation and high-dose steroid treatment.[2] It is believed to be caused by activated leukocytes infiltrating skeletal muscle and causing the release of pro- and anti-inflammatory cytokines, leading to axonal degeneration with preservation of the myelin sheath.[13] This disorder is characterized by a normal cerebrospinal fluid protein level, preservation of cranial nerve and autonomic function and a lack of lymphocyte infiltration of neurons.[13] Clinically, patients maintain sensation (via peripheral nerves), and testing reveals elevated serum CK and decreased thick filaments with fiber atrophy and necrosis on biopsy.[2,13]

Neuropathy

Similarly, neurologic manifestations of SARS have not been well described in the literature.[12] A relationship between the SARS-CoV and neurological symptoms has not been established; it is currently unknown if the virus has the potential to damage peripheral nerves directly or if the observed neuropathy is an immune mediated process.[12]

Critical illness polyneuropathy (CIP) has been suggested most commonly to explain the neurologic presentation following a diagnosis of SARS.[11,13] CIP develops as an acute neuropathy during severe illness and typically remits when the underlying illness is controlled.[11] An illness such as SARS could have produced elevated levels of proinflammatory cytokines, platelet activating factor, arachidonic acid, free radicals and proteases.[13] These factors could create a neurotoxic environment and lead to neuropathy.[13] If acute, practitioners must ensure the underlying systemic inflammatory response (sepsis) is medically managed and other causes (neurotoxic drugs, poisoning and nutritional deficiencies) are ruled out as there is no specific treatment for CIP.[13] Prognosis is unknown and may vary depending on the severity of the disease. It has been suggested that symptoms (especially weakness) may persist in those patients with a long duration of sepsis or those requiring long-term care in intensive care, however, actual durations of illness or treatment are not defined.[13] Chao et al. reported rapid improvement in neurologic status following extubation in a patient with severe respiratory symptoms.[11]

Clinical considerations

In the cases one and two, the patients were diagnosed with a psoas contracture. The psoas major may be related to the respiratory system due to its anatomical relationship with diaphragm. The psoas originates on the transverse processes and lateral aspects of the vertebral bodies of T12-L5 (and associated intervertebral discs). At its most superior attachment, the psoas is related to the medial and lateral arcuate ligaments, and the central tendon of the diaphragm.[14] In case three, the jump sign elicited during palpation of the scalenes highlights a more apparent involvement of accessory respiratory muscles. Though this

has yet to be discussed in the literature, the involvement of muscles related with respiration in all three cases is an interesting finding following a respiratory illness. The respiratory difficulties reported by the patients in this case series may have required increased involvement of accessory muscles and resultant muscular pain. Future clinical or anatomical studies may be warranted to examine the relationship between viral respiratory infections and related muscular complaints.

Interestingly, all three patients complained of easy bruising following SARS. In a review by Yang et al., thrombocytopenia was a common haematological change reported in patients with SARS, though the exact cause was not well understood.[15] Increased destruction and/or decreased production of platelets in damaged lungs may be a mechanism resulting in thrombocytopenia in severe pulmonary conditions.[15] Clinicians should be aware of this possibility and educate patients and/or modify treatment plans accordingly.

Prognosis

As indicated above, the long-term prognosis of SARS and its associated complications are unknown. Practitioners must be prudent to re-evaluate frequently and ensure patients are improving or maintaining pain/disability status. Certainly, any deterioration in health status requires further investigation and co-management as appropriate.

Law et al. presented a case series to examine factors affecting return to work in 128 health care workers in Hong Kong with musculoskeletal complaints two years following in the SARS outbreak.[8] These authors noted patients continued to experience difficulties in performing activities of daily living and work tasks despite receiving acute treatment and rehabilitation. Return to work (RTW) has been suggested as an important measure of prognosis; however, it is known that pain does not correlate well with RTW.[8] A number of important considerations beyond pain and functional ability impact a worker's ability and desire to return.[7,8] Factors such as support in the workplace, feasibility of providing alternate duties, and the worker's beliefs on the effects of return-to-work on their injury progression must be considered.[8]

The lack of evidence regarding prognosis of neuromuscular complaints in patients previously diagnosed with SARS must be clearly communicated to patients, however, it does not preclude treatment of conditions within the chiropractic scope. The current case series suggests the importance of appropriate use of outcome measures, both generic and disease-specific. Although patients may report short-term pain relief and positive effects on health related quality of life, outcome measures (VAS, NDI, OBDI) may not demonstrate clinically relevant changes. The inclusion of an outcome measure that allows the patient to identify specific limitations (such as the MYMOP[16]) or addresses overall health related quality of life (such as the SF-36[17,18]) may allow for the measurement of subjective improvement.

Conclusion

Myopathic and neuropathic complications in patients diagnosed with SARS have been reported previously; however, to our knowledge, this is the first case series to describe patient presentation in a chiropractic clinic. Furthermore, we believe this case series represents a longer follow-up period (up to six years following SARS diagnosis) than was previously available in the literature. Little is known regarding the cause of these neuromuscular symptoms, and even less is known regarding treatment options for these patients, particularly after the acute illness has been controlled.[2,5,11,13] Follow-up research should be conducted to obtain more information about the long-term outcomes of SARS.

Clinicians should be aware of the proposed pathogenesis of neuromuscular complaints with a previous SARS or other severe respiratory infections and ensure any differential causes have been ruled out prior to commencing a plan of management focused on conservative therapies.

In this case series, three patients with varied neuromuscular complaints reported short-term subjective improvements in their pain experience and quality of life, and two were able to return to work. Future research should investigate the role of conservative care and manual therapies for this type of patient population using subjective outcome measures.

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Manual therapy and ear pain: a report of four cases

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Purpose: *To report and discuss four cases of ear pain which were treated successfully with manual therapy.*

Methods: *Report of four cases.*

Results: *Four patients with ear pain were referred for chiropractic consult. They were all treated with a combination of manual therapy and exercise with resolution of their ear symptoms.*

Conclusions: *The mechanism of idiopathic ear pain that may be amenable to manual therapy is not fully known. Further research is needed to investigate the etiology of this disorder and to determine whether manual therapy and exercise are viable options in some patients with idiopathic ear pain. In the meantime, it may be advantageous for otolaryngologists to seek input from physicians skilled in assessment and treatment of the musculoskeletal system in cases ear pain for which an otolarygologic etiology cannot be found.*
(JCCA 2011; 55(1):40–46)

KEY WORDS: earache; musculoskeletal manipulations; temporomandibular joint; pain

Objectif : *Signaler et discuter de quatre cas d'otalgie qui ont été traités avec succès grâce à la thérapie manuelle.*

Méthodes : *Signalement de quatre cas.*

Résultats : *On a conseillé à quatre patients souffrant d'otalgie de consulter un chiropraticien. Ils ont tous été traités avec un ensemble de thérapies manuelles et d'exercices ayant conduit à la disparition des symptômes d'otalgie.*

Conclusions : *Le mécanisme d'otalgie idiopathique qui peut être traité par la thérapie manuelle n'est pas entièrement connu. Des recherches supplémentaires sont nécessaires afin d'étudier l'étiologie de ce trouble et de déterminer si la thérapie manuelle et l'exercice sont des options viables chez des patients souffrant d'otalgies idiopathiques. Il peut également être bénéfique pour les oto-rhino-laryngologistes de consulter des médecins compétents en matière d'évaluation et de traitement des systèmes musculosquelettique dans les cas où aucune étiologie oto-rhino-laryngologique ne peut être trouvée pour l'otalgie.*
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MOTS CLÉS : otalgie; manipulations musculosquelettiques; articulation temporomandibulaire; douleur

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Introduction

Otalgia is said to be common although specific incidence and prevalence is not known. It has a number of potential causes. Otalgia is generally separated into two types. Primary otalgia is that which arises from ear pathology, the most common of which is otitis media, but which also includes otitis externa (often referred to as "swimmer's ear") and Eustachian tube dysfunction.[1] Less commonly, primary otalgia may be attributed to primary neoplasms and benign tumors.[2] However, up to 50% of cases are classified as secondary otalgia which involves referred pain from other areas, including chronic infection which spreads to other tissues such as the skull base, dental abnormalities, sinus, pharyngeal or salivary gland infections, temporal arteritis, or cervical or temporomandibular joint dysfunction.[1–3] It has also been reported to arise from disorders of the cervical spine.[4] It is not clear how frequently ear pain involves musculoskeletal dysfunction that may be amenable to manual therapy, however it is the experience of the authors that a variety of problems in the musculoskeletal system can cause or contribute to ear pain. Very little information about this can be found in the literature.

The purpose of this paper is to report and discuss four cases of patients who complained of ear pain with a normal otolaryngologic examination whose pain improved or resolved with a manual therapy/ exercise approach.

Case reports

The study protocol was reviewed by the Health Insurance Portability And Accountability Act (HIPAA) compliance officer of the facility at which the data were gathered and was deemed to be in compliance with HIPAA regulations. Informed consent was received from each patient.

Case 1

This was a 26-year-old woman who complained of bilateral ear pain which had developed insidiously one month previously. She had seen an otolaryngologist who did not find any intra-aural pathology that would explain the symptoms and referred the patient for chiropractic consult. The pain was restricted to the intraural area bilaterally and was rated on a Numeric Rating Scale as 6/10. She denied tinnitus, hearing loss and loss of balance. She also denied hyperacusis, blurred vision, diplopia, dysarthria, dysphagia, vertigo or other bulbar symptoms. There were no particular exacerbating or remitting factors. Past medical history was otherwise unremarkable and she was not taking any medications. She had no previous history of ear problems. She had no history of cervical trauma and had never seen a chiropractor before. Review of systems was unremarkable. She was married with no children. She did not smoke or drink alcohol and walked and used an elliptical machine for exercise. Family history was remarkable for hypertension and heart disease in her father.

Blood pressure was 120/80 on the left. Oral temperature was 98.1 degrees Fahrenheit. Pulse was 80 per minute. Respirations were 16 per minute. Heel, toe and tandem walking were within normal limits. Romberg's position was held with eyes closed without difficulty. Examination of cranial nerves II through XII was within normal limits. Pupils were equal, round and reactive to light and accommodation. Funduscopic examination was unremarkable. Sensory examination to pin in the upper and lower extremities revealed no abnormalities. Motor strength was 5/5 bilaterally throughout. Muscle stretch reflexes were 2+ and symmetric throughout. Plantar responses were downgoing bilaterally. Rapid alternating movements, heel to shin movements and finger to nose movements were carried out without dysmetria or tremor. There was no evidence of pronator drift. Joint play palpation of the temporomandibular joint (TMJ)[5] revealed mild loss of joint play bilaterally. There was tenderness of the lateral pterygoid muscles bilaterally but mandibular gait[5] was normal. Segmental palpation of the cervical zygapophyseal joints[6–9] revealed restriction of motion and pain at approximately C1–2 bilaterally. This did not reproduce her ear pain. Myofascial trigger points were noted in the sternocleidomastoid (SCM) muscles bilaterally, palpation of which reproduced the patient's ear pain. No pain or perceived increased resistance to manual traction was noted upon palpation of the ears.

She was diagnosed with bilateral TMJ dysfunction, upper cervical joint dysfunction and SCM trigger points and was treated with manual mobilization of the TMJ,[10] manipulation directed to the C1–2 segments using a non-thrusting muscle energy technique[11] (the patient expressed fear of "cracking" in the cervical spine) and ischemic compression and post-isometric relaxation to the SCM's. She was also given TMJ exercises[5] as well as a cervical brace exercise.[12] After five treatments she reported herself on a written 0–100% scale to be 90% improved. Pain intensity was rated as 2/10. She had 2 exacerbations over

the following month, each of which was treated with resolution. She was then followed up two years later and remained pain-free with no further exacerbations.

Case 2

This was an 18-year-old woman who complained of left ear pain. This had begun 3 months previously when she awoke in the morning with it. She had seen an otolaryngologist who did not find any intra-aural pathology that explained the symptoms and referred the patient for chiropractic consult. The pain was well localized to the intraural area and was rated on a Numeric Rating Scale as 7–8/10. The pain was constant but worsened when she used her cellular phone. She described a "gushing" sound but no hearing loss. She denied hyperacusis, blurred vision, diplopia, dysarthria, dysphagia, vertigo or other bulbar symptoms. Past medical history was remarkable for a recent bout of mononucleosis from which she had fully recovered. She was not taking any medications. She had no previous history of ear problems. She had no history of cervical trauma and had never seen a chiropractor before. Review of systems was unremarkable. She was single with no children. She did not smoke or drink alcohol and did not exercise regularly. Family history was remarkable for hypertension and cancer in both parents.

Blood pressure was 120/64 on the left. Oral temperature was 97.8 degrees Fahrenheit. Pulse was 76 per minute. Respirations were 16 per minute. Heel, toe and tandem walking were within normal limits. Romberg's position was held with eyes closed without difficulty. Examination of cranial nerves II through XII was within normal limits. Pupils were equal, round and reactive to light and accommodation. Funduscopic examination was unremarkable. Sensory examination to pin in the upper and lower extremities revealed no abnormalities. Motor strength was 5/5 bilaterally throughout. Muscle stretch reflexes were 2+ and symmetric throughout. Plantar responses were downgoing bilaterally. Rapid alternating movements, heel to shin movements and finger to nose movements were carried out without dysmetria or tremor. There was no evidence of pronator drift.

Examination of the TMJ and its related muscles was unremarkable but there was pain and perceived increased resistance to manual traction of the left ear which reproduced the patient's ear pain. Segmental palpation of the cervical zygapophyseal joints[6–9] revealed perceived restriction of motion and pain at approximately C1–2 and C2–3 on the left. This pain was at the point of palpation and did not reproduce the ear pain. She was diagnosed with idiopathic ear pain and upper cervical joint dysfunction and was initially treated with manipulation of the left ear. Upper cervical manipulation was deferred in order to monitor her response to treatment of the ear. She was taught self-mobilization maneuvers for the ear, which involved manually mimicking the practitioner-applied manipulative maneuver but with low-velocity oscillatory movements rather than high-velocity maneuver. After the initial treatment the patient verbally reported that her pain was "much better." She was then treated twice more with manipulation of the ear and high-velocity, low-amplitude diversified manipulation directed to the C1–2 and C2–3 segments on the left. She was advised to continue the self-mobilization maneuvers for the ear. After 3 treatments she was completely pain free. There was no pain or abnormal sounds in the ear. She was followed up 10 months later and remained symptom-free.

Case 3

This was a 52-year-old woman who complained of bilateral ear pain. This had developed insidiously 3 months previously. She had a previous history of recurrent ear infections. She saw an otolaryngologist, who noted that, while he usually found fluid in her ears when she had an infection, no fluid was found. He referred the patient for chiropractic consult. The pain was located intraurally bilaterally and was rated 6/10 in intensity. There were no particular exacerbating factors and she found temporary relief by pulling on her tragus and applying heat packs. She denied hyperacusis, blurred vision, diplopia, dysarthria, dysphagia, vertigo or other bulbar symptoms. Past medical history was remarkable for a previous history of symptomatic lumbar spine stenosis, fusion surgery at C5–6 and C6–7, migraine headaches, hypertension, hypercholesterolemia, hysterectomy and esophageal ulcer. Her medications included Cymbalta, tizanidine, symvastatin, gabapentin, topiramate, nortryptyline and hydrochlorothiazide. She had no previous history of ear problems. She had no history of cervical trauma and had never seen a chiropractor before. Review of systems was remarkable for night sweats for the previous several months that her primary care practitioner had attributed to menopause. She was married with one child. She did

not smoke or drink alcohol and did not exercise regularly. Family history was remarkable for cancer, heart disease, hypertension, and type 2 diabetes in her father and heart disease in her mother.

Blood pressure was 122/70 on the left. Oral temperature was 97.6 degrees Fahrenheit. Pulse was 84 per minute. Respirations were 12 per minute. Heel, toe and tandem walking were within normal limits. Romberg's position was held with eyes closed without difficulty. Examination of cranial nerves II through XII was within normal limits. Pupils were equal, round and reactive to light and accommodation. Funduscopic examination was unremarkable. Sensory examination to pin in the upper and lower extremities revealed no abnormalities. Motor strength was 5/5 bilaterally throughout. Muscle stretch reflexes were 2+ and symmetric throughout. Plantar responses were downgoing bilaterally. Rapid alternating movements, heel to shin movements and finger to nose movements were carried out without dysmetria or tremor. There was no evidence of pronator drift. Segmental palpation of the cervical zygapophyseal joints[6–9] was unremarkable. Examination of the TMJ and its related muscles was unremarkable. There was perceived increased resistance to manual traction on palpation of the ears bilaterally and this reproduced the patient's ear pain. Myofascial trigger points were noted in the SCM muscles bilaterally, which referred pain into the face but did not exactly reproduce the patient's pain. She was diagnosed with idiopathic otalgia and SCM trigger points and treated with manipulation of the ears along with ischemic compression and postisometric relaxation to the SCM muscles. She was also taught self-mobilization maneuvers for the ear. She was treated six times, after which she reported that she only had occasional mild ear pain, but the severe pain was gone. Pain rating was 0/10. There was no pain upon joint play palpation of the ears. The SCM muscles were non-tender to palpation. She was contacted by phone five weeks later and reported that she remained pain-free.

Case 4

This was a 77-year-old man who complained of right sided ear pain, neck pain and headache. This had developed insidiously 9 months previously. He saw his primary care doctor as well as an otolaryngologist, neither of whom found evidence of intra-aural or other pathology. They both referred the patient for chiropractic consult. The pain was most severe deep within the right ear but he also reported pain in the right side of the cervical spine and the right parietal area. The pain was rated 5/10 in intensity. It was especially severe in the morning but there were no particular movements, positions or activities that aggravated the pain. He noted some decreased hearing acuity since the onset of the pain but denied blurred vision, diplopia, dysarthria, dysphagia, vertigo or other bulbar symptoms. He had a previous history of gout and coronary bypass surgery 17 years previously. Medications included atenolol, losartin, clopidogrel, lisinopril, rosuvastatin and allopurinol. He had no previous history of ear problems. He had no history of cervical trauma and had never seen a chiropractor before. Review of systems was remarkable for occasional lightheadedness when he arose from a seated position quickly.

Blood pressure was 140/60 on the left. Oral temperature was 97.0 degrees Fahrenheit. Pulse was 48 per minute. Respirations were 24 per minute. Heel, toe and tandem walking were within normal limits. Romberg's position was held with eyes closed without difficulty. Examination of cranial nerves II through XII was within normal limits. Pupils were equal, round and reactive to light and accommodation. Funduscopic examination was unremarkable. Sensory examination to pin in the upper and lower extremities revealed no abnormalities. Motor strength was 5/5 bilaterally throughout. Muscle stretch reflexes were 2+ and symmetric throughout with the exception of the ankle jerks which were absent bilaterally. Plantar responses were downgoing bilaterally. Rapid alternating movements, heel to shin movements and finger to nose movements were carried out without dysmetria or tremor. There was no evidence of pronator drift. Segmental palpation of the cervical zygapophyseal joints[6–9] revealed perceived restriction of motion and pain at approximately C2–3 bilaterally. This palpation did not reproduce his ear pain. Restricted opening range of the TMJ was noted and there was painful loss of joint play on the right. The right lateral pterygoid was painful on palpation. Pain and perceived increased resistance to manual traction was also noted in the right ear and this reproduced the patient's ear pain. He was diagnosed with idiopathic ear pain, right C2–3 joint dysfunction and right TMJ dysfunction and

was treated with manipulation of the right ear, mobilization directed to the C2–3 joints bilaterally, manual mobilization of the right TMJ[10] and postisometric relaxation of the right lateral pterygoid muscle. He was also taught self-mobilization maneuvers for the right ear and exercises for the TMJ.[5] He was treated five times after which he reported that his ear pain was resolved (rated 0/10). He still had some residual cervical and parietal area pain, but this was mild. Range of motion and joint play in the TMJ was nearly normal and there was no pain on palpation of the right ear. He had not yet been followed up by the time of this writing.

Discussion

The differential diagnosis in patients with ear pain includes primary otalgia, which can arise from infectious processes, inflammatory processes, direct trauma, perforation of the tympanic membrane and Eustachian tube dysfunction and secondary otalgia, which can result from referred pain from neoplasm, cranial neuralgias, TMJ dysfunction, cervical joint pain, SCM triggers points, gastroesophageal reflux or Eagle's syndrome (symptomatic elongation of the styloid process or calcification of the stylohyoid ligaments).[1] Therefore, a thorough workup of the patient with ear pain, including a careful neurologic examination and assessment of the cervical spine and TMJ and its related muscles[5] is essential. All patients reported here were referred by otolaryngologists after having had primary otalgic causes ruled out. In cases of ear pain presenting to the non-surgical spine specialist it is advisable to seek otolaryngologic consult prior to proceeding with manual therapy treatment.

Pain from the cervical spine may refer to the ear. Feinstein et al[13] found that when 6% saline solution was injected into the intervertebral tissues at the C1 level, a referred pain pattern was created that included the ipsilateral ear. Some authors[4] have reported that the C1 dermatome includes the ear while others[14] include the ear in the C3 dermatome. The discrepancy may be reflective of the general inaccuracy of dermatome maps when it comes to radicular pain.[15] The superior aspect of the outer ear is innervated by the trigeminal nerve.[1] This area can still be a source of referred pain from the cervical spine, however, as nociceptive afferents from both the upper cervical spine and the trigeminal nerve synapse at a common area in the cervical spinal cord known as the trigeminocervical nucleus.[16] Simons et al[17] describes the referred pain pattern of trigger points in the SCM as including the ear. Finally, the TMJ is reported to commonly cause referred pain into the ear.[3,18,19]

Little has been previously published regarding manual treatment and otalgia. Cowin and Bryner[20] reported a patient with hearing loss, tinnitus, otalgia, vertigo, unsteadiness and disorientation who was treated over a period of seven years with "fixed stylus, compression-wave adjustments" to the cervical spine with reported positive results. Kaye[21] reported a patient with left-sided otalgia along with headache, neck pain and upper extremity pain who was treated with diversified manipulation to the lower cervical and upper thoracic spine, home stretching and trigger point injections followed by strength training exercise with resolution of all symptoms.

The method of manipulation of the ear reported here has not previously been described. Channell[22] described two osteopathic techniques. The first, called the Galbreath Technique, is an attempt at lymphatic drainage by applying inferior and medial pressure across the mandible. The second is the Muncie Technique, which attempts to correct Eustachian tube dysfunction by applying a pumping action with the index finger in the vicinity of the palantine tonsil. Channell reports a case of a patient with vertigo who was successfully treated with a modification of the Muncie technique,[22] however, no studies on either technique are presented. The technique used in the cases reported here was one in which the thumb is placed just inside the intertragic notch, with the proximal interphalgeal joint of the index finger contacting just inside the lobule (figure 1). A gentle lateral movement is applied and the patient is asked whether this produces pain. The practitioner also attempts to assess the degree of resistance to the movement (the reliability and validity of this assessment is unknown). If manipulation is deemed indicated, a high-velocity, low-amplitude thrust is performed in a straight lateral direction. An audible release typically occurs. The patient can then be taught self-mobilization in the same direction, applying low-velocity, low-amplitude oscillatory maneuvers.

The mechanism of the perceived benefit of this manipulation is unknown. With Eustacian tube dysfunction there occurs an inability of the middle ear to equalize

Figure 1 *Method of ear manipulation*

pressure with the atmosphere, resulting in distortion of the mucosa of the middle ear and tympanic membrane.[1] This can cause otalgia with or without otitis media. As several muscles are involved in opening and closing the Eustachian tube (salpingopharyngeus, levator veli palatini, tensor veli palatini, and tensor tympani), it is possible that disruption of the tone of these muscles can lead to Eustachian tube dysfunction and that manipulation of the ear restores normal tone. Alternately, as the middle ear ossicles are synovial joints,[23] it is possible that these joints can become painful, as do other synovial joints, and that ear manipulation affects these joints in a similar way that spinal manipulation affects zygapophyseal joints.[24,25] However it is unknown whether external manipulation of the ear has any effect on these muscles or joints.

Mobilization or manipulation was applied to the upper cervical spine in three of these four cases. The decision to apply this treatment was based on, first, the presence of painful joint dysfunction[7] at the involved levels and, second, previous literature that suggested the possible role of referred pain from the cervical spine in the causation of in some cases of secondary otalgia. However, joint palpation in these cases did not exactly reproduce the ear pain in any case, thus there is no way to determine whether the cervical findings were directly involved in any individual case. Also because the treatment of these cases was multi-modal, there is no way to determine the extent to which any individual treatment modality may or may not have contributed to the perceived beneficial outcome. In addition, there is no way to determine on the basis of a case report whether the perceived beneficial outcome occurred as a result of the management strategy applied or whether it occurred by natural history. Further research is needed to confirm or deny the theoretical model by which the treatment may have beneficial, as well as to determine whether the findings reported here are generalizable.

The treatment in these cases was done at a primary spine care center at which chiropractors and physiotherapists provide all examination and treatment and for which 80% of its patients are referred by medical doctors. A number of these patients are those with ear and face pain who are referred by otolaryngologists. This referral relationship arose as a result of communication by the clinical director of the spine center with local otolaryngologists through Grand Rounds presentations and personal communication regarding the role of the cervical spine and other aspects of the neuromusculoskeletal system may play in symptoms referable to the ear, mouth and face. It is the experience of the authors that otolaryngologists see a considerable number of such patients for which an otolaryngological etiology cannot be identified. Despite this, it is uncommon for chiropractors to be consulted in these cases. In the 2010 edition of the "Practice Analysis of Chiropractic" which is published by the National Board of Chiropractic Examiners and which documents the frequency with which US chiropractors evaluate and treat various health conditions, "otalgia" and "ear pain" were not even listed. "Cranial nerve disorders" were seen "rarely" and "significant ear pathology" and "eye, ear, nose or throat tumor" were seen "virtually never." "TMJ syndrome," on the other hand, was seen "sometimes." In our opinion, a chiropractor or chiropractor-physiotherapist team may be a useful resource for these practitioners for those patients who report pain in the ear and face for which a primary otalgic explanation cannot be found. It may be useful for chiropractors to communicate with otolaryngologists in order to provide a resource for these patients.

Conclusion

Otalgia may have a variety of causes. One of these can be musculoskeletal disorders involving the cervical spine, TMJ and its related muscles and ear, which may be amenable to manual therapy and exercise. It may be advantageous for otolaryngologists and primary care physicians

to have at their disposal clinicians who are skilled at the examination and manual treatment of cervical spine and the musculoskeletal system in general, who can provide input regarding the possible involvement of these tissues.

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Efficacy of glucosamine, chondroitin, and methylsulfonylmethane for spinal degenerative joint disease and degenerative disc disease: a systematic review

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Background: *Nutritional supplements are commonly used for a variety of musculoskeletal conditions, including knee and hip degenerative joint disease. Although these supplements are occasionally recommended for patients with degenerative disc disease and spinal degenerative joint disease, the evidence supporting this use is unknown.*

Objective: *To systematically search and assess the quality of the literature on the use of glucosamine, chondroitin sulfate, and methylsulfonylmethane for the treatment of spinal osteoarthritis / degenerative joint disease, and degenerative disc disease.*

Data Sources: *The Index of Chiropractic Literature, AMED, Medline, and CINAHL were searched for randomized controlled trials in English from 1984 to July 2009.*

Data Extraction and Synthesis: *Data from studies meeting the inclusion criteria was extracted and reviewed by three reviewers. The Jadad scale was used to assess study quality. No attempts were made at meta-analysis due to variation in study design.*

Results: *Two articles met the inclusion criteria. One study was found to have good quality but reported negative results for the supplemented group compared with placebo, the other study had low quality but reported significant positive results for the supplemented group when compared with a no intervention control group.*

Conclusion: *There was little literature found to*

Contexte : *Les suppléments alimentaires sont couramment utilisés dans une variété de troubles musculosquelettiques, y compris les maladies dégénératives des articulations des genoux et des hanches. Bien que ces suppléments soient occasionnellement recommandés pour les patients atteints de discarthrose et d'arthrose cervicale, aucune preuve ne vient à l'appui de cette utilisation.*

Objectif : *Rechercher systématiquement et évaluer la qualité de la littérature concernant l'utilisation de la glucosamine, du sulfate de chondroïtine et du méthylsulfonylméthane pour le traitement de l'ostéo-arthrite et l'ostéoarthrose cervicale ainsi que de la discarthrose.*

Sources : *Des essais cliniques aléatoires en anglais menés entre 1984 et juillet 2009 ont été recherchés dans l'Index of Chiropractic Literature, AMED, Medline, et CINAHL.*

Extraction et synthèse des données : *Les données des études respectant les critères d'inclusion ont été extraites et examinées par trois réviseurs. L'échelle de Jadad a été utilisée pour évaluer la qualité des études. Il n'a pas été tenté de procéder à une méta-analyse en raison de la diversité des modèles d'étude.*

Résultats : *Deux articles ont respecté les critères d'inclusion. Une étude était de bonne qualité, mais indiquait des résultats négatifs du groupe supplémenté par rapport au groupe placebo. L'autre étude était de moindre qualité mais indiquait des résultats positifs*

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support the use of common nutritional supplements for spinal degeneration, making it difficult to determine whether clinicians should recommend them.
(JCCA 2011; 55(1):47–55)

KEY WORDS: systematic review, glucosamine, chondroitin, methylsulfonylmethane, osteoarthritis, degenerative joint disease, spine

du groupe supplémenté par rapport à un groupe de contrôle.

Conclusion : *Peu de littérature était disponible à l'appui de l'utilisation de suppléments alimentaires communs dans le traitement de la dégénérescence cervicale. Il est par conséquent difficile de déterminer si les cliniciens doivent les recommander.*
(JCCA 2011; 55(1):47–55)

MOTS CLÉS : examen systématique, glucosamine, chondroïtine, méthylsulfonylméthane, ostéo-arthrite, ostéoarthrose cervicale, discarthrose, colonne vertébrale

Introduction

Osteoarthritis is a pathology that affects approximately 15% of the world's population.[1] It is a chronic condition that is most prevalent in the elderly and three times more common in women than in men.[2] Its characterizing feature is the progressive destruction of the articular cartilage of joint surfaces which can result in impaired joint biomechanics, swelling, pain, and disability.

Typically, the literature surrounding osteoarthritis is categorized according to the affected body region. Spinal osteoarthritis is one area that has garnered attention due to its relatively high prevalence and the impact that it can have on those affected. As individuals age, spinal osseous degeneration and age-related changes occur in the macroscopic, histologic and biochemical composition and structure of the nucleus pulposus and the annulus fibrosus. It has been suggested that these changes occur more frequently in the lumbar spine than the thoracic region due to the "splinting" by the costovertebral joints, and again less frequently in the cervical spine due to the relatively low need for weight-bearing.[3]

A common medicinal treatment for individuals suffering from spinal osteoarthritis is nonsteroidal anti-inflammatory drugs (NSAIDs), but with the associated serious gastrointestinal side effects many patients look towards complementary and alternative medicine to gain symptomatic relief and avoid iatrogenic illness.[4]

Glucosamine and chondroitin sulfate have been utilized medicinally in Europe for over 40 years and have gained in popularity in North America since the late 1990's.[5] Glucosamine and chondroitin sulfate, studied alone or in combination, appear to be somewhat effective for osteoarthritis of the knee[6–8] or hip[7,8] but there is no consensus with respect to a specific biochemical rationale or reasoning behind the results. It has been suggested that osteoarthritis is associated with a local deficiency in some key natural substances and that glucosamine acts as a substrate for cartilage repair by stimulating proteoglycan synthesis by chondrocytes.[9] In the case of chondroitin, it has been contended that since it constitutes the majority of the glycosaminoglycans (GAGs) in articular cartilage, it helps to maintain the viscosity in joints, stimulates cartilage repair and inhibits enzymes that lead to degeneration of cartilage.[10]

More recently, methylsulfonylmethane or MSM has been promoted as a possible supplement for osteoarthritis due to its suggested anti-inflammatory and analgesic effects.[11] Similar to glucosamine and chondroitin sulfate, most MSM research has evaluated the effects of MSM supplementation on knee osteoarthritis, as Usha and Naidu[12] and Kim et al[13] both looked at the effects of 12-weeks of supplementation with methylsulfonylmethane on knee osteoarthritis. In both studies, there was a significant difference between the supplementation and placebo group with the supplementation group showing decreased pain levels. In the study by Usha and Naidu[12] specifically, when methylsulfonylmethane and glucosamine were combined there was a significant difference in swelling index, joint function, walking time, joint mobility index, and overall function ability when compared to the placebo and the supplements when taken individually.

The objective of this paper was to systematically search and assess the quality of the literature on the use of glucosamine, chondroitin sulfate, and methylsulfonyl-

Table 1 *Review Inclusion Criteria*

- Published in English
- Published in a peer-reviewed journal
- Published in the past 25 years (1984–2009)
- Randomized controlled trial
- Patients must have spinal osteoarthritis / osteoarthrosis / degenerative joint disease and/or degenerative disc disease proven via diagnostic imaging
- Use glucosamine sulfate (or glucosamine HCl) and/or chondroitin sulfate and/or methylsulfonylmethane (MSM)
- Use of other medications, supplements, or interventions tolerable
- Comparison group could consist of a do nothing control, placebo, or a different active treatment
- Outcome measures include an assessment of pain and/or disability due to pain

methane, alone or in combination, for the treatment of spinal osteoarthritis / degenerative joint disease, and degenerative disc disease.

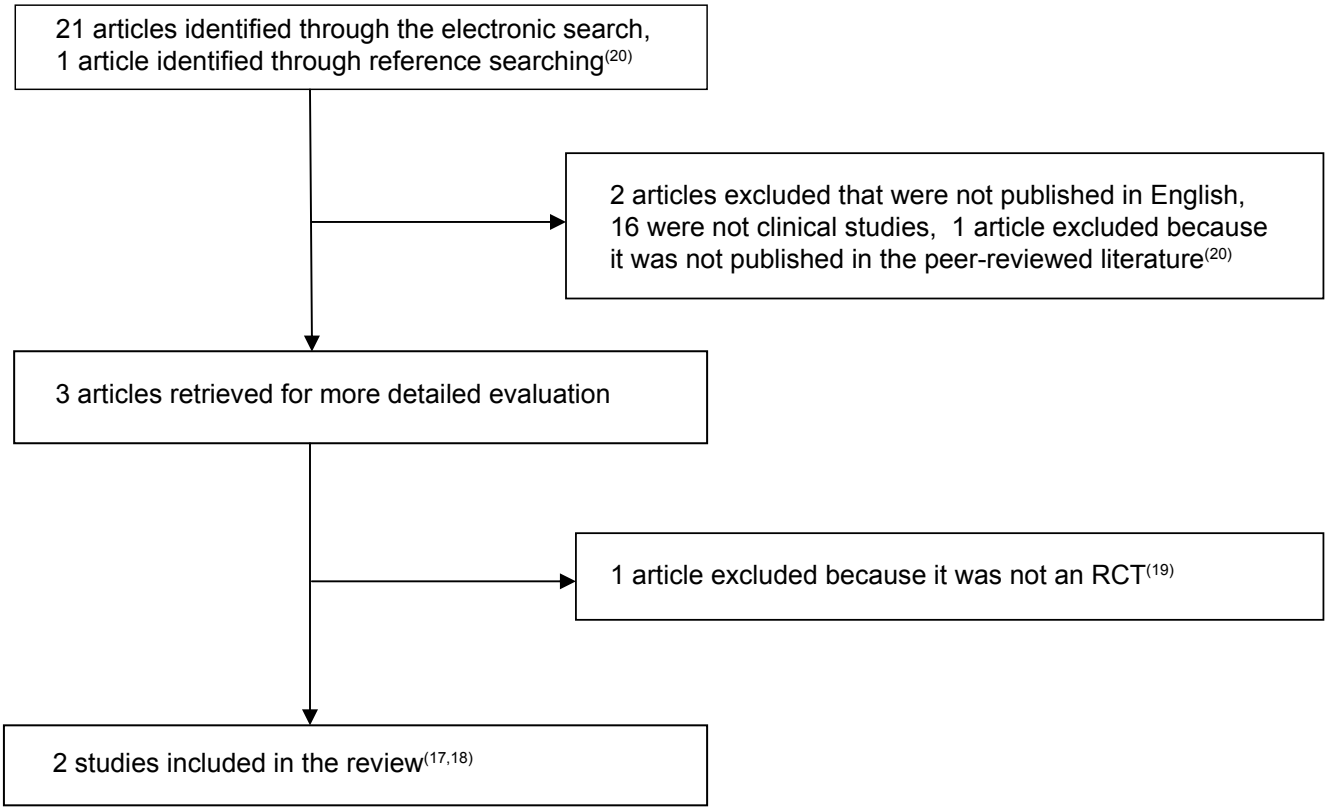
Methods

An electronic search for relevant literature was conducted on the Index of Chiropractic Literature, AMED, Medline, and CINAHL up to and including July 2009. Search terms consisted of combinations of glucosamine sulfate (GS), chondrotin sulfate (CS), or methylsulfonylmethane (MSM) with terms for spinal arthritis or osteoarthritis, spinal degenerative joint disease, or degenerative disc disease (the exact search terms and strategies employed are available from the authors). Relevant MeSH terms were employed whenever possible. The Cochrane Library was also searched for relevant reviews or articles using similar search terms. The authors also hand searched their personal libraries. Two of the authors (KS and SS) scrutinized the electronic search results, titles and abstracts in particular, to determine which full manuscripts should be obtained and evaluated. Each of these authors composed a list of studies from the electronic search results that they felt may be clinical studies using GS, CS, or MSM, these lists were compared and any differences were resolved by discussion to obtain a final list of manuscripts to obtain. The full manuscripts that were obtained were for any clinical studies on spinal arthritis, osteoarthritis, degenerative joint disease, or degenerative disc disease using GS, CS or MSM.

The inclusion criteria used for this review are indicated in Table 1, but consisted of studies that were randomized controlled trials conducted on patients with spinal degenerative joint disease, spinal osteoarthritis/osteoarthrosis, and/or degenerative disc disease. Interventions could include glucosamine (sulfate or HCl), chondroitin sulfate, and methylsulfonylmethane (MSM) in any combination or dosage with co-interventions being allowed; these could be compared to a do nothing control group, placebo, or another active intervention. Outcome measures of interest had to include at least one validated and reliable assessment of pain (such as a visual analog scale or numerical pain rating scale) or disability due to pain (such as the Oswestry Low Back Disability Index). Only articles published in a peer-reviewed journal in English within the past 25 years (1984–2009) were considered. These criteria were applied to all of the obtained full manuscripts. Reference searching was conducted from the reference lists of all retrieved studies.

One of the authors (KS) initially extracted data (such as sample details, interventions, outcome measures, results, adverse events, withdrawals/dropouts) from the studies meeting the inclusion criteria into a data extraction sheet that was checked and edited by the other authors (SS, KK). The Jadad scale (or Oxford quality scoring system) was used to assess study quality.[14] The Jadad scale is among the most referenced and widely used of all quality scoring systems and considered valid and reliable.[14,15] The Jadad scale asks questions about three different aspects of study design: double blinding, randomization, and the handling of withdrawals and dropouts.[14] There are seven questions which lead to a score that out of five, with zero being the lowest score and five being the highest.[14] We applied the classification developed by Abraham et al to determine whether included trials were of good or poor quality, where they defined a good quality trial as receiving four or higher on the Jadad scale and a poor quality trial as one

Figure 1 *Literature Search Flow*



earning three or less.[16] All three authors independently reviewed the included studies and resolved any differences by discussion. No attempts were made at meta-analysis as it was felt there would be too much variation in study parameters to allow for suitable synthesis.

Results

Figure 1 depicts the flow of trials through the review. The electronic database search initially yielded 17 articles from Medline, 2 from CINAHL, 2 from the Index to Chiropractic Literature, 1 from AMED, and none from the Cochrane Library, for a total or 21 articles excluding overlap. These search results were scrutinized and only three articles were obtained for full manuscript review. Upon review of these three manuscripts, two were found to be RCTs[17,18] and one was a case report[19] and thus excluded. One article was identified by reference searching from a previous systematic review of glucosamine for osteoarthritis[8] but was excluded as it was not published in the peer-reviewed literature.[20] Thus only two articles were accepted for analysis.[17,18] Table 2 depicts the quality rating of the two articles included in the review using the Jadad scale. There was complete (100%) agreement between the authors on the rating of these articles.

The paper by Leffler et al[17] received a score of 4/5 which corresponds with a good quality article[16], with the only point missing being for the description of randomization method. Leffler et al compared the use of a combination of glucosamine, chondroitin, and manganese ascorbate with placebo for patients with degenerative joint disease of the knee or low back. The subjects were 34 males in the United States Navy with x-ray proven degenerative changes in the knees or low back. The 23 subjects with low back DJD were 43.6 years old on average. The subjects received either oral Cosamin (at a dosage of 1500 mg/day of glucosamine HCl, 1200 mg/day of chondroitin sulphate, and 228 mg/day of manganese ascorbate) or a matching placebo, each taken three times daily. Sub-

Table 2 *Jadad Scale Scoring Results*

Jadad Scale Item	**Leffler CT, et al. Military Med 1999; 164(2): 85–91.**	**Fujita T, et al. J Bone Miner Metab 2002; 20: 298–302.**
Study described as randomized?	**1**	**1**
Randomization method described and appropriate?	**0**	**0**
Study described as double blind?	**1**	**0**
Double blinding method described and appropriate?	**1**	**0**
Description of withdrawals and dropouts?	**1**	**0**
Subtract 1 point if the randomization method was described but was inappropriate.	**0**	**0**
Subtract 1 point if the double blinding method was described but was inappropriate.	**0**	**0**
Total Score (/5)	**4**	**1**

jects spent three weeks in a baseline period, then received either 8 weeks of Cosamin or placebo, then crossed over to the other group for a final 8 weeks. Subjects were not permitted to take NSAIDs during the trial but they could take acetaminophen as necessary.

Outcome measure assessment occurred after weeks 2 and 3 of the baseline period and after weeks 7 and 8 of each treatment period (thus 6 times in total); there was no long term follow-up. Outcome measures for the low back degenerative joint disease subjects included the Roland-Morris questionnaire for back disability, patient subjective assessment of handicap (from 0 to 5), physician assessment of severity (from 0 to 3), an 11 point visual analog scale, tenderness with movement of the low back (from 0 to 3), a sprint and stair run, Pavelka physical examination maneuvers, the Modified Schober technique for assessing lumbar flexion, and patient's subjective assessment of results of treatment (from –3 to +3) (Leffler). All of these assessments were totalled to provide an overall summary score.

By the end of the trial, four patients withdrew from the low back degenerative joint disease group. There were no statistically significant changes in the low back group when considering the overall summary score or individual outcome measures. However, the summary score and patient assessment of treatment effect did show wide 95% Confidence Interval's indicating that clinically meaningful results may have been obtained. No statistically significant differences were identified between groups with respect to reported adverse effects.

Fujita et al's paper[18] scored 1/5 which corresponds with a low quality article,[16] with the only point allocated for the study being described as randomized. This study compared the use of a combination of glucosamine (1800 mg/day), active absorbable algal calcium (900 mg/day), porcine skin collagen (10,500 mg/day), composite mucopolysaccharide (600 mg/day), and vitamin C (600 mg/day) with control for 80 patients with knee or low back pain. The number of subjects in this trial with low back degenerative joint disease was not indicated. The subjects were randomly divided into two groups: one that would receive three daily doses of the glucosamine combination treatment over a four month time period (after a suitable washout period) and a second group that did not receive supplements. Subjects were not permitted analgesics during the trial. The average age of the subjects was approximately 65 years old and 75 out of 80 were female. The supplement group had an average of 1.47/3 in terms of radiographic degree of spondylosis deformans, compared with 1.65 in the control group (not a significant difference).

Outcome measures were assessed at baseline and after

the 4 month trial period and included a subjective pain rating (from 0–3). Pain levels were also measured by skin impedance when quietly sitting (the basal value), when standing up, walking, squatting, climbing up and down stairs (which were all expressed in terms of percentage change from the basal value). Lumbar spinal radiographs and bone mineral densities were performed prior to and following the trial. The supplement group had a significant decrease in skin impedance from the beginning to conclusion of the trial; this change was not seen in the control group. Significant decreases in skin impedance during various tasks (standing up, walking, squatting, climbing up and down stairs) when compared with rest were again noted in the supplement group. Subjective pain values decreased significantly in the supplement group, but not the control group. The lumbar bone mineral density increased significantly in the supplement group; however the degree of vertebral deformity did not change in either group.

Discussion

Only two papers met the inclusion criteria for this review and these articles by Leffler et al[17] and Fujita et al[18] are contradictory in their findings. Leffler et al[17] examined the effects of glucosamine, chrondroitin sulfate, and manganese ascorbate on degenerative joint disease of the low back or knee. These authors found no discernable improvements or change in the supplemented group when compared to the control group. The article was rated as having good quality.[16] Fujita et al[18] looked at the effect of glucosamine, active absorbable algal calcium, porcine skin collage, composite mucopolysaccharide, and vitamin C on back or knee pain. The results indicated that the group assigned to supplements had significant decreases in skin impedance and pain over the duration of the study when compared to the control group. This article was rated as having poor quality.[16]

The supplements used by the active treatment (i.e. non-control) groups in both Leffler et al's[17] and Fujita et al's[18] studies each had several components, thus it cannot be ascertained which component(s) of the supplements produced the improvements (if any) in those subjects. For the purposes of this review, it cannot be discerned whether the glucosamine or chondroitin sulfate produced any beneficial effects in the study by Leffler et al[17] or if glucosamine was responsible for any improvements noted in the study by Fujita et al.[18] The methods of randomization used in both of the included studies were not revealed. Both studies indicated that randomization of subjects did take place, but the exact methods were not disclosed and thus we cannot discern if the methods were appropriate. The follow-up periods of 7 to 8 weeks employed by Leffler et al[17] and 4 months by Fujita et al[18] were likely inadequate, given that spinal osteoarthritis is a long-term condition. It would seem more suitable for researchers to utilize longer follow-up periods of at least one year and preferably to five years or more. Both of the involved studies had mixed populations with Leffler et al including patients with low back and/or knee degenerative joint disease[17] and Fujita et al including patients with back or knee pain.[18] In the case of Fujita et al[18] the average degree of spondylosis deformans on a scale of zero to three was noted at baseline indicating that there was some amount of radiograph-proven spinal osteoarthritis present on average, however the number of subjects diagnosed with spinal degeneration was not indicated.[18]

Thus, for the clinician there is contradictory evidence to support the use of glucosamine in the treatment of spinal osteoarthritis or disc degeneration based on the results of one positive study with low quality and one negative study with good quality. We identified no articles to support the use of chondroitin sulfate based on one negative study with good quality, or MSM based on no identified studies. Regardless, use of these supplements and their recommendation in practice is widespread.

In a recent randomized clinical trial analyzing the use of alternative therapies by individuals with osteoarthritis, the authors found that 47% of their participants reported utilizing at least one type of alternative care with the most common types being massage therapy (57% of alternative care users), chiropractic (20.7%) and non-prescribed alternative medications (17.2%).[21] A survey of over 2,500 full-time chiropractors in the United States revealed that on average they treat patients with osteoarthritis/degenerative joint disease "often" which was equivalent to one to two times per week.[22] The specific anatomic locations of the osteoarthritis/degenerative joint disease were not indicated in that survey. The specific methods of treatment for a patient with osteoarthritis/degenerative joint disease was not assessed, however 89% of the chiropractors surveyed utilized nutritional counselling, therapy, or supplementation in their practices over the previous year and on average they indicated that 34.6% of their

patients would receive this type of passive adjunctive procedure.[22]

A prospective cohort study of a random sample of 9423 Canadians found that 11.5% of their participants were taking glucosamine five years into the trial compared with 1.6% at baseline.[23] This increased usage was associated with several factors including age, presence of arthritis and or back pain, calcium intake, regular physical activity, and use of glucosamine previously.[23] The authors felt that some participants use glucosamine to manage the symptoms of arthritis and/or back pain, while others use it on a preventive basis.[23] In 2007 glucosamine was the second most commonly used natural health product, used by 19.9% of participants over the previous thirty days in a survey of adults in the general population of the United States who used nonvitamin, nonmineral health products.[24] In the same survey chondroitin was used by 11.9% of the participants, ranking eighth, while MSM was used by 4.1% of the participants, ranking eighteenth.[24]

For clinicians who do choose to recommend these supplements, it is important to bear in mind that there are some potential side-effects or contraindications to their use. It has been proposed that glucosamine sulfate could potentially alter glucose control, specifically interfering with the hexosamine biosynthesis pathway,[25] and as such down-regulating cellular glucose uptake and leading to hypergylcemia and insulin resistance. To date, no effects on glucose concentrations were documented in studies evaluating the use of long-term oral glucosamine for osteoarthritis.[9,26] Although no specific glucosamine sulfate induced changes in glycemic control are found in the literature, it should be noted that the subjects in these studies had well-controlled type II diabetes and it is unclear how glucosamine sulfate would affect individuals with type I diabetes who are unable to secrete additional endogenous insulin to compensate for the potential glucosamine-induced insulin resistance.[27] Recently, a case report by Knudsen and Sokol addressed the effects of glucosamine sulfate on an individual utilizing warfarin.[28] The authors suggested that the supplementation of glucosamine or glucosamine combined with chondroitin sulfate in individuals consuming warfarin could potentiate the anticoagulant effects of warfarin and thereby increase the risk of bleeding.[28] Although this was only a case report, chiropractors should be cognizant of this potential glucosamine-warfarin interaction as some of the patients for whom they may consider a recommendation for glucosamine may be currently taking warfarin as an anti-coagulant.

The literature regarding possible contraindications for MSM is limited, as no formal safety data or long-term assessment was available. Animal toxicity studies have shown only minor adverse effects in levels that are 5 to 7 times the proposed maximum recommended human dose of 6 grams per day.[29] The only proposed adverse effects regarding human supplementation with MSM include allergic gastrointestinal disruptions and skin rashes.[30]

This review has some possible limitations including the limitations of the literature itself as there were only two articles that met our inclusion criteria. This calls into question whether there may be some publication bias in this area. It is striking that there have only been two RCTs published on these supplements for spinal osteoarthritis when compared with the number of available studies for these supplements on hip and knee osteoarthritis. Reference searching of the Cochrane systematic review by Towheed et al[8] yielded an additional short term pilot RCT article pertaining to the use of glucosamine for osteoarthritis of the spine.[20] However, this article was excluded from the review by Towheed et al[8] and did not meet the inclusion criteria for this review as it was not published in the peer-reviewed literature; it was an unpublished technical report by a pharmaceutical company.[20]

From this limited evidence base firm conclusions cannot be drawn with respect to the effectiveness of glucosamine, chondroitin, or MSM for spinal osteoarthritis, because their effectiveness is still largely untested. It is difficult to generalize the findings from systematic reviews pertaining to topics that are as poorly studied as this one and if more studies had been eligible for this review it would have led to a stronger conclusion. However it is still important to present the results of such systematic reviews so that clinicians can make evidence-based decisions; there have even been systematic reviews published that had zero articles meet their inclusion criteria.[31] From this overt lack of studies it can be easily stated that there is a definite need for more research in this area.

Another possible limitation of this review is by way of a language bias as we only permitted articles published in English. Furthermore we did not search the "grey" literature or additional electronic databases such as EMBASE. However, we conducted a multi-modal search strategy using several electronic databases with hand reference

searching of obtained articles, thus numerous steps were taken to thoroughly evaluate the literature.

It could also be argued that a weakness in the methods of this systematic review was only including RCTs according to the inclusion criteria employed. However, in looking at the results of the literature search as seen in Figure 1, the only other clinical study identified in the electronic literature search, which was not limited by study type, was a case report by van Blitterswijkk et al[19] that would have been excluded from the review regardless as it did not employ suitable outcome measures of pain and/or disability due to pain, along with the single study found through reference searching, the aforementioned pilot RCT[20] which was excluded as it was not published in a peer-reviewed journal. As such, use of this particular inclusion criterion did not affect the outcome of the review." The use of the Jadad scale may be questioned as it is a relatively simple tool for rating the quality of RCTs.[14] The Jadad scale only evaluates randomization, blinding, and withdrawals and dropouts, and does not look at other areas to assess study quality.[15] However the Jadad scale is the most frequently used health care literature quality assessment tool and it has been tested extensively and found to be valid and reliable.[15]

Future research in this area should take place to determine the rates at which health care professionals recommend or prescribe nutritional supplements such as glucosamine sulfate, chondroitin sulfate, and MSM to patients with spinal arthritis and disc degeneration, as well as the consumer usage rates of these supplements. Further clinical research by way of randomized controlled trials on the effects of these supplements is also suggested as there have been only two RCTs in this area using vastly different supplements and without solely examining patients with spinal osteoarthritis and/or disc degeneration.

Conclusions

Given the paucity of evidence surrounding the use of glucosamine, chondroitin, and MSM for spinal arthritis and disc degeneration and the conflicting results in the two studies that were identified, it would be difficult for evidence-based practitioners to justify the recommendation of these supplements for the pain and resultant disability from spinal degenerative conditions. There is an inadequate amount of literature examining the use of these supplements for lumbar spinal degenerative conditions in comparison with the volume available pertaining to their use for knee or hip osteoarthritis. Further research is necessary to clarify if these supplements are of any potential benefit for patients with spinal degenerative conditions.

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Quantitative corpus-based analysis of the chiropractic literature – a pilot study

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In this pilot study, a collection of peer-reviewed articles from the Journal of the Canadian Chiropractic Association was analyzed by computer to identify the more commonly occurring words and phrases. The results were compared to a reference collection of general English in order to identify the vocabulary which is distinctive of chiropractic. From texts with a combined word count in excess of 280,000, it was possible to identify almost 2,500 words which were over-represented in the chiropractic literature and therefore likely to hold special importance within this domain. Additionally, readability statistics were calculated and suggest that the peer-reviewed chiropractic literature is approximately as challenging to read as that of nursing, public health and midwifery. Certain words widely considered to be of importance to the profession, for example "subluxation and adjustment," were not particularly prevalent in the literature surveyed.
(JCCA 2011; 55(1):56–60)

KEY WORDS: JCCA, chiropractic, corpus, linguistics

Dans le cadre de la présente étude pilote, un ensemble d'articles évalués par les pairs tirés du Journal de l'Association chiropratique canadienne a été analysé par ordinateur afin de déterminer les mots et les phrases les plus communément utilisés. Les résultats ont été comparés à un corpus de référence en anglais général afin d'identifier le vocabulaire spécifique à la chiropratique. À partir de textes ayant un total combiné de mots dépassant les 280 000 mots, il a été possible de déterminer près de 25 000 mots surreprésentés dans la littérature chripratique et qui ont probablement une importance particulière dans ce domaine. Par ailleurs, des statistiques sur la lisibilité ont été calculées et indiquent que la littérature chiropratique évaluée par les pairs est aussi compliquée à lire que celle liée aux soins infirmiers, à la santé publique et à la profession de sage-femme. Certains mots considérés par de nombreuses personnes comme étant importants pour la profession, par exemple « subluxation and adujstment », n'étaient pas particulièrement prévalents dans la littérature en examen.
(JCCA 2011; 55(1):56–60)

MOTS CLÉS : JACC, chiropratique, corpus, linguistique

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Introduction

The domain-specific dialects of biomedical and health language include esoteric technical vocabularies as well as conventions of grammar and discourse which distinguish them from root languages such as general English.[1] Characterization of the dialect of a discipline may provide important cultural insights. On a more pragmatic level, identifying a target dialect also permits definition of the language learning burden imposed on students, and therefore, could greatly enhance strategies to impart fluency.[2] Enhanced communicative competence would likely improve education, patient-practitioner cooperation and communications within and between disciplines. Additionally, a quantitative analysis of a dialect shows language as it actually is rather than as we might wish it were. This is particularly valuable to a discipline such as chiropractic where proximity to or distance from other disciplines is an important consideration in the formulation of educational programmes, legislation and health care policy.

Corpus linguistics provides well validated methods to identify distinctive dialects, such as that of chiropractic. The term corpus refers to a large (usually electronic) archive of samples chosen to be representative of a target language.[3] Specialized computer programs permit the analysis of corpora (the plural of corpus) for such quantitative measures as word and phrase frequency, part of speech and even semantic class (meaning of a word or phrase).[4] Previously, the methods of corpus linguistics have been applied to and have discerned distinctive features of the languages of nursing,[5] public health,[6] and midwifery.[7] However, while debate about the meanings of terms such as *subluxation* and *adjustment* is not uncommon in the chiropractic literature (for example, see[8]), no studies have attempted to quantify the lexical and syntactical features of the professional literature, nor to define the extant usages of key words and phrases. Thus the present study was undertaken to determine the lexical and syntactical features of a corpus of modern chiropractic writings.

Methods

A corpus was created by downloading the full texts of 98 articles – editorials, commentaries and research papers – published in the Journal of the Canadian Chiropractic Association from 2005 to 2008. Notices, short announcements and personal profiles were not included in the corpus. Titles, legends, references, acknowledgements and tables were removed from manuscripts, as were figures. Hence, the remaining textual material consisted overwhelmingly of full sentences. The texts were saved as XML files and meta-data markers were inserted by hand to facilitate later analysis on a section by section basis.

The corpus was analyzed using a number of software programmes, including WordSmith Tools V5.0 (Oxford University Press). WordSmith Tools was used to calculate the number of occurrences of each unique word (referred to as a "type" in the jargon of linguists) and compared the relative prevalence of each type to a reference corpus of general English – the New York Times (NYT) corpus. Types (words) which occurred significantly more often in the chiropractic corpus than in the comparison (NYT) corpus (as determined by log-likelihood) were identified as keywords.[9]

Additionally, using the open access tool Vocabprofile,[10,11] each type was classified as belonging to the General Service List (GSL), the 2,000 most common word families in general English,[12] the Academic Word List (AWL), the approximately 570 word families commonly encountered in academic settings,[13] and off-list, that is not belonging to either of the 2 preceding lists. Their absence from the GSL and AWL means that off-list words are more likely to hold special meaning within a target corpus.[14]

The corpus was also analyzed with the readability statistics function of MSWord 2007 to determine average sentence length, prevalence of sentences in the passive voice, Flesch Reading Ease Index and Flesch-Kincaid Grade Level.

Results

The experimental corpus consisted of approximately 280,000 tokens: individual words, letters and numbers, regardless of number of occurrences. The reference corpus of general English (NYT corpus) comprised approximately 3.6 million tokens. Based on a log-likelihood of >15.13[15] and in comparison to the corpus of general English, 2448 types were significantly over-represented ($p < .01$) in the chiropractic corpus. In the language of corpus linguistics, such words are referred to as "keywords."[9] Approximately 74% of the tokens (total collection of words)

were from the General Service List, approximately 11% were from the Academic Word List, and approximately 15% were off-list.

The 10 most prevalent words (tokens) in the chiropractic corpus were *the, of, #, and, to, in, a, is, that* and *for*. In linguistics, such words are known as function words as they aid in sentence construction but do not convey meaning by themselves. The 10 most prevalent content ("meaningful") words (and their % prevalences in the corpus) were *chiropractic (0.71), treatment (0.53), pain (0.52), care (0.35), patient(s) (0.63), health (0.33), evidence (0.31), practice (0.27)*, *study (0.25) and cervical (0.25)*. All of these words were keywords in the sense that their percentage prevalences were significantly higher in the chiropractic literature than in the reference corpus of general English. Other keywords of somewhat lower prevalence included *clinical, manipulation, spine, profession, symptoms, lumbar, research, technique, position* and *injury(ies)*. *Adjust* and words derived from this root had a collective prevalence of 0.05%. *Subluxation* and *subluxations* had a collective prevalence of 0.04%. The types *he*, *him* and *his* occurred approximately 5 times as often as their corresponding female types *she*, *her* and *hers*. The complete list of keywords is posted at http://bmhlinguistics.org/joomla2/chiropractic.

In 12 instances, the word *subluxation*(*s*) collocated with the word *vertebral*. The other common collocation (7 instances) was with the word *chiropractic*. There was only one instance of the phrase *vertebral subluxation complex*. In approximately 40% of instances, the phraseology implied that the meaning of the term *subluxation* was apparent from context or common knowledge. In other instances, there was explicit reference to a specific definition or the need for a definition. Interestingly, in approximately 25% of instances, the reference to subluxation was emotive, politicized and even explicitly disparaging of the term.

Adjust or words derived from it (*adjusting, adjustment* etc.) occurred 113 times in the corpus. There were 117 instances of *mobilize*, or some variation thereof, such as *mobilization*, *mobilizations*, etc. However, there were 405 occurrences of *manipulate* or some variation thereof, and the word *manipulation* was one of the most common keywords in the literature.

The average number of words per sentence was 23.7. The passive voice occurred in 24% of sentences. Overall, the Flesch Reading Ease Index was 29.0 and the Flesch-Kincaid Grade Level was 14.7.

Discussion

The chiropractic corpus created for this study is comparable in size to one previously created for the nursing literature[5] and likely of adequate size to reasonably represent the written language of the modern Canadian chiropractic profession. The written language is, of course, somewhat different from the spoken language used in educational, clinical and professional encounters, and so the results of this study have limited implications. Nonetheless, the outcomes of this exercise are of pragmatic interest to the profession.

Approximately 15% of the words in the chiropractic literature were off-list. That is to say they did not appear in either the General Service List or the Academic Word List. Such words, *subluxation, lumbar* etc., would therefore likely be unfamiliar even to the well-educated reader who did not have specialist knowledge of chiropractic. This is consistent with findings concerning the literature of public health[6] and the literature of midwifery.[7] Furthermore, chiropractic appears to have its own specialized lexicon. Thus, while it shares keywords such as *patients* and *treatment* with other disciplines,[5–7] it also contains its own particular keywords including, of course, *subluxation* and *adjustment*. On the other hand, words which are conceptually important to chiropractic, such as *subluxation* and *adjustment*, are not necessarily highly prevalent in the literature.

As with the languages of nursing[5] and midwifery,[7] in the chiropractic corpus there was a bias in the representation of masculine versus feminine pronouns and possessive adjectives. However, in the instance of chiropractic, the bias is in favour masculine words. Much of the writing in midwifery concerns the experience of the mother, and so it is not surprising that female references abound. In nursing and chiropractic, a proportion of the literature is also introspective, dealing with the respective professions as a whole and with notable individuals within each profession. To the extent that nursing and chiropractic have historically been populated more by women versus men, respectively, any skewing of the balance in masculine and feminine references may be due to the effect of the introspective literature. This hypothesis could be tested by quantifying the contexts

of masculine and feminine words in the respective corpora.

Pertaining to the accessibility of the literature, measures of readability for the chiropractic corpus fell quite close to those of both public health[6] and midwifery.[7] Thus, while the average number of words per sentence was 23.7 for chiropractic, it was 25.8 and 22.4 for public health and midwifery, respectively. The passive voice was used in 24% of sentences in the chiropractic corpus, versus 26% for public health and 29% for midwifery. The passive voice is more prevalent in biomedical literature than in general English and often results in longer and more complex sentence structure.[16] The Flesch Reading Ease index for chiropractic was 29.0 versus 23.2 for public health and 30.7 for midwifery. Flesch Reading Ease is calculated on the basis of word and sentence complexity[17] and is one of the most widely used measures of readability. A higher readability score indicates that text is easier to read and, by implication, easier to understand. The readability indices for this study suggest that the literature of these three disciplines (public health, midwifery and chiropractic) is generally readable to those with an education equivalent to American college graduation.[17] By contrast, the literature of biomedical domains such as clinical microbiology and infectious diseases is much less accessible.[1]

Conclusion

Although concepts such as *subluxation* and *adjustment* may be important within the discipline of chiropractic, the actual terms were not highly prevalent in the literature which we sampled. This may be a particular feature of the Canadian peer-reviewed literature, and so it would be useful to perform a comparison with literature from other sources. Quantitative analysis of the chiropractic corpus also suggests a gender bias in word choice, with over-representation of masculine words. The converse phenomenon, with over-representation of female references has been reported for nursing[5] and for midwifery.[7] In comparison to the literature of other health and biomedical disciplines, that of chiropractic is reasonably accessible.

The findings of these and similar studies could be used in the design of teaching and testing materials, particularly in creating materials which are appropriate to the language of the discipline and the level of education of the target readership. The full data set and search engine on our project web site would also permit authors, reviewers and editors to determine whether a particular turn of phrase is justified by usage.

The degree to which the current results may be extrapolated to other times, settings and professions remains unknown. However, our group is currently applying the same methodology to historical chiropractic literature and to the literature of other groups of manual therapists.

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Divided into 9 chapters, the text addresses different structures to be tested as opposed to specific conditions. This allows the user to quickly reference which tests to use when assessing patients with unknown conditions. Of particular interest was the inclusion of the final 3 chapters consisting of quick reference tables, a musculoskeletal atlas and muscle tables. These additions were concise and are excellent to expedite memory recollection.

Although the text is quite inclusive, it is not without the flaw of being unable to include all of the tests for the musculoskeletal system. Therefore, this text should only be used for quick referencing and complete reliance on this text should be cautioned.

The acquisition of this text would be excellent for new or old practitioners in assessing the musculoskeletal system and providing a quick reference tool in clinical practice.

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The Physician's Golf Injury Desk Reference
Dr. Jeff Blanchard
Jones & Bartlett Publishers 2007
Sudbury, Massachusetts
Soft Cover, 182 pp., US $115.95
ISBN: 978-0-7637-4613-1

The author of this text is both a chiropractor and a professional golfer, and aims to diagnose and treat golf injuries by associating mechanics of the golf swing with common presenting injuries. Almost one third of the text is devoted to improving your game.

This paperback reference is divided into 2 parts: Part 1 – For the Physician and Part 2 – For the Player. The first part is subdivided into 3 chapters: physical examination, swing mechanics and barriers to performance. The second part is divided into 2 chapters: training for golf, and fear and freedom.

The sections relating to posture, balance and flexibility clearly link deficits and/or weaknesses in these areas to common injuries seen in the golfer. The author demonstrates good application of geometry and biomechanics following 3 simple rules throughout the text, as well as provides appropriate use of basic easy-to-follow exercises.

In reference to the few case studies included, the author offers only primary treatment protocols for common sprain/strain injuries, and limited information regarding foot mechanics.

Due to considerable repetition in the author's use of diagrams, photographs and overall content, a condensed version of this text would be rendered far more useful for the health care practitioner interested in treating golfers and preventing their injuries.

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Pocket Orthopaedics: Evidence-Based Survival Guide
Michael Wong DPT, OCS, FAAOMPT
Jones & Bartlett Publishers 2010
Sudbury, Massachusetts
Soft Cover, 408 pp., US $34.95
ISBN: 978-0-7637-5075-6

This first edition of Pocket Orthopaedics: Evidence-Based Survival Guide provides both recent graduates and seasoned practitioners in manual therapy an up-to-date resource for orthopaedic assessments and treatments with an evidence-based approach.

This pocket-sized guide is divided into 16 chapters: the first 4 chapters outline the basics of orthopaedics, medical screening, patient examination and pain; the next 11 chapters highlight assessment and treatment protocols for specific anatomical regions of the body; and the final chapter charts individual muscles with their origins, insertions, actions and innervations, as well as provides a summary of special tests for each anatomical region.

The user-friendly format proficiently follows a logical progression of regional examination protocols and specific orthopaedic tests. The text is exceptionally referenced with ample use of clear, concise tables, charts and diagrams. Highlights include post-op pearls for the shoulder, hip and knee; outcome tools; red flags and clinical prediction rules for spinal manipulation. The specificity and sensitivity of all diagnostic tests are included, which warrants this guide a useful tool in validating procedures to third parties.

Overall this text provides good value for money as a provisional aide to both students and clinicians in health care that use manual therapies. It will however, need to be continually revised as and when more current research becomes available.

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Skeletal Imaging: Atlas of the Spine and Extremities, 2nd edition
John AM Taylor, Tudor H Hughes, and Donald Resnick
Maryland Heights, Missouri: Saunders, 2010.
1136pp. ISBN 978-1-4160-5623-2

Attempting to limit their work to a single volume, while still providing a comprehensive overview of the important musculoskeletal conditions can be a difficult task. These accomplished authors have successfully met these two principle objectives. The second edition of Skeletal Imaging provides updated case images and a synthesis of the new literature published since the first edition.

The text in organized 17 chapters. An introductory chapter provides an overview of general concepts of musculoskeletal imaging and systemic skeletal pathologies, organized into effective tables. The remaining chapters are arranged by anatomical region with numerous images, tables, and limited text describing the normal anatomy, variants, and pathology specific to the area.

The images are large and a primary strength of this text. Each one is labeled for ease in interpretation and accompanied with a thoughtful and well-written legend. The focus is primarily on plain radiographs with some accompanying corresponding cross-sectional imaging (CT and MRI) when appropriate. Within each chapter introductory text and intermittent tables provide a more focused discussion of the various pathologies. The tables are organized well, with numerous associated images to aid in understanding, as well as, references to direct the reader to other resources.

This is an excellent text, that will serve the chiropractic student, resident or clinician well. The scope is comprehensive, with a focus on the commonly seen pathologies. Given the format, there is less room for some topics and as such, tumours and metabolic bone disease, differential diagnosis, and advanced imaging modalities receive less attention; representing the only weakness of the text. Overall, the authors have produced a great read and a welcome addition to your collection of musculoskeletal imaging resources.

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Essentials of Dermatology for Chiropractors
Michael R. Wiles, Jonathan Williams, Kashif A. Ahmad
Jones and Bartlett, 2011
226 pages, paperback, $69.95

Essentials of Dermatology for Chiropractors is a reference for diagnostic screening, early recognition and timely referral of dermatological conditions. The authors are experts in the field of chiropractic and dermatology.

The importance of dermatology to chiropractors is introduced in 10 chapters. Skin health is discussed followed by a summary of biology and pathophysiology and an outline of history and physical examination. One hundred skin disorders chiropractors may encounter are discussed as well as dermatological therapeutics.

I commend the authors on providing a dermatology resource and recommend this book as a reference for differential diagnosis; it is well indexed and includes a table grouping conditions by lesion type for quick reference. This book is successful in emphasizing the description of lesions using dermatological terminology for interprofessional communication. The format was disorganized at times, with bullets placed under the wrong heading and repetition of information. Material would be easier to follow if conditions were organized by lesion type or severity. Illustrations, although adequate, don't always provide sufficient detail or illustrate the full spectrum of the condition. Management strategies are not presented in an evidence-based manner and it is difficult to find references to particular claims, for example the management of herpes zoster using spinal manipulation. A second edition could provide more efficient organization and an evidence-based presentation of management strategies.

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Loose Your Mummy Tummy
Tupler J & Gould J.
De Capo Press (member of Perseus Books Group), 11 Cambridge Center, Cambridge, MA, 02142, USA; 2005.
Soft Cover, 140 pages, CAN $15.60
ISBN 0-7382-0981-3

In this book, the authors discuss a self-named pre and post partum technique that claims to "flatten your stomach NOW." Tupler (an RN, certified childbirth educator, and fitness instructor) and Gould (an author, book publicist and Tupler's former client) include eight chapters in their book which describe the anatomy, the first two weeks postpartum, recovering from surgery and other traumas, other body parts, injury prevention, performing other exercises, a 30-minute workout and final helpful postpartum tips.

With a celebrity-supermodel authored preface and an OB/GYN's introduction, the technique has many enthusiasts. The authors claim a very high prevalence of "mummy tummy" or rectus diastasis, as well as good outcomes using their technique, but there is no reference for these claims. The technique appears to be a combination of abdominal hollowing/ bracing and focuses on reactivating the transversus abdominis, as well as other familiar stretching, core strengthening and pelvic floor exercises. The authors also address rarely discussed exercises to avoid increasing diastasis. Their advice on postpartum ergonomics and prevention of injuries is very useful. Unfortunately, they do not reference the existing published core rehabilitation evidence.

While I recommend this book to clinicians, I would also suggest they provide patients with other current evidence-based references to complement it.

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Exercises for Back Pain: The Complete Reference Guide to Caring for Your Back through Fitness
Smith, W
Hatherleigh Press, Ltd., (member of Random House), www.hatherleighpress.com; USA; 2009.
Soft cover, 139 pages, $17.00 CAN
ISBN 978-1-57826-304-2

In *Exercises for Back Pain*, Smith provides a balanced approach to back pain prevention and rehabilitation. The book has seven chapters and three appendices, including: the causes of back pain, recent research findings, long-term back health, the benefits of exercise, exercise precautions, exercise programs and progressions, a healthy back quiz and stress screening, a health chart, and references and resources.

The book includes references from most of the leading researchers in the field and breaks down the concepts into more reader-friendly descriptions. Smith also takes a more holistic approach, including relaxation exercises, as well as discussing longevity, aging, and active patient participation. The photos provided a good visual aid to the exercise descriptions. Disappointingly, Smith does not discuss chiropractic as a treatment option for back pain. Also, the exercise progression may advance a little too rapidly for some participants. Finally, he discusses the importance of abdominal bracing before doing the exercises, but does not describe HOW to perform it.

In conclusion, I would recommend this book to readers who want to actively participate in their care as a written and visual aid to our usual clinical rehabilitation advice.

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Functional Soft-Tissue Examination and Treatment by Manual Methods. Third Edition.
Edited by Warren I. Hammer
Jones and Bartlett Publishers, Sudbury, Massachusetts, 2007
Hard cover, 775 pages $189.90
ISBN 0763733105

A growing trend amongst chiropractors including soft-tissue therapy in their treatment toolbox, coupled with an ever-increasing body of research has led Dr. Hammer to update his textbook. The first section consists of an overview of soft-tissue examination and response of tissues to manual therapy. The second section is a review of the anatomy, examination and treatment of the lumbar spine and extremities. The functional diagnosis charts included here for each region are valuable practice aids. The new chapter on the lumbar spine is a thorough and up-to-date review of instability and exercise rehabilitation. The final section consists of a detailed explanation of the various manual treatment methods available to the practitioner with several topics new to this edition. The description of techniques can serve as an introduction to the respective fields or as a refresher for the experienced practitioner. Another highlight of this section is the summary of the clinical implications of Janda's work. While the majority of the text is extensively referenced and effectively illustrated, I was disappointed in some chapters that had little evidence supporting their efficacy and central concepts. In addition, the text's different contributors from various disciplines creates a disconnect between certain chapters rendering some topics redundant. Despite these minor shortcomings, the text is a thorough and well-referenced review that can be read cover-to-cover, or used as a reference text.

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