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# ABSTRACTS OF ACC CONFERENCE PROCEEDINGS

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## Platform Presentations

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### **Uterine Perforation and Migration of an Intrauterine Device in a 24-Year-Old Patient Seeking Care for Abdominal Pain**

**Michelle Barber, Daryl Chalifour, and Maria Anderson,** Palmer College of Chiropractic

**Objective:** To describe the case of a 24-year-old female complaining of diffuse abdominal pain following insertion of an IUD.

**Clinical Features:** A 24-year-old postpartum female sought care for intermittent stabbing pain in her left upper quadrant. She returned 1 week later with no resolution of her complaint. She recalled at this time that at her 6-week gynecological exam she had undergone insertion of an IUD device and that the abdominal pain had begun 15 days later. She was advised to return to her gynecologist. Subsequent evaluation by the gynecologist revealed that the IUD had perforated her uterus and had migrated to the upper left quadrant of her abdomen, where it was found lying on the abdominal aorta adjacent and anterior to the L1–2 vertebral bodies. To our knowledge, this

is the only report of this type of presentation in a chiropractic office.

**Intervention and Outcome:** The initial intervention with this patient included chiropractic adjustment and myofascial release. At her subsequent visit, with no resolution of her complaint, she was referred back to her gynecologist for additional evaluation. Because the IUD had perforated her uterus, she underwent emergency laparoscopic surgery. The surgery was successful, and she recovered fully.

**Conclusion:** Chiropractic physicians should consider uterine perforation by IUD in the differential diagnosis of a female patient of childbearing age seeking care for abdominal pain.

### **The Chiropractic Hospital-Based Interventions Research Outcomes (CHIRO) Study: A Randomized Controlled Trial of Clinical Practice Guidelines-Based Medical and Chiropractic Care for Acute Lower Back Pain**

**Paul Bishop,** International Collaboration on Repair Discoveries (ICORD), Vancouver General Hospital, University of British Columbia, **Jeffrey Quon,** University of British Columbia, **Charles Fisher,** ICORD, Vancouver General Hospital, University of British Columbia, and **Marcel Dvorak,** ICORD, Vancouver General Hospital, University of British Columbia

**Introduction:** Evidence-based clinical practice guidelines (CPG) for the management of acute lower back pain (ALBP) have been defined on an international scale. Multicenter clinical trials have demonstrated that most ALBP patients do not receive CPG-based treatment. This study compared full CPG-based care with usual care (UC) in the treatment of ALBP.

**Methods:** A two-arm, parallel design, randomized controlled trial. Inclusion: Ages 19–59; QTFSD I and II ALBP <4 weeks. Exclusion: Red flag conditions, comorbidities contraindicating chiropractic spinal manipulative therapy

(CSMT). Patients assessed by a physician in a hospital-based spine program outpatient clinic were randomized to CPG care (reassurance, avoidance of passive treatments, acetaminophen, 4–6 weeks of lumbar CSMT) or family physician-directed UC, the components of which were recorded. Primary outcome: Difference in Roland Morris Disability (RDQ) scores at 16 weeks between the study groups. Secondary outcome: Differences in Bodily Pain (BP) and Physical Functioning (PF) SF-36 domain scores at 16 weeks.

**Results:** Eighty-eight patients were recruited with 39 in the CPG group and 38 in the UC group completing the study. Baseline prognostic variables were evenly distributed

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between groups. Primary outcome: Mean difference in RDQ scores in the CPG group ( $-2.52$ ) was statistically significantly greater than in the UC group ( $-0.25$ ) ( $p < .001$ ). Secondary outcomes: Statistically significantly improved ( $p < .05$ ) BP and PF scores in the CPG group compared with the UC group.

**Discussion/Conclusion:** This is the first randomized control trial demonstrating that full CPG care, including CSMT, produces more favorable patient outcomes than family physician-directed UC in patients with ALBP.

### The Chiropractic Hospital-Based Interventions Research Outcomes (CHIRO) Study: Consistency of Standardized Outcomes in Chiropractors Treating Patients with Acute Lower Back Pain

**Paul Bishop**, International Collaboration on Repair Discoveries (ICORD), Vancouver General Hospital, University of British Columbia, **Jeffrey Quon**, University of British Columbia, **David Olsen**, British Columbia Chiropractic Association, **Bradley Yee**, British Columbia Chiropractic Association, **Don Nixdorf**, British Columbia Chiropractic Association, and **Heather Hoskin**, British Columbia Chiropractic Association

**Introduction:** Evidence-based clinical practice treatment guidelines (CPG) for patients with acute mechanical lower back pain (ALBP) have been defined on an international scale and include chiropractic spinal manipulative therapy. However, the content of community-based chiropractic treatment varies widely, leading to the perception that treatment outcomes may differ significantly between chiropractors. This study investigated the consistency of treatment outcomes in patients who received clinical practice guideline-based treatment.

**Methods:** All patients received consistent CPG treatment including a maximum 4-week course of spinal manipulative therapy administered by four community-based chiropractors (three male and one female) in a hospital spine program clinic. Primary analysis: Comparison of differences from baseline in Roland Morris Disability scores (Primary Outcome) and Bodily Pain (BP) and Physical Functioning

(PF) SF-36 domains (Secondary Outcomes) at 8, 16, and 24 weeks after the start of treatment. Linear regression was used to model the association between treatment groups and average change in each outcome measure.

**Results:** One hundred and three patients were enrolled. There was no association between the variable "treatment group" and the primary outcome ( $p = .58$ ) or in secondary outcomes ( $p = .61; .49$ ). The variable SF-36 Mental Health (MH) domain score was significantly associated with the primary outcome measure (correlation coefficient = 0.68).

**Discussion/Conclusions:** Patients with acute lower back pain experienced similar clinical improvements when treated by different chiropractors who employed a standardized pattern of practice. Lower SF-36 MH scores were associated with poorer treatment outcomes.

### The Chiropractic Hospital-Based Interventions Research Outcomes (CHIRO) Study: Clinical Practice Guideline-Based Treatment Is Not Effective for All Patients with Acute Lower Back Pain: A Randomized Controlled Clinical Trial

**Paul Bishop**, International Collaboration on Repair Discoveries (ICORD), Vancouver General Hospital, University of British Columbia, **Charles Fisher**, ICORD, Vancouver General Hospital, University of British Columbia, **Jeffrey Quon**, University of British Columbia, and **Marcel Dvorak**, ICORD, Vancouver General Hospital, University of British Columbia

**Introduction:** Clinical practice guideline concordant treatment (Ctx) is more effective than discordant treatment (Dtx) in a heterogeneous cohort of patients (ie, with differing underlying spine pathology) with acute lower back pain (ALBP). The goal of this study was to determine if Ctx is more effective than Dtx in patients with differing underlying spine pathology who present with ALBP.

**Methods:** Subgroup analysis of a two-arm, randomized controlled trial. Inclusion: Ages 19–59; QTFSD I and II ALBP <4 weeks. Exclusion: Red flag conditions, comorbidities contraindicating Ctx. Primary outcome: Difference between Ctx and Dtx Roland Morris Disability (RDQ) scores at 16 weeks post baseline between study groups. Secondary outcomes: Differences in Bodily Pain (BP) and Physical Functioning (PF) SF-36 domain scores at 16 weeks. Patients

were randomized to Ctx or Dtx and stratified on the basis of CT or MRI evidence of 1) spinal stenosis, 2) disc degeneration, or 3) no identifiable pathology.

**Results:** A total of 102 patients were recruited; 50 in Ctx and 52 in Dtx group completed the study. Baseline prognostic variables were evenly distributed between treatment groups. Outcomes: Mean difference in 16-week RDQ, BP, and PF scores between Ctx and Dtx were statistically significant in subgroups 1 and 3 ( $p < .05$ ;  $p < .001$ ). There was no significant clinical improvement in RDQ, BP, or PF scores in either the Ctx or Dtx in subgroup 2.

**Discussion/Conclusion:** Ctx was more effective than Dtx in patients with spinal stenosis or no identifiable spine pathology and ineffective and equivalent to Dtx in patients with underlying disc degeneration.

## The Chiropractic Hospital-Based Interventions Research Outcomes (CHIRO) Study: The Multidisciplinary Interexaminer Reliability of Patient Screening Assessments in a Hospital-Based Spine Program: A Pilot Study

**Paul Bishop**, International Collaboration on Repair Discoveries (ICORD), Vancouver General Hospital, University of British Columbia, **David Brunarski**, Ontario Chiropractic Association, **Charles Fisher**, ICORD, Vancouver General Hospital, University of British Columbia, and **John Street**, ICORD, Vancouver General Hospital, University of British Columbia

**Introduction:** Screening patients for appropriate treatment is a key component of a hospital-based spine service. A standardized and validated method for carrying out this process has not been established. Studies to determine who should staff these screening services, their safety, and reliability have not been reported. This study determined the interexaminer reliability of patient screening assessments by chiropractors and spine physicians.

**Methods:** Fifty consecutive patients with acute lower back pain <16 weeks duration (QTFSD I and II) referred to a quaternary care hospital spine program were studied. The interexaminer agreement for 10 physical examination procedures and five red flag conditions was calculated using Cohen's kappa statistic. Patients were assessed by one of three spine physicians and one of three chiropractors for normal or abnormal reflexes, nerve root tension signs,

sensorimotor deficit, muscle atrophy, Schober's test, and lordosis depth. History of cauda equina, fracture, infection, spinal malignancy, or progressive neurological deficit was recorded. Results were compared with previously published kappa values for physical examination procedures.

**Results:** Four of 50 patients had one or more red flag conditions with an interobserver reliability of 0.96; 8 of 10 examination procedures were associated with kappa values >0.9; the kappa for positive sensory deficit was 0.66 and 0.47 for positive femoral nerve stretch test.

**Discussion/Conclusions:** In this pilot study, patient screening assessments carried out by chiropractors and spine physicians had high interobserver reliability in 8 of the 10 examination procedures tested and were superior to previously reported multidisciplinary interobserver kappa values.

## Assessment of Students' Perceptions After the Implementation of a Geriatrics Case Studies Seminar Elective Course

**Cara Borggren** and **Michael Wiles**, Northwestern Health Sciences University

**Introduction:** In response to the need for further geriatrics training in chiropractic colleges, an elective course was developed and offered at our institution to enrich the student exposure to geriatrics topics in chiropractic curricula. After inception of this elective course, students were surveyed to document their perceptions.

**Methods:** The evaluation was conducted using 5-point Likert scale surveys that contain 10 identical items each at the commencement of the elective course and at its conclusion. Pre- and post-program class subscale scores for Affinity and Efficacy were compared using the group *t* test for independent samples.

**Results:** The data indicate that, from pre to post, the average of the class survey Affinity scores increased by one-half an ordinal rating. This result, as indicated by the statistic and probability, could have happened by chance and is not

considered statistically significant. The average class Efficacy scores, however, increased an average of 2.25 ratings. This result indicates that the students' perceptions of the benefits of chiropractic care for the geriatric population were influenced.

**Discussion:** The findings indicate that, with the limitations imposed by unmatched data, the research was a fair, albeit preliminary, assessment of the effect of an elective geriatric health care course on a representative sample of students in a graduate-level chiropractic program.

**Conclusion:** The implementation of this elective course was an attempt to broaden the courses offered to students relating to chiropractic care and the geriatric patient. With the given feedback and trends that indicate a possible significance, we plan to pursue further studies.

## Integration of Hospital-Based Chiropractic Care Within a Large Private Hospital System in Minnesota—A 10-Year Example

**Richard Branson**, Fairview Health Systems

**Purpose:** To describe a model of chiropractic integration developed over a 10-year period within a private hospital system in Minnesota.

**Methods:** Needs were assessed by surveying attitudes and behaviors of physicians associated with the hospital related to chiropractic and complementary and alternative medicine

(CAM). Analysis of referral and utilization patterns was used to assess chiropractic integration into the hospital system.

**Results:** One hundred and five surveys were returned after two mailings for a response rate of 74%. Seventy-four percent of respondents supported integration of CAM into the hospital system, while 45% supported the primary care physician as the gatekeeper for CAM use. A total of 8294 unique new patients were seen in the chiropractic program from 2006 to 2008. Primary care providers (medical doctors and physician assistants) were the most common referral source, followed by self-referred patients, sports medicine physicians, and orthopedic physicians. Overall examination of the program identified facilitators of chiropractic integration to

be 1) growth in interest in CAM, 2) establishing relationships with key administrators and providers, 3) use of evidence-based practice, 4) adequate physical space, and 5) creation of an integrated spine care program. Barriers were 1) lack of a clear chiropractic professional identity and 2) certain financial aspects of third-party payment for chiropractic.

**Conclusion:** The chiropractic profession has the opportunity to participate with the private hospital industry as conservative spine care specialists. Further research is needed to assess the cost-effectiveness of national and international hospital-based integration of chiropractic in improving the health and well-being of the communities served.

## Teaching Public Health: An Experiential Approach

Kara Burnham, Western States Chiropractic College

**Background:** Teaching public health, as part of the chiropractic college curriculum, is an important piece of the overall education of future physicians. Utilizing interactive exercises, in addition to lecture, can provide new learning opportunities and help students to recall information presented in a “hands on” format. This report details the use of two interactive activities: a hand-washing activity and a simulated epidemic exercise.

**Methods:** Students are given a survey on the first day of the course that asks questions about hand washing. The importance of hand washing is demonstrated using Glo-Germ lotion. The simulated epidemic activity involves using tubes filled with liquid that the students exchange with one another to mimic contact. One student in the group is unknowingly the index patient and his or her tube contains sodium hydroxide (NaOH). At the end of the exercise the

tubes are tested for the presence of NaOH. Data are collected to calculate incidence of infection.

**Results:** Seventy-six students completed the hand-washing survey. Most students felt their hand-washing technique was effective and the majority felt it important to wash their hands following typical activities. Seventy-six students participated in the simulated HIV epidemic activity. Following the time allowed for exchange of liquids, 12 students tested positive for the presence of the simulated virus. The incidence of the simulated virus was 15.7% in our exercise.

**Conclusions:** Experiential learning engages the student in a manner not achieved in a lecture setting. Participating in activities is both fun and educational, allowing students to attain new knowledge through active behavior rather than passive listening.

## The Status of Health Insurance for Students Enrolled in a Chiropractic Curriculum

Marni Capes, Laura Huber, Life University

**Introduction:** The purpose of this study was to obtain data concerning health insurance coverage and the financial impact of the medical intervention on students enrolled in a chiropractic curriculum.

**Methods:** This 30-question survey of chiropractic students asked if they had health insurance coverage, the terms of their policies, and the amount of money spent to cover illness/injuries.

**Results:** Fifty-four percent currently held health insurance and 46% did not have any type of health insurance. Of these students, 36% had a deductible of greater than \$1000, and 7% had a deductible greater than \$5000. A third of those surveyed did not seek treatment after suffering an illness because of financial cost.

**Discussion:** Almost half of the enrolled college students lack medical coverage. Many cite financial constraints as the reason for failure to have coverage. Unfortunately, any illness or injury could have devastating impact on an already fragile budget. These statistics cannot be ignored by college administrators. Failure to properly treat injuries could prevent the students from being able to practice chiropractic.

**Conclusion:** It would benefit our profession to tend to our young professionals enrolled in chiropractic schools. This ensures that graduates matriculate healthy and prepared to care for future generations. Perhaps the national chiropractic organizations will combine resources and compose an insurance plan for enrolled students in chiropractic programs using this incentive for “student” memberships. This would benefit both the national professional organizations and ensure a healthy future for our profession.

## Anterior Knee Pain in a Symptomatic Medial Knee Synovial Plica: A Case Report

Marni Capes, Tim Gooding, Life University

**Objective:** To discuss the case of a patient with a symptomatic right knee medial synovial plica.

**Clinical Features:** A 23-year old female soccer player presented with right anterior knee pain that was previously misdiagnosed. She came to our office after 18 months of unsuccessful management and treatment for the knee injury. Upon physical examination, positive Mital-Hayden and patellar bowstring tests were found.

**Intervention and Outcome:** A thorough clinical history and comprehensive physical exam led to a referral to an orthopedic knee specialist, who performed arthroscopic release and partial synovectomy on a symptomatic right

knee synovial plica. The patient had an excellent response to surgery and made a complete recovery.

**Conclusions:** This case study describes the travails of a patient with anterior knee pain who was presented with three diagnoses from different clinicians. Through careful investigation of her history and comprehensive assessment, we were able to determine a working diagnosis and refer her to the appropriate knee specialist. The patient then received a timely intervention, enabling her to resume sporting activity with full knee function. This case highlights the integral role that chiropractors play in the patient management continuum.

## CAM Services Provided at Select Integrative Medicine Centers: What Do Their Websites Tell Us?

Michael Carucci and Anthony Lisi, University of Bridgeport Chiropractic College and Department of Veterans Affairs

**Background:** The utilization of complementary and alternative medicine (CAM) services in the United States has been well described. Recently there has been a growth of integrative medicine (IM) centers located at or affiliated with academic medical centers. Chiropractors are reported to be providing services at some facilities. There are no published data describing the types of CAM services and types of CAM providers included in such centers. CAM is subject to multiple interpretations and there may be variation among such centers.

**Purpose:** To document and describe CAM services and CAM provider types that are specified on the websites of a group of IM clinics affiliated with academic medical centers.

**Methods:** The websites of the IM centers of the 44 member institutions of the Consortium of Academic Health Centers for Integrative Medicine (CAHCIM) were searched. Select

data from the website review were entered in a spreadsheet (Microsoft Excel) for analysis. Descriptive statistics are reported.

**Results:** The public websites of 29 out of the 44 CAHCIM member institutions specify any clinical services provided. Data on provider types were scarce. The most common CAM therapies specified were stress reduction, acupuncture, and unspecified biologically based practices, each included in 72% or more of websites. Chiropractic services were specified in 24.1% of websites.

**Conclusion:** There is variation in breadth and depth of content provided on public websites of CAHCIM member institutions. These preliminary results can inform further research to understand the variation in services provided, as well as the determinants and consequences of such variation.

## Chiropractic Management of a Patient with an Anatomic Anomaly of the Piriformis Muscle: A Case Study

Cynthia Chapman, Private Practice, and Barclay Bakkum, Illinois College of Optometry

**Objective:** The objective of this article is to present and discuss a case of an anatomic anomaly of the piriformis muscle in a chiropractic clinic setting.

**Clinical Features:** A 32-year-old male patient presented to a chiropractic clinic with a chief complaint of low back pain that radiated into his right buttock, right posterior thigh, and right posterior calf. MRI demonstrated a mild decreased intradiscal T2 signal with shallow central subligamentous disc displacement and low-grade facet arthropathy at L5/S1, a hypolordotic lumbar curvature, and accessory superior

bundles of the right piriformis muscle without morphologic MRI evidence of piriformis syndrome.

**Interventions and Outcomes:** The patient received lumbar and sacral spinal manipulation with soft tissue massage to associated musculature and home exercise recommendations. Variations from routine care included proprioceptive neuromuscular facilitation stretches, electric muscle stimulation, acupressure point stimulation, Sacro Occipital Technique pelvic blocking, Craniosacral therapy, and an ergonomic evaluation.

**Conclusion:** This patient's low back pain and any associated piriformis syndrome has been managed quite successfully

with conservative chiropractic care, although the underlying cause of the piriformis syndrome still exists.

## Normative Evaluation of the Cross-Sectional Area of the Greater Occipital Nerve and the Obliquus Capitis Inferior Muscle Using Ultrasonography

John Chin Suk Cho, Daniel Haun, Norman Kettner, Tom Clark, and Frank Scali, Logan University, College of Chiropractic

**Background:** Occipital neuralgia is typically found in the distribution of the greater occipital nerve (GON) and usually localized ipsilateral to trigger points along its course. Four possible zones of GON entrapment are known. The zone of GON entrapment between the obliquus capitis inferior (OCI) and semispinalis capitis muscles is investigated in this study.

**Objectives:** To utilize ultrasonography for measuring the normative cross-sectional area (CSA) of the GON and the adjacent OCI muscle.

**Methods:** Data from 30 asymptomatic consented and IRB-approved subjects between the ages of 20 and 45 were collected. CSA and circumference of the GON and CSA of OCI muscle were measured using ultrasonography (GE LOGIQ e, 8–10 MHz transducer). Interexaminer reliability analysis was performed using the intraclass correlation coefficient (ICC).

**Results:** The CSA of the GON and OCI muscle were  $0.02 \text{ cm}^2 \pm 0.01 \text{ cm}^2$  and  $1.86 \text{ cm}^2 \pm 0.51 \text{ cm}^2$ , respectively. The average circumference of the GON was  $0.48 \text{ cm} \pm 0.13 \text{ cm}$ . The interexaminer reliability was excellent with ICC coefficients of 0.908, 0.843, and 0.726 for the total GON CSA, total GON circumference, and total OCI muscle CSA, respectively.

**Conclusion:** This is the first study to report normative data on the CSA of the GON and OCI muscle using ultrasonography. Interexaminer reliability was excellent. Our data may have clinical potential due to excellent interexaminer reliability and because the scans were obtained at the site of occipital nerve anastomoses. These normative data may facilitate the diagnosis of GON entrapment and provide outcome measures in subsequent studies of therapeutic interventions.

## The Reliability of Cervical Motion Palpation Using Continuous Analysis and Confidence Ratings

Robert Cooperstein, Palmer Chiropractic College, San Jose, Michael Haneline, International Medical University, and Morgan Young, Palmer Chiropractic College, San Jose

**Introduction:** Most studies show motion palpation (MP) to be unreliable, with concordance not much above chance levels. The objective of this study was to assess the interexaminer reliability of cervical MP by 1) defining agreement as relative proximity to each other's findings, and 2) taking into account the examiners' confidence in their palpation finding.

**Methods:** Twenty-nine asymptomatic supine subjects were each palpated for cervical joint restriction by three randomized examiners. A research assistant determined the distance of the most fixated level identified to the vertebra prominens and also recorded confidence ratings. Intraclass correlation coefficient (ICC) values were determined for concordance, stratified by degree of examiner confidence.

**Results:** Continuous analysis was used to determine interexaminer concordance. ICC varied from 0.34 (examiners 2 and 3, not confident) to 0.79 (examiners 2 and 3, confident). In

three of four computations, ICC increased when all three examiners were confident. The smallest mean differences and standard deviations occurred between examiners 2 and 3 (0.83 cm, SD = 0.66.)

**Discussion:** The confidence level of examiners has an effect on the interexaminer reliability of cervical spine MP, such that agreement approaches "excellent" when examiners are "very confident" in their calls and is less concordant when they are not.

**Conclusion:** The use of a continuous measures methodology and an analysis of subgroups defined by degree of palpator confidence is more sensitive than level-by-level discrete analysis for detecting interexaminer agreement. Our clinical method of identifying the most fixated level better captures what motion palpators actually do and thus is more clinically relevant.

## Concurrent Validity of Tape Measure Methods for Determining Leg Length Inequality Compared to a Radiographic Reference Standard

Robert Cooperstein and Michael Laguex, Palmer Chiropractic College, San Jose

**Introduction:** There are many methods for measuring leg length inequality (LLI), ranging from high-tech procedures,

such as MRI, CT scan, and scanogram x-rays, to low-tech procedures, such as tape measure methods (TMMs) and

visual inspection. Although TMMs are commonly used, it is not clear which of the described TMMs is most accurate and precise. Since the threshold of LLI that is considered to be clinically significant may be as low as 3 mm, it is important to address this question.

**Methods:** We used electronic databases, secondary searching, and Google searches to retrieve English language articles that assessed the concurrent validity of TMMs in relation to a radiographic reference standard, using a variety of search strategies.

**Results:** Eleven primary studies were retrieved, all of which emphasized or exclusively used the medial malleolus (MM) TMM. The reference standard was plane or scanogram x-ray,

scanogram x-ray, or CT scanogram. Among the studies where a mean discrepancy between the TMM and imaging was meaningfully reported, the average was about 4–5 mm, and the standard deviation was somewhat larger.

**Discussion:** Several of the retrieved studies used inappropriate statistical methods or reported their results unclearly. There is little evidence that the most commonly used TMM, the MM method, is superior to the lateral malleolus method.

**Conclusion:** It is unlikely that any TMM is accurate and precise enough to detect the small magnitudes of LLI that some authorities believe to be clinically significant, when the threshold thought to be clinically significant may be as little as 3 mm.

### Integrative Health Care Under Review: An Emerging Field

Ian Couflet, RAND Corp, Raheleh Khorsan, Samuelli Institute, Cindy Crawford, Samuelli Institute, and An-Fu Hsiao, VA Long Beach Healthcare System

**Objective:** To examine the challenges of reviewing the field of integrative medicine/integrative health care (IM) using the methods of systematic review.

**Methods:** We conducted an electronic literature search of IM using PubMed, Allied and Complementary Medicine (AMED), BIOSIS Previews, EMBASE, the entire Cochrane Library, MANTIS, Social SciSearch, SciSearch Cited Ref Sci, PsychInfo, CINAHL, and NCCAM grantee publications listings, from database inception to May 2009, as well as searches of the “gray literature.” Available studies published in the English language were included. Three independent reviewers rated each article and assessed the methodological quality of studies using the Scottish Intercollegiate Guidelines Network (SIGN).

**Results:** Our initial search yielded 11,591 citations. Of these, only 660 were judged to be relevant to the purpose of our search. Most articles deal with implementing and implemented programs. They focus on practice models, strategies for integrative health, and business case and descriptive studies. This is followed in terms of numbers with conceptual/philosophical writings. These in turn are followed by research papers including random controlled trials, program evaluations, and cost-effectiveness studies.

**Discussion:** The literature reflects an emerging field in that it is focused more on how to create IM than on researching outcomes. However, the lack of definition and clarity about the term “integrative medicine” (aka integrative health care) and the absence of taxonomy for models of IM make it very difficult to efficiently conduct systematic reviews of this field at the moment.

### Qualitative Analysis of the Composition of the Vapor Produced by an Electronic Cigarette

Dwain Daniel, Parker College of Chiropractic, Xiaohua Cai, Evans Analytical Group, and Harold Fick, Parker College of Chiropractic

**Introduction:** The deleterious effects of tobacco use have been well documented. Over 400,000 deaths are attributed to tobacco use on an annual basis in the United States. An electronic cigarette containing a cartridge containing a mixture of compounds that includes nicotine, a lithium battery, and a heating element has been recently introduced. Nicotine is delivered in an inhaled nicotine vapor similar to cigarette smoke but, according to manufacturer claims, is less dangerous than regular cigarettes. As sales of electronic cigarettes have increased, the Food and Drug Administration (FDA) has become concerned about the safety of electronic cigarettes and has attempted to curtail sales.

**Purpose:** The purpose of this study is to perform a preliminary, qualitative analysis of the vapor produced by electronic cigarettes and to develop a test procedure to analyze the vapor produced by electronic cigarettes. To the best of

our knowledge, this is the first study of this nature to be published.

**Methods:** The vapor produced by the electronic cigarettes was analyzed using a properly calibrated Hewlett-Packard 6890 Gas Chromatograph/Hewlett-Packard 5973 Mass Spectrometer.

**Results:** The following compounds were identified: propylene glycol, propylene carbonate, adiminothiourea, nicotine, and propanoic acid.

**Discussion:** The nicotine replacement therapies have clearly demonstrated improvements in success rates in smoking cessation. Electronic cigarettes may be an effective method to reduce or eliminate cigarette use. There is an urgent need for additional independent, quantitative testing of electronic cigarettes.

## Utilization and Expenditures on Chiropractic Care in the United States from 1997 to 2006

**Matthew Davis**, Grace Cottage Hospital

**Objective:** To investigate national utilization and expenditures on chiropractic care between 1997 and 2006.

**Data Source:** The nationally representative Medical Expenditure Panel Survey (MEPS). Study Design was used. We performed descriptive analyses and generated national estimates from data obtained from US adult ( $\geq 18$  years) MEPS respondents who reported having visited a chiropractor (annual sample size between 789 and 1082). For each year, we examined the estimated total national expenditure, the total number of US adults who received chiropractic care, the total number of ambulatory visits to US chiropractors, and the inflation-adjusted charges and expenditures per US adult chiropractic patient.

**Principal Findings:** The total number of US adults who visited a chiropractor rose 36% from 7.7 million in 2000 to 12.1 million in 2003. From 1997 to 2006, the inflation-adjusted national expenditures on chiropractic care rose 36% from \$3.8 billion to \$5.9 billion. Inflation-adjusted total mean expenditures per patient and expenditures per office visit remained unchanged.

**Conclusion:** The large increase in US adult expenditures on chiropractic care between 1997 and 2006 was due to a 36% increase in the total number of US adult chiropractic patients that occurred from 2000 to 2003. From 2003 to 2006, the total number of US adult chiropractic patients has remained stable.

## Learning Spinal Manipulation Skills: Assessment of Biomechanical Parameters in a 5-Year Longitudinal Study

**Claude Dugas** and **Martin Descarreaux**, Université du Québec à Trois-Rivières

**Introduction:** Teaching spinal manipulation (SM) is a fundamental aspect of chiropractic training. In recent years, studies have identified various biomechanical variables as indicators of SM performance and learning. However, only data from cross-sectional studies are available, limiting conclusions regarding persistence of SM performance over the years. Therefore the main objective of this study was to quantify, over a 5-year learning period, the evolution of biomechanical parameters of SM.

**Methods:** Thirty-three students enrolled in a chiropractic program participated in this study. Participants were tested each year at the beginning of each fall semester by performing 10 spinal manipulations on an instrumented manikin and standing on a force platform. This procedure allowed us to measure various force-time parameters.

**Results:** Overall significant time effects were noted for most dependent variables. The results indicated a rapid improvement in the peak force applied and the rate of force production during the first 2 years. Time to peak force decreased drastically during the 1st year, while preload forces reached satisfactory levels until the 3rd year.

**Discussion:** When the various force-time requirements of the bimanual task components were met, learners significantly reduced the trial-to-trial variability of SM peak and preload force, indicating automaticity of the performance. While global coordination improved in all the learning process, it is only in the later phase that learners reached values that approached those of experts.

**Conclusion:** Overall these results highlighted the importance of considering learning principles in the development of didactic strategies related to SM motor skills.

## Screening for Posttraumatic Stress Within a Veterans Affairs Medical Center Chiropractic Clinic

**Andrew Dunn**, VA of Western New York Healthcare System and New York Chiropractic College, **Terri Julian**, VA of Western New York Healthcare System and Batavia VA Medical Center, **Lance Formolo**, VA of Western New York Healthcare System, **Jeanmarie Burke**, New York Chiropractic College, and **David Chicoine**, New York Chiropractic College

**Introduction:** Escalating estimates of posttraumatic stress disorder (PTSD) among recently returning veterans highlight the need for early detection and management to reduce chronic mental illness and disability. As PTSD and chronic pain commonly co-occur, patients with musculoskeletal complaints may have unidentified PTSD. This study evaluated the effectiveness of PTSD screening within a

Veterans Affairs (VA) chiropractic clinic utilizing the PTSD Checklist (PCL).

**Methods:** A retrospective analysis of quality assurance data was carried out at VA of Western New York to determine if the PCL with a cutoff of 50 was an effective predictor for the established diagnosis for PTSD. Measures of diagnostic



efficiency were calculated for a range of PCL values with receiver operating characteristic (ROC) curves to identify optimal PCL cutoffs for both the entire sample ( $N = 181$ ) and the subset of Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) veterans ( $n = 42$ ).

**Results:** The prevalence of PTSD among the entire sample and OEF/OIF subset were 30% and 52%, respectively. At a cutoff of 50, only one identified false positive (0.55%) received a diagnosis of PTSD upon referral to behavioral health. The optimal PCL cutoff was determined to be 40 for both the entire sample and the OEF/OIF subset.

## Variability in the Morphology of the Articular Surface of the Sacroiliac Joint

**Dennis Enix**, Logan College of Chiropractic, and **Doug Smith**, University of Missouri

**Introduction:** Variations in morphology of the articular surface of the sacroiliac joint result from congenital and acquired changes. The pelvis is subject to compressive and vertical shearing forces transmitted primarily through the layer of cortical bone to the sacroiliac joint and the surrounding stabilizing ligament system. These stresses put the sacroiliac joint under unequal loads, placing ligaments in a state of constant tension resulting in the gradual formation of joint osteophytes and ligament ossification.

**Objective:** To document anatomical variations in articular surface topography of the sacroiliac joint and changes in surrounding ligaments in human cadavers.

**Methods:** Fourteen human cadaveric specimens (nine males and five females), with a mean age of  $61.7 \pm 12.9$ , were fully dissected, revealing ligaments and osseous structures of the sacroiliac joint. Impressions of the articular surface of the

**Discussion:** Published accounts of suggested PCL cutoffs vary and tend to be lower with higher sensitivity when applied for clinical screening purposes in populations with high PTSD prevalence.

**Conclusion:** A PCL cutoff score of 40 was preferable to 50 for PTSD screening with this sample of VA chiropractic patients including a subset of OEF/OIF veterans.

sacra were cast with a synthetic polymer for future examination.

**Results:** Sacral morphology varied greatly without apparent correlation to other factors; 50% were straight, 33% were concave, and 17% showed a convex configuration, and 43% had a transitional segment on at least one side. The mean  $\pm$  SD of articular surface angles for the right sacral angle was  $70.8 \pm 9.3$  and  $75.6 \pm 6.8$  for the left sacral angle. Mild osteophytic bridging was seen in 85.7%, while 7.2% were moderate or severe.

**Conclusions:** The sacroiliac joint presents in wide variations in joint surface morphology and ligament histopathology. A previously undocumented partial insertion of dorsal sacroiliac ligament fibers to the sacral articular cartilage was noted in several specimens.

## The Regenerative Capacity of the Notochordal Cell: Tissue Constructs Generated In Vitro Under Hypoxic Conditions

**William Mark Erwin**, Toronto Western Hospital/University of Toronto/Canadian Memorial Chiropractic College

**Introduction:** The intervertebral disc of the nonchondrodystrophic canine (NCD) contains a large population of notochordal cells (NCs) and is protected from developing degenerative disease (DDD). The study of NCs and their role in protecting the disc from DDD has been hampered by the inability to maintain these cells in vitro and in most studies concerning disc biology, these cells have been cultured under normoxic in vitro conditions (21%  $O_2$ ). Here for the first time we contrast the effects of long-term hypoxic and normoxic tissue culture of notochordal cells.

**Methods:** NCs obtained from NCDs were cultured under either hypoxic (3.5%  $O_2$ ) or normoxic (21%  $O_2$ ) conditions for varying time intervals and subsequently evaluated using histological, immunohistochemical, scanning electron microscopy and histomorphometric methods at periods up to 5 months in culture.

**Results:** Hypoxia induces notochordal cells to produce a highly complex and organized three-dimensional cellular construct rich in aggrecan and collagen II with cells demonstrating an intact cell membrane, nucleus, clear cytoplasm, and classic "physaliferous" appearance. Cells cultured under normoxia fail to thrive.

**Conclusion:** Hypoxia is a vital component for NCD NC survival and the biologically relevant condition provides the necessary and sufficient environment for NCD notochordal cells to flourish in culture and produce a rich, complex tissue construct that is strikingly similar to the in vivo NP tissue. It is suggested that in future studies nucleus pulposus and, in particular, notochordal cells should be cultured under hypoxia in order to derive meaningful, biologically relevant conclusions concerning possible biological and molecular interventions.

## Induction and Evaluation of Apoptosis in Disc Nucleus Pulposus Cells

**William Mark Erwin**, Toronto Western Hospital/University of Toronto/Canadian Memorial Chiropractic College, and  
**Elizabeth Rok**, Canadian Memorial Chiropractic College

**Introduction:** Apoptosis, or programmed cell death, is a normal part of the regular repair, maintenance, and remodeling process in all tissues. Accelerated apoptosis is also known to be a component part of the increased degradation seen in tissues such as the intervertebral disc nucleus pulposus (NP) where an imbalance in regulated cellular remodeling contributes to impaired cell-cell and cell-extra-cellular matrix integrity. Here we demonstrate a proof-of-concept in vitro, quantitative evaluation of NP cells under the influence of the degradation-inducing cytokine interleukin-1 (IL-1) and the extrinsic apoptotic-inducing ligand CD-95 (death) receptor Fas.

**Methods:** Bovine NP cells were obtained and placed under hypoxic tissue culture conditions according to our established methods and were treated with complete medium or complete medium plus either IL-1 or IL-1 + Fas-ligand for 48 hours. After 48 hours the cells were harvested and

evaluated for apoptosis using flow cytometry with Annexin-V and propidium iodide labeling.

**Results:** Cells cultured with complete medium demonstrate barely detectable apoptotic events, whereas only modest apoptosis was detected using IL-1. However, IL-1 + Fas-ligand treatment demonstrated significantly more apoptotic signaling.

**Discussion:** It has been reported that notochordal cells secrete matrix-protective factors as well as anabolic growth factors; however, the impact of potential anti-apoptotic signaling conferred by notochordal cells within the disc nucleus is unknown. We are interested in the pursuit of potential anti-apoptotic signaling conferred upon NP cells by notochordal cells and this pilot study has optimized the conditions necessary to reliably and mechanistically study apoptotic signaling in NP cells.

## Evaluation of Evidence-Informed Practice Attitudes, Skills, and Behaviors

**Roni Evans** and **Edward Owens**, Northwestern Health Sciences University

**Introduction:** Our institution has implemented an evidence-informed practice (EIP) education project, funded by NCCAM (R-25AT003582). An important benchmark for success is an observed increase in EIP knowledge, skills, attitudes, and behaviors. The purpose of this presentation is to present the development and results of a student EIP attitudes, skills, and behaviors survey.

**Methods:** A 16-item survey was developed based on stakeholder focus groups and surveys and is based on eight broad competencies developed for the EIP education project. The instrument assesses students' perceived importance and own skill level and queries self-reported EIP behaviors. As part of initial pilot testing, it was administered at the start and end of a new, third- trimester Foundations of EIP course.

**Results:** One cohort of third-trimester students completed pre- and postcourse surveys. Students reported that they felt it was very important to have EIP competencies (mean range from 7.98 to 9.10). Gains in self-reported EIP skill level were observed in several areas (mean changes from 1.33 to 3.53). Modest changes in EIP behaviors were reported.

**Conclusion:** Pilot testing on the first cohort of students enrolled in a new Foundations of EIP course demonstrated that a newly developed instrument is simple to administer and score. Overall, the survey demonstrated that students perceived that EIP skills are important to possess. A change in perceived EIP skill level was observed, as was a modest change in some EIP behaviors. This survey will serve as a complement to other evaluation methods to evaluate the success of the evidence-informed practice project.

## Osteomesopyknosis: A Rare Cause of Axial Skeleton Osteosclerosis

**R. Bruce Fox**, Life University

**Objective:** To discuss the case of a female patient who presented in a chiropractic office with low back pain. Radiography revealed osteomesopyknosis, an autosomal dominant genetic disorder associated with axial skeleton osteosclerosis.

**Clinical Features:** A 50-year-old female patient complained of acute onset of low back pain and was radiographed subsequent to a physical examination. Radiographs revealed focal osteosclerosis at the posterior portion of the T11 through

L5 vertebral bodies with faint hazy osteosclerosis located centrally at the same vertebra. Faint osteosclerosis was seen over the bony pedicles, with patchy sacral and bony pelvis osteosclerosis. A small cystic, geographic radiolucent lesion was present at the superior portion of the left femoral neck. Radiographic differential includes other similar osteosclerotic skeletal disorders such as osteopoikilosis, osteopetrosis, pyknodysostosis, renal osteodystrophy, and osteoblastic metastasis.

**Conclusion:** Awareness and recognition of osteomesopyknosis may avoid confusion with other similar appearing axial skeleton osteosclerotic disorders that have more complex clinical significance. It is important for primary

health care providers to recognize this disorder to avoid unnecessary patient anxiety and unwarranted testing and advanced imaging.

### Laboratory Preparticipation Screening Examination in a Chiropractic College: Development, Implementation, and Results

Matthew Funk and Albert Cantito, University of Bridgeport College of Chiropractic

**Introduction:** Chiropractic students often serve as subjects in laboratories where they and their classmates practice examinations, various soft tissue techniques, physiological therapeutic modalities, and active rehabilitation. There are contraindications and risks associated with these procedures. This article describes the development and implementation of a process to identify health concerns and risks that students may face while serving as subjects or performing in clinical skills laboratories.

**Methods:** Screening questions and examination procedures were developed through a consensus process. Findings from the screening process determine whether students may engage in full participation or limited participation (precautions) or are prohibited from receiving certain procedures (contraindications) in skills laboratories. Students and their instructors are informed of any identifiable precautions or contraindications to participation. This research was determined to be exempt from review by the Institutional Review Board.

**Results:** Since its implementation, precautions regarding delivery of manual therapies were found in 1.6% of those examined and precautions regarding receiving manual therapies in 9.1%. Contraindications to receiving manual therapies were found in 10.7%, and 5.8% had contraindications to certain physiological therapeutic modalities.

**Discussion:** Further work is necessary to improve compliance with follow-up regarding diagnosis of conditions revealed or suspected. Future efforts should address how well students adhered to precautions and contraindications, the nature of any injuries sustained within our laboratories, and specific measures taken by faculty to help students with special needs.

**Conclusion:** Our chiropractic college now has a method to describe potential risks, explain rules of laboratory participation, and obtain consent from each student.

### Jurisprudence and Business Management Course Content Taught at Accredited Chiropractic Colleges: A Comparative Audit

Brian Gleberzon, Canadian Memorial Chiropractic College

**Introduction:** The purpose of this study was to conduct a comparative audit of the jurisprudence and business management courses offered at a number of different accredited chiropractic colleges.

**Methods:** Faculty members responsible for teaching students jurisprudence and/or business management courses at a number of accredited colleges were contacted and asked to electronically submit their course outlines for review.

**Results:** Of the 62 different topics delivered at the 11 chiropractic colleges surveyed, not one topic was taught at all of them. The following topics were taught at 10 of the 11 respondent chiropractic colleges: business plan development,

ethics and codes of conduct, and office staff/employees. Several topics were only taught at one accredited chiropractic college.

**Conclusion:** While most chiropractic colleges provide some education in the areas of jurisprudence and business management, it would appear that there is no consensus opinion or “model curriculum” on these topics toward which chiropractic programs may align themselves. Based on a literature search, this study is the first of its kind. A more extensive study is required, as well as a Delphi process to determine what should be taught to chiropractic students with respect to jurisprudence and business management in order to protect the public interest.

### Self-Assessment Skills of Students in Radiology

Julie-Marthe Grenier and Jean-Philippe Pialasse, Université du Québec à Trois-Rivières

**Introduction:** Self-assessment and self-evaluation skills are vital abilities for health care professionals such as chiropractors. Their importance is widely accepted and acknowledged

as basic skills required for daily practice and self-regulation. These skills have not been studied in chiropractors and have been shown to be unreliable as well as inaccurate in many

other professions. Because chiropractors report utilizing radiology quite often, this subject may be a way to evaluate self-assessment skills relevant to clinical practice. The purpose of this project is to evaluate the self-assessment skills of chiropractic students in radiology.

**Methods:** Two consecutive cohorts of 2nd-year chiropractic students were asked to predict their score after taking practical radiology tests. Class format and instructor were constant. Variables of interest were actual and predicted scores as well as the accuracy of the predicted score. This project was evaluated by the Institutional Review Board.

**Results:** There was no difference between the predicted and actual scores ( $p \approx 1$ ) overall. Individually, students with the

higher scores demonstrated a tendency to underestimate their score and students who scored poorly tended to overevaluate their performance.

**Discussion:** Self-evaluation skills were identified as poor, which is consistent with results for other professions. Study limitations include sample size and the students' academic level.

**Conclusion:** The observations made seem to indicate that chiropractic students do not differ from other students and seem to have flawed self-assessment skills. Impacts may reach undergraduate but also continuing education policies.

## Do the Majority of People Find an Additional Lumbar Support More Comfortable Than a Regular Ergonomic Office Chair?

Diane Grondin and Jay Triano, Canadian Memorial Chiropractic College

**Introduction:** This paper is part of a larger study testing the effectiveness of a lumbar back support in improving several biomechanical measures in healthy individuals and low back pain (LBP) patients. This particular study quantifies the level of comfort in the back support through the measure of center of pressure (CoP) shifting at the buttock/leg-chair interface.

**Methods:** The study was reviewed by the Canadian Memorial Chiropractic College (CMCC) Ethics Committee in the application to involve human participants in research prior to testing. Twenty-four male participants (12 healthy controls and 12 LBP patients) were asked to sit in a regular ergonomic

office chair or the same chair with an added lumbar back support over a 30-minute period. The cumulative distance traveled of the CoP was calculated.

**Results:** Preliminary results showed a trend toward a greater number of individuals shifting over less distance with the added lumbar support than a standard ergonomic chair; however, this difference was not significant.

**Conclusions:** Although a lumbar back support may offer solutions for LBP sufferers for other reasons, it does not significantly improve comfort levels based on this evaluation.

## Assessment of Today's Senior Population: A Critical Need for Fall and Injury Prevention

Joseph Haezebrouck, Life University

**Introduction:** An assessment was made of the quantitative response of a survey that obtains and reports opinions from our focus group: active seniors ages 60 and older.

**Objectives:** To recognize impaired functional deficits that exist with advanced age and to help aging adult seniors avoid the risks of chronic disease, disability, and injury.

**Methods:** Creating a six-question survey distributed to a group of 200 aging seniors who were present at a health information senior extravaganza fair. (Appropriate Institutional Review Board review process is complete.)

**Results:** Survey results reflect that 172 seniors had never been given a test for standing balance. Other results include the following: 150 seniors reported losing their balance

causing them to fall; 110 seniors reported having fears of breaking a bone from falling downward; 145 seniors reported never having any of their doctors show them any prevention type exercise or fall prevention instructions; 168 seniors reported that they would perform exercise if their doctor showed them; and 112 seniors reported that they would never start an exercise program on their own without their doctors' advice.

**Discussion:** The quality of life for adult aging seniors can certainly only improve if we actively assist in disseminating focus on prevention efforts and programs.

**Conclusion:** Surveying 180 aging senior adults was my first step toward implementing a beneficial plan within my own community of aging seniors.

## Normative Cross-Sectional Area of the C5–C8 Nerve Roots Using Ultrasonography

Daniel Haun, John C.S. Cho, and Norman Kettner, Logan College of Chiropractic

**Introduction:** Ultrasonography has been used to measure the cross-sectional area (CSA) of peripheral nerves.

Correlations have been made between CSA and peripheral nerve pathology. The cross-sectional area of the C5–C8

ventral rami has not been described using ultrasound. The interexaminer reliability of the CSA measurements is also unknown.

**Objective:** To establish a normal range of values for the CSA of the C5–C8 nerve roots at their exit from the intervertebral foramina in normals using ultrasonography and to assess the interexaminer reliability. To describe the normal sonoanatomy of the C5–C8 ventral rami.

**Methods:** Institutional Review Board approval was obtained along with patient consent. Thirty-three normal subjects (20 female) were scanned bilaterally. The mean age was  $23.1 \pm 9.8$ . CSA means and standard deviations were calculated and reference ranges were proposed. The interclass correlation coefficient (ICC) was utilized to assess interexaminer reliability. The presence of normal intraneural echoes

was measured as well as anatomical anomalies of the nerve roots.

**Results:** The mean CSA and reference ranges for the C5, C6, C7, and C8 ventral rami were  $7.1 \pm 4.1 \text{ mm}^2$ ,  $10.6 \pm 4.3 \text{ mm}^2$ ,  $12.1 \pm 4.1 \text{ mm}^2$ , and  $10.7 \pm 4.8 \text{ mm}^2$ , respectively. The ICC demonstrated good reliability with a coefficient of 0.76 overall. The coefficients for the C5, C6, C7, and C8 levels were 0.69, 0.71, 0.76, and 0.72, respectively.

**Conclusions:** These are the first normative sonographic CSA measurements of the C5–C8 ventral rami. The study also demonstrated good interexaminer reliability. These data may be beneficial in future studies assessing the C5–C8 nerve roots in symptomatic subjects with radiculopathy.

## Student Self-Assessment: What Research Says and What Practice Shows

Xiaohua He and Anne Canty, Palmer College of Chiropractic Florida

**Objective:** Self-assessment is a process of formative assessment during which students reflect on the quality of their work, judge the degree to which it reflects explicitly stated goals, and revise their work accordingly. However, faculty often overlook self-assessment as a valuable tool to enhance student learning. This study was undertaken to understand students' reactions to self-assessment and the influence of self-assessment on course examination outcomes.

**Methods:** A total of 37 students formed the focus group. Each student was provided with four assignments that were used to practice self-assessment skills. A comparison group was chosen that consisted of 37 students who had taken the same tests during the previous quarter, but had not engaged in self-assessment. After the focus group performed self-assessment, they were tested on course material and those scores were compared to the scores of the comparison group

of students. Interviews were carried out to collect students' feedback about the self-assessment.

**Results:** The study has several findings: 1) students were more positive toward self-assessment as they gained experience with it; 2) self-assessment and instructor's objectives were extricable; 3) students gained the ability to enhance their performance on course exams through practicing self-assessment; and 4) there were no gender differences in performing self-assessment.

**Conclusion:** This study provides support for the use of student self-assessment to enhance learning. Instructors should frame self-assessment as an opportunity for students to reflect on their own work with the goal of learning more, making the work better, and thereby improving the chances for a good grade.

## Beyond Minimally Important Change: Defining a Successful Outcome of Physical Therapy for Patients with Low Back Pain

Jeffrey Hebert, Julie Fritz, Shane Koppenhaver, University of Utah, and Eric Parent, University of Alberta

**Introduction:** Making research findings interpretable is a goal of evidence-based practice. One attempt at improving interpretability is to report treatment results as the percentage of patients achieving a threshold level of improvement. The most common threshold is the minimum clinically important difference. For clinical conditions such as low back pain (LBP), thresholds requiring more than minimal improvement may be preferable. Therefore, the purpose of this study is to examine the validity of a threshold that has been used to define a successful outcome for patients with LBP undergoing nonsurgical rehabilitation based on a 50% improvement on the modified Oswestry disability index (ODI).

**Methods:** Patients with LBP receiving 4 weeks of physical therapy were examined. The ODI and a 15-point global rating of change were recorded at baseline and after treatment. The percent ODI change with treatment was

computed and compared to the global rating of change to determine the accuracy of various thresholds of success based on the percent ODI change.

**Results:** A total of 243 subjects were included, and 109 subjects (44.9%) had a successful outcome ( $\geq 50\%$  ODI improvement). The 50% ODI improvement threshold for success had high sensitivity (0.84; 95% CI: 0.79, 0.88) and specificity (0.89; 95% CI: 0.85, 0.93) when compared with success based on the global rating of change. No other percent improvement threshold for the ODI had a higher level of diagnostic accuracy.

**Conclusion:** A threshold of 50% improvement on the ODI may be a valid measure for defining a successful outcome for patients with LBP.

## The Association of Self-Reported Backpack Use and Backpack Weight with Low Back Pain Among College Students

Zachary Heuscher, Jennifer Peel, David Gilkey, and Cathy Kennedy, Colorado State University

**Introduction:** A cross-sectional survey was designed to measure prevalence of low back pain and to evaluate the association between self-reported annual low back pain (back pain in the previous year) with the frequency of backpack use and the estimated usual backpack weight among college students.

**Methods:** Data were collected from health education students during the spring semester of 2007 at Colorado State University using an online survey. Adjusted odds ratios were calculated using logistic regression. Effect modification by gender was evaluated for each association, and potential confounders were assessed in the models.

**Results:** A total of 473 of the 500 (94.6%) students completed the survey. The annual prevalence of low back pain was 29.2% ( $N = 136$ ); lifetime prevalence was 37.8% ( $N = 176$ ). The mean reported backpack weight was 6 kg among males and 5 kg among females ( $SD = 3.3$  and  $3.7$ , respectively). After adjusting for age, gender, smoking, body mass index, and reporting frequently feeling overwhelmed, a suggestive association was observed for the odds of annual

low back pain when using a backpack always versus using a backpack mostly to never [adjusted odds ratio (OR) = 1.23; 95% confidence interval (CI): 0.79, 1.92]. A 25% increase in the odds of annual low back pain for each 4-kg increase in the estimated usual backpack weight was observed after adjusting for gender, smoking, reporting frequently feeling overwhelmed, and body mass index (adjusted OR per 4-kg increase = 1.25; 95% CI: 1.17, 1.32). There was no evidence of an increased association of annual low back pain with carrying a backpack weight greater than 10% of the student's body weight compared to those carrying less (adjusted OR = 1.02; 95% CI: 0.63, 1.65). There was no evidence of effect modification by gender in any of the models.

**Conclusion:** The prevalence of annual low back pain in this population is lower than national estimates for this age group. Increasing reported backpack weight is associated with increased prevalence of low back pain within the past year. However, these results do not provide evidence to support the recommendation that backpack weight be less than 10% of body weight.

## If They Look, Will They Learn? Access of Online Content Compared to Performance on a Related Examination Question

Glori Hinck, James Hulbert, and Tom Bergmann, Northwestern Health Sciences University

**Introduction:** Even with modern computer-assisted teaching, learning does not occur by simply placing content online. Students must access and synthesize this information. Course management systems offer an opportunity to document whether students have "opened the book." This research examined the effect of students accessing online information on learning outcome.

**Methods:** Information concerning a musculoskeletal condition was presented on the Moodle course management system using three complementary formats. Moodle logs were evaluated to document student accessing of this content. A related final examination essay question was used to evaluate student knowledge of this material. Data were examined using a cross-sectional postcourse categorical analysis of student online accessing of three available learning objects and student single-item outcome. The sample size included 113 students. Institutional Review Board approval was granted for the study.

**Results:** Data indicate a significant dependent association between accesses of online content and essay score with a chi-square of 42.68 ( $df = 4$ ;  $p = .000$ ). Data also suggest that access to at least two of these three objects was strongly associated with a passing score.

**Discussion:** The findings suggest that for learning to occur in an online course, students must access the content they are provided and that doing so will increase the likelihood of better learning outcomes.

**Conclusion:** It is important that chiropractic educators evaluate the factors that lead to successful online learning outcomes. Students may need encouragement to access online resources.

## Falls Risk Profile of Elderly Chiropractic Patients

**Kelly Holt**, New Zealand College of Chiropractic, **Paul Noone**, Private Practice, **Krystal Short**, New Zealand College of Chiropractic, and **Heidi Haavik Taylor**, New Zealand College of Chiropractic

**Purpose:** The aim of this study was to identify the prevalence of falls risk factors associated with elderly patients presenting to chiropractors and to compare this to reported population rates.

**Methods:** An observational cross-sectional study was conducted at chiropractic practices throughout Auckland, New Zealand and Melbourne, Australia. The study involved gaining a profile of health status, falls history, and falls risk from a convenience sample of adults 65 years or older who were active chiropractic patients. This study received ethical approval from the New Zealand Northern Regional Y Ethics Committee (Ref NTY/06/12/131) and Bellberry Human Ethics Committee (Ref 66/07).

**Results:** One hundred and one elderly chiropractic patients participated in this study. Thirty-five percent of participants

had experienced at least one fall in the previous 12 months. Of those who had fallen, 80% suffered from at least a minor injury, with 37% of fallers requiring medical attention and 6% suffering a serious injury. The prevalence of most falls risk factors was consistent with published data for community-dwelling older adults. Neck pain was more common in the chiropractic patients, which is a potential concern to chiropractors due to the increased risk of falling associated with neck pain.

**Conclusions:** Chiropractors are ideally placed to identify risks and ultimately intervene with patients at risk of falling. Elderly chiropractic patients should be assessed on a regular basis for the presence of modifiable falls risk factors and appropriate advice should be given when falls risks are identified.

## Frequency with Which the Atlas Vertebra's Transverse Process Lies Superior to the Mastoid Process Horizontal Plane Line: Implications for Chiropractic Technique

**Todd Hubbard**, Palmer College of Chiropractic

**Objective:** This project explored the morphological asymmetry of the distance between the inferior tip of the mastoid process and the transverse process of the C1 vertebra to determine the percentage of occlusion of the first cervical transverse process by the mastoid process.

**Methods:** A total of 120 anterior-to-posterior open-mouth (APOM) radiographs were obtained. The following dimensions were bilaterally measured: the vertical distance from the inferior mastoid to the superior margin of the C1 transverse process (C1TP) and the vertical distance from the inferior mastoid to the inferior margin of the C1TP. The percentage of the C1 transverse process occluded by the mastoid process was calculated by determining the occlusal distance. These percentages were grouped into four categories: no occlusion, 1%–50%, 50%–99%, and 100%.

**Results:** The occlusal distance for the left and right ranged from  $-7.1$  to  $19.0$  mm and  $-7.5$  to  $19.5$  mm, respectively. The mean occlusal distance was identical on the left and right sides [4.6 mm (SD 5.1) and 4.7 mm (SD 5.0), respectively]. The percentage of occlusion for the left and right transverse processes ranged from 0 to 80% and 0 to 100%, respectively. The mean percentage was 6.4% (SD 16.4) on the left and 6.2% (SD 16.3) on the right.

**Conclusion:** This study shows that the occlusal distance for the left and right ranged from  $-7.1$  to  $19.0$  mm and  $-7.5$  to  $19.5$  mm, respectively. A total occlusion of the C1 transverse process occurred in just one side of 120 participants. Further investigation needs to be done to determine how the soft tissue under the mastoid affects the occlusal distance under the mastoid process.

## A Finite Element Analysis of the Intervertebral Disc with Complete and Incomplete Length of Collagen Fibers: Application of Distraction Forces on Compressed Discs

**Mozammil Hussain**, Logan College of Chiropractic

**Introduction:** Degenerated discs show the presence of incomplete collagen fibers. There may be a possible mechanism by which such fibers contribute to disc degeneration (DD). The present study investigated how much biomechanical changes the disc undergoes from compression to distraction loadings when disc is simulated with incomplete length of fibers.

**Materials and Methods:** A previously validated three-dimensional finite element model of a cervical segment was used, with six fiber-reinforced layers in annulus. From this model, five additional models were built with incomplete length of fibers in various annulus regions—outer, middle, inner, outer-middle, and middle-inner regions. The complete fibers ran between superior and inferior disc surfaces in a

zigzag (X) fashion, whereas the incomplete fibers ran only 50% of their length compared to the complete fibers length in a wedge (>) fashion originating from superior or inferior disc surfaces up to mid-disc height. The inferior vertebral surface was fixed in three perpendicular planes. A compression (50 N) followed by distraction (17 N) was applied on the superior vertebral surface.

**Results:** With incomplete length of fibers and more layers of such fibers, the disc biomechanical response changed. The

application of compression followed by distraction decreased the nucleus stress, anterior and posterior disc bulging, and fiber stress.

**Discussion:** The effects of incomplete length of fibers on stresses and disc bulging patterns and corresponding disc biomechanical changes from compression to distraction may help in understanding the underlying mechanisms for relieving degenerated discs from peak pressures. Future in vitro experiments may add insights to such mechanisms.

## Report of Anatomic Variation of the Anterior Compartment of the Leg: Anterior Peroneocalcaneus

Everett Johnson, Parker College of Chiropractic

**Background:** Muscular variations in the leg are well reported in the literature. The most common variation of the lateral compartment is the peroneus quartus muscle. The most common variation in musculature of the anterior compartment is the peroneus tertius, while the most common to the posterior compartment is the flexor digitorum accessorius longus.

**Methods:** A bilateral, well-defined accessory muscle in the anterior compartment of the leg in a 52-year-old female Caucasian was found during routine dissection in the gross anatomy laboratory. A review of the literature was performed to identify any previous findings of a similar muscle.

**Results:** Bilaterally, this muscle attaches to the upper, anterior shaft of the fibula. As it descends, the tendon of the muscle begins at approximately the distal half of the tibial shaft. The tendon travels anterior to the lateral malleolus of the fibula and courses inferiorly and posteriorly to blend with the inferior fibular retinaculum, and continues to insert on the fibular trochlea of the calcaneus.

**Discussion:** The placement of this muscle in the anterior compartment and the course of its tendon have not been previously documented in the literature.

**Conclusion:** Clinicians should be aware of anatomic variations of the leg and ankle for proper diagnosis and treatment of chronic leg and ankle issues.

## Survey of Student-Perceived Discomfort While Wearing Contact Lenses in the Gross Anatomy Laboratory

Everett Johnson, Parker College of Chiropractic

**Background:** Formaldehyde is a known irritant of the mucous membranes in the eyes, nose, and upper respiratory tract. The purpose of this survey is to assess perceived eye discomfort in contact lens wearers versus non-contact lens wearers as they attend the gross anatomy laboratory.

**Methodology:** An initial questionnaire was distributed to the students before they entered the gross anatomy lab, asking about contact lens use and eye discomfort. Each week in the lab the students were asked to fill out a chart listing gender and use of contact lenses or glasses and to rate eye discomfort on a visual analog scale. Data were collected for the first 8 weeks of the lab session.

**Results:** Statistical analysis was performed on the data gathered. The first week of laboratory had the best student

participation for the survey and was the only week with a significant finding. The mean pain of contact lens wearers was actually lower than those not wearing contact lenses.

**Discussion:** Sample size and participation for the survey were less than expected. Students should have been tracked individually, with before and after pain questionnaires for each lab session to determine if the lab sessions were truly the causative factors for the students' eye irritation.

**Conclusion:** Due to our small sample size and low student participation, it is difficult to draw any significant conclusions from this survey. Future surveys should be conducted to determine the significance of this subject.



## Chronic Recurrent Ankle Sprain: A Randomized Clinical Trial Studying the Impact of Two Treatment Protocols

**Lynette Joseph**, Durban University of Technology, **Nikki de Busser**, Durban University of Technology, **James Brantingham**, Cleveland Chiropractic College Los Angeles, **Gary Globe**, Cleveland Chiropractic College Los Angeles, **Tammy Cassa**, Cleveland Chiropractic College Los Angeles, **Charmaine Korporaal**, Durban University of Technology, and **Rodney Bonello**, Macquarie University

**Introduction:** Ankle injuries account for 23,000 US inversion sprains daily and 85% involve lateral ligaments. Inversion sprains cause pain, swelling, stiffness, instability, and predisposition to reinjury. Untreated, these become risk factors for reinjury. This randomized clinical trial compared ankle manipulation (group 1) versus muscle energy technique mobilization (MET) (group 2) in the treatment of mild to moderate, chronic recurrent ankle inversion sprain, or ankle instability syndrome (AIS).

**Methods:** Seventy-one AIS candidates, ages 18 to 50, were examined and 40 were included. Twenty were randomized to manipulation and 20 to MET. The primary outcome measure was the one leg standing test (OLST); secondary measures included the numerical (pain) rating scale-101 (NRS-101), inclinometer, the functional evaluation scale (FES), and the short-form McGill pain questionnaire (SFMPQ). Six treatments over 3 weeks were delivered. Outcome measures were

collected at baseline and at the 4th and the follow-up 6th visit.

**Results:** No difference was detected between groups. Post-hoc power suggested that  $N = 40$  was too small to detect differences. Resources did not allow for a blind assessor. Therefore, no efficacy extrapolation between groups should be made. However, Kolmogorov–Smirnov tests demonstrated normal data. Consequently, paired  $t$  tests demonstrated significant and clinically meaningful changes for the OLST, NRS-101, SFMPQ, dorsiflexion, and FES at  $p \leq .05$ . The OLST was  $\geq 10$  seconds, which suggests a centrally mediated positive neurological effect on the function of the locomotive system.

**Conclusions:** Ankle manipulation and mobilization significantly increased balance, range of motion, and function. Both decreased pain, appearing beneficial in short-term AIS treatment. Further research is merited.

## Chiropractic Care for Patients with Asthma: A Systematic Review of the Literature

**Adrienne Kaminskyj**, **Michelle Frazier**, **Kyle Johnstone**, and **Brian Gleberzon**, Canadian Memorial Chiropractic College

**Objective:** To provide a systematic review and annotated bibliography and to rate the quality of published studies regarding chiropractic care, including spinal manipulation, for asthmatic patients.

**Methods:** A multimodal search strategy was conducted, including multiple database searches, along with reference and journal hand-searching. Studies were limited to those published in English and in peer-reviewed journals or conference proceedings between January 1980 and March 2009. All study designs were considered except personal narratives or reviews. Retrieved articles that met the inclusion criteria were rated for quality by using the Downs and Black checklist. An annotated bibliography was also written of each retrieved study.

**Results:** Eight articles met the inclusion criteria of this review in the form of one case series, one case study, one survey, two randomized controlled trials, one randomized patient and observer-blinded cross-over trial, one single-blind cross-study design, and one self-reported impairment questionnaire. Their quality scores ranged from 5 to 22 out of 27.

**Conclusion:** Results of the eight retrieved studies indicated that chiropractic care showed improvements in subjective measures and, to a lesser degree, objective measures, none of which were statistically significant. It is evident that some asthmatic patients may benefit from this treatment approach; however, at this time, the evidence suggests chiropractic care should be used as an adjunct, not a replacement, to traditional medical therapy.

## Chiropractic Care of a Student Athlete with Lumbar Disc Herniation, Sacroiliac Joint Dysfunction, Spina Bifida Occulta, and Clasp-Knife Syndrome

**Kimberly Keene**, Palmer College of Chiropractic Florida

**Objective:** Chiropractors frequently treat lumbar disc pathology in practice, but typically in adult patients. This case involves a 16-year-old football player diagnosed with an L5 disc herniation in association with sacroiliac joint dysfunction, spina bifida occulta, and clasp-knife syndrome.

**Clinical Features:** A 16-year-old male high school football player with a history of chronic low back pain and multiple traumas sought care for his chronic low back pain. Radiographic examination showed a nonunion at S1, and MRI examination showed a disc herniation at L5–S1. Diagnosis

was lumbar disc herniation with spina bifida occulta and clasp-knife syndrome.

**Intervention and Outcome:** The patient was managed with chiropractic care over a period of 24 weeks. On re-evaluation his condition was significantly improved. Because of this diagnosis, he and his parents questioned the safety of sports participation and whether or not he would qualify for a military career; we therefore explored sports participation and career advice.

**Conclusion:** This case describes chiropractic management of an adolescent with conditions not usually seen in this age group. Information is provided on how to advise patients about the possibility of serious injury during sports participation as well as potential military career choices based on this diagnosis.

## Mapping Cerebral Activation of Tactile Stimuli Using fMRI

**Norman Kettner**, Logan College of Chiropractic, **Yumi Maeda**, HMS/MIT/MGH, **Athinoula A. Martinos**, Center for Biomedical Imaging and Logan College of Chiropractic, and **Vitaly Napadow**, HMS/MIT/MGH

**Purpose:** Tactile responses processed by the somatosensory cortex could underlie the clinical benefits of manual therapy. Cortical activations by three different innocuous tactile stimuli were mapped to operationalize a carpal tunnel syndrome study protocol.

**Methods:** There were 20 healthy right-handed subjects (10 female, range 21–38 years) recruited and consented with IRB approval by MGH. All subjects were screened for MRI compatibility. Structural MRI scans were performed prior to stimulation scans with fMRI. Continuous tactile stimulation utilizing electrical and two different mechanical sources (monofilament and piezoelectric driven probe) at variable interstimulus intervals (ISI) finger number and frequencies were applied to each hand in separate sessions with block compared to event related fMRI designs. MRI was conducted using a 3.0-T scanner (Siemens, Erlangen, Germany) with a 32-channel head coil. Anatomical images

were acquired with T1-weighted MEMPRAGE sequence, BOLD functional imaging with gradient echo T2\*-weighted pulse sequences. Data analysis was performed using FEAT, FSL, and surface mapping in AFNI and FSL. Cortical surface maps of both hemispheres were generated.

**Results:** All subjects undergoing the finger tactile protocol demonstrated cortical activations along the posterior bank of the central sulcus and the post central gyrus. Activations of individual fingers mapped along the expected somatotopic representations. The piezoelectric mechanical stimulation at 30 Hz with ISI of 15 seconds produced the greatest activation in S1 and S2.

**Conclusion:** The optimal cortical BOLD activation of S1 and S2 was seen in the single finger stimulation with piezoelectric mechanical stimulation utilizing the event-related fMRI design.

## Aging and Public Health: A Role for Chiropractic

**Lisa Killinger**, Palmer College of Chiropractic, and **Paul Dougherty**, New York College of Chiropractic

**Introduction:** The first signs of the “silver tsunami” are lapping at the shores of most nations, and the United States is no exception. Even conservative estimates project that there could be nearly 1 million Americans over the age of 100 by 2050. Doctors of Chiropractic (DCs) can play a key role in caring for an aging nation. DCs and public health professionals both value a proactive approach to health and conservative interventions for specific health concerns, a strategy essential in a strained health care system.

**Methods:** Through an extensive review of the scientific literature, personal participation, and interviews of chiropractic leaders in the public health effort, chiropractic’s role in public health and aging is explored. This summary includes ways for chiropractors to engage in public health efforts at the national, state, and local levels.

**Results:** Chiropractic’s current involvement in the American Public Health Association, its state affiliates, local public health efforts, and geriatric education centers is outlined. Examples of the public health burden of common musculoskeletal disorders in aging are given, proposing chiropractic’s role in relieving this burden, consistent with the evidence base.

**Conclusion:** Chiropractic is well positioned to take a leading role in reducing the public health burden of many diseases common in the aging population. Engagement in all levels of the public health effort is also important in raising public awareness of the role of chiropractic in caring for an aging world.

## Empowering Impoverished People in Health Promotion Focusing on Intrinsic Community Assets

Ron Kirk, Life University

**Introduction:** While many relatively prosperous people enjoy better health and longer life, others in impoverished areas suffer from an increasing burden of disease, environmental degradation, and resource deprivation. In the face of the burgeoning health equity gap between the rich and the poor, this paper describes sustainable, cost-effective best practices in grass roots health promotion and empowerment.

**Objective:** To help to begin to close the health equity gap between the rich and the poor.

**Methods:** A small working group/seed panel studied health equity and empowerment issues, queried NGO Alliance for Health Promotion members on the characteristics of successful community health promotion initiatives, received broad input, summarized results, and made recommendations.

**Results/Discussion:** Through diverse health promotion initiatives, impoverished peoples cleaned up their communities

and improved their health, their habits, their self-esteem, and their sense of community pride through early and active participation in health promotion program design and implementation. Participants included a complete spectrum of citizens with involvement of grandmothers, HIV-positive individuals, women's groups, youth, and traditional practitioners.

**Conclusion:** In conclusion, after describing methodologies and outcomes for community empowerment, the NGO Alliance for Health Promotion offers recommendations in best practices for using community assets and local knowledge in promoting health. The recommendations include: broadly-based community involvement and local leadership, mutuality, respect, open honest dialogue, creative and comprehensive communication, extensive partnering networks, and the honoring of local knowledge, traditions, and culture.

## Effects of a Short Trial of Posture Exercises on Forward Head and Forward Shoulder Posture in Healthy Adults

Ron Kirk, Richard Franz, Kathryn Hoiriis, and Anquonette Stiles, Life University

**Introduction:** Slouched posture is highly prevalent and problematic, representing a continuing public health dilemma. Multiple studies link slouched forward head posture with reduced quality of life and disability in a wide range of domains, including increased risk for falls, functional disabilities, osteoporotic fractures, and increased mortality in elderly adults and headaches, neck, shoulder, and arm disorders in computer operators. The objective of this repeated measure design study was to assess the efficacy of a short set of posture exercises for slouched posture.

**Methods:** Using a Foot Levelers Posture Check unit, students were assessed for forward head and shoulder posture, pre- and post-8-week exercise intervention.

**Results/Discussion:** In 221 participants, we found a significant difference [paired  $t(220) = 13.002$ ,  $p < .000$ ] for

z-axis (sagittal) head position by an average difference of 1.51 cm. The mean postexercise head position measurement (+3.27 cm) was significantly lower than the pre-exercise head position measurement (+4.79 cm). There were also significant differences in z-axis (sagittal) shoulder measurements [paired  $t(220) = 13.055$ ,  $p < .000$ ]. The mean postexercise scores were significantly lower than the mean pre-exercise scores by an average of 1.43 cm. There were no significant changes for the z-axis (sagittal) "ear" position scores. The study population had a very high prevalence of slouched posture.

**Conclusion:** The short set of posture exercises shows promise in reducing slouched posture. Hopefully, exercise habituation will increase because of exercise brevity and simplicity.

## Consistency of Instruction on Five Commonly Used Orthopedic Tests

Steven Kleinfeld, Dwain Daniel, and Harrison Ndetan, Parker College of Chiropractic

**Introduction:** Consistency of instruction among faculty members is necessary in the educational process. A general lack of high-quality studies available for the diagnosis and treatment of many conditions, particularly musculoskeletal conditions, may be reflected in inconsistency among academic and clinical faculty members.

**Purpose:** The purpose of this study is to examine consistency relating to the value of five commonly used orthopedic tests (straight-leg raise, Braggard's test, Kemp's test, Valsalva maneuver, and Patrick-Fabere test) among the faculty of a large chiropractic college.

**Design:** This is an observational study that employed a survey of 41 academic and clinic faculty members in a chiropractic teaching college.

**Results:** Of the 12 responses solicited, only four demonstrated statistically significant consistency (– SLR for disc pathology, + KT for lateral disc protrusion, – VM to rule out disc pathology, and + and – PF for hip joint pathology). Subgroup analysis demonstrated that the school of graduation may be the only predictor of consistency.

**Discussion:** There were strong indications that faculty members were not consistent in their perception of the value for common orthopedic tests for diagnosing specific conditions.

**Conclusion:** In an evidence-based model of education, there should be a consensus among academic and clinical faculty in order for the students to learn, integrate, and apply in practice what they have learned in the classroom. Active intervention in the academic process is required to accomplish necessary change.

## Morphology of the Longissimus Thoracis Muscle and Its Clinical Application

**Myroslava Kumka**, Canadian Memorial Chiropractic College

**Introduction:** With the increase of interest in back pain and musculoskeletal models, understanding of a more detailed knowledge of the longissimus thoracis (LT) muscle is required.

**Objectives:** To study the proximal attachment of LT, location and dimensions of the superior tendons of LT, muscular continuity of LT with posterior cervical musculature, and lateral branches of posterior primary rami of the thoracic spinal nerves.

**Methods:** This study utilized 28 embalmed cadavers of both sexes and of different ages using traditional anatomical dissections.

**Results:** Direct connections between LT and thoracic facet fibrous capsules were not found. In all specimens the superior tendinous attachment of LT was at T2 vertebra. At T2, T5,

and T8, the LT lateral tendons were attached at the lateral part of the posterior surface of the inferior margin of the transverse processes. The tendinous attachment of LT to posterior cervical musculature was found in all specimens. The nerve branches of the dorsal primary rami of the thoracic spinal nerves were found to course through the muscle substance of LT in 31.5% of the identified nerves.

**Conclusion:** Our findings suggest that the LT does not have direct attachments to the fibrous capsules of thoracic facets. The continuity between the LT muscle and posterior cervical musculature suggests a mechanism of myofascial pain or mechanical dysfunction of these muscles. The lateral branches of the posterior primary rami of the thoracic spinal nerves perforating the LT muscle create the possibility of neurogenic back pain associated with hypertonicity in the LT muscle.

## A Quantitative Corpus-Based Analysis of the Chiropractic Literature

**Alice Kwong** and **Brian Budgell**, Canadian Memorial Chiropractic College

**Background:** The language used in chiropractic literature helps to define the profession and guides the formation of curricula, legislation, and health care policy. To date, no studies have attempted to characterize the lexical and syntactical features of the language or to define extant usages of key words and phrases. Thus, the current study was undertaken to determine the lexical and syntactical features of a corpus of modern chiropractic writings.

**Methods:** A corpus was constructed incorporating editorials, commentaries, and research articles published in the *Journal of the Canadian Chiropractic Association* from 2005 to 2007. The corpus was analyzed using the software WordSmith V5.0, with statistical comparison to a corpus of general English to identify key words and phrases.

**Results:** Approximately 15% of the words appearing in the chiropractic corpus were uncommon in general English. The 10 most common key words were chiropractic, treatment, pain, care, patient(s), health, evidence, practice, study, and cervical. The passive voice was used more frequently than in general English. However, overall readability was high in comparison to the literature of other health disciplines.

**Discussion:** Based on analysis of a pilot corpus, the language of chiropractic is likely to be inaccessible to those without a specialist's knowledge of the domain. The language is characterized by an esoteric vocabulary, and gender citations are skewed heavily toward male references. Conventions of grammar and readability are consistent with those of other health professions.

## Resolution of Maigne's Syndrome with Chiropractic Care: A Case Report

**Philip Librone**, **Catherine O'Neill**, and **Steven Roffers**, Life University

**Objective:** This case report describes the course of chiropractic care for a 58-year-old male presenting with lower

back, gluteal, and groin pain diagnosed as Maigne's syndrome. This report also explores the link between spinal

dysfunction and its effect on nerve function to target tissues.

**Clinical Features:** The patient was a 58-year-old male experiencing right lower back, gluteal, and groin pain of 2 days' duration. He had been previously under chiropractic care and was enduring symptoms unlike any he had ever experienced.

**Intervention and Outcomes:** Examination protocols of Maigne's syndrome and Diversified analysis were used to determine the diagnosis and the levels of vertebral

subluxations to adjust for 1 month. The patient obtained complete resolution of symptoms with Diversified adjustments and soft tissue trigger point release.

**Conclusion:** Chiropractic care effectively resolved the patient's spinal dysfunction and related nerve symptoms. Further study is warranted in evaluating the effectiveness of chiropractic care in treating Maigne's syndrome, as well as the effects of other spinal dysfunctions as they relate to nerve function.

## Incidence and Impact of Neck and Shoulder Dysfunction in Nursing Mothers

Tina Lowes and Christina Cunliffe, McTimoney College of Chiropractic

**Objectives:** To investigate whether nursing mothers (breast- and/or bottle-feeding) of infants less than 6 months of age are at risk of developing neck and/or upper extremity (UE) pain or dysfunction. Secondary analyses assessed whether the method of feeding increased the risk of developing neck and/or UE symptoms and the impact of symptoms during the postnatal period.

**Methods:** After institutional research and ethics approval, 19 pregnant women were interviewed at 4–6 weeks and 5–6 months postpartum. At both time points, qualitative data were collected to evaluate the incidence of neck/UE pain or dysfunction, and in those individuals with symptoms, the Neck Disability Index and the DASH Symptom Scale were used to evaluate the impact on quality of life and disability level.

**Results:** At 4–6 weeks postpartum, 53% of mothers reported neck and/or UE pain or dysfunction. By 5–6 months after the birth, three mothers continued to experience symptoms. Assessment of feeding strategies indicated that the relative risk of developing neck and/or shoulder symptoms was 1.35 times greater if the mother was bottle-feeding or combination feeding compared with those breast-feeding. In mothers who did experience symptoms, these appeared to be of mild disability and had minimal impact on their quality of life.

**Conclusions:** Nursing mothers of infants <6 months old are at risk of developing mild neck and/or upper limb pain or dysfunction regardless of feeding strategy. Larger scale research is required to validate these preliminary findings to assess the need for postural advice during the antenatal period to minimize the risk of developing musculoskeletal disorders.

## Multi-investigational Approach to the Study of the Deep Fibular Nerve on Its Course Through the Anterior Compartment of the Leg

Calin Lucaciu, Jessica Lee, Laurie Hung, and Guy Sovak, Canadian Memorial Chiropractic College

**Introduction:** The deep fibular nerve (DFN) is one of the most common peripheral nerves impinged at the level of different bony and muscular tunnels through which the nerve passes. During the past decade, ultrasonography became an important tool in visualization of nerves and to diagnose their associated pathologies; however, its application to visualize DFN is sparsely covered.

**Objective:** This study was designed to evaluate the ability of ultrasonography to visualize the DFN as it courses down the leg, with focus at the 1/4 and 3/4 landmarks established between the tibial tuberosity and bimalleolar line.

**Methods:** The study involves a multidisciplinary approach in that it applies findings from gross anatomy, histology, and ultrasonography of the DFN to the DFN ultrasonographical

examination in six healthy patients. The DFN was extracted from six cadavers and the largest and smallest diameters were measured using a caliper. The nerves were then imaged using ultrasonography and the diameters were measured on the long and short axis. The extracted nerves were then histologically prepared using the Mallory's trichrome stain. The number of nerve fascicles and proportion of connective tissue versus nerve tissue was analyzed.

**Results/Discussion:** The low number of nerve fascicles and the small amount of epineurium and perineurium associated with the DFN may contribute to the difficulty in visualizing this nerve. Results of this study may have important further implications in diagnosis of DFN conditions and treatment in a clinical chiropractic setting.

## Nutrition Services in the Chiropractic College Clinic: A Review of Literature and Survey Results

Cynthia Lund, Life University

**Introduction:** Many chiropractors include nutrition counseling in their practices because many chiropractic colleges

include that subject in the Doctor of Chiropractic (DC) curriculum. This college clinic is part of a university with

a nutrition/dietetics program, and it is reasonable to work together and include the availability of nutrition services in the clinic. How do various users of nutrition counseling services see those services, and is there a correlation between the views of faculty doctors and the actual usage of the nutrition program?

**Methods:** A review of literature is presented concerning the views of DCs in private practice, clinic patients, United States chiropractors, chiropractic students, and medical students. A survey was given to doctors at this chiropractic college clinic, student interns working in the clinic, and members of the American Chiropractic Association (ACA) Council on Nutrition.

**Results:** Faculty at this clinic believe that the majority of chiropractic patients should receive nutritional counseling and that they are not necessarily the ones to give the counseling; yet they do not refer to the nutritionist on-site.

**Discussion:** The results of the survey prompt further discussion about awareness and familiarity with the nutrition services department of the clinic. The chiropractic college wishes to continue the department and needs the support and referrals of the faculty DCs.

## Chiropractic Manipulation, Functional Neurology, and Nutritional Management for the Reduction of Tourette Syndrome Symptoms in a 27-Year-Old Woman

Daniel Martinez, Parker College of Chiropractic, and Adam Marashi, Private Practice

**Background:** Tourette syndrome (TS) is a neurodevelopmental disorder characterized by involuntary motor and phonic tics. Disturbances in the maturation of frontostriatal systems in individuals with TS likely contribute to impairment in self-regulatory control processes, which contributes to the difficulty in suppressing tics. Therapies are designed around cortical stimulation to induce plastic changes in the brain. Cortical stimulation can be achieved via joint mechanoreceptors, auditory, and visual input. Nutritional management is centered on neuronal health.

**Purpose:** The proposed treatment plan, chiropractic adjusting coupled with brain-based neurological exercises and nutritional supplementation, can provide a nonpharmacological and noninvasive alternative to Tourette symptom management.

**Case Report:** The patient is a 27-year-old female diagnosed with TS at age 23. Outcome measures included the Yale Global Tic Severity Scale (YGTSS), Yale-Brown Obsessive Compulsive Scale (Y-BOCS), and the Health Status Questionnaire-12 (HSQ-12). Treatment consisted of vertebral and extremity adjusting, saccadic eye exercises, audio therapy, and supplementation of magnesium, vitamin B6, and omega-3 fatty acid for 4 weeks.

**Results:** At baseline the YGTSS score was 52, Y-BOCS was 22, and the HSQ-12 was 53. At 2 weeks, the YGTSS was 22 and the Y-BOCS was 17. At completion the YGTSS was 14, the Y-BOCS was 12, and the HSQ-12 was 82.1.

**Conclusion:** The patient showed a dramatic improvement in her symptoms. Future studies are warranted.

## Hidden Instability of the Upper Cervical Spine: A Case Report and Review

Kevin S. Mathers and Michael J. Schneider, University of Pittsburgh

**Introduction:** Patients often present to chiropractors with chief complaints of neck pain, occipital headache, and dizziness, associated with a past history of cervical spine injury. These symptoms may be associated with various cervical spine conditions, including upper cervical instability. This case report reviews the history, physical exam, and diagnostic imaging findings of a patient with the above symptoms who was found to have a previously undiagnosed instability of the atlanto-axial joint.

**Methods:** A patient with a history of multiple cervical spine injuries was assessed for the symptoms complex described above. The upper cervical spine was screened with two manual provocative tests: the Sharp-Purser test, which stresses the transverse ligament, and the lateral shear test, which stresses the alar ligaments.

**Results:** The lateral shear test detected a hypermobile end-feel with a “clunk” of C1 on C2. Open-mouth x-rays were taken in neutral, left, and right lateral flexion; revealing a 3-mm lateral offset of the right lateral mass of C1 on C2. MRI evaluation of the cervical spine did not reveal any disc pathology but showed an increased signal over the alar ligament. The patient was advised to avoid rotational manipulation and end-range stretching exercises in lateral bending. Axial traction manipulation and midrange exercises were prescribed with good relief of symptoms.

**Conclusion:** Chiropractors should consider the possible diagnosis of lateral/rotational upper cervical instability when examining the cervical spine. More research is needed to determine the reliability and validity of the diagnostic tests used to determine the integrity of the alar ligaments.

## Patients' Assessment of Relational Continuity of Care in a Chiropractor-Physician Collaborative Practice

Silvano Mior, Canadian Memorial Chiropractic College

**Introduction:** Relational continuity is measured by levels of communication, trust, knowledge of patient's health and personal life, and comfort with the encounter. The Primary Care Assessment Survey (PCAS) measures such components. This cross-sectional study provides comparative information of patient assessment of the relational continuity of chiropractic and physician patients who were and were not participants in a study of interprofessional collaborative practice.

**Methods:** PCAS data were collected from two groups of patients in physicians' and chiropractors' offices located in two and three different locations, respectively. There were 590 surveys collected from 10 physicians' offices and 1567 collected from 15 chiropractors' offices. About half of the physicians' patients reported being "completely satisfied" and about 34% "very satisfied." Levels of satisfaction with chiropractic care were rated as "completely satisfied" and "very satisfied" by 68% and 30% and 61% and 35% of nonstudy and study patients, respectively.

**Results/Discussion:** Statistical and important differences in scale scores were found between patient groups and locations for physician and chiropractic patients. Assuming PCAS scores are measures of quality of care, chiropractors and physicians provide quality patient care, although preventive counseling strategies require further attention. Patients reported that costs of chiropractic services and medication may impact upon their use.

**Conclusion:** The strong location and group interaction requires further investigation to determine if this is an issue of sample size, selection bias, or behavioral differences among providers. Relational continuity of care as measured by the PCAS appears to be sensitive to the duration of the provider-patient relationship, provider type, and practice location.

## Changes in Physician's Management of Low Back Pain in a Model of Interdisciplinary Collaborative Care: A Case Study

Silvano Mior, Canadian Memorial Chiropractic College

**Introduction:** The relationship between pain and disability and the use of health services delivered by multiple health care providers suggests a unique opportunity to explore how care is coordinated, delivered, and influenced. This case study followed the changes to a physician's management of patients as a consequence of their involvement in the implementation of a model of interdisciplinary collaborative practice.

**Methods:** Coded patient data from the electronic medical record of one physician who participated in a study assessing the implementation of a model of chiropractic-medical collaboration were retrospectively collected prior to the start (ie, prestudy,  $n = 51$ ) and toward the end of the collaborative study (ie, study,  $n = 49$ ).

**Results:** Demographics were similar in both groups but median number of physician visits (2.5 and 1.0), average

prescriptions (1.24 and 0.47), and narcotic use (14 and 6) differed between prestudy and study groups, respectively. Further analysis of the study group records revealed that 61% were referred for chiropractic care. Patients who were not referred had more complex low back pain, but pain severity was about the same. Average prescriptions were about the same in both groups, but referred patients had about a quarter fewer physician visits and imaging requests.

**Conclusion:** The results suggested that the physician's prescribing behavior and patient visits changed over time as part of participating in an interprofessional collaborative study. Further research is required to confirm such findings.

## An Informal Review of Recent Evidence-Based Practice Initiatives in Washington State: Roles and Impact by Chiropractors

Robert Mootz, State of Washington, Department of Labor & Industries

**Introduction:** Chiropractors generally remain outside of formal public-sector policy-making settings. Although examples of DCs in policy-level positions can be found,

rarely are they specifically designated for chiropractic participation. In Washington State, chiropractors have roles in several state government commissions and work groups,

including two legislatively mandated evidence-based practice committees. Both were established without any lobbying efforts on the part of the chiropractic profession. A case is offered that recent research and constructive engagement by DCs to find solutions to greater health system questions has strongly contributed to policy makers' perceptions of chiropractors as an important health care resource.

**Methods:** Informal observational review of Washington legislative/policy initiatives since 2005 on evidence-based practice.

**Results:** Since 2005, three committees have been enacted to advise on evidence-based practice. One, an Industrial Insurance Chiropractic Advisory Committee, is charged with

evidence-based chiropractic care for injured workers. Another, a Health Technology Assessment Clinical Committee, is charged with evidence-based insurance coverage decisions for state agencies. Legislation designated that half the committee would not be MDs. State policy makers' experience with DCs, including state research on chiropractic care in injured workers populations, has contributed to more routine involvement of DCs.

**Conclusions:** Washington State provides an interesting case study for the roles of chiropractors in public policy. Research directed at pressing health care system needs, combined with DCs' willingness to find solutions to greater public health and health care system needs, has strongly contributed to state initiatives specifically designating chiropractic participation.

### The Effects of Short Arc Banding: A Novel Exercise Intervention in Patients with Chronic Low Back Pain

Adam Morrell, Laney Nelson, Rodger Tepe, and Daniel Haun, Logan College of Chiropractic

**Objective:** This IRB-approved pilot trial was designed to determine the effects of a novel rehabilitation exercise intervention, short arc banding (SAB), on the cross-sectional area of lumbar multifidus, pain, and function in participants with chronic low back pain (CLBP).

**Methods:** Seven consenting volunteer participants received SAB three times per week for 4 weeks. Rehabilitative ultrasound imaging (RUSI), lumbar revised Oswestry (LRO), and quadruple visual analog scale (QVAS) were administered before and immediately after treatment.

**Results:** All participants had significant decreases in LRO ( $p < .05$ ) and QVAS ( $p < .05$ ). No differences were found for RUSI.

**Discussion:** Results of the current pilot study are similar to other studies in the literature reporting positive outcomes

for rehabilitative exercise interventions for CLBP. The SAB procedure was relatively brief (about 5 minutes), uncomplicated to administer, and mostly pain-free for the participants. These factors, along with the relatively low cost of the equipment, may be of interest to practitioners who want to include rehabilitation exercise in treatment protocols for their patients with CLBP. Limitations of this pilot trial include small sample size and lack of a control or comparison treatment group. Future study should include a random controlled trial with control group and/or sham intervention followed by studies combining SAB and spinal manipulation.

**Conclusion:** SAB preliminarily appears to improve function and reduce pain in participants with CLBP.

### Application of a Diagnosis-Based Clinical Decision Rule in Patients with Low Back Pain

Donald Murphy, Alpert Medical School of Brown University and New York Chiropractic College, and Eric Hurwitz, John A. Burns School of Medicine, University of Hawaii at Mānoa

**Background:** Low back pain (LBP) is common and costly. Accurate and efficacious methods of diagnosis and treatment have been elusive. A diagnosis-based clinical decision rule (DBCDDR) has been developed that attempts to provide the clinician with a systematic, evidence-based means to apply the biopsychosocial model of care. The approach is based on three questions of diagnosis.

**Objective:** The purpose of this study is to present the prevalence of findings using the DBCDDR in consecutive patients with LBP.

**Methods:** Demographic, diagnostic, and baseline outcome measure data were gathered on a cohort of LBP patients examined by one of three examiners trained in the application of the DBCDDR.

**Results:** Data were gathered on 264 patients. Signs of visceral disease or potentially serious illness were found

in 2.7%. Centralization signs were found in 41%, lumbar and sacroiliac segmental signs were found in 23% and 27%, respectively, and radicular signs were found in 24%. Clinically relevant myofascial signs were diagnosed in 10%. Dynamic instability was diagnosed in 63%, fear beliefs in 40%, central pain hypersensitivity in 5%, passive coping in 3%, and depression in 3%.

**Conclusion:** It is feasible to apply the DBCDDR in a busy private practice environment. LBP patients can be distinguished on the basis of the findings of the DBCDDR. Further studies are planned to investigate clinically relevant means to identify central pain hypersensitivity, poor coping and depression, correlations and patterns among the diagnostic components of the DBCDDR, as well as interexaminer reliability and efficacy of treatment based on the DBCDDR.



## Application of a Diagnosis-Based Clinical Decision Rule in Patients with Neck Pain

**Donald Murphy**, Alpert Medical School of Brown University and New York Chiropractic College, and **Eric Hurwitz**, John A. Burns School of Medicine, University of Hawaii at Mānoa

**Background:** Neck pain (NP) is a common cause of disability. Accurate and efficacious methods of diagnosis and treatment have been elusive. A diagnosis-based clinical decision rule (DBC DR) has been developed that attempts to provide the clinician with a systematic, evidence-based means to apply the biopsychosocial model of care. The approach is based on three questions of diagnosis.

**Objective:** The purpose of this study is to present the prevalence of findings using the DBC DR in consecutive patients with NP.

**Methods:** The study protocol was approved by the Institutional Review Board of New York Chiropractic College. Demographic, diagnostic, and baseline outcome measure data were gathered on a cohort of NP patients examined by one of three examiners trained in the application of the DBC DR.

**Results:** Data were gathered on 95 patients. Signs of visceral disease or potentially serious illness were found in 2%. Centralization signs were found in 27%, segmental signs were found in 69%, and radicular signs were found in 19%. Clinically relevant myofascial signs were diagnosed in 22%. Dynamic instability was diagnosed in 40%, oculomotor dysfunction in 11.6%, fear beliefs in 31.6%, central pain hypersensitivity in 4%, passive coping in 5%, and depression in 2%.

**Conclusion:** It is feasible to apply the DBC DR in a busy private practice environment. NP patients can be distinguished on the basis of the findings of the DBC DR. Further studies are planned to investigate clinically relevant means to identify central pain hypersensitivity, poor coping and depression, correlations and patterns among the diagnostic components of the DBC DR, as well as interexaminer reliability and efficacy of treatment based on the DBC DR.

## Collaborative Testing: The Effect of Group Formation Process on Overall Student Performance

**Rita Nafziger**, Palmer College of Chiropractic, **Jamie Meseke**, Walden University, and **Christopher Meseke**, Palmer College of Chiropractic

**Background:** With increased focus on student preparation for high-stakes licensure exams, there has been an increased interest in the use of alternate forms of content delivery and assessment as learning tools. This interest has focused on factors within the learning environment that may impact a student's course performance and program progress. In this project the method of collaborative group determination (randomized and student selected) on student performance in a neuroanatomy course is examined.

**Methods:** The course performances of two cohorts (cohort one: randomized grouping = 80; cohort two: student-selected grouping = 82) were compared. All students completed weekly quizzes (90 points total) within collaborative groups, while completing unit exams (120 points). Likewise, the mean sum of both the quiz scores and examination scores were compared.

**Results:** While the two groups differed overall (Wilks  $\lambda = 0.211$ ;  $F = 53.541$ ;  $df = 10, 143$ ;  $p < .05$ ), no pattern was evident in regards to the assessments (ie, one group did not differ significantly on all quizzes or examinations). In overall quiz performance, the randomized grouping scored significantly higher than the student selected group ( $F = 112.252$ ;  $df = 1, 152$ ;  $p < .05$ ), while no difference was noted relative to overall exam scores ( $F = 2.672$ ;  $df = 1, 152$ ;  $p > .05$ ).

**Conclusions:** No differences were apparent in the course performance between students in randomly chosen groups as compared to those in the student-selected groups. We believe that the very nature of random groups forced the students to be proficient in the whole of the material, whereas students allowed to choose their groups may divide the material among themselves and not become individually proficient.

## A Possible Relationship Between Reliability of Thoracic Outlet Syndrome Diagnostic Testing and the Position of the Axillary Artery. Part II: The Effect of Diagnostic Testing on Intra-arterial Pressure

**Anthony Olinger**, Kansas City University of Medicine and Biosciences

**Introduction:** Publications describe anomalous spatial relationships between the axillary and brachial plexus that are clinically significant because the axillary artery can be compressed by the median nerve roots when the upper extremity is hyperabducted. Previous work described and

quantified an anomalous positioning of the axillary artery anterior to the brachial plexus. The purpose of this study was to evaluate intra-arterial pressure in axillary arteries of classical and anomalous cadavers when the upper extremity is hyperabducted.

**Methods:** Four embalmed human cadavers were selected based on the relationship between each specimen's axillary artery and brachial plexus. A small inflatable latex device was inserted into the axillary artery to evaluate intra-arterial pressure.

**Results:** A pressure increase was observed in the one cadaver that had a high union of the median nerve and a classical spatial relationship between the axillary artery and median nerve. No pressure change was observed in the cadavers that possessed a low union of the median nerve or the anomaly that placed the axillary artery anterior to the median nerve roots.

**Discussion:** The symptoms observed during the provocative test could be the result of compression between the median nerve roots and the axillary artery. The current study presents concerns for thoracic outlet syndrome provocative testing. A patient could possess a reciprocal compression of the axillary neurovasculature and still test negative for thoracic outlet syndrome following a hyperabduction provocative test.

**Conclusion:** Anatomical variations involving the axillary artery and the brachial plexus can decrease the reliability of provocative tests for thoracic outlet syndrome.

## Standardized Geriatric Patients Are Associated with Increased Novice Student Confidence Levels Taking Health Histories

Paul J. Osterbauer and Katie Burns Ryan, Northwestern Health Sciences University

**Objective:** To achieve institutional learning objectives that place a high priority on communication skills and prepare for the demands associated with an aging society, this study sought to determine if chiropractic students' confidence increased following an encounter with standardized geriatric patients (SGPs) while obtaining their health histories.

**Methods:** Eighty-five third-term chiropractic students enrolled in an initial clinical interviewing course consented to and completed a questionnaire measuring their confidence in obtaining a health history. Six SGPs were trained to present a complex case: 1) an elderly patient with simple neck pain and 2) an acute condition, requiring co-management. This case and SGP exercise was placed at the end of the course to challenge the students with a more realistic, clinical scenario. Data were collected from each student at the beginning and end of the course. Three questions specifically assessed confidence in obtaining geriatric patients. Data included

a numerical student identifier permitting matched, paired-*t* analysis.

**Results:** Data from 61 of the 85 (72%) students could be matched before and after. Significant increases were noted in average confidence levels. Paired-*t* analysis found a mean increased score of 1.13 ( $t = 3.91$ ,  $p = .000$ ) and, among the geriatric questions, scores increased an average of 0.61 ( $t = 3.696$ ,  $p = .000$ ).

**Discussion:** This pilot study supports the use of standardized patients to introduce more realistic cases earlier in the curriculum. Furthermore, recruitment and training of standardized patients represents a significant cost. Benefits of this project include training of a pool of standardized patients who can be integrated within the curriculum for tutorials and testing.

## A Community-Based Public Health Approach to Low Back Pain

Ian Paskowski, Jordan Hospital, and Michael Schneider, University of Pittsburgh

**Introduction:** Low back pain (LBP) is a public health issue that drains the US economy of up to \$200 billion per year. It is one of the leading causes of disability in working-age adults and the second most common reason for a visit to a physician. This paper presents preliminary data suggesting that LBP is best managed by a multidisciplinary team using a standardized spine care pathway and clinical approach based on current evidence-based guidelines.

**Methods:** Our facility developed a standardized Spine Care Pathway (SCP) to manage and treat LBP patients using a hybrid of existing best LBP guidelines, including the AHCPR guidelines, NCQA Back Pain Recognition Program (BPRP) guidelines, and clinical prediction rules from the scientific literature. All patients referred to this facility were managed according to strict adherence to the standardized

SCP. Outcome measures included the following: baseline/final pain and function scores, cost per visit, total cost per case, number of treatment sessions, and patient satisfaction.

**Results:** During the first 6 months of implementation of the standardized SCP at our facility, a total of 518 LBP patients were examined and treated. Descriptive statistics revealed significant reduction in pain and improved function with a mean of 4.3 visits, total cost of \$214 per case, with over 95% of patients reporting high satisfaction.

**Conclusion:** These preliminary data suggest that use of a standardized spine care pathway by a multidisciplinary team of clinicians to manage LBP patients can lead to significant cost savings, high patient satisfaction, and good clinical outcomes.

## The Impact of Ulnar Nerve Paresthesia During Practice Performance of a Vibrotactile Morse Code Letter Acquisition Task

Steven Passmore, McMaster University/New York Chiropractic College, Bernadette Murphy, University of Ontario Institute of Technology, and Timothy Lee, McMaster University

**Introduction:** Although a frequent clinical complaint, quantitative measurement of the effects of paresthesia on limb sensation and perception are understudied. The objective of this study was to determine if induced paresthesia impacts practice performance during a vibrotactile Morse code letter acquisition task.

**Methods:** In a between-participants experimental study, 18 healthy volunteers (18–31 years old) naive to Morse code interpretation, received transcutaneous radiating ulnar nerve paresthesia at the right ulnar notch or no paresthesia during letter acquisition trials. Vibration patterns representing eight Morse code letters were individually delivered randomly to the palmar surface of the right fifth digit's distal phalange. Eight letters were exhibited six times (48 presentations). Participants responded which letter was communicated, and augmented accuracy feedback was displayed. Dependent variables' response accuracy and reaction time were recorded. Approval was attained by the local ethics review board.

**Results:** Paresthesia group to nonparesthesia group comparison yielded significant main effects for reaction time [ $F(1, 16) = 111.31, p < .01$ ] and accuracy [ $F(1, 16) = 94.15, p < .01$ ]. The paresthesia group reacted faster but was less accurate during Morse code letter acquisition compared to the nonparesthesia group.

**Conclusion:** The paresthesia model and experimental design facilitate collection of quantitative data during practice performance of a vibrotactile letter acquisition task. The question remains whether paresthesia serves as a distraction or a nerve-specific perturbation during sensory learning tasks. Extension of this design to subsequent retention and transfer trials may further illuminate what is known about the effect of paresthesia and vibrotactile stimuli on sensory processing and the potential clinical applications.

## A Study of the Effectiveness of Table Disinfection Protocols in the Clinics of a Chiropractic College

Georgina Pearson, Paula Robinson, Gene Giggelman, Ronald Rupert, and Tracy Stark, Parker College of Chiropractic

**Background:** Contamination of chiropractic adjusting tables has been well documented. The Center for Clinics of a Chiropractic College instituted a protocol for disinfection of the adjusting tables in May 2008.

**Purpose:** This study was to assess the relative efficacy of three different sanitation protocols in the setting of the clinics of a chiropractic college.

**Methods:** Samples were taken from selected parts of 15% of the tables chosen at random. The samples were tested for the presence of enteric bacteria, particularly *Escherichia coli*, the presence of staphylococci, particularly *Staphylococcus aureus*, the presence of coagulase, and the presence of methicillin-resistant *Staphylococcus aureus* (MRSA).

**Results:** In the fall of 2008, 69% of the samples were contaminated with staphylococci (one being MRSA) and 7%

were contaminated with enteric bacteria, none being *E. coli*. In spring 2009, 17% of the samples were contaminated with staphylococci (11 were *S. aureus* and 4 were MRSA) and 20% were contaminated with enteric bacteria with no *E. coli*. In summer 2009, 44% were contaminated with staphylococci (no *S. aureus*) and 19% were contaminated with enteric bacteria (no *E. coli*).

**Discussion:** Originally, student interns disinfected the tables after every patient. In spring 2009, there was reduced contamination when the tables were disinfected twice a day by clinic doctors. In summer 2009, a different brand of disinfectant was used.

**Conclusion:** The decreased contamination may be due to improved adherence to the protocol by the clinic doctors and the second brand of disinfectant seems more effective against *Staphylococcus aureus*.

## A Model for Teaching Integrative Health Care

Kristina Petrocco-Napuli, New York Chiropractic College

**Introduction:** As health care changes and patients choose more than one provider, it is important that academic institutions train students to have an understanding of integrative health care models and how to function as a team member

within an integrative setting. In order to meet this goal of training both chiropractic and acupuncture students, a 6-week experiential and blended course was developed and implemented.

**Methods:** This course was designed based on educational best practices and models utilized at medical institutions to train students regarding CAM. The course is a 6-week course which is taught online and with two experiential face-to-face sessions. A student perception survey was administered via Zoomerang and utilized a 5-point Likert scale.

**Results:** The students enjoyed the delivery of the course in a blended and experiential format and identified CAM topics as being new. There was a 100% satisfaction rate and 100% of the students would recommend the course.

**Discussion:** The majority of the students rated the course topics as excellent or good. The students perceived the material as being new to them and for all topics rated a 3 or better on the Likert scale. The students rated the topics as being applicable to practice and enjoyment of the CAM session in which there appears to be a varying degree of perspectives.

**Conclusion:** An experiential blended model can be beneficial in educating students on CAM and integration because it provides the students the foundation to form abstract conceptualization.

## The Role of Chiropractors in Identifying and Reporting Nonaccidental Injuries in Children

Mark Pfefer and Stephan Cooper, Cleveland Chiropractic College Kansas City

Child abuse is a serious problem that all chiropractors should be aware of in their everyday practices. The purpose of this presentation is to make clinicians aware of specific findings on history and physical examination that point toward intentional injury/abuse and to provide resources for appropriate reporting. The annual incidence of nonaccidental injuries due to maltreatment in children is currently estimated to be in the range of 15 to 42 cases per 1000 children and, of these, 1200 children will die each year as an immediate consequence of abuse. Detection of child abuse requires a

high index of clinical suspicion, as caregivers often attempt to conceal or explain away concerns. Careful investigation and accurate documentation of physical signs and examination findings are imperative. As a health care profession in which direct personal contact, visual observation, and radiographic evaluation often occurs during the examination and/or treatment of the musculoskeletal system, chiropractors are well situated to recognize the signs of nonaccidental injuries in children.

## Avulsion Fractures of the Hip Bones: A Systematic Review of the Literature

Jason Porr and Calin Lucaciu, Canadian Memorial Chiropractic College

**Objective:** To present the demographics, distribution, presenting signs and symptoms, diagnostic methods, and treatments of avulsion fractures of the hip bones.

**Methods:** A literature search was performed using PubMed database. The search terms used included the bony projections of the hip bone serving for muscle attachments and their associated muscles. The search was restricted to case reports and case series of English language articles. The search retrieved 134 papers from which 77 case reports were selected based on bony involvement only. Studies showing musculotendinous pathologies were rejected.

**Results:** The mean age of the 77 case reports was 27. The predominance per avulsion site shows the three most common sites of avulsion are the anterior superior iliac

spine, anterior inferior iliac spine, and the ischial tuberosity. The mean age of these three sites was 16.3. Within the athletic group, the sport distribution shows 39% of cases coming from soccer and running injuries. The predominant presentation of injury highlights the association of nonfusions of the cartilaginous growth plates with a sudden muscle contraction, local pain, and decreased ambulation. Plain-film radiographs represent a cost-efficient method of diagnosis.

**Conclusions:** Avulsion fractures of the hip bones represent a highly prevalent pathology among the adolescence athletic population. Conservative treatment is preferred for avulsions with a displacement of less than 2 cm, making these patients suitable for management by chiropractic care.

## The Status of Mental Health in Chiropractic Schools in the United States

Lisa Rubin and Danielle Holtman, Life University

**Introduction:** The goal of this paper was to assess the need and use of counseling services on a chiropractic school campus compared to other chiropractic schools. Counseling needs are increasing on college campuses across the country.

**Methods:** This study collected data to identify the needs and trends in the population across chiropractic schools. The researchers sent out a survey to all of the 16 chiropractic schools in the United States. The returned surveys were

compiled to determine if there were any specific trends in counseling in a doctoral-level specific program.

**Results:** Five out of 16 schools returned the survey, which makes a total of six reported chiropractic schools. Only two out of the six locations have a PhD overseeing their counseling department. Three of the six schools have licensed

counselors on-site. The maximum number of sessions varied across all locations. Outside referrals exist at most locations but were not necessarily tracked by the institutions.

**Conclusion:** This study identified anxiety/stress as the number one frequently addressed issue in chiropractic college counseling centers that responded to surveys.

## A Survey of the Public Perception of Chiropractic and Chiropractic Spinal Screenings

David Russell, Kelly Holt, Heidi Haavik Taylor, George Ellis, and Richard Kashmiri, New Zealand College of Chiropractic

**Objective:** To assess the general public perception of chiropractic in Auckland, New Zealand and how exposure to a chiropractic spinal screening influenced this perception.

**Method:** Members of the public were interviewed at chiropractic spinal screenings that were held at a wide range of events and venues, including sports events, expositions, shopping malls, and university campus market days, in Auckland, New Zealand. All interviews were anonymous, with no identifiable details taken at any time. Interview questions focused on the persons' perception of chiropractic and whether their perception was influenced in a positive or negative manner due to their exposure to the screening. Due to the nature of the interview and survey questions, this study was exempted from requiring ethical approval by the local Northern Y Regional Ethics Committee.

**Results:** Three hundred and forty-five interviews were completed. The results showed that 15.9% of respondents had a negative view of chiropractic, 29.2% were neutral, and 54.9% had a positive view of chiropractic. As a result of their exposure to the spinal screening, 54% of the general public did not change their opinion of chiropractic. A change for the positive was expressed by 44.3% of respondents, with 1.7% changing their perception of chiropractic in a negative way.

**Conclusion:** In this survey, members of the public held a largely positive perception of chiropractic that was not negatively influenced by exposure to a chiropractic spinal screening.

## Reproducibility of Cervical Muscle Strength and Endurance Measurements in Chronic Neck Pain Patients

Craig Schulz and Gert Bronfort, Northwestern Health Sciences University

**Introduction:** Neck pain is a common health care complaint affecting approximately three quarters of individuals at some time in their lives. The etiology of most neck pain remains largely unknown, resulting in the generic classification of nonspecific mechanical neck pain, which suggests that optimizing the mechanics of the cervical spine may lead to decreased neck pain.

**Methods:** A secondary analysis of functional performance measures was conducted to assess the intra- and interobserver reproducibility of baseline measurements collected from participants in a clinical trial comparing treatment approaches for chronic neck pain. This secondary analysis was approved by the participating institutions' review boards. Reproducibility was quantified using two methods: reliability and limits of agreement.

**Results:** The ICC demonstrated good to excellent intra- and interobserver reliability with the intraobserver measurements

ranging from 0.84 to 0.95 and the interobserver measurements ranging from 0.74 to 0.90. Strength measures and static flexion endurance were at 0.90 (excellent range) and dynamic flexion endurance was at the lower end of the range and only considered to represent moderate reliability. The range of agreement measures are wide and on the order of one-half to two times the measurement value when repeated under similar circumstances within individual chronic neck pain patients.

**Conclusion:** The results indicate the measurement method to be reliable and suitable for group comparisons in the study setting. The wide range in limits of agreement does not support the use of the method to monitor treatment response for individual patients and is likely related to the heterogeneity of the study population.

## Differences in Learning and Study Strategies Inventory Scores Between Lower and Higher Grade Point Average Chiropractic Students

Christine Schutz, Megan Gallagher, and Rodger Tepe, Logan College of Chiropractic

**Introduction:** This IRB-approved pilot study was designed to investigate the relationship between chiropractic students' learning and study strategies and academic performance. Differences between lower and higher academically performing chiropractic students on aspects of strategic learning have not been previously reported.

**Methods:** Fifty-seven consenting chiropractic students were divided into high and low cumulative grade point average (GPA) groups. Ten subtests and three factors of the Learning and Study Strategies Inventory (LASSI) measured strategic learning strategies; *t* tests were used to compare the high and low GPA groups on LASSI subtest and factor scores.

**Results:** The high GPA group scored significantly higher ( $p < .05$ ) on LASSI subtests Anxiety, Attitude, Concentration, Motivation, Test Strategies, and Selecting Main Ideas, and on factors Effort-Related Activities and Goal Orientation.

**Discussion:** This investigation found that, for the sample studied, motivational and affective aspects of strategic learning contributed to higher academic performance, whereas cognitive strategies did not. These findings are generally in agreement with related studies in the literature.

**Conclusion:** Higher performing students utilized effort and goal orientation learning strategies at significantly higher levels than lower performing students. These findings support the use of the LASSI for identifying students who may benefit from learning and study skills development. Longitudinal study is recommended to investigate the effects of students' learning and study strategies on different academic content domains as well as the effects of strategic study skills training on academic performance.

## Using the Haddon Matrix to Assess Strategies for the Prevention of Upper Extremity Musculoskeletal Disorders in a Knowledge Worker Population

Charles Sherrod and Dale Johnson, Life Chiropractic College West

**Objective:** To demonstrate the use of the Haddon matrix as an investigatory tool for the identification and deployment of preventative intervention strategies at the primary, secondary, and tertiary injury prevention levels in a population of knowledge workers facing the emerging public health threat of upper extremity musculoskeletal disorders (UE-MSDs).

**Methods:** Literature searches (PubMed, CINAHL, EMBASE, MANTIS, and Cochran Review) were conducted on upper extremity musculoskeletal disorders in knowledge worker populations and for the application of the Haddon matrix to public health threats. Data were sequestered from a feasibility study in 2007 involving a convenience population of knowledge workers, and risk analysis was conducted with the Haddon matrix model.

**Results:** A selective search strategy using subheadings of injury epidemiology of the upper extremity and ergonomic

intervention for UE-MSDs in workers using computers resulted in 380 citations, of which 50 were controlled studies and 12 were reviews. A more focused search on the use of the Haddon matrix as an assessment tool for risk analysis and prevention generated 26 citations containing four controlled studies and five reviews, but none related to UE-MSDs affecting knowledge workers.

**Conclusions:** Current research efforts have focused on the preventive management of UE-MSDs. It is essential to recognize the complexity and multivariant nature of the causal web of factors associated with UE-MSDs. The Haddon matrix combined with multivariant mathematical analysis of high-quality ergonomic and patient health data shows promise toward the development of comprehensive risk analysis and intervention strategies for UE-MSDs.

## Implementation of Chiropractic Care in the Long-Term Setting: A Pilot Study Through a Chiropractic College and the Volunteers of America

Jodell Skaufel, Cara Borggren, Kristine Westrom, and Roni Evans, Northwestern Health Sciences University

**Introduction:** A partnership was formed between a chiropractic college and the Volunteers of America to create and implement a pilot project in which complementary and alternative medicine (CAM) services would be delivered within long-term care settings. While CAM services are utilized by

older adults in the community, little is known about the potential for such services, especially chiropractic, within geriatric care centers. There are few preexisting models that demonstrate chiropractic in long-term care facilities, and this project explored its potential.

**Discussion:** As with any innovative project, there were barriers that challenged the implementation of chiropractic care. Strengths and weaknesses were also identified,

especially later in time when chiropractic care was established and utilized. This project demonstrates key points to consider in building sustainable models.

### Seasonality in the Incidence of Claims of Cervical Artery Dissection Associated with Chiropractic Care

Dave Soave and John J. Triano, Canadian Memorial Chiropractic College

**Introduction:** Evidence suggests that a seasonal pattern exists within the occurrence of spontaneous cervical artery dissections (CADs), with a significant increase in occurrence during colder weather months. If a seasonal pattern is representative of the incidence of arterial dissection, then it should be apparent within cases that are claimed to be caused by manipulation or adjustment to the cervical spine.

**Methods:** A claims database containing adverse events attributable to spinal manipulation covering the 12-year interval of 1996–2008 was identified. Edwards' test for seasonality was used to test whether or not the monthly distribution of the data follows a simple harmonic curve having one peak and one trough within a 12-month period.

**Results:** The distribution of cases by season was highest for spring (29.4%; CI: 23.1–35.6), followed by winter (27.9%; 95% CI: 21.7–34.1), fall (24.4%; 95% CI: 18.4–30.3), and summer (18.4%; 95% CI: 13.1–23.8). Edwards' test indicates there is significant evidence of seasonality of monthly frequency ( $p = .047$ ) with the maximum rate estimated to be mid to late March.

**Conclusion:** The occurrence of CAD, like infection, hypertension, and aortic dissection displays a seasonal pattern with a peak occurring in the winter and spring. This seasonal variability is seen to be similar to previous studies. Chiropractors treating patients with symptoms that begin in the winter season and overlap with CAD may be advised to increase their vigilance in differential diagnosis.

### A Survey of Chiropractors Regarding the Treatment of Low Back Pain During Pregnancy

Paula Stern, Natalie Cervini, Melissa Goncalves, and Nicole Obal, Canadian Memorial Chiropractic College

**Background:** Spinal pain is common during pregnancy. Little is known about the chiropractic management of back and neck pain in this population. Understanding whether chiropractors manage these patients and how they treat these women needs to be studied to improve quality of care in this population.

**Purpose:** The purpose of the study was to determine the proportion of chiropractors employed at a chiropractic college who treat pregnant patients. We also aimed to understand the most common complaints in pregnant women. Finally, we studied how these patients are managed.

**Design:** The study design was a survey of chiropractors employed at a chiropractic college.

**Methods:** We administered a questionnaire to all chiropractors employed at a chiropractic college in 2008–2009. Fourth-year students contacted all eligible doctors and described the study to potential participants. The questionnaire was

designed to collect data on demographics, type of practice, complaints, and treatment of pregnant patients.

**Results:** The participation rate was 70.6% (53/75). Of the 53 participants, 46 (86.8%) treat pregnant women. The most common complaints were low back pain (95.7%), posterior pelvic pain (52.2%), thoracic pain (43.5%), and neck pain (37.0%). Most chiropractors used spinal manipulation (84.9%), soft tissue therapy (83%), exercise (73.6%), postural advice (71.7%), and ergonomic advice (67.9%).

**Conclusion:** Most chiropractors employed at our chiropractic college treat pregnant women. Our survey suggests that the chiropractic treatment of spinal pain in pregnant women is similar to the treatment provided to other patients. Future research aimed at understanding the effectiveness of chiropractic management is needed.

### Interests, Activities, and Concerns Within a Focus Group of Adult Senior Members in a University-Sponsored Senior Program

Stephanie Sullivan and Jennifer Fisher, Life University

**Introduction:** The purpose of this research study was to determine through a focus group format the general interests, activities, and concerns of a group of adult seniors within a university-sponsored senior program. Broad, open-ended, and general questions as well as a basic demographic questionnaire were utilized in order to gain both qualitative and quantitative information.

**Methods:** Senior members of a university-sponsored senior membership organization were asked to participate in one of two focus groups. The focus groups consisted of a 1-minute introduction, 40-minute allocation for questions, and 5 minutes for completion of a brief demographic questionnaire. Five questions concerning member interests, activities, and concerns were asked of the participants.

**Results:** The study resulted in two focus groups with four members participating in each group. Eight emergent thematic categories evolved: education, health, travel, current events/politics, finances, family/friends, volunteering/charity, hobbies. Education followed by health, family/friends, and finances were all highly rated as topics of interest for both groups. The category of health was the only category represented in all five questions.

**Discussion:** This study provided a base of information and illustrated that health is a priority topic for members, and the participants would like to increase the time spent in activities relative to health, education, current affairs/politics, volunteering/charity, finance, travel, hobbies, and family/friends. Future focus groups will be conducted on a much larger scale, will involve more specific topics, and will include senior participants outside the institution.

## Cervical Adjustments Improve Elbow Joint Position Sense

**Heidi Haavik Taylor**, New Zealand College of Chiropractic, and **Bernadette Murphy**, University of Ontario Institute of Technology

**Objective:** To investigate whether joint position sense (JPS) accuracy differs between subjects with a history of subclinical neck pain syndrome (SCNPS) and those with no neck complaints, and to see whether adjusting dysfunctional cervical segments in the SCNPS group improves their JPS accuracy.

**Methods:** Twenty-five SCNPS subjects and 18 control subjects participated in this study. Elbow JPS was measured utilizing an electrogoniometer. Subjects reproduced a previously presented angle of the elbow joint with their neck in four positions: neutral, flexion, rotation, and combined flexion/rotation. The experimental intervention was high-velocity, low-amplitude cervical adjustments and the control intervention was a 5-minute rest period. Group JPS data were compared and assessed pre- and postinterventions using three parameters: absolute, constant, and variable error.

**Results:** At baseline the control group was significantly better at reproducing the elbow target angle. The SCNPS group's absolute error significantly improved following the cervical adjustments when the subjects' heads were in the neutral and left rotation positions. They displayed a significant overall decrease in variable error following the cervical adjustments. The control group subjects' JPS accuracy was worse after the control intervention with a significant overall effect in absolute and variable error. No other significant effects were detected.

**Conclusion:** These results suggest that asymptomatic people with a history of SCNPS have reduced elbow JPS accuracy compared with those with no history of any neck complaints. Furthermore, the results suggest that adjusting dysfunctional cervical segments in people with SCNPS can improve their upper limb JPS accuracy.

## Effects of Chiropractic Care on Pain and Function in Patients with Hip Osteoarthritis Waiting for Arthroplasty: A Controlled Clinical Pilot Trial

**Pernilla Thorman**, Scandinavian College of Chiropractic, **Alexander Dixner**, Scandinavian College of Chiropractic, and **Tobias Sundberg**, Karolinska Institutet

**Purpose:** To explore short-term effects of chiropractic care on pain and function in patients with hip osteoarthritis.

**Methods:** Patients waiting for unilateral hip arthroplasty at a large university hospital received either chiropractic care for 3 weeks ( $n = 7$ ) or no additional treatment (ie, waiting list controls,  $n = 7$ ). Main outcome was self-rated hip pain [visual analog scale (VAS), 0–100]. Secondary outcomes were the five hip disability and osteoarthritis outcome subscales (HOOS, 0–100): pain, function in daily living, function in sport and recreation, hip-related quality of life, and other symptoms. Nonparametric statistics were used to explore the outcome changes from baseline to follow-up after 3 weeks within and between the groups.

**Results:** After 3 weeks the chiropractic group had a mean (SD) improvement in self-rated hip pain VAS of  $-26.0$  (28.4)

points ( $p = .043$ ) and borderline improvements in the HOOS subscales of pain [ie, 15.4 (17.2) points,  $p = .063$ ] and function of daily living [ie, 18.6 (18.5) points,  $p = .063$ ]. The patients who remained on the waiting list had no statistically significant improvements in any outcome measure, but a borderline improvement in HOOS pain [ie, 12.2 (18.2) points,  $p = .051$ ]. There were no statistically significant findings between the groups due to the small sample size. It was estimated that the adequate sample size for a full-scale randomized clinical trial would need about 30 patients in each group.

**Conclusions:** Chiropractic care may be of valuable short-term benefit for patients with hip osteoarthritis waiting for hip arthroplasty. The pilot findings warrant larger scale randomized controlled trials.



## Maturation in Rate of High-Velocity, Low-Amplitude Force Development

John Triano, Matthew Forgie, Tobias Gissler, and Denain Milwid, Canadian Memorial Chiropractic College

**Background:** Controlled direction, amplitude, and speed of manipulation produce systematic responses in animal biomarkers. The clinical relevance is unknown. Stability of high-velocity, low-amplitude (HVLA) parameters is not reported in clinical studies. This work tests for a natural maturation to stable level related to duration of experience.

**Methods:** Five cohorts of 10 were recruited. The first four groups represented each year of chiropractic training. The last consisted of licensed providers in continuous active practice for a minimum of 5 years. The hypothenar transverse push, upper thoracic procedure was studied. Participants were paired by group and stature, exchanging roles as doctor or simulated patient. Measure of thorax forces was recorded through a triaxial force-sensing table (ATMI OR6-5-1, Advanced Medical Technology, Inc., Watertown, MA). Data were analyzed by analysis of variance and Holm's post-hoc test.

**Results:** Data from all 50 participants were analyzed. A highly significant [ $F(4, 45) = 11.43, p < .001$ ] difference based on group was observed. Group mean values for speed performances in Newtons per second (N/s) were 1768 N/s (830), 1788 N/s (750), 3183 N/s (1023), 3990 N/s (1220), and 4305 N/s (1565) for groups 1 to 5, respectively. The group speed differences appear to plateau by the 4th year of training.

**Discussion:** Relevant research in manual therapy must demonstrate that biological responses are achievable in clinical settings. This requires the ability to test biomarkers, quantify treatment, and select the most stable performers.

**Conclusion:** Selection of participants acting as treating providers may have an impact on the outcome of clinical studies depending on the relevance of the treatment factors that they are able to provide.

## Nonuniform Paraspinal Response to Flexion Continuous Passive Motion Stretch Associated with Background Muscle Activation

John Triano, Canadian Memorial Chiropractic College, Helene Langevin, University of Vermont, James Fox, University of Vermont, and Elisa Konofagou, Columbia University

**Introduction:** Manual therapies induce relative movements within tissues. Effects may arise from different tissue strata and evidence concludes that small proportions of force reach the target. It is critical to identify how the motions and strains are distributed. Ultrasound (US) elastography directly images tissue and can quantify relative motions. The project tested whether adjacent small (~3 mm) thicknesses of muscle behave differently under the influence of a simple therapeutic load (flexion) and how levels of muscle activation affect that behavior.

**Methods:** Motorized, flexion-distraction/continuous passive motion over a course of three trials (X5 cycles) was applied on separate days. Paraspinal muscle was monitored at L2/3 by surface EMG and elastography. Myoelectric activity, motion, and ultrasound images were electronically synchronized. A region of interest (ROI, three parallel bands) was defined at the center of the US B-mode image, immediately deep to the undersurface of the lumbodorsal fascia. Tissue displacement between successive images was calculated

using cross-correlation techniques. Differences (analysis of variance) of motion between bands and time-linked RMS-EMG were obtained.

**Results:** Variation in measure of motion between cycles was small (coefficient of variation, 7%–11%). Muscle motion between the three bands of the ROI were distinctly different ( $F = 7.41, p \leq .0151$ ). The difference between bands seemed to accentuate with increased background myoelectric activity.

**Discussion:** Displacement within different regions of contiguous tissue, such as paraspinal muscle, is nonuniform with respect to loading. Within-subject consistency is possible.

**Conclusion:** US elastography is able to identify systematically different internal tissue displacements within the paraspinal muscle as a result of simple flexion therapeutic maneuvers.

## Quantifying "Line of Drive" in High-Velocity, Low-Amplitude Biomechanics

John Triano, Matthew Forgie, Tobias Gissler, and Denain Milwid, Canadian Memorial Chiropractic College

**Introduction:** Common reported high-velocity, low-amplitude (HVLA) parameters are force, speed, and thrust duration. The line of action is not well quantified, even though

animal biomarker responses vary according to direction. This study quantified the direction of loads together with force and speed.

**Methods:** A mathematical representation of direction was derived from the triaxial force components normalized to magnitude.

$$F = (1/|F|) [fx, fy, fz] \quad (1)$$

Change in direction is reflected in the level curve plots and their path length. Fifty subjects were recruited across a spectrum of experience. Forces from the hypothenar transverse push were measured by a triaxial sensing table (ATMI OR6-5-1, Advanced Medical Technology, Inc., Watertown, MA). Statistical analysis used analysis of variance with Scheffe's and Kruskal-Wallis post-hoc tests.

**Results:** Results represent natural development of biomechanical parameters using cross-sectional data for defined experience. At greater experience, force decreased as speed

increased ( $F = 11.43$ ,  $df = 4/45$ ,  $p < .0001$ ;  $F = 5.93$ ,  $df = 4/45$ ,  $p = .0006$ ). Path length trended ( $p = .0814$ ) short for experienced providers ( $19.6^\circ \pm 6.1^\circ$ ) versus novice ( $26.0^\circ \pm 8.1^\circ$ ).

**Discussion:** The line of action/drive is intended to steer the procedure. Both speed and force should be independent. Measures show that it may not be the case. There is a trend for change to shorter path length while force changes inversely to speed. The conscious control of HVLA parameters is important to defining the clinical relevance of biological changes thus far reported.

**Conclusion:** Future studies should examine whether there is a linkage between controlled variation in force parameters during HVLA and clinical outcomes.

## Baseline Physical Exam Predicts Final Self-Reported Pain Outcomes from a Randomized Trial on Chronic Cervicogenic Headache

Darcy Vavrek, Mitch Haas, and Dave Peterson, Western States Chiropractic College

**Purpose:** The goal of this analysis is to find which baseline physical exam (PE) measures best predict clinically relevant self-reported outcomes at 24 weeks.

**Methods:** This is an exploratory analysis of data generated by baseline PE from an open-label, randomized, controlled study. Eighty subjects were randomized to 8 or 16 treatments of spinal manipulative therapy or light massage control over 8 weeks. Self-reported outcomes of interest included headache and neck pain and disability rated on a 100-point pain scale and number of headaches and related disability days in the last 4 weeks. PE included motion-palpation of the cervical and upper thoracic regions, inclinometric evaluation of active cervical range of motion (ROM) and associated pain, and algometric pain threshold (PPT) over articular pillars. The association between baseline PE variables and week 24 outcome change from baseline were evaluated individually and then by backwards stepwise regression, adjusting for treatment group and randomization variables. The resulting

prediction models identify independent PE predictors of self-reported outcomes.

**Results:** Adjusted increases in PPT at C4-5 was predictive of changes of  $-5.2$  CI( $-9.5, -1.0$ ) in mean headache pain,  $-7.6$  CI( $-12.4, -2.7$ ) in mean neck pain,  $-6.9$  CI( $-10.8, -1.2$ ) in mean neck disability, and  $-2.1$  CI( $-3.4, -0.8$ ) headaches over 4 weeks. These were statistically significant ( $p = .017, .001, .007, .002$ , respectively) and remained so after backwards stepwise regression. Other predictors of week 24 self-reported outcomes include cervical lateral bending ROM, cervical flexion ROM, and sitting rotation endplay restriction at C6-7 to C7-T1.

**Conclusions:** We noted a number of baseline PE findings that predict measures of 24-week headache and neck pain and disability. This is an important step toward establishing and understanding objective measures of outcomes for clinical studies.

## Degree of Vertical Integration Between the Undergraduate Program and Clinical Internship with Respect to Lumbopelvic Diagnostic and Therapeutic Procedures at a Chiropractic College

Shannon Vermet, Karen McGinnis, Melissa Boodham, and Brian Gleberzon, Canadian Memorial Chiropractic College

**Introduction:** The objective of this study was to determine if, and to what extent, the diagnostic and therapeutic procedures taught in the undergraduate program with respect to the lumbopelvis at this college are expected to be utilized by students during their clinical internship program and/or are being used by clinical faculty themselves.

**Methods:** The study was approved by the Research and Ethics Board. A confidential survey was distributed to clinical faculty at a chiropractic college. It consisted of a list of diagnostic and therapeutic procedures used for lumbopelvic conditions taught at that college. Clinicians were asked to

indicate the frequency with which they performed or they required students to perform each item. Demographic data of the clinicians were also gathered.

**Results:** Seventeen of 23 clinicians responded. The following procedures were most likely required to be performed by clinicians: posture; ranges of motion; lower limb sensory, motor, and reflex testing; and core orthopedic tests. The following were less likely to be required to be performed: Waddell testing, Schober's test, Gillet tests, and abdominal palpation. Students were expected to perform (or clinicians performed) most of the mobilization (in particular, iliocostal,

iliotransverse, iliofemoral) and spinal manipulative (especially the lumbar roll, lumbar pull/hook, and upper sacroiliac) procedures taught at the college.

**Discussion:** Vertical integration is important because there ought to be a smooth transition for students from their under-

graduate program to their clinical internship and ultimately to their practice activities.

**Conclusion:** This study suggests that there was considerable vertical integration between the undergraduate and clinical education program at this college.

## Simulated Malingered in the Testing of Cervical Muscle Isometric Strength

Howard Vernon, Steven Tran, David Soave, and Jesse Moreton, Canadian Memorial Chiropractic College

**Introduction:** Determination of sincerity of effort in cervical strength testing is difficult, especially since there is a lack of a gold standard with which to compare clinical subjects' performances. As an alternative design, we sought to determine if simulated malingered trials of isometric cervical muscular strength in flexion, extension, and right/left bending are substantially different from maximum effort trials in young healthy subjects.

**Methods:** A convenience sample of healthy young adult subjects was used (nine males and nine females) who were free of neck pain. A uniaxial load cell was used to measure forces (N) produced by isometric contractions of the head/neck muscles in flexion, extension, and bilateral side bending in two modes: 75% maximum (MAX) and simulated malingered (INSIN). An analysis of variance model was created and tested post hoc for paired differences between modes, genders, and directions.

**Results:** In MAX mode, males were stronger in all ranges versus females; the expected flexion/extension and bilateral ratios were demonstrated and good consistency of effort in and between trials was demonstrated by high intraclass correlation coefficients. In INSIN mode, all mean peak values were significantly lower in both genders; however, the difference between genders disappeared. Within-trial consistency was much poorer with significantly higher coefficients of variation. The flexion/extension ratio was greatly reduced in males.

**Discussion:** Simulated malingered trials produced consistent patterns of deviation from maximal effort trials: reduced peak values, increased symmetry of effort, and increased variability of within- and between-trial effort.

**Conclusion:** These findings may provide a basis for valid indicators of malingered behavior in whiplash patients.

## An Epidemiological Study on Metabolic Abnormality and Carotid IMT in Chinese Children from Yueyang City

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**Objective:** To study the metabolic health status in children living in Yueyang City of China.

**Methods:** Five elementary schools in the city were randomly selected and 2024 7-year-old and 1784 11-year-old pupils from those schools were screened for overweight and obese children using the standard body mass index (BMI) method. Among them, 206 pupil volunteers were examined further for blood pressure, fasting plasma glucose, lipid profiles, fasting insulin, as well as the carotid IMT by B-ultrasound.

**Results:** No metabolic abnormality has been detected in the 7-year-old overweight and obese children. The prevalence of metabolic syndrome (MS) in the 11-year-old overweight and obese children reached 5.97% and 10.81%, respectively, which was significantly higher than in a normal group

( $p = .000$ ). Carotid IMT was significantly different among four metabolic groups of 11-year-old children ( $p = .034$ ); particularly, the IMTs in the subgroup with MS were much thicker than in the control subgroup ( $p = .004$ ). Relevance analysis revealed carotid IMT was positively correlated with the age, SBP, DBP, PP, WC, HC, TG ( $p < .05$ ).

**Discussion and Conclusions:** The recent economic boom in the inland region of China has now impacted the health of children living there; obese children in Yueyang City, a mid-sized town in the Chinese inland, presented various metabolic abnormalities, with thickened carotid IMTs. Screening carotid IMT by ultrasound may be an important and convenient method for early identification of children at risk for cardiovascular diseases.

## Design of an Integrated Care Model Within a Long-Term Care Facility

Kristine Westrom and Roni Evans, Northwestern Health Sciences University

**Background:** Complementary and alternative medicine (CAM) services are commonly used by older adults in the

community; however, little is known about providing services within a long-term care (LTC) facility. Introducing

chiropractic, acupuncture and oriental medicine (AOM), and massage into a LTC facility has the potential to improve residents' quality of life and improve institutional internal quality measures. A collaborative effort between allopathic and CAM stakeholders is essential to the success of this initiative.

**Objectives:** The primary goal is to develop a sustainable and replicable model for integrated chiropractic, AOM, and massage services in a long-term care facility.

**Methods:** A grant from the Volunteers of America and in-kind contribution from the university provides chiropractic, AOM, and massage services to nursing home residents who experience pain, sleep disturbance, decline in function, or behavior changes.

**Discussion:** Integrating within a LTC facility required designing forms and processes of care acceptable to both allopathic and CAM clinicians. Challenges included the process for obtaining orders for treatment and consent for care from health care proxies. Training was undertaken for CAM clinicians and LTC facility staff.

**Conclusion:** This paper describes challenges and successes in placing integrated services in a LTC facility. Administrative leadership paved the way for implementation at the facility level. Nurse managers at the LTC facility have proven to be invaluable allies in accomplishing goals. Further projects beyond the scope of this pilot demonstration have been identified.

## An Analysis of Medicare Part B Claims for Spinal Manipulation, 1998–2004

James Whedon and Matthew Davis, The Dartmouth Institute for Health Policy & Clinical Practice

**Background:** Cross-sectional studies have demonstrated high rates of utilization of spinal manipulation (SM) in the United States, but few studies have investigated longitudinal trends. In the present study, we investigated longitudinal trends in the utilization of SM among US Medicare beneficiaries.

**Methods:** We employed a retrospective cohort design. We analyzed a 5% representative sample of Medicare part B data to estimate the total number and rate of use of SM procedures for Medicare beneficiaries from 1998 to 2004. To determine rates of SM claims per Medicare beneficiary, we divided total SM claims by the total number of Medicare beneficiaries as of the 30th of June for our 5% representative sample each year from 1998 to 2004.

**Results:** From 1998 through 2003, the number of SM procedures increased by 28%, followed by a 25% decline from 2003 to 2004. From 1998 to 2003, claims for code 98940 remained relatively stable, while claims for codes 98941 and 98942 increased. Claims for all three codes fell precipitously from 2003 to 2004. Cumulative rates of use for all SM procedures increased by 30% from 1998 to 2003 and then declined by 25% in 2004.

**Conclusion:** From 1998 through 2003, both the number of claims and the cumulative procedure rates for SM steadily increased, and then decreased sharply in 2004. The 25% decline from 2003 to 2004 was unexpected, remains unexplained, and will be the subject of further inquiry.

## Palpation of the Atlas Transverse Process: A Validity Study with a Radiographic Gold Standard

Morgan Young, Robert Cooperstein, and Makani Lew, Palmer College of Chiropractic West

**Objective:** This study aimed to determine whether the atlas transverse process (TVP) was a palpable structure and, if palpable, how accurate was a palpator in determining its location.

**Methods:** The study participants were 21 volunteer chiropractic students. A palpator placed a 1.5-mm lead marker bilaterally on the atlas TVP prior to the taking of an APOM x-ray, the need for which was established independently of our secondary analysis. The vertical distance was measured between the lead marker and the center lateral aspect of the atlas TVP, left and right, for a total of 42 measurements.

**Results:** A two-tailed paired *t* test was performed ( $N = 42$  and  $df = 41$ , for  $\alpha = .05$ ). The computed value of *t* was  $-0.68$ , which was less than the *t* critical value of 2.02. This confirmed that the palpatory results were not statistically

different from the radiologic results. The absolute value of the mean left and right errors was 5.4 and 4.6 mm, respectively. The left/right standard deviations were 6.9 and 5.4 mm, respectively, suggesting greater precision on the right. As for accuracy, 90.5% of the time the marker was closer to C1 than either the mastoid process or C2.

**Discussion:** Upper cervical adjusters and other health care professionals who need to locate the atlas for diagnostic and/or therapeutic procedures would generally be able to locate it.

**Conclusion:** Palpation was judged to be accurate in finding the atlas TVP and not statistically different than radiographic examination.

## Understanding the Intrigue of Extraocular Muscles and Oculomotor, Trochlear, and Abducens Nerves Through Physical Examination: An Innovative Approach

Niu Zhang and Xiaohua He, Palmer College of Chiropractic Florida

**Objective:** The innervations and actions of the extraocular muscles are usually explained to students in a lecture format. Therefore, students often have difficulty performing physical examination of cranial nerve tests regarding the extraocular muscles. The purposes of this study were to investigate 1) the effect of an innovative approach using an exhibitory eye model in a physical examination laboratory format on explaining the Listing law concerning the individual extraocular muscle action and the rationale for cranial nerve testing, and 2) whether this innovative approach could help students' clinical examination skills and their written examination scores.

**Methods:** Participants were 37 volunteers in the third quarter. The study involved a special designed eyeball model used

to explain the individual extraocular muscle movement and innervation (Listing law). Written pre- and posttests were used to assess participants' understanding of the subjects. The comparisons of the test results were made to nonparticipants who also took the same pre- and posttests.

**Results:** The participants were generally more accurate and quicker in performing clinical cranial testing. The results also suggest that the participants achieved better grades in their written test after implementation of the innovative approach.

**Conclusion:** Using an innovative approach to explain the Listing law and rationale for cranial nerve tests can improve physical examination skill and help produce more effective written test results.