
ABSTRACTS OF ACC CONFERENCE PROCEEDINGS

Platform Presentations

Symptomatic Herniation Pit of the Femoral Neck A Case Report

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Herniation pits (HPs) of the femoral neck were first described as small (usually ≤ 1 cm) central lucency surrounded by a thin sclerotic border, exclusively located in the superolateral quadrant of the adult femoral neck. The prevalence of HPs of the femoral neck is reported to be 5% and is generally considered an incidental finding. There have been four reported cases of hip pain in a young athletic population associated with the presence of a HP in the femoral neck of the affected hip.

CASE REPORT

This report discusses a case of a 25-year-old elite male volleyball player with insidious onset left hip pain that began to affect his athletic performance during his last season as a varsity athlete, approximately 5 years ago. Following his volleyball career, the hip pain became episodic, flaring up following running, tennis, and weight training. Pain increased with motions that combined hip flexion, adduction, and internal rotation. He resumed training for competitive volleyball and the hip symptoms became more frequent and intense. Hip ranges of motion were normal except for passive internal rotation, which was mildly reduced due to sharp pain. There was no bruising or edema, and deep tendon reflexes were normal. Palpation revealed multiple tender points in the gluteal muscles and hip rotators bilaterally. Isokinetic evaluation of the hip musculature indicated a significant discrepancy ($>25\%$) of the left abductors compared to the right abductors and only mild ($\leq 10\%$) differences between right and left hip flexors, extensors,

and adductors. Plain films revealed a small, oval, lobulated radiolucency with a thin sclerotic border in the superolateral aspect of the left femoral neck. The lucency was diagnosed as a HP of the femoral neck. However, its clinical relevancy remained in question. A bone scan showed no excessive uptake by the lesion. An MRI revealed no significant fluid collections in the joint or regional bursae, and no significant abnormal signal in the surrounding musculature.

DISCUSSION

HP of the femoral neck is considered to be the result of mechanical stress from the hip capsule and related musculature on the superolateral quadrant of the femoral neck. This region of the femoral neck is prone to developing a reaction area composed of fibrocartilaginous elements that may penetrate tiny defects in the degenerative cortex leading to the formation of a herniation pit. The corresponding area of the hip capsule is particularly thick. A positive correlation between the incidence and prominence of the reaction area and the thickness and roughness of the overlying capsule has been previously reported.

Recent reports have challenged the classical description by suggesting that these benign lesions may grow significantly larger than 1 cm, appear lobulated, and may be a source of pain. Differential diagnoses include osteoid osteoma, chronic abscess, intraosseous ganglion, focal avascular necrosis, and atypical metastatic disease. Since herniation pits of the femoral neck are considered to be painless, the clinical focus often shifts to relate hip symptoms to a soft tissue condition.

In this case, the patient's symptoms have not responded to various conservative therapies provided over 2–3 months, including: soft tissue therapy, electrical modalities, and long-axis distraction. Currently only surgical curettage has been

reported to alleviate effectively the hip pain associated with herniation pits. The case-based evidence describing the relationship between HP of the femoral neck and associated

hip pain and potential expansion of the HP suggests that athletic activity (notably repetitive hip flexion/extension) may contribute to the pathogenesis of these lesions.



The Effect of Mechanical Force, Manually Assisted Spinal Manipulative Therapy on the Alpha Motoneuron Pool as Assessed by Hoffmann Reflex Methodology

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Back pain is a major health concern due to its high prevalence and health care costs. Spinal manipulation is a commonly used and effective conservative treatment for back pain. Of the spinal manipulation techniques used, Activator, involving a mechanical force, manually assisted (MFMA) thrust, is one of the top three most utilized techniques by chiropractors. Activator MFMA manipulation has numerous documented case studies describing positive outcomes as a conservative therapy for back pain. The actual mechanism underlying the neurophysiologic effects of a MFMA thrust has yet to be elucidated. The objective of this study was to determine the effect of a MFMA thrust on the excitability of the alpha motoneuron pool, using H-reflex methodology in the lumbar spine. To address this objective, the specific aims of the proposed research were to determine if a MFMA thrust to L5 decreases motoneuron pool excitability as assessed by H-reflex methodology in the lumbar spine, and to compare and contrast the effects of a MFMA thrust and prone manual spinal manipulation with assist, including appropriate sham procedures, on motoneuron pool excitability.

METHODS

This study was approved by the New York Chiropractic College IRB. Sixty asymptomatic subjects (15 per group) were randomly assigned to one of four experimental groups: Activator MFMA thrust, Activator sham MFMA thrust, prone manual spinal manipulation with assist, and prone sham manual spinal manipulation with assist. Quantitative tibial nerve H-reflex evaluations were used to ascertain information on the physiologic effects of MFMA thrusts on the spinal motor system, and how these effects compare with prone manual spinal manipulation with assist in the lumbar spine.

RESULTS

Activator MFMA treatment did not affect H/Mmax ratios ($F[6,336] = 1.19$; $p > .05$). H/Mmax ratios were significantly

attenuated immediately following the prone manual spinal manipulation with assist, as compared to the other spinal procedures ($F[3,56] = 4.87$; partial eta squared = .207; $p < .05$). The treatment effect of the L5–S1 prone manual spinal manipulation on decreases in H/Mmax ratios accounted for 55% of measurement variance. The time by group interaction term was significant ($F[18, 336] = 20.23$; partial eta squared = .520; $p < .05$). The significant interaction between treatment procedure and H/Mmax recovery profiles provided statistical evidence that H-reflex attenuation following a L5–S1 prone manual spinal manipulation was dependent in part on the high-velocity, low-amplitude thrust.

DISCUSSION

The results of this investigation indicate that a lumbar MFMA thrust does not decrease the excitability of the lumbar alpha motoneuron pool as measured by tibial nerve H-reflex amplitude changes. In agreement with previous results, attenuation of lumbar alpha motoneuron pool excitability occurred after manual lumbar spinal manipulation. There appears to be different afferent inputs from each technique. Activator MFMA thrusts may have a more localized affect on afferent input that does not manifest as a reduction of the alpha motoneuron pool excitability as measured by tibial H-reflex. This lack of reduction may be due to the asymptomatic subject population. Activator MFMA thrusts may also generate afferent input that is subthreshold for detectable changes in the alpha motoneuron pool excitability. The stimulus response characteristics appear to be different between Activator MFMA thrusts and prone manual spinal manipulation with assist.

CONCLUSION

Activator MFMA thrusts did not decrease the excitability of the lumbar alpha motoneuron pool when measured by tibial nerve H-reflex. These data indicate that Activator MFMA thrusts appear to have a different neurophysiologic

effect on lumbar alpha motoneuron pool excitability as compared to manual lumbar spinal manipulation. Specifically, tibial nerve H-reflexes are significantly attenuated immediately following manual lumbar spinal manipulation procedures.

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Radiology Practice Guidelines for Adult Spinal Disorders and Pediatric Musculoskeletal Complaints Indications for X-Ray Taking for the Chiropractic Intern and Clinician

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The Universit  du Qu bec   Trois-Rivi eres chiropractic clinic X-ray guideline was recently revised to favor a more selective application of this imaging to reduce unnecessary patient exposure to ionizing radiation. Clinical judgment based on recognized chiropractic science principles is necessary for the evaluation of health conditions that are within a chiropractor's scope of practice. The proposed guideline is a shift to an evidence-based approach and is supported by a literature review of over 250 scientific original contributions.

METHODS

The literature review resulted in the elaboration of a condition-specific guideline for musculoskeletal complaints commonly seen by chiropractors. Search for pertinent articles was carried out in Medline, the Cochrane Library, the National Research Register, and in the references cited in articles uncovered in the course of this search. A few sources were found in well-known books, governmental and paragonmental publications, nonprofit organizations, and international practice guidelines. Topics covered in the review include the use of radiography and potential associated risks, biomechanics, degenerative changes and spinal curvatures in relation to patient symptoms, indicators of potentially serious pathologies (red flags), as well as cervical congenital anomalies, trauma, scoliosis, and osteoporosis. A review of various national and international radiology practice guidelines is also presented in the literature review. Based on the literature review, a Radiology Practice Guideline for the chiropractic intern and clinician was produced in collaboration with a chiropractic radiologist. The Guideline was then reviewed for input by members of the profession and sent for external review.

RESULTS

The Guideline is condition specific and the X-ray dose to patients is indicated. The phrase "not routinely indicated" means that a radiograph does not generally give information susceptible to alter the therapeutic intervention. Finally, comments often assist recommendations. The Radiology Practice Guidelines were summarized for the intent of clinical research and the ACC conference.

DISCUSSION

The frequency of X-ray utilization by chiropractors is considered high both in Europe and North America, but most reasons for utilization given by chiropractors are not supported by the literature. Effects on human health of ionizing radiation exposure have been a source of controversy. However, Evans and colleagues believe that diagnostic radiology in general is responsible for 1% of leukemia and at least 1% of breast cancers. For now, it is important to remember that health effects of all forms of exposures are cumulative. Clinical usefulness, cost/efficacy ratio, and procedure acceptance, as well as the reliability, validity, sensitivity, specificity, and predictive value of the proposed study, should be addressed. Given the risks associated with X-ray taking, only clinical motives can justify the use of radiography. In this regard, the need to eliminate or confirm pathology, to follow the evolution of a pathology possibly affecting therapy, or to eliminate a contraindication to vertebral manipulation are the better documented reasons. Guideline application should help avoid unnecessary radiographs, increase examination precision, and decrease health care cost without compromising the quality of care. This guide is meant to assist interns and clinicians and

should, in all cases, be accompanied by sound clinical judgment and experience. Future research should also attempt to refine biomechanical analysis of spinal radiograph as well

as patient selection criteria to further reduce unnecessary patient exposure to ionizing radiation without altering sensitivity.



The Effects of Side-Posture Adjusting on the Lumbar Zygapophysial Joints of Low Back Pain Patients as Evaluated by Magnetic Resonance Imaging A Preliminary Study

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Spinal adjusting of the lumbar region is thought to separate the articular surfaces of the zygapophysial (Z) joints. This “gapping” is theoretically the action that “breaks up” adhesions. Elimination of such adhesions would allow the Z joints to become more mobile, thus helping the motion segment (two adjacent vertebrae and the ligamentous structures connecting them) to re-establish a physiological range of motion. Adhesions and degenerative changes of the Z joints of rats have been identified following induced hypomobility. In addition, Z joint gapping has been demonstrated in healthy volunteers during both side-posture positioning and during chiropractic adjusting, with the joints gapping significantly more during the latter procedure. However, no reports have been published regarding gapping of the Z joints in the low back pain (LBP) population. Therefore, this “proof of concept” pilot project addressed the chiropractic treatment of spinal fixation at a very fundamental clinical level. This IRB-approved preliminary study sought to recruit 10 acute and 10 chronic LBP subjects from the faculty, staff, and students of the National University of Health Sciences (NUHS). The acute and chronic LBP components of the study were run simultaneously. However, because acute and chronic LBP subjects represent two distinct populations, assignment to treatment and control MRI groups and data analyses were conducted separately for each of these components of the study.

The objective of this study was to collect preliminary data on gapping of the lumbar Z joints in the low back pain population as a follow-up to previous work that demonstrated gapping with manipulation in healthy volunteers. This was a prospective clinical study with blinded assessment.

METHODS

The work was done at a university health care center and magnetic resonance imaging center (NUHS). Twenty subjects (10 acute and 10 chronic LBP subjects) were recruited from university students, faculty and staff. The

subjects were assigned to four groups (five subjects per group). The groups were: 1) acute LBP adjustment, 2) acute LBP control, 3) chronic LBP adjustment, and 4) chronic LBP control. All subjects received two magnetic resonance imaging (MRI) scans during a single MRI appointment. The scans were taken before and after lumbar side-posture spinal adjusting followed by side-posture positioning for the adjustment groups, or before and after transient side-posture positioning for the control groups. No adjustive procedures were performed on the subjects in the control groups. Anterior to posterior measurements of the lumbar Z joints from MRI scans were performed by an independent observer who was blinded to group and intervention (pre- or postintervention).

RESULTS

An increase in Z joint gapping pre- vs. postintervention was observed in subjects who received a lumbar side-posture adjustment for both acute (1.5 ± 0.7) and chronic (0.7 ± 0.8) low back pain subjects vs. control subjects (acute 0.1 ± 0.2 , chronic 0.0 ± 0.3).

CONCLUSION

The design of this pilot study was successful. Compared to controls, chiropractic spinal adjusting gapped the Z joints in a low back pain population. This study demonstrates the need for a larger study, using the same methods to explore the mechanism and benefits of chiropractic spinal adjusting.

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A Preliminary Analysis of Preparation Strategies Used by Chiropractic Students in Preparing for NBCE Part I

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The National Board of Chiropractic Examiners (NBCE), established in 1963, is the principal testing agency for the chiropractic profession and functions similarly to the National Board of Medical Examiners (NBME). The NBCE licensing exam has evolved into a series of four primary high-stakes assessments of cognition and psychomotor aptitude, offered to chiropractic students at various stages in their educational training. Due to the high-stakes nature of these examinations, chiropractic students spend a significant amount of time and money on preparation strategies, including college-supported board reviews, commercial coaching courses, course notes, old test questions, online resources, textbooks, and small-group study sessions. Predicting academic performance on National Board examinations based on preparation strategies has received little attention by researchers in chiropractic education.

The purpose of this study was to empirically identify different strategies used by chiropractic students to prepare for the NBCE Part I examination and to present a preliminary analysis of the correlations between test scores and strategies. The study consisted of a student survey utilizing descriptive statistics and multivariable analysis.

METHODS

A convenience sample of 229 (52%) students was identified from a pool of 438 first-time Part I examination candidates at a large Midwestern chiropractic college. Participants were asked about their study preparation for the Part I examination: the number of hours of study each week; group versus individual study; study material used; number of weeks of study prior to the exam; and, if relevant, a succession of questions about coaching courses. Consideration was also given as to whether the participant worked outside of school, and, if so, the number of hours worked per week. Survey responses were then correlated with NBCE Part I scores, selected demographics (age and gender), prechiropractic cumulative grade point average (GPA), and chiropractic college cumulative GPA at the time of the examination.

RESULTS

Of the predictors studied, only past education (bachelor's degree and prechiropractic GPA) and current chiropractic GPA significantly correlated with the Part I NBCE scores. Using multiple regression, the variables of prechiropractic and chiropractic GPA accounted for a significant portion of the total variance in Part I NBCE scores ($R^2 = .638$, $p < .001$). Further, the variables of prechiropractic and chiropractic GPA alone accounted for significant unique explanation (change $R^2 = .368$, $p < .001$). Demographics, employment history, study effort, and prepared materials (private tutors, commercial coaching courses, and commercial note sets) were considerably less potent predictors of success on Part I of the NBCE.

DISCUSSION

Due to the high-stakes nature of National Board examinations, it seems reasonable that students would spend a significant amount of time preparing for them. However, the results of this study fail to identify a significant relationship between Part I scores and demographic characteristics, preparation strategies, and duration of study. This study raises questions concerning the impact of preparation strategies, including commercial coaching courses on the National Board examination scores for those preparing to enter the chiropractic profession. Further, the results suggest that short-term preparation strategies and study efforts immediately prior to the NBCE Part I have a minimal effect on exam scores. In this study, prechiropractic GPA, chiropractic GPA, and postsecondary education completed at the time of matriculation were the best predictors of success on NBCE Part I. With changes in curricula and student assessment, other variables may be investigated in the future to improve the prediction of student success on National Board examinations.



Low Back Pain in Hispanic Residential Carpenters Job-Task Variables and Personal Risk Factors

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Low back pain (LBP) is a leading cause of lost work time and has been recognized as America's number one workplace safety challenge. LBP is occurring at epidemic proportions among construction workers, and minority populations are at risk of injury due to ergonomic hazards. The purpose of this study was to investigate construction job-task variables and personal risk factors and their contribution to LBP among Hispanic residential construction workers.

METHODS

This investigation was a nested cross-sectional study of 241 Hispanic residential framing carpenters within a larger longitudinal cohort study of residential construction workers in the Denver, Colorado metropolitan area. Data were collected using a 91-question survey designed to assess the amount of a "self-reported" back strain experienced during major job tasks performed by residential framing carpenters, and to gather personal and workplace information on other potential risk factors for low back pain. Participants rated perceived strain to the low back while performing 44 major job tasks required to build a wood-framed house using a modified Borg scale. Descriptive statistics were used to estimate mean scores for each of the variables measured including job-task strain scores, personal risk factors, and prevalence proportions for low back pain. Binary logistic regression was used to evaluate explanatory variables for point, 12-month, and lifetime prevalence of LBP.

RESULTS

All respondents were males between the ages of 15 and 56 and were of smaller height and body weight when

compared to the average US male. The majority of respondents worked fewer than 45 hours per week and had been working in residential construction and residential framing for less than 5 years. Eleven percent of respondents reported having to take time off from work due to low back pain. Nineteen percent of respondents reported they had suffered an episode of LBP or injury in their lifetime that had caused them to seek medical care or alter some aspect of normal living. When individual task and personal variables were combined, years in construction and health status were significant for predicting lifetime work-related LBP. Ten percent of respondents reported suffering an episode of LBP within the past 12 months sufficient to seek treatment or alter some aspect of normal living. Combining task variables and personal risk factors in the regression model produced coworker caring, time pressure, and smoking status as significant predictors of LBP within the last year. Eight percent of respondents reported that they had suffered a recent episode of LBP within the past 2 weeks of sufficient intensity to seek treatment or alter some aspect of normal living. Combining task variables and personal risk factors in the regression model produced level of coworker caring and rollup as significant predictors of the point prevalence of LBP.

DISCUSSION

Hispanic residential carpenters reported less than expected prevalence of LBP. Ergonomic job tasks and personal risk factors, including psychological and morphological characteristics, impact the prevalence of LBP among Hispanic carpenters.



Cervical Spinal Manipulative Therapy and Cerebrovascular Accidents A Case Study in Investigative Teaching

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Cerebrovascular accidents (CVAs) are a rare yet serious complication associated with cervical spinal manipulative therapy (SMT). Incidents involving the vertebral artery (VA) or carotid artery have been reported. Recently, there has been

increased activity concerning this in the literature, requiring teachers to examine closely how they address this topic in lecture, laboratories, and outpatient clinics. Historically, technique textbooks and instructors gave warnings about the

“dangers of rotation and/or extension” during cervical SMT. Some recent authors have questioned this, but others have maintained these cautions and even argued to abandon the use of upper cervical rotational SMT. Other factors such as dissections in progress, vascular “repetitive strain” injuries, and arteriopathies have been implicated. Additionally, well-intentioned yet questionable evidence has been published, further muddying the waters. Teachers are forced to make timely decisions when developing course content and guidelines for applying cervical SMT, despite this lack of clarity. These issues were addressed by undertaking an in-depth investigation into the topic area. This can serve as a “best practice” case study on approaching contentious classroom issues. The outcomes of this investigation illustrate how this process can also be useful in professional development.

METHODS

A comprehensive review of the literature was undertaken, including surveying recent technique textbooks, performing a literature search, and reviewing articles in trade journals, newspapers, and newsletters. National and international conferences were attended when material pertinent to this area was being presented. Interviews were performed with authors and other noted authorities during conferences. In other cases, authors were e-mailed with specific questions or concerns. Web searches were performed on various authors to examine links to political or entrepreneurial concerns to assess for potential conflicts of interest. Response articles, letters to the editor, and personal letters were written concerning articles that appeared to use questionable interpretations of the literature or conclusions. Presentations were made to various professional groups, including the college faculty and student body, the Technique Consortium at the ACC 2003 conference, and the World Federation of Chiropractic Congress. Important discussion and feedback from these constituents were gained at this time.

RESULTS

During the investigation, the context in which various experts’ positions were developed was gleaned and biases became apparent. Some individuals were responding to the current zealotry found in the lay press and by the profession’s adversaries; others seemed emotionally tied to the topic because of personal, professional, or national relationships, or pressure placed upon them during expert testimony. Web searches identified sites that suggested conflicting interests in nutritional companies that were not acknowledged as part of a published article. Others appeared to be publishing as a function of self/business promotion. After response pieces were written, some authors publicly retracted statements, while others exposed their own experimental shortcomings in their replies. Presentations to one’s peers helped foster informed discussion and this resulted in increased clarity and also fraternity. A number of new professional collaborations were created which resulted in coauthored articles and appointment as a peer reviewer.

DISCUSSION

The results of this type of investigative teaching process led to a greater understanding of the issues, the facts, and the misinformation, and this led to increased content mastery. This translated into more informed lectures in classroom and more profound discussion within the technique department. New avenues of professional endeavors became available. Chiropractic educators have a role to play in political and professional issues, especially when it concerns patient care. We should not hesitate to enter the fray, despite the potential negative repercussions. The nature of our jobs prepares us to address these issues well, and our ethical perspective is one which is least tainted by conflicts of interest.



Teaching Cervical Technique in Climate of Concern Facts, Fiction, and the Moral Imperative

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An investigation was undertaken into cervical spinal manipulative therapy (SMT), its effectiveness for specific clinical conditions, and associated cerebrovascular accidents (CVAs). This presentation focuses on presenting this material in the classroom and considers the application of the moral principle of “do no harm” in decision making.

METHODS

A comprehensive review of the literature was undertaken. Conferences were attended when material pertinent to this area was presented. Interviews were performed with authors

and other authorities. Authors were e-mailed specific questions. Potential conflicts of interest were assessed on authors by examining links to political or entrepreneurial concerns. Response articles and letters were written concerning articles that used questionable interpretations of the literature. Presentations were made to professional groups. Important discussion and feedback from these constituents was thereby gained.

RESULTS AND DISCUSSION

“CVA associated with SMT” is a “loaded phrase.” It is undetermined whether a “typical” cervical manipulation of a “normal” patient could cause CVA. In authoritative reports, over 60% of such patients had immediate reaction. Risk of serious accident is approximately 1 in 1.5 million cervical SMTs; the risk of death is much smaller. It is estimated that 1 in 33 practitioners will have a serious CVA-SMT case, but some type of cerebrovascular incident will probably happen to every practitioner.

Some cases probably represent prior dissections in progress. Detection is essential: knowing the signs of CVA is paramount. Practitioners are strongly advised not to manipulate patients with such signs and to seek appropriate follow-up care.

A genetic aberration may create vascular fragility. Examples include Marfan’s syndrome and Ehlers-Danlos syndrome, but these account for few of the serious SMT-CVAs. Other as yet unknown predisposing factors could be present in some patients. As at this time there is no way to determine who is at risk, it would be prudent to minimize the forces applied during SMT.

Experimental evidence shows mechanical stress on the vertebral artery during rotation. This has resulted in changes in technique instruction, limiting the amount of global rotation to 45° by incorporating intersegmental distraction, flexion, and lateral flexion. Similarly, the site of SMT appears important. Three studies identified the most common site of dissection as C1–C2. Another study found that 45/49 cases involved a rotational SMT of the upper cervical spine. It would seem prudent to minimize the amount of rotation and rotational thrust in the upper cervical spine.

It has been hypothesized that the vertebral arteries can undergo failure from repetitive stress, supporting the importance of a detailed history. This becomes controversial in consideration of “preventative” care for asymptomatic patients. The principle of nonmaleficence would place SMT lower on the list of acceptable long-term treatments, especially given the current lack of evidence of real benefit.

No author currently supports the use of provocative tests to indicate risk of SMT-related CVA. Patient consent is straightforward and has strong consensus: explain the real level of risk and potential benefits and let the patient decide if cervical SMT is acceptable. While cervical SMT has been shown to be effective for neck pain and some headaches, the evidence is weak. It is important for practitioners to understand their responsibility: researchers are needed and money to support their work must be donated.

Continual monitoring of the professional literature and adapting teaching strategies appropriately are important. Adopting ultimate concern for patients and gaining a profound understanding of SMT sets the stage for claiming that only doctors with very advanced training (such as chiropractors) be allowed to perform such procedures.



Henry G. Higley: Pioneer Chiropractic Scientist

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A vibrant, productive research enterprise in the chiropractic profession is a rather recent phenomenon. Unfortunately, this success has led some people to believe that no research, or credible researchers, existed in the profession before the late 1970s. The purpose of this study was to chronicle the life of one of chiropractic’s modern scientific pioneers, Henry Grant Higley, D.C., M.S., to demonstrate that one man had a very clear vision for collaborative

data-driven clinical research based on a firm professional infrastructure.

METHODS

Review of the literature, review of historical documents, qualitative interviews with relatives and colleagues of the subject, and language interpretation were conducted.

DISCUSSION

Trained at universities in Mexico and California as an engineer and mathematician, Henry brought his skills to the chiropractic arena and introduced a level of scholarship not previously seen in the profession. The topics of his research and published works included clinical outcomes of manipulation, costs of chiropractic services, criminal justice, physiology, educational testing, information processing, nutrition, orthopedics, radiology, and radionics. He attracted numerous small grants for his many investigations, and organized the Department of Research and Statistics for the American Chiropractic Association. Dr. Higley was also a successful practitioner and a much respected instructor at the Los Angeles College of Chiropractic. His 1960 monograph on the intervertebral disc syndrome was a substantive and wide-ranging review of the literature on low back disorders, and attracted the attention of many within and beyond the

profession. That document is the first chiropractic publication to be indexed in *Index Medicus*.

CONCLUSION

Henry's pioneering research efforts were not fully appreciated in his day and were eventually forgotten by a profession that had not yet learned the value of meticulous quantitative studies and inferential statistical analysis. Twenty years following his demise, the early glimmerings of greater research consciousness and industry were just coming into view. While in many respects the dimensions of his vision for chiropractic science have come to pass, it is unfortunate that the profession he loved so dearly has forgotten this remarkable pioneer chiropractic scientist. His career provides a model for chiropractic scholars today.



Awareness and Use of the Ottawa Ankle Rule in a Chiropractic Teaching Clinic and General Attitudes of Faculty Clinicians Toward Clinical Guidelines A Preliminary Survey

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Clinical algorithms have been the subject of a large number of articles and discussion in the recent health care literature. The Ottawa Ankle Rules (OAR) is one example. Since its development in 1992, they were the topic of more than 100 articles. It is comprised of a series of criteria that aid in the diagnostic workup for ankle injuries in adults and children. The purpose of this survey was to document the usage of the Ottawa Ankle Rule in chiropractors of this institution as well as to assess their attitudes regarding general clinical guidelines.

METHODS

The survey was distributed at a mandatory clinic faculty meeting in a large, multilocation teaching clinic of a chiropractic college. Participants were all full-time clinicians and included faculty, adjuncts, and residents. Questions regarding their awareness of the Ottawa rule were asked. Their general opinions about practice guidelines were also investigated in the second part of the survey. The questions were similar to surveys distributed to internists and emergency room physicians by other authors.

RESULTS

Six doctors reported having heard of the OAR. However, only two of them reported using it on eligible patients. A majority of respondents were interested in learning about this rule by participating in a workshop. The majority of clinicians (97%) agreed that general clinical guidelines were good educational tools, simplified workup (87%), and improved quality of care (76%). Most also believed guidelines decreased health care costs and protected against malpractice. However 40% of the clinicians thought guidelines were a form of "cookbook chiropractic" and 30% believed they represented a challenge to the authority of the physician.

DISCUSSION

This is the first survey of its kind eliciting the opinion of chiropractors regarding the OAR and general practice guidelines. The survey revealed that outside residency programs, the OAR was virtually unknown in this clinic system. This is well illustrated by the fact that more than 100 ankle series

were taken in this institution from July 2002 to August 2003, but all were negative for fractures. Clinicians in this institution rely heavily but inefficiently on ankle radiographs following injury. When asked about general decision rules, the clinic faculty overall expressed positive attitudes. Although there is a tendency to believe that guidelines are generally perceived as challenges to the authority of the physician, the results of this study do not reflect this very well. A majority of respondents even showed interest in learning about a particular guideline, the OAR, without even knowing about them. This shows openness and desire on the part of the clinicians to learn about different algorithms. All but one respondent thought guidelines are good educational tools, although only 70% admitted to using them in their practice. This is quite interesting since all the respondents primarily practice in a doctor-based teaching clinic.

CONCLUSION

This study revealed that, excluding residents, the Ottawa Ankle Rule was virtually unknown to the clinic faculty of this chiropractic college. It also demonstrated that the faculty had in general positive attitudes regarding practice guidelines. This, however, cannot be generalized to the chiropractic profession, due to the small sample size and by the relative homogeneity of the respondents of this survey. In a way, this survey raised more questions than it answered. For this reason, the author plans to expand the questionnaire and this study to include teaching faculty in other colleges and perhaps practitioners in the field.



Proprioceptive Accuracy in Subjects With Cervical Pain of Mechanical Origin

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The purpose of this study was to determine if there is a relationship between cervical pain of mechanical origin and upper limb proprioception. Proprioception is defined as sensibility to position, whether conscious or unconscious.

METHODS

Subjects with mechanical neck pain (group 3, $n = 22$) were compared with asymptomatic subjects ($n = 33$) in an assessor blind correlation study. Asymptomatic subjects were further divided into those with a positive Kemp's test (group 2, $n = 15$) and those without (group 1, $n = 18$). Exclusion criteria included nonmechanical neck pain, organic pathology, or age less than 20 years old. The testing apparatus consisted of a horizontally mounted board with predetermined finger holes on the underside. Blindfolded subjects were asked to approximate their index fingers by moving their free upper hand over the superior surface of the table to a position perceived to be directly overlying the preplaced index finger of the opposite hand under the table. In total, eight points with four trials at each point were attempted in a predetermined randomized sequence and performed

for both dominant and nondominant hands. The outcome measures were points [$S(x, y)$] and distances (L) measuring the difference between the perceived and actual points as determined by finger position.

RESULTS

L values of groups 1, 2, and 3 were 1.2, 2.2, and 2.5, respectively. Results of the symptomatic and asymptomatic groups were compared using an unpaired t test. A statistically significant difference was noted between L values of group 1 and 3 and L values of group 1 and groups 2 and 3 combined. The points (S) of groups 1, 2, and 3 were also compared for the scatter around the central point of the apparatus. Group 1 had very little scatter, group 2 had mild to moderate scatter, and group 3 had severe scattering.

CONCLUSION

The results suggest that mechanical neck pain may have a significant role in decreasing proprioceptive accuracy.



A Randomized Clinical Trial Comparing Flexion–Distraction With Active Exercise for Chronic Low Back Pain

A Feasibility Study

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In the United States, low back pain (LBP) represents a substantial health care burden. The list of conservative treatments includes: physical therapy and stabilizing procedures directed to the lumbar spine and sometimes and affected leg; radiofrequency denervation; botulinum toxin; acupuncture; physical therapy and back education; high-velocity, low-amplitude manipulation; massage; willow bark extract; continuous passive motion; traction procedures; and homeopathy. Meta-analyses and systematic reviews of the literature are often less optimistic for individual procedures than selected studies would suggest. Some of the disparity in results for chronic low back pain patients may be attributed to a substantial variation in the definition of the word “chronic.”

OBJECTIVES

The aim of this study was to compare the outcome of flexion–distraction procedures (FD) performed by chiropractors with an exercise protocol (ATEP) performed by physical therapists, for patients with chronic low back pain. There were three objectives in this investigation. First, the feasibility of working with a multidisciplinary group to provide contrasting treatments according to a strict protocol was to be tested. Second, the data from this investigation were expected to provide information to aid the design of future clinical trials (e.g., sample size estimates). Third, this study intended to investigate the premise that chronic low back pain is composed of a subgroup of disorders that may respond differently to differing treatment regimes.

METHODS

This study was approved by the Institutional Review Board at the National University of Health Sciences. Subjects, 18 years of age and older, with a primary complaint of low back pain (≥ 3 months) were recruited. They were randomly allocated to receive either FD manipulation procedures or ATEP. The FD intervention consisted of the application of flexion and traction applied to specific regions in the low back, with the aid of a specially designed manipulation table. The ATEP intervention included stabilizing and flexibility exercises, the use of modalities, and cardiovascular training.

A 100-mm visual analogue scale for perceived pain and the short form SF-36 for overall health status served as primary outcome measures. Analysis consisted of descriptive and inferential evaluation of study variables and included analysis of covariance and *t* tests.

RESULTS

A total of 235 subjects met the inclusion/exclusion criteria and signed the informed consent. Of these, 123 were randomly allocated to FD and 112 to the ATEP. One hundred ninety-three subjects (82%) completed the intervention phase and provided all necessary data for analysis of primary outcomes. A strong statistically significant postintervention decrease in pain was observed regardless of treatment group ($F = 40.43$, $p < .01$). Controlling for preintervention pain, a statistically significant difference between treatment groups ($F = 6.20$, $p = .01$) favoring FD was also found. Trends favoring both groups were found for differing scales of the SF-36. Subjects categorized as “chronic and moderate” or “chronic and severe” responded more favorably to FD ($t = 3.48$, $p < .01$), while subjects categorized as “recurrent and moderate” or “recurrent and severe” tended to respond more favorably to the ATEP ($t = 1.51$, $p = .15$).

DISCUSSION

Study patients perceived significantly less pain after intervention, regardless of treatment group. Subjects randomly allocated to the flexion–distraction group had significantly greater relief from pain than those allocated to the exercise program. Subjects categorized as chronic, with moderate to severe symptoms, improved most with the flexion–distraction protocol. Subjects categorized with recurrent pain and moderate to severe symptoms improved most with the exercise program.

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Three-Dimensional Doctor–Patient Contact Loads During Side-Posture Lumbar Spinal Manipulation

M. Ram Gudavalli, Ph.D., and **Robert M. Rowell**, D.C., Palmer Center for Chiropractic Research

Low back pain is one of the major health problems in terms of the costs and lost work days to society. Low back pain patients seek chiropractic care for pain relief and return to normal activities. The doctor of chiropractic delivers forces by means of hand contact on the patient during side-posture adjustments. These forces are complex three-dimensional forces and are delivered to create forces and moments at the joint of interest and create joint movements. Triano and his colleagues have used force plates mounted to the manipulation table and estimated the loads delivered to the joint of interest using an inverse dynamics approach. Herzog and his colleagues have measured the contact forces between the doctor and the patient using EMED pressure mats during sacroiliac manipulations. Kirstukas reported the doctor–patient hand contact forces using Teckscan pressure mat during thoracic adjustments. These measurements are limited to compressive loads at the doctor’s hand contact. The objective of this article is to report on the three-dimensional forces at the hand contact between the doctor and the patient during side-posture adjustments.

METHODS

A three-dimensional force transducer (Model No. Mini-45, ATI-Industrial Automation, Greensboro, SC) was used to measure the three-dimensional loads (three forces and three moments). Informed consent was obtained from five human subjects. Two doctors of chiropractic delivered high-velocity, low-amplitude adjustments to the lumbar spine of the subjects in a side-lying posture. The transducer was placed between the doctor’s hand and the patient. The x-axis was pointed inferiorly on the spine, y-axis was pointing right laterally, and the z-axis was pointing anteriorly. The load-time histories were recorded at a sampling rate of 1000 Hz using Lab view software and a laptop computer connected to the force transducer by means of Keithly Instruments PCMCIA card. The force-time histories were plotted. MathCAD software

was used to analyze the data in terms of preloads, peak loads, and the duration of the thrusts.

RESULTS

The compressive forces at the hand contact reached as high as 450 N, and shear forces reached as high as 150 N. Moments reached as high as 4 Nm. The preload magnitudes were as high as 200 N. Rates of loading was as high as 2407 N/s. These magnitudes are comparable to previously published values regarding the doctor–patient interface. The shear forces and moment loads were smaller compared to the transmitted loads in the lumbar spine using inverse dynamics approach and force plate measurements. This study demonstrates that shear forces and moments are present at the doctor’s hand–patient interface while delivering treatments to the lumbar spine. Clear trends of distinction between the two doctors of chiropractic were observed in delivering the three-dimensional loads.

DISCUSSION

This is a preliminary study that shows there are shear forces and moments applied at the doctor’s hand–patient interface. These measurements are important and have an important role in understanding the effects at the spinal joints that are being treated. Future studies will be aimed in studying the three-dimensional loads delivered to different patient populations.

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A Nonrandomized Clinical Control Trial of Harrison Mirror Image Methods for Correcting Trunk List (Lateral Translations of the Thoracic Cage)

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The purpose of this nonrandomized clinical control trial was to determine amount of improvement in lateral thoracic cage translation posture with Harrison mirror image postural methods. Clinically, altered vertical alignment of thoracic cage relative to median sagittal plane of the pelvis is common and is termed *trunk list*. Studies reporting improvements in this translation posture are rare in the literature.

METHODS

Sixty-three treatment subjects were compared to 23 volunteer controls, with lateral thoracic cage translation posture and chronic low back pain. Initial and follow-up pain scales [Numerical Pain Rating Scales (NRS)] and AP lumbar radiographs were obtained after a mean of 11.5 weeks of care (average of 36 visits) for the treatment group and after a mean of 37.5 weeks for the control group. The radiographs were digitized and analyzed for a horizontal displacement of T12 from the second sacral tubercle, verticality of the lumbar spine at the sacral base, and any dextro/levo angle at

the midlumbar spine. Subjects were treated with the Harrison mirror image postural methods, which included an opposite trunk list exercise and opposite trunk list traction.

RESULTS

For the control group, no significant radiographic and NRS differences were found except in trunk list displacement of T12 to S1, which increased by 2.4 mm. For the treatment group, there were statistically significant improvements (approximately 50%) in all radiographic measurements and in pain intensity.

CONCLUSION

The use of Harrison mirror image methods can reduce chronic low back pain and trunk list posture in 3 months of care at a frequency of three visits per week.



Effect of Paper Color on Test Performance A Preliminary Investigation

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This preliminary investigation seeks to identify a link correlating color environment to performance, and whether further study may be warranted. If there is a physiological change that occurs due to exposure to color, one may postulate that the performance of logic tasks, memory, and creativity may be influenced by the color of the environment or media to which a subject is exposed.

METHODS

Volunteer subjects were recruited from a college student population of students at a chiropractic college. Twenty-six students were randomly assigned to one of three experimental groups. All subjects were screened for color blindness

utilizing the Ishihara test before receiving the color paper test with the intention of identifying those with color vision deficiencies. A seven-page "test" booklet was developed which included memory tasks, perceptual puzzles, and word problems similar to those typically given in standardized IQ tests. All of the pages of each booklet were printed on one of three colors of paper: green, pink, or white. The test instruments were randomly shuffled and handed out in order along rows of seated students. Those who arrived after the time period began were not allowed to participate, since it was a timed event, and noncompletion of sections would have influenced the results.

RESULTS

Subjects ranged in age between 20 and 40 years (average age, 28), with 18 males and 8 females. Comparison suggests the combined color-blind group performed better (79.8% correct, $n = 10$) than those subjects with good color vision (73.8% correct, $n = 16$). However, statistical significance was not achieved on the Student t test ($p = .15$). Comparison between gender revealed no significant difference ($p = .45$). Those using the green paper instruments ($n = 8$, 80% correct) performed slightly better than those with white paper ($n = 10$, 78.1% correct), and significantly better than those with pink paper ($n = 8$, 71.3% correct). Comparisons of the colors were performed two at a time: green and white, pink and white, and pink and green.

DISCUSSION

Since color blindness is a result of retinal malfunction, the brain does not receive signals that would be sent by the normal retina. The color-blind group performed surprisingly higher overall, suggesting the brain is in fact able to receive information about color, even if the color itself cannot be perceived. Several participants complained after the event that the green paper made reading the questions very difficult. This was particularly true for the spatial relationship questions, since the shapes became difficult to interpret as shading and contouring was diminished with the color. In spite of this, the percentage of correct answers was higher for those from the green group than those from the white group, and much higher than those from the pink group ($p = .055$). One might theorize that the difficulty in reading the questions caused the subjects to concentrate harder, resulting in a higher performance. A postreview of the data did reflect a higher average completion rate for the green group (97.5% completed) than for the white group (95.6% completed) or the pink group (90% completed).

CONCLUSION

This preliminary investigation suggests a possible link between the color paper of exam forms and the performance of the test-taker. It remains unclear to what degree (if any) color blindness negates the influence of color exposure. A more rigorous test instrument should be developed for analyzing mental performance.



The Applicability of the Biopsychosocial Model to Back Pain in Pregnant Women Seeking Midwifery Care

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Musculoskeletal pain is a major complaint of pregnant women. Studies suggest that between 50% and 76% of women suffer from back pain during pregnancy. Thus, pregnancy is a strong self-reported risk factor for the development of low back pain. Little attention has been paid to the assessment of low back pain during pregnancy because the condition is viewed as transient and time limited when it might be a chronic problem that is composed of acute episodes and recurrences. Currently, the biopsychosocial (BPS) model best describes patients' back pain experience. However, the BPS components of low back pain and the impact of back pain on disability in the pregnant women affected are unknown. This study was designed to address some important deficits in our understanding of musculoskeletal pain in pregnancy.

METHODS

Although numerous instruments to measure the nature of low back pain are available, few are comprehensive, with most concentrating on the physical aspects of back pain rather than its multidimensional nature. A review of the literature suggests that the factors best describing patients' back pain experience include pain severity, physical disability, psychological variables related to cognitive/behavioral and affective domains, and interference with social activities and sleep. These are captured in the Bournemouth Questionnaire. Along with this instrument and a series of questions on the presence and location of back pain, this study is systematically

gathering information on back pain and its related factors in a cohort of approximately 100 pregnant women at three time intervals during their normal term of midwifery care (at entry to the practice, at the 28- to 36-week time period, and at the 6-week postpartum visit). Thirteen midwifery practices in Ontario, Canada are participating in this study. Each practice was asked to recruit 10 subjects. This abstract is based on 29 subjects (as this study is still underway).

RESULTS

Twenty-nine women from 11 midwifery practices have completed the three phases of the study. Their average age is 32 (SD = 3.6). Three-quarters (70%) have completed their university education. Half (50%) had no children prior to this pregnancy. On average, they entered midwifery care in their 16th week of pregnancy (SD = 6). Over the course of midwifery care, 67% had reported back pain on their first visit. However, only 40% reported back pain at all three time

periods. With the exception of pain intensity, which showed a reduction from 4.18 out of 11 (SD = 1.94) to 3.45 (SD = 2.46) to 2.55 (SD = 1.70), all other biopsychosocial measures showed a curvilinear trend for this group. For example, back pain interference with sleep had an average of 2.55 (SD = 2.25) at entry to practice, 3.55 (SD = 2.62) at the second testing, and 1.18 (SD = 2.27) postpartum ($F = 25.498$, 1 df, $p = .0005$).

DISCUSSION

These preliminary data support the literature that a high percentage of women suffer from back pain during pregnancy and that sleep is interfered with because of the pain. Sleep interference also influences activities of daily living. The curvilinear change over time in pain intensity, functional status, sleep, social activities, coping, work, anxiety, and depression will be more fully examined as more subjects complete the study.



Faculty Perceptions of the Residencies and Residents at a Chiropractic College Teaching Clinic

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In the 1970s and 1980s, residency programs were beginning to be established in various chiropractic colleges, as the profession came to the realization that chiropractic was lacking its own trained specialists, researchers, and teachers. Three decades later, most of the chiropractic colleges in the United States and Canada have residency programs. The aim of the residency programs is to produce graduates who will fulfill the aforementioned roles. The training of residents in general includes self-directed and guided academic and clinical activities. The importance of residency programs to the chiropractic profession has been discussed in the literature. Palmer College has offered residency programs since 1986 and currently offers programs in Radiology, Orthopedics, Rehabilitation, and Pediatrics. Faculty perceptions of these residencies have never been explored. This study is the first to do so.

METHODS

The subjects in the study were clinic faculty in the college's teaching clinics. A questionnaire was used in which the first 13 questions sought the faculty's general perceptions on aspects of training, competencies, and worth related to the residents and the residencies. The faculty was instructed to direct their perceptions toward senior residents (2nd or

3rd year). Questions 14 and 15 examined how the faculty perceived the value of the individual residency programs and the individual chiropractic specialties. Question 16 examined the level of awareness faculty had regarding the academic qualifications of the residents. The results were analyzed using descriptive statistics.

RESULTS

Twenty-seven out of a total of 38 eligible clinic faculty participated in the questionnaire. In general, respondents found residents to be valuable to the college (92%) and were supportive of resident activities such as teaching and patient care (83%). The confidence of the doctors in the residents' abilities was only moderate (54%). The doctors felt that all the residency programs the college offers are valuable to the college and all the respective chiropractic specialties are valuable to the profession. Most doctors were aware of the academic qualifications of the residents.

DISCUSSION

One's productivity, success, and attitudes can be influenced by the workplace and peers. Overall, the faculty perceptions

of the residencies and the residents at Palmer Clinics were positive. Teaching and patient care were considered valuable to the residents' training, as it should be since residencies aim to produce future teachers and specialists for our profession. The benefits of teaching have also been discussed in the literature. Residents were also regarded as very valuable to the college and its clinics. A large majority of doctors indicated that they can benefit from seminars given by the residents. The use of residencies as a source of consultation needs to

be increased, as it is beneficial to doctors, students, and residents alike. Given the moderate confidence in the residents' abilities in adjusting and patient management, a compelling future study will be to compare faculty confidence in newly graduated chiropractors and residents. Some shortcomings of this study include the small sample size and the method of distribution. The author plans to expand this study in the future to include academic faculty.



High-Velocity, Low-Amplitude Spinal Manipulation for Symptomatic Lumbar Disc Disease A Systematic Review of the Literature

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Chiropractors commonly use spinal manipulation in the management of low back pain patients, and lumbar intervertebral disc disease is a common cause of low back pain. However, the role of high-velocity, low-amplitude (HVLA) manipulation in the treatment of symptomatic lumbar disc disease (SLDD) is of significant controversy. It has alternately been suggested that in such cases HVLA manipulation can be safe and effective or dangerous and contraindicated. Despite this controversy, it appears that patients with SLDD do seek manipulative treatment. Utilization studies of chiropractic and osteopathic patients suggest that 3–4.5% of all cases may include an unspecified disc problem, and 6.1% of cases with low back pain may represent SLDD. The purpose of this study was to review and summarize the literature regarding outcomes evidence of HVLA spinal manipulation for SLDD.

METHODS

Four electronic databases (The Cochrane Central Register of Controlled Trials [CENTRAL], Medline, Cumulative Index to Nursing and Allied Health Literature [CINAHL], and MANTIS) were searched for the terms *manipulation*, *intervertebral*, *disc*, *disk*, *chiropractic*, *adjustment*, and *osteopathic*. Relevant articles were retrieved and searched for additional citations. For the purpose of this review, evidence-based operational definitions of SLDD, HVLA spinal manipulation, and outcomes measures were established. Articles were assessed with respect to the following inclusion criteria: 1) published in English; 2) measured at least one outcome in subjects with SLDD undergoing HVLA spinal manipulation; and 3) descriptions were sufficiently clear to meet all three categories of our operational definitions. Articles

that met this study's inclusion criteria were reviewed and assessed by two independent reviewers. In the case of discrepancies, consensus was reached after discussion. Articles were assigned quality ratings based on previously published guidelines.

RESULTS

Sixteen studies met our inclusion criteria, representing a total of 203 subjects. Of these, 171 subjects received HVLA spinal manipulation as active treatment, and 32 received other treatments as comparison subjects. Study design included two equivalence trials, two single-group intervention studies, and 12 case series or case reports. One study was rated level I (fair); one level II-1 (fair); one level II-2 (good); one level II-2 (fair); seven level III (good); three level III (fair); and two level III (poor). Although improvements in patient-based and physiologic outcomes were reported among subjects receiving manipulation, no conclusions regarding safety and effectiveness could be drawn from this review since the overall body of evidence we uncovered was lacking in quality and quantity.

DISCUSSION

Diagnosis and management of SLDD are controversial, largely because the current understanding of lumbar disc pain pathogenesis is incomplete and often controversial. Evidence-based diagnostic criteria are required to establish a reasonable diagnosis, and many previously published reports of HVLA manipulation have not used such criteria. The

number of SLDD patients undergoing HVLA manipulation, the clinical importance of herniation size regression, and the mechanism of action of HVLA manipulation SLDD are not clearly known.

CONCLUSION

HVLA spinal manipulation for symptomatic lumbar disc disease has been reasonably described in the literature.

However, since the evidence is lacking in both quality and quantity, conclusions on safety and effectiveness cannot be made at this time. Despite this lack of evidence, it appears that patients with lumbar disc pathology do undergo manipulative treatment in practice. Consequently, this should be an area of research importance for the chiropractic profession. High-quality clinical trials employing valid and reliable diagnostic criteria and outcomes measures are greatly needed. Basic science data on the physiological effect of HVLA manipulation on the lumbar disc would also be valuable.



Organizational Commitment of a Health Profession Faculty Dimensions, Correlates, and Conditions

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Health professions depend on their faculties to prepare new practitioners, conduct research, and provide essential services. Organizational commitment is an important aspect of faculty effectiveness and job performance and may impact turnover, absenteeism, and interpersonal trust.

METHODS

A survey of organizational commitment, including faculty demographics and workplace variables, was conducted. Respondents were full- and part-time chiropractic faculty working in the United States and Canada. Correlation and regression analysis was applied to the variables of interest.

RESULTS

More than 54% of the study population ($N = 609$) completed and returned the instrument. A large majority of the respondents were male (68.4%) and were employed full-time

(81.6%). Almost half (47.5%) of the respondents were assigned to the area of patient care at their institutions.

CONCLUSION

This study provides an initial assessment of organizational commitment among chiropractic faculty. Long-term tenure in higher education emerged as a significant factor in effective commitment among faculty in this study. Gender differences in our findings suggest that women on a faculty may demonstrate higher levels of normative commitment—specifically, commitment associated with intrinsic work-related morals and standards. Senior academic faculty who have worked at the same institution for a long period of time, furthermore, showed increased continuance commitment, suggesting a relationship with the institution that may be characterized by commitment in exchange for salary and fringe benefits. Comparable research in other areas of health care is needed to identify factors that may significantly impact faculty–organizational connectedness in the health professions.



Effects of a Chiropractic Benefit on the Use of Specific Diagnostic and Therapeutic Procedures in the Management of Low Back Pain and Neck Pain

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A growing body of clinical studies has indicated that a more conservative approach to the management of low back pain and cervical spine pain is appropriate. The evidence indicates that procedures and practices such as inpatient care, advanced imaging, surgery, and even plain-film radiographs are only infrequently necessary for the successful treatment of most cases of low back pain and neck pain. While chiropractors do not directly provide these services (with the exception of plain-film radiographs), it is not known whether the availability of chiropractic care has any effect on the overall rate of utilization of these procedures. This study evaluated the effects of the presence of a chiropractic benefit (and thus, the increased utilization of chiropractic care) on the rates of these procedures in the management of low back pain and neck pain.

METHODS

Using administrative data, this study evaluated the treatment of patients with low back pain and neck pain conditions who are enrolled in a managed care health plan. Individual employers had the option of selecting the health plan with or without a benefit for chiropractic care. The health plan benefits and utilization management were otherwise the same. The identification of low back pain and neck pain episodes of care was made by the use of ICD-9 codes that are a part of all administrative data (claims data). All services using a back pain or neck pain code and with a maximum gap of 45 days between claims were aggregated into one episode of care. A new episode was created when claims exceeded the 45-day period. Utilization rates for the following procedures were measured in the two cohorts: inpatient care for back pain and neck pain; CT/MRI use related to back pain and neck pain; surgeries for back pain and neck pain; and

plain-film radiographs for back pain and neck pain. Rates for the procedures were calculated both on a per-episode basis and a per-patient basis. Tests for group differences were done using the Wilcoxon test.

RESULTS

A total of 810,499 episodes of low back pain or neck pain were evaluated. For low back pain patients, the utilization rates of all four studied procedures were lower in the group with chiropractic coverage. On a per-episode basis, the rates in the group with coverage were reduced by the following: surgery, 32%; CT/MRI use, 38%; plain-film radiography, 23%; and inpatient care, 41%. On a per-patient basis, the rates were reduced by the following: surgery, 14%; CT/MRI, 21%; plain-film radiography, 3%; and inpatient care, 24%. For neck pain patients, the utilization rates per episode were reduced in the group with chiropractic coverage by the following: surgery, 49%; CT/MRI, 47%; plain-film radiography, 34%; and inpatient care, 49%. For neck pain patients, the utilization rates per patient were reduced in the group with chiropractic coverage by the following: surgery, 31%; CT/MRI, 26%; plain-film radiography, 12%; and inpatient care, 39%. All group differences were statistically significant.

DISCUSSION

Among employer groups with chiropractic coverage compared to those without such coverage, there is a significant reduction in the utilization of high cost and invasive procedures for the treatment of low back pain and neck pain. The presumed mechanism of this effect is the substitution of chiropractic care for medical care for the treatment of back and neck pain.



Chiropractic's Philosophical Context

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Recent scholarship disputes the right of traditional chiropractic philosophy to be classified as philosophy at all. This article offers a contrasting perspective by tracing

the philosophical roots of B. J. Palmer's ideas. Isolating chiropractic philosophy from its context has obscured the significance of its premises. Seen in this broader perspective,

chiropractic philosophy can be recognized as part of a larger, influential philosophical movement.

METHODS

B.J. Palmer rarely admitted indebtedness to anyone, yet he paid homage to influential American writers by carving their names on the columns of the building he called his “printery.” Although the physical monument has disappeared, it signified his conviction that American literary, political, and philosophical works deserved recognition from the chiropractic community. It thus invites a comparison between chiropractic tenets and contemporary American beliefs. Three transcendentalist authors are included in his list: Ralph Waldo Emerson, Henry David Thoreau, and Lousia May Alcott. Transcendentalism is an American philosophical, literary, and religious movement that was incorporated into mainstream culture after the Civil War. It is based on the belief that a spiritual element permeates all material objects. Any object transcends (goes beyond) its physical manifestation to express the essential spirituality and order of the universe. A review of the “Green Books” using the CD-ROM to isolate references reveals, however, 15 citations of Emerson as well as additional citations of Thoreau. A textual analysis, comparing passages from B. J. Palmer to the essays of Emerson and ideas of Thoreau, establishes strong similarities between transcendentalist ideas and Palmer’s philosophy. Transcendentalism did not just offer an expedient rationale for chiropractic philosophy, but actually shaped Palmer’s philosophical principles. It suggested, moreover, the techniques that were used to gain political acceptance for chiropractic.

DISCUSSION

Emerson believed that the world of nature and all human endeavors are expressions of an “Oversoul.” B.J. translated Emerson’s Oversoul into chiropractic’s “Universal Intelli-

gence.” The vision of the all-embracing universe expressing itself in each separate individual is present in passages written by each author. Chiropractic’s “Innate Intelligence” is also evident in Emerson’s cosmology. Interestingly, the apparent anti-intellectualism of chiropractic is consistent with Emerson’s stance that the mind alone is insufficient to provide an understanding of the world. Emerson and Palmer agree that real wisdom eludes the scholar who neglects his or her humanity and denies any connection to the universe. Education may be necessary, but it is not sufficient for knowledge.

The method chosen by chiropractors to gain political acceptance has a puzzling quality. To seek legitimacy by publicizing one’s lawless behavior may seem futile or at least unnecessarily difficult. Henry David Thoreau provides the solution to this puzzle. Thoreau’s system, expressed in his essay “On the Duty of Civil Disobedience,” consists of four steps. First, a respected person breaks a law. Second, the illegal action must be public. Third, observers reconsider their own complacency about the law. Fourth, the newly aware people change the law and thus improve their society. Chiropractic’s quest for legalization incorporates all the elements of Thoreau’s plan. Chiropractors did not go to jail like Thoreau did; they went to jail because Thoreau did.

CONCLUSION

Transcendentalism’s influence encompassed literature, education, painting, architecture, law, politics throughout the world, and even business. Transcendentalism also enfolded chiropractic into its broader, vibrant intellectual and social context. Not surprisingly, the criticism of Transcendentalism mirrors the criticism of chiropractic philosophy. Before dismissing chiropractic philosophy, it is important to note that the widespread acceptance of Transcendentalism, despite its critics, probably encouraged—and could continue to encourage—acceptance of chiropractic philosophy.



A Model of Collaborative Health Care Delivery Between Chiropractors and Physicians in Primary Care Reform

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Collaborative practice between different health care professionals is a key component of an integrated delivery system. The goals of primary care reform in the province of Ontario include increased collaboration between family physicians and other providers and improved patient-

provider satisfaction. Chiropractic is one of the most frequently accessed nonphysician provider groups. The objective of this study was to identify the benefits, challenges, and facilitators that would contribute to designing a model of collaboration between family physicians and

chiropractors that could then be implemented in a primary care reform (PCR) site.

METHODS

The study involved a four-step process, employing key informant interviews and focus groups, using semistructured interview guides. Step 1 involved key informant interviews conducted with primary health care experts from across North America. Interviewing continued until saturation was reached. Step 2 employed eight focus group meetings that were held with two physician, two chiropractor, and four patient focus groups in two PCR sites. Step 3 involved the development of the model by the research team using data obtained from the first two steps. The final step was to obtain consensus agreement for the model by two multidisciplinary focus groups.

Purposeful sampling was used to select 16 key informants representing nine different professions with experience in multidisciplinary collaboration. Two PCR rural sites were selected to help in the development of the model. Focus groups included 11 physicians, 17 chiropractors, and 34 patients, drawn from the two sites.

Grounded theory method was used to analyze the data. All the interviews and focus group sessions were audiotaped and transcribed verbatim by a professional transcriber. All data sources were closely examined for each meaningful phrase, sentence, or paragraph while being compared for similarities and differences. Open coding was used to identify each category or subcategory. Periodic research team meetings were held to further refine the coding scheme based on the data from each new interview using the NVivo qualitative data analysis software (QSR NUD*IST Vivo (NVivo) Version 1.1). The reliability and credibility of the data were upheld through data triangulation.

RESULTS

A patient-centered model of collaborative care, including a care path, referral strategies, and use of preexisting

treatment algorithms evolved from data analysis. Trust emerged as the core category. Identified benefits of collaboration included expanding the service base and improved communication, efficiency, patient access, and outcomes. Challenges included negative stereotypes, controversies regarding practice philosophy and scope, liability concerns, time requirements, lack of trust, and discipline-specific terminology. The facilitators included communication strategies (clinical information, social events, administrative meetings, education sessions), scope of practice agreement (evidence-based care, focus on musculoskeletal problems), and service delivery (access, liability, affordability, and equitable reimbursement).

DISCUSSION

Although there have been models exploring the integration of chiropractic services in multidisciplinary settings, these have met with varied success both from the perspective of organizational structure and practice integration. We present a model of collaborative practice between physicians and chiropractors that could be implemented in a rural Ontario PCR site. Participation of providers and patients is required to identify the critical components of a collaborative model. If the focus of collaboration is patients, then it should also be responsive to their needs. Limitations to this study include the subjectivity of data analysis and narrowness of participant selection. The model will undoubtedly require changes as the collaboration evolves, necessitating ongoing coordination and supervision of the relationship.

CONCLUSION

Our data support the outcomes of other studies that have identified the barriers or challenges of integrating nonphysician providers into physician-based environments.



The Relationship Between Annual Billing Income and Personal, Practice, and Treatment Characteristics of Ontario Chiropractors

Silvano A. Mior, D.C., F.C.C.S.C., and **Judith Waalen**, Ph.D., Canadian Memorial Chiropractic College

Understanding the practice profiles of health care professionals is helpful in estimating financial and human resource allocations, facilitating organizational strategic planning, and for government negotiations and policy development. The objective of this study was to assess the relationship between

income and specific personal, practice, and treatment characteristics in a sample of Ontario chiropractors. It was hypothesized that the treatment characteristics are better predictors of income than chiropractor and practice demographics.

METHODS

End-of-year practice summary data obtained from the billing software program, Patient Management Program (PMP), was used in the analysis. PMP summary data include about 2000 variables providing information related to basic practitioner demographics (e.g., sex, age, year and school of graduation, practice location, staff); treatment profiles (e.g., range of patient age and gender, conditions by billing codes, number of visits, visit characteristics by age and gender, and types of payments); and financial data (e.g., fees, amounts billed and received).

Individual chiropractors subscribing to the PMP voluntarily submitted a summary of their year-end practice data. Of the 1700 eligible chiropractors who subscribed to PMP, 731 (43%) disks were received. This represented about 30% of chiropractors practicing in Ontario at the time of the study.

Annual income was defined as the amount of dollars billed for patient-related activities, such as treatment costs from provincial plans, patient copayments, third-party payors, and inventory. Descriptive statistics were used to examine the distribution of and provide summary data for the predictor variables. Multiple linear regression analysis was used to assess the relationship between annual practice income and predictor variables involving practitioner, practice, and treatment characteristics. A stepwise model was employed. The exclusion method used was pairwise deletion. The level of significance was set at $p = .05$.

RESULTS

The mean average annual income of the chiropractors was $\$149,000 \pm 87,000$. The median income was $\$135,000$

with the 75th percentile billing about $\$199,000$ during the study year. Income from patients and the provincial health plan comprised about 69% and 28% of the total dollars charged, respectively. The average age was 41 years ± 9.8 . The average number of patients visits for the year was 9 ± 3.5 and the average cost per patient visit was $\$18 \pm 5.5$. The model predicted about 66% of the variance in income. The significant explanatory factors of income were those related to visit characteristics. The largest contribution was made by the ratio of average visit cost to annual patient volume, which was inversely related to and uniquely contributed to 26% of the total income variance. The amount of inventory sold contributed about 13%, and the number and cost of patient visits each contributed about 8.5% of the variance. Practice location, gender, and school of graduation each made small but significant contributions to the model.

CONCLUSION

The variance in annual practitioner income was predicted by a combination of personal, practice, and treatment characteristics, but more importantly by the ratio of visit cost to annual patient volume. The hypothesized model accounted for 66% of the variance in income. The model suggests that volume generators, entrepreneurial activities that may substitute visit billings, and location relate to income levels. However, the one factor contributing the most, the ratio of visit cost to annual patient volume, was inversely related to annual income, suggesting that increasing patient visit costs does not necessarily offset seeing fewer discrete patients.



Does the Typical Procedure for Evaluating the Success of Patient Masking Assess Expectation or Outcome of Treatment? A Literature Review and Suggested New Practice

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A placebo control is intended to generate similar expectation of treatment outcome between patients who receive the treatment under investigation and those who do not. Often overlooked in published results is whether patients believed that they received the active or control treatment. It is important to know whether active and control patients' expectations of treatment effect were similar. A previous study asked patients whether anything about the study had caused them to believe that they did or did not receive the active treatment. Most patients said that they based their guess on whether or not they felt better after 6 weeks of care. Assessing patients' beliefs about their treatment assignment

at the end of a treatment phase does not assess the expectation of treatment effect, and thus does not provide convincing evidence that masking to treatment assignment was effective.

This study undertook a literature search to investigate the following: whether sham-controlled trials of spinal manipulation reported on the effectiveness of patient masking; whether assessment occurred after a period that would allow a treatment effect; whether patients were invited to comment why they guessed as they did; and novel methods that might better evaluate patients' expectations rather than evaluating their opinion of treatment outcome.

METHODS

A MEDLINE search was performed for 1966–August 2003 on the MeSH terms “controlled clinical trial” OR “randomized clinical trial,” combined with the MeSH term “manipulation.” The Manual Alternative and Natural Therapy Index System (MANTIS) was searched for 1965–2003, for the search phrase “clinical trial AND (chiropractic OR manipulation)”. Results were manually scanned to identify sham-controlled clinical trials of chiropractic care and/or spinal manipulation.

RESULTS

Fifteen of 22 trials did not report that they had assessed patient beliefs regarding treatment assignment. Of seven trials that did, five asked the patients at the end of a treatment phase which treatment they thought they had received. One was a crossover study and asked patients at the end of both treatments which they had “preferred.” The remaining study uniquely reported that the “expected treatment outcome” was similar in both the manipulation group and the control group as assessed before the initial treatment. The expectation did not change when assessed following the initial treatment. It is unclear how the expected treatment outcome was assessed. None of the published results of clinical trials indicated that

they had asked for comments to indicate what had influenced patients’ treatment assignment guess.

DISCUSSION

Patients are likely to conclude that they received an active treatment if they feel better than they did at the start of the trial, and to conclude that they received the control treatment if they do not feel better. Thus, treatment outcome can unmask patients in a clinical trial. Assessment is done typically at the end of the trial, so unmasking of patients by treatment outcome is likely. A better method may be to assess the patients’ perception before the effect of treatment can be expected or experienced.

CONCLUSION

New methods should be employed to better assess potential placeboogenic differences between treatment methods in a clinical trial. Assessing patients’ perceptions of treatment at the end of a trial may still be valuable to detect unmasking due to treatment effect. Reporting on the success of patient masking should be a quality criterion for publishing the results of controlled clinical trials.



Chiropractic Care in a Managed Health Care Organization Is It Substitution Care or Add-on Care?

Craig F. Nelson, M.S., D.C., R. Doug Metz, D.C., Kurt Hegetschweiler, D.C., Thomas LaBrot, D.C., and Rene Vega, M.D., American Specialty Health

In this economic environment, there is little interest in adding benefits to health insurance plans that may increase total costs. Whether or not a chiropractic benefit increases total health care costs is primarily a function of the extent to which chiropractic care is add-on care (care provided in addition to normally provided medical care) or substitution care (care provided in place of medical care). The effects of adding a chiropractic insurance benefit have never been studied in this regard.

This study evaluates administrative data (claims data) from a health plan that offers coverage both with and without a chiropractic benefit. By comparing the rates of neuro-musculoskeletal (NMS) claims among the patients with and without chiropractic coverage, it is possible to measure the degree to which chiropractic care is add-on or substitution care.

METHODS

Administrative data (claims data) from a managed care organization (MCO) over a 4-year period was used to evaluate the utilization of chiropractic and medical care for the treatment of NMS pain conditions. Within this MCO, individual employers had the option of selecting the health plan with or without a benefit for chiropractic care. Patients of employer groups that did cover chiropractic care could self-select to receive either chiropractic or medical treatment for their conditions. For the purposes of this study, four cohorts were evaluated. The first (A) was patients in health plans that cover chiropractic care who received any treatment (D.C. or M.D.) for NMS conditions. The second (B) was patients in health plans that cover chiropractic care

who received chiropractic treatment for NMS conditions. The third (C) was patients in health plans that cover chiropractic care who received medical treatment for NMS conditions. The fourth (D) was patients in health plans that do not cover chiropractic care who received treatment for NMS conditions (by definition, medical care). The identification of NMS pain episodes of care was made by the use of ICD-9 codes that are a part of all administrative data (claims data). A total of 657 ICD-9 codes were identified as representing this set of conditions. These codes were classified into nine different diagnostic categories: low back pain (1); complicated low back pain (2); neck pain (3); complicated neck pain (4); thoracic spinal pain (5); headache (6); myalgias and arthralgias (7); latent effects (8); and other/miscellaneous (9). The "complicated" designation in the low back and neck pain categories identify those diagnoses suggestive of discopathy and/or radiculopathy. An expert panel of chiropractors and medical physicians evaluated this classification for appropriateness and completeness.

RESULTS

Comparing the rates of patient complaints in the medical cohorts with (cohort C) and without (cohort D) chiropractic

coverage demonstrated significant reductions in the rates of complaints in cohort C. In the five largest diagnostic categories, rates were reduced in cohort C relative to cohort D as follows: low back pain, 41% reduction; complicated low back pain, 44% reduction; neck pain, 43% reduction; complicated neck pain, 32% reduction; and thoracic spine pain, 52% reduction. Analysis of other diagnostic groups and cohorts A and B are ongoing.

DISCUSSION

The presence of a chiropractic benefit in a health plan results in a significant reduction in the rates of medical care for low back pain, neck pain, and thoracic spine pain in that plan. This indicates that a significant percentage of chiropractic care directly substitutes for medical care. There is a residual amount of chiropractic care, however, that appears to be the result of induced demand for chiropractic services.



The Selection Effects of the Inclusion of a Chiropractic Benefit on the Patient Population of a Managed Health Care Organization

Craig F. Nelson, M.S., D.C., R. Doug Metz, D.C., Kurt Hegetschweiler, D.C., Thomas LaBrot, D.C., and Rene Vega, M.D., American Specialty Health

It is generally assumed by health insurers that by offering a broader and more comprehensive health benefit package, an adverse selection process (attracting less healthy members) will result. The selection effects of offering chiropractic benefit are unknown in this regard.

This study compares the risk profile (demographics, comorbidities) of employer groups that select a chiropractic benefit and those that do not. This study also compares the risk profiles of individual patients who utilize chiropractic care versus those who use medical care.

METHODS

This study evaluated the demographic characteristics and rates of selected comorbidities within a health plan. Individual employers had the option of selecting the health plan with or without a benefit for chiropractic care. Individual health plan members did not make this selection. Patients of employer

groups that did cover chiropractic care could self-select to receive either chiropractic medical treatment. The following cohorts were evaluated in the study: patients in health plans that cover chiropractic care (cohort A); patients in health plans that cover chiropractic care who received treatment for neuromusculoskeletal (NMS) conditions (cohort A1); patients in health plans that cover chiropractic care who received chiropractic treatment for NMS conditions (cohort A1a); patients in health plans that cover chiropractic care who received medical treatment for NMS conditions (cohort A1b); patients in health plans that do not cover chiropractic care (cohort B); and patients in health plans that do not cover chiropractic care who received treatment for NMS conditions (cohort B1). Patient enrollment data were used to identify age and gender of subjects. Administrative claims data, which contain ICD-9 diagnostic codes, were used to identify the presence of the following set of comorbid conditions: congestive heart failure, cardiac arrhythmia, hypertension, diabetes, hypothyroidism, nutritional/metabolic disorders, psychosis, and depression.

RESULTS

A total of 1.7 million subjects were evaluated: 707,000 with chiropractic coverage (cohort A) and 1,002,000 without chiropractic coverage (cohort B). Cohort A was younger with fewer persons in the over-65 age group (6.5% vs. 9.6%) and more subjects in the 0–17 group (31.9% vs. 26.2%). The mean age of cohort A was 32.9 vs. 35.5 in cohort B. There were no significant differences in gender. In six of the eight comorbid conditions studied, the rates were lower in the group with chiropractic coverage. For psychosis and depression, the rates were slightly higher in the group with coverage. The same trends and magnitudes of differences were seen when comparing cohorts A1 vs. B1. Comparing cohorts A1a and A1b, the mean ages were nearly identical (40.0 vs. 39.3). However, the age distributions were markedly different. There were far fewer over 65 (4.9% vs. 9.2%) in A1a than in A1b, and also far fewer 0–17 (9.4% vs. 19.4%). The rates of comorbid conditions were much lower in all

eight categories in A1a than in A1b. After age adjustment the differences in rates of comorbidities narrowed somewhat between these two cohorts, but remained significantly lower in six of the eight categories. The rates were slightly higher for psychosis and depression. All differences between cohorts were statistically significant.

DISCUSSION

The inclusion of a chiropractic benefit in a health plan seems to produce favorable selection processes, resulting in a slightly younger patient population with fewer comorbidities. This favorable selection effect appears to result in lower total health care costs among groups with coverage. At the level of patient self-selection, chiropractic patients are considerably younger and healthier than comparable medical patients. The lower rates of comorbidities in the chiropractic population persist even after adjusting for age differences.



Influences of an Open-Book Practical Radiology Examination on Student Anxiety Levels, Study Approaches, and Overall Performance

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Examination format has a huge impact on the way that students learn and whether or not this learning is “deep” or “superficial.” Problem-solving integrated examinations foster the deeper level of learning, but their ability to do this is limited if a multiple-choice (MCQ) format is used. Short-answer examinations have good reliability and simulate the realities of clinical practice much more closely than MCQ tests. Open-book examinations have been suggested for advanced courses requiring higher levels of problem solving and integration, once the core knowledge and skills are developed. Open-book examinations have been shown to reduce student anxiety levels, without necessarily increasing performance. The final, comprehensive, film-reading examination given to the 3rd-year students prior to entry into their clinical year was a problem-solving, case-based exam requiring short answers. Students were allowed to use notes or books on this exam for the first time since starting their radiology courses. The effect that this open-book format had on anxiety levels, approaches to studying, and performance levels needed to be evaluated.

METHODS

A 10-item questionnaire was designed, peer reviewed, and administered anonymously to all 3rd-year students immediately following their radiology practical open-book examination. Questions were included covering whether

or not anxiety levels, study habits, or exam preparedness changed. Other questions focused on the students’ opinions of the “ideal study approaches,” whether or not open-book exams were appropriate, and how often they used their notes or books during the exam. Finally, questions concerning frequency of attendance at lecture and lab classes were included. Descriptive statistics were evaluated for each question individually and correlation coefficients were calculated comparing frequency of attendance with frequency of note/book use during the exam, as well as anxiety levels to both preparedness level and appropriateness of open-book exams. The exams were marked and the mean score was calculated.

RESULTS

Student anxiety level was slightly reduced on this exam compared to previous examinations (2.74 on a 5-point Likert scale where 3 = unchanged), and there was a significant negative correlation between anxiety level and students’ opinion of having an open-book exam (Spearman’s $\rho = -0.217$, $p < .05$). Students with lower anxiety levels were more in favor of open-book exams. A significant correlation was also noted between frequency of note or book use during the exam and favorable opinion of this exam format (Spearman’s $\rho = .255$, $p < .05$). Students were overall slightly in favor of the open-book format (3.49 on a 5-point Likert

scale, where 1 = completely against it, 3 = neutral, 5 = highly in favor of it). The students did not change the way that they studied for this examination and they did not feel less prepared. However, they did not use the method of studying that they rated as most useful. A significant correlation was found between attendance at lectures and labs with frequency of book and note use during the exam (Spearman's $= .228, p < .05$; Spearman's $= .225, p < .05$), indicating that those with infrequent attendance were more reliant on their notes and books. The range of marks for this exam was very wide (42–97%), with nine failures and eight students with marks of 90% and above.

DISCUSSION

An open-book radiology examination only slightly reduced the students' anxiety level and the students were only slightly

in favor of this format of examination. They did not change their study approaches for this exam and stated that they felt just as prepared coming into it compared to previous traditional radiology examinations. The way that the students preferred to study and the way that they actually studied were not the same due to time constraints. The exam results were not inflated and the examination was discriminatory between those who were competent and those who were not. Students with infrequent class attendance used their notes and books more often during the examination. More reassurance from the faculty that an open-book exam does not mean a more difficult exam may further alleviate anxiety levels. Open-book exams should not be used in introductory courses, but are good for more advanced classes where problem solving can be evaluated and the realities of clinical practice more closely simulated.



The Effect of a Spinal Manipulation's Impulse Speed on Low-Threshold Mechanoreceptors in Lumbar Paraspinal Muscles

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The therapeutic effects of spinal manipulation are thought to arise, at least in part, from neural responses during the biomechanical input of the manipulation. Because impulse-type loading characterizes a spinal manipulation, it is important to understand how the speed with which the load is applied affects the signaling properties of primary afferent neurons innervating paraspinal tissues. The purpose of this study was to classify sensory nerve endings in lumbar paraspinal muscles and to characterize their responses to biomechanical loads applied over a range of speeds that encompass those occurring during spinal manipulation. If alterations in sensory input do contribute to the mechanism of spinal manipulation's therapeutic effect, it seems reasonable to expect that these primary afferents would respond to spinal manipulation in some unique fashion.

METHODS

Experiments were performed on six adult cats. An L4–L5 laminectomy was performed and the L6 dorsal roots were exposed. The L6–L7 vertebrae and associated paraspinal tissues remained intact bilaterally, including lumbodorsal fascia, multifidus, longissimus, iliocostalis muscles, and deeper tissues. Forceps were clamped tightly onto the lateral

surfaces of the L6 spinous process through a thin narrow slit in the lumbodorsal fascia. Single-unit afferent activity was recorded from fine filaments teased from the L6 dorsal root. Instantaneous discharge frequency was calculated. Afferents were classified based on von Frey threshold and conduction velocity. Loads resembling spinal manipulation were applied to the L6 vertebra (posterior to anterior) using a programmable electronic feedback control system. Force-time profiles were half-sine waves with durations of 25, 50, 100, 200, 400, and 800 ms and magnitudes of 33%, 66%, or 100% body weight.

RESULTS

Electrophysiological recordings were obtained from primary afferent neurons innervating lumbar multifidus and longissimus muscles. The receptive field for two of the six afferents was in the multifidus muscle, and the receptive field of the remaining four afferents was in the longissimus muscle. The six afferents were classified as low-threshold mechanoreceptors based on von Frey thresholds being less than 6 g. Conduction velocities ranged from 4.4 to 50 m/s. In general, the instantaneous discharge frequency for all six afferents increased abruptly as the speed of the impulse

approached 100 ms in duration. The increase in loading magnitude (33% vs. 66% vs. 100% BW) did not appear to affect systematically the discharge of the six low-threshold mechanoreceptors.

CONCLUSION

The responses from a small group of sensory neurons innervating lumbar paraspinal muscle suggest that abrupt

changes in neural discharge occur in low-threshold muscle mechanoreceptors as the speed of a biomechanical load approaches those typically used during spinal manipulation. Such a change in neural discharge during spinal manipulation could comprise part of the mechanism contributing to its physiological effects.



The Accuracy and Specificity of Lumbar and Thoracic Spinal Manipulation

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Clinicians utilizing spinal manipulative therapy (SMT) claim to be very specific and accurate with the delivery of their dynamic thrust. It has been suggested that the clinical success of SMT is dependent on the accurate delivery of that therapy to the target spinal joints. The purpose of this study was to locate the joints that cavitate during spinal manipulative procedures so that the accuracy and specificity of manipulation could be assessed.

METHODS

Sixty-four asymptomatic participants, ranging from 22 to 49 years, volunteered to act as patients for the study. Twenty-eight different clinicians performed thoracic and lumbar spinal manipulative procedures. The range of clinical experience was 1–43 years.

Asymptomatic participants received SMT to either the thoracic or lumbar regions of their spine. Accelerometers were secured to the skin over the spinal column, and the relative time at which each accelerometer detected the vibration from the cavitation associated with the SMT was used to calculate the source of the vibration. The site of cavitation was then compared to the target location.

RESULTS

For lumbar SMT, the average error from target of 124 cavitations in lumbar procedures was 5.29 cm (at least one vertebra away from target), with a range of 0–14 cm. Of these cavitations, 57 were deemed to be accurate and 67 were deemed to be inaccurate. The average error from target of 54 cavitations in the thoracic spine was 3.5 cm, with a range of 0–9.5 cm. Of these cavitations, 29 were deemed to be accurate and 25 were deemed to be inaccurate. In most cases, individual manipulative procedures were associated with multiple cavitations, ranging from two to six sites.

CONCLUSION

In the lumbar spine, SMT was accurate about half the time. However, because most procedures were associated with multiple cavitations, in most cases, at least one cavitation emanated from the target joints. In the thoracic spine, SMT appears to be more accurate.



Epidemiology of Occupational Injuries in Chiropractic Practice

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Chiropractic practice requires the performance of many labor-intensive tasks. These physical demands have been found to contribute to work-related musculoskeletal disorders in other health care occupations. The US Department of Labor defines occupational injury as one that results from a work-related event from a single instantaneous exposure in the work environment. Work activities and conditions may also contribute to musculoskeletal disorders. Studies indicate a high injury rate among health care workers such as nurses and physical therapists, with low back pain an especially common and costly problem. Tasks performed by chiropractors are similar to those engaged in by other health care providers, thus also placing them at risk of injury, although no published indexed information is currently available on occupational injuries among chiropractors. Consequently, the primary objectives of this study were: 1) to estimate the prevalence of occupational related injury among US chiropractors; 2) to identify possible contributing factors to occupational injuries; and 3) to describe the injury and any subsequent changes in practice patterns.

METHODS

In 2002, we conducted a mail survey of 1500 doctors of chiropractic randomly selected from a list of a national chiropractic professional organizations. Inclusion criteria were active practice and at least 15 years of practice experience. Recipients were informed that response implied consent. Postage-paid return envelopes were provided and postcard reminders were mailed 2 and 4 weeks after the initial mailing. The survey instrument was a two-page questionnaire with predominantly closed-ended questions on work-related injuries, demographics, and selected health habits. It was piloted with a sample of chiropractors and modified prior to administration. Descriptive statistics were computed using Statistical Package for Social Sciences (SPSS), version 10.5 for Windows.

RESULTS

A total of 451 valid questionnaires were returned (30% response rate). Respondents were primarily male (93%) with

a mean of 28 years in practice. Fifty-seven percent of the respondents reported work-related musculoskeletal injury during their career, distributed as follows: wrist (52%), lower back and hand (50% each), shoulder (35%), neck (22%), and upper back (21%). Injuries reported were ligament sprain (45%), muscle strain (43%), tendinitis (37%), vertebral disc (26%), and degeneration (23%). Most frequently reported injury-related activities were performing manual procedures (73%), repetitive tasks (48%), bending/twisting (31%), and working when physically fatigued (18%). Of respondents reporting work-related injuries, 85% reported that practice activities exacerbated their symptoms, specifically manual procedures (69%), repetitive tasks (50%), bending or twisting (33%), and long hours/fatigue (25%). Eighty-two percent of the respondents reported that injury caused them to alter activities such as work position (64%), body mechanics (50%), delegation to other personnel (38%), and frequency of manual techniques (33%). Sixty-two percent reported modifying patient care due to their symptoms, specifically treatment technique (53%), reduced number of patients (21%), and reducing work hours (18%).

DISCUSSION

There are a number of limitations to this study, including possible self-report, recall, and response bias. The chiropractic profession has historically emphasized prevention and health promotion, especially regarding ergonomics, body mechanics, and minimizing neuromusculoskeletal injury. However, despite this emphasis, this study suggests that risks associated with physical stressors are common in chiropractic practice.

CONCLUSION

This study suggests that a majority of chiropractors have suffered an occupational injury, primarily related to administering manual procedures. It is important for chiropractic educators, practitioners, and professional organizations to recognize such risk factors and seriously address prevention of these injuries through both training programs and additional research.



Predictability of Student Performance in a Chiropractic Graduate Program, Based on College Admissions Requirements

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Previous research has tested the validity of using various admissions criteria as predictors of graduate and professional school performance. Many of these studies have shown that specific undergraduate coursework, as well as other admissions requirements, are better predictors of graduate and professional school performance than total undergraduate grade point average (GPA). Similar studies on chiropractic-based programs are limited. However, early results have indicated that predictors of performance in chiropractic-based programs are similar to the predictors of performance in related fields. The current study builds on the previous research, analyzing the degree to which various admissions requirements predict performance in a chiropractic college, as indicated by graduate GPA and National Chiropractic Board Exam scores.

METHODS

Data were randomly collected through institutional recorders on 100 graduates of a chiropractic college in the Midwest. Linear regression analysis was used to determine individual admissions criteria's predictability of graduate performance and to establish the various composites for multiple regression analysis. Composites were analyzed using forced-entry and stepwise multiple regressions to determine the best predictor models for the various graduate performance indicators.

RESULTS

Multiple regression analysis revealed that a model containing organic II grade, degree status, and organic I grade was the best predictor of overall graduate performance for both GPA and board scores. Graduate students with degrees in biology, chemistry, or other related fields had significantly higher performance levels in their graduate work than

students with no degree upon matriculation into a graduate chiropractic program.

DISCUSSION

Given the nature of organic chemistry, it is logical that organic chemistry, especially organic chemistry II, would be a good predictor of performance on both the chiropractic boards and graduate-level GPAs. Organic chemistry requires that students incorporate material from classes such as general chemistry, while synthesizing and mastering new material. The thought processes used in organic chemistry are similar to the thought processes required in the diagnostic classes of a chiropractic program. In addition, organic chemistry is the foundation of biology; thus, a sound understanding of organic would translate into stronger performance in biological classes.

Based on the findings of this study, admissions offices should implement some changes to admissions practices. For example, the research supports altering admissions procedures to place an emphasis on organic chemistry grades. In addition, admissions offices could significantly increase the performance of chiropractic students by requiring students to have an undergraduate degree upon matriculation of the chiropractic program.

CONCLUSION

The current study has shown that one can use specific undergraduate grades and other specific admissions requirements as predictors of graduate performance in a chiropractic program. The current research, as well as further research in this area, will allow undergraduate colleges to enhance their preprofessional health programs. In addition, the current study provides additional information that admissions personnel can use to select students with a high probability of success in a chiropractic program.



A Randomized Clinical Trial of the Relative Effectiveness of Manual Versus Mechanical Force Chiropractic Adjustments in the Management of Sacroiliac Joint Syndrome

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This study was submitted as a dissertation to the Faculty of Health, in compliance with the requirements for the Master's Degree in Technology from the Chiropractic Department, Durban Institute of Technology, Durban, South Africa.

Sacroiliac joint (SIJ) syndrome is a common presenting disorder among patients with back pain. Previous research has demonstrated a benefit of spinal manipulation in patients with SIJ syndrome. However, no study has compared the relative effectiveness of different forms of spinal manipulation or chiropractic adjustments in its management. The purpose of this study was to determine the relative effect of instrument-delivered as compared to traditional manual-delivered thrust chiropractic adjustments in the treatment of SIJ syndrome.

METHODS

A prospective, randomized, comparative clinical trial was conducted at the outpatient chiropractic clinic, Durban Institute of Technology, Durban, South Africa. Sixty patients (31 male, 29 female, ages 18–59) diagnosed with SIJ syndrome were randomized into two groups of 30 subjects. Each subject received four chiropractic adjustments over a 2-week period and was subsequently evaluated at 1-week follow-up. The subjects in one group (group 1) received side posture, high-velocity, low-amplitude (HVLA) chiropractic adjustments of the symptomatic SIJ using the National-Diversified technique. The subjects in the other group (group 2) received mechanical force, manually assisted (MFMA) chiropractic adjustments of the symptomatic SIJ using an Activator Adjusting Instrument. Both groups received only chiropractic adjustment as treatment intervention with no other treatment modalities or interventions utilized, including medication use. Outcomes included the Numerical Pain Rating Scale-101 (NRS), Revised Oswestry Low Back Pain Disability Questionnaire (Oswestry), algometry, and Orthopedic Rating

Scale (ORS). Outcomes were statistically analyzed using the Mann-Whitney *U* test (for intergroup analysis), and Friedman's *T* test (for intragroup analysis) to assess differences from the first, third, and final consultations within and between groups.

RESULTS

No significant differences between groups were noted at the initial consultation for any of the subjective and objective variables. Statistically significant improvements in subjective and objective outcomes were observed in both groups from the first to third, third to fifth, and first to fifth consultations for all measures except pain pressure threshold. Specifically, statistically significant improvements ($p < .001$) in mean NRS (group 1 = 49.1 to 23.4; group 2 = 48.9 to 22.5), Oswestry (group 1 = 37.4 to 18.5; group 2 = 36.6 to 15.1), ORS (group 1 = 7.6 to 0.6; group 2 = 7.5 to 0.8), and algometry measures (group 1 = 4.8 to 6.5; group 2 = 5.0 to 6.8) were observed from the first to last visit for both groups. Statistical analysis of the subjective and objective data showed equal improvement for both groups. Intergroup analysis showed that there was a slight difference between the two groups, favoring MFMA (group 2). However, these observations were not statistically significant for all the outcome measures.

CONCLUSION

The results of this clinical trial indicate that a relatively short regimen of both MFMA and HVLA chiropractic adjustments provides a beneficial effect associated with reducing pain and disability in patients diagnosed with SIJ syndrome. Neither MFMA nor HVLA adjustments were found to be more effective than the other in the treatment of this patient population.



CMCC's Grand Rounds Presentations as a Core Component Within the Third-Year Module Structure

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Grand rounds (GR), large group presentations of recent advances in clinical practice, interesting cases, or concurrent

research, are an integral part of the teaching, continuing education, and practice of medicine. Students at the Canadian

Memorial Chiropractic College (CMCC) have extensive observational programs throughout their first 3 years of study. Simulated cases or case-based studies are also used extensively. However, our students have few opportunities to observe the clinical problem solving that occurs when an experienced clinician evaluates a patient. In 2002, the 3rd year was converted into a modular format with nine regionally based modules. Each module was approximately 3 weeks in length, composed of 17 days of class time, a study day, 2 days for theory assessment, the GR day, and a final day to assess psychomotor/orthopedics skills and history, physical examination, and diagnosis.

METHODS

The learning needs that we attempted to address were to enhance student's knowledge of taking a comprehensive history, performing a focused physical examination, and generating a plan of management which was clinically evidence based. In addition, the study was designed to demonstrate a proficient chiropractor's real-time clinical reasoning processes and skills, and further, to complement, enhance, and integrate basic sciences and the preclinical courses. Finally, we wanted to expose students to their clinical learning deficiencies, subsequent needs, and dealing with uncertainty. Premeetings were conducted to decide the complexity of the case (e.g., overlapping and/or conflicting symptomology, inclusion of red and/or yellow flags). A script was composed and made available to the standardized patient (SP). After SP selection, the history responses, review of the examination procedures, and the SP's appropriate reactions were rehearsed. Inquiry was made into the SP's current and past real history for secondary or tertiary complaints to be woven into the case to add both complexity and reality. An experienced clinician (minimum 5 years in practice) was recruited from one of our college's outpatient clinics. She/he was asked to proceed with the completeness,

thoroughness, and attention to detail that is expected by the interns in the college's clinics without prior knowledge of the SP or their clinical condition(s). The GR format was coordinated around the doctor-patient encounter, which was divided into three phases: history taking; physical examination and report of findings; and plan of management and patient consent. Preceding, during, and following the three phases were 10- to 15-minute didactic, focused, integrative review presentations from the preclinical program. Each student received a complete new patient case package identical to that which they will be using during their upcoming clinical year. Prefilled intake forms and the clinician's notations were displayed via overheads. The GR day is the first exposure the students had to any information related to the SP.

DISCUSSION

Assessment of the GR days has been informal to date. Under consideration is a portfolio that, structured appropriately, would address the learning needs of the students in terms of enhancing deeper and personal learning, taking responsibility for their own learning, and personalizing their learning experience. Formal evaluations during the year were not undertaken at this early stage but are in the planning stages. However, personal preliminary observations and constant informal feedback during the academic year from the students indicated to us that their clinical education was enhanced with deeper learning and student satisfaction was apparent. As reported in the literature, case-based presentations provide a valuable and realistic methodology in bringing the reality of the doctor-patient encounter into the classroom environment. In addition, it provides for curricular integration of relevant lecture content for each module and in our opinion facilitates vertical curricular integration by bridging the gap between the 3rd and clinic year.



Attenuation of Tumor Necrosis Factor Secretion Following Spinal Manipulative Therapy in Normal Subjects

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Spinal manipulation therapy (SMT) may influence the production of certain mediators of the immune and inflammatory responses such as neurotransmitters and cytokines. It has been suggested that normal subjects receiving SMT produce higher concentrations of the pro-inflammatory cytokine, tumor necrosis factor alpha (TNF- α), a pivotal proinflammatory and immunoregulatory mediator. The present study was undertaken to determine the effect of SMT on the in vitro

capacity for bacterial lipopolysaccharide (endotoxin, LPS) - induced TNF- α synthesis.

METHODS

The study included 60 age- and gender-matched normal (asymptomatic) subjects who were assigned to one of three

groups: SMT, sham manipulation (SHM), or venipuncture control (VC). SMT consisted of a cross-bilateral setup with a single thrust applied to the involved vertebral segment. Sham manipulation also consisted of a cross-lateral setup using similar force but with positioning and line of drive that did not cavitate the joint. Subjects in the VC group were treated similarly to the SMT and SHM groups in every way except for the thrust. Blood samples were collected prior to any intervention and then at 20 minutes and 2 hours post-treatment. Samples collected before intervention served as a self-control (baseline) to which post-treatment responses were compared. A whole blood culture system was utilized. Cultures were stimulated at initiation with LPS at doses of 1, 5, and 10 $\mu\text{g}/\text{mL}$. Following 24 hours of cultivation, culture supernatants were collected for determination of TNF- α levels by a specific enzyme-linked immunosorbent assay (ELISA). Statistical significance of differences was determined using the Student paired *t* test. Analysis of proportions in independent samples was performed using Chi-square with Yates' correction. Ethics approval for the present study was received from CMCC Institutional Research Board.

RESULTS

Prior to intervention, the mean magnitudes of this cytokine production were comparable in all groups (range, 1400–2300 pg/mL). In cultures derived from VC and SHM subjects at 20 minutes postintervention, the levels of TNF- α were consistently higher (1600–2500 pg/mL) compared with their

respective baselines and increased further in supernatants from cultures initiated 2 hours postintervention (range, 1700–2800 pg/mL). Conversely, in cultures stimulated with 1 or 5 $\mu\text{g}/\text{mL}$ of LPS and derived from SMT-treated subjects, the production of TNF- α declined at 20 minutes and remained unaltered at 2 hours. In parallel preparations stimulated with the highest dose of LPS (10 $\mu\text{g}/\text{mL}$), the levels of TNF- α decreased further (by close to 35% compared with respective VC and SMH cultures and by over 20% compared with baseline). In VC- and SHM-treated subjects, frequencies of cultures showing increased levels of TNF- α production were significantly higher than those in SMT-treated individuals. In contrast, frequencies of cultures in which the synthesis of TNF- α was reduced were significantly higher in subjects receiving SMT.

DISCUSSION

The present report is the first to demonstrate that in asymptomatic subjects, a single SMT can produce time-dependent reduction in the capacity for LPS-induced production of TNF- α . Moreover, peripheral blood cells from these individuals display diminished sensitivity for response to LPS stimulation in a dose-dependent fashion. Attenuation of TNF- α secretion in the presence of high concentrations of endotoxin combined with amelioration of the peripheral blood cells response to additional inflammatory stimulus (repeated venipuncture) in SMT-receiving normal subjects suggest that SMT can exert a modulatory and/or stabilizing effect on the inflammatory response *in vivo*.



Symmetry Within Cadaver Pelves Across Gender, Severity of Lower Lumbar Osteophytes, and Age

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Radiographic pelvic marking systems are utilized with the intent to help isolate potential pelvic mechanical dysfunctions. However, if predictable symmetry is not common between pelvic structures, then these marking systems may not be identifying pelvic dysfunction but rather natural anatomy. Previous findings indicate that the height of the pelvis tends to be predictable; however, there is more variation between the widths. Therefore, additional study is needed to examine for further evidence of symmetry and if this symmetry is conveyed to their respective radiographs.

METHODS

One hundred two cadaver pelvis (53 males, 49 females) were placed in the horizontal spino-symphysial plane for

measurement and radiographs. Linear ($n = 8$) and area ($n = 11$) calculations were performed on the cadaver and radiographs measurements to identify paired dimensions that exhibited high and low levels of symmetry. Subgroup analysis was performed between gender, degree of lower lumbar osteophytes, and age groups.

RESULTS

Comparison between genders found the highest symmetry between the paired area from the iliac crest to sacral base to ipsilateral tuberosity (males: $R^2 = .992$; females: $R^2 = .990$), but this high symmetry was not conveyed to the radiographs. However, all measurements for gender were significant on both the cadaver and the radiographs. Comparison of the

severity of lower lumbar osteophytes (on a scale of 0–4) with means set at 3.00 and above ($n = 24$) and a mean below 2.00 ($n = 26$) were similar between groups. The exception was the linear dimension from the iliac wing to the iliac crest on the cadaver where an increase in the mean osteophyte grade decreased linear symmetry; however, this difference was not found on the radiographs. Comparisons between the age groups of the 40s ($n = 8$), 50s ($n = 13$), 60s ($n = 19$), 70s ($n = 24$), 80s ($n = 29$), and 90–100 ($n = 8$) demonstrated that the 40-year-old age group consistently had the highest correlations, whereas the 90-year-old age group had the lowest correlations. A post hoc analysis of removing pelvises with lumbosacral anomalies ($n = 14$) did not significantly alter any of the above findings.

DISCUSSION

The linear and area measurements between genders, as well as severity of lower lumbar osteophytes, tended to have moderate to strong symmetry unless the measurement included from the iliac wing to the iliac crest. However, the strong symmetry found on cadavers was not always conveyed to the radiographs. It appears that regardless of the severity

of osteophytes in the lower lumbar spine, the core of the pelvis is either not affected by these changes, or osseous changes occur in the pelvis in such a manner that the pelvic core remains symmetrical. There is indication that the lateral part of the iliac wing and/or the most superior aspect of the iliac crest undergo changes with the progression of age and may account for the gradual loss of symmetry with age. Since some radiographic marking systems rely on these landmarks, additional investigation is warranted to determine how these osseous changes may relate to joint mechanics and marking analysis.

CONCLUSION

There appear to be areas in the human pelvis, particularly within the pelvic core, which maintain strong symmetry across genders as well as with the severity of lower lumbar osteophytes. Whether this pelvic core symmetry is an adaptive response or unaffected by lumbar osteophytes requires further study. It does appear that a decrease in symmetry may occur with an increase in age and thus age may be a covariable that needs to be considered when performing pelvic radiographic marking analysis.



Effects of Visual Feedback on Manipulation Performance and Patient Ratings

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Various training methods have included didactics, instructor modeling, verbal feedback, and mechanical aids. This study tested the effectiveness of changing performance by providing novices knowledge of results (KR) through visual feedback of their own manipulation load-time histories in comparison to a gold standard “expert.”

METHODS

Forty students with no formal training in spinal manipulation therapy (SMT) were paired after IRB-approved consent. Each pair was randomized into two groups (G1 and G2). An L4 mamillary push procedure was performed by each other while monitored by an AMTI table. Students viewed documentation of the setup prior to performing the procedure. Five geometric measures defining the patient setup were quantified by one of the investigators. When ready, the student signaled

and data collection was begun. The procedure was administered within a 5-second interval. Loads transmitted to the force plate were captured. G1 was blinded to KR and not informed that G2 would have KR. In G2, KR was provided in the form of load-time histories. These were visually contrasted with a gold standard from an expert manipulator. G2 then performed the procedure again, cued by “Make yours look like this.” Clarifications prompted by student query were permitted. G2 performed three replications of the L4 procedure followed by feedback. After the third, the student performed a 10-minute intellectual exercise followed by a final effort. On completion, students rated their partner (six parameters, 10-cm visual analog scale). For G1, the single performance was rated. For G2, the postdistraction performance was rated. Results were analyzed separately for biomechanical parameters (duration, speed, amplitude) and for partner ratings. Results were tested using the Student t test with levels of significance ($p < .01$) adjusted for repeated testing.

RESULTS

The biomechanical parameters compared the procedure after the distraction task to the initial performance a few minutes earlier. Force duration fell from a mean of 0.4 second to 0.33 second ($p < .01$). Duration for moment load fell from 0.38 second to 0.31 second ($p < .001$). Speeds increased for force (2132 N/s to 2761 N/s; $p < .006$) and moment (477 Nm/s to 781 Nm/s; $p < .005$). Mean peak amplitudes increased but only force was statistically significant (force: 312 N to 372 N, $p < .008$; moment: 75 Nm to 86 Nm, $p < .07$). Expressed in terms of percent change for each individual, feedback altered the performance of G2 a minimum of 14% and a maximum of 32%. The rating instrument parameters were "comfort, fast, force, precision, confidence and composite" on a 10-cm scale. Statistical analysis rating the performance of G1 vs. G2 favored G2 on four of the parameters (fast, $p < .0008$; force, $p < .0056$; precision, $p < .0034$; composite, $p < .0016$).

DISCUSSION

The training of SMT historically provides instructor feedback and tactile cueing without actual measurement. A

previous study demonstrated that self-directed feedback without a target end point resulted in small differences of performance. This study suggests that visual feedback and targeting a specific end point results in immediate and large differences. "Experienced" subjects noted differences in four of six ratings between G1 (no feedback) and G2 (feedback). Providing KR in the form of visual feedback to novice students improves performance rapidly. Retention of the differences is currently under investigation.

CONCLUSION

With biomechanical parameters and rating scores significantly higher for the unblinded group in duration, speed, and amplitude, as well as ratings of fast, force, and precision parameters, the implementation of visual feedback into the adjusting curriculum seems worth investigating.



Influence of Axial Rotation on Chiropractic Pelvic X-Ray Analysis

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Most doctors of chiropractic analyze X-ray images, with the results impacting clinical decisions. The Gonstead system of analysis, incorporating pelvic line drawing analysis, is widely utilized in practice and is taught within chiropractic curricula. As a result of potential positioning error, validity of this measurement system is questionable. The purpose of this study was to explore associations between axial (y-axis) rotation of the pelvis and pelvic radiographic measurements. Descriptive film statistics of an incrementally rotated pelvis and linear regression analysis were used.

METHODS

A phantom pelvic model was incrementally imaged (1° increments) at 40 inches source-to-image distance through 10° of axial rotation. Chiropractic line drawing analysis was performed. The chiropractic examiner was blinded to the degree of rotation during the film analysis. Regression analysis was performed between axial rotation and pubic

symphysis deviation, sacral width, and innominate height. Each measurement corresponds to a chiropractic listing within the Gonstead system.

RESULTS

Regression analysis revealed a strong association between the degree of axial rotation and each response variable: pubic symphysis deviation, sacral width, and innominate height. The strongest relationship existed between y-axis rotation and pubic symphysis deviation.

CONCLUSION

Chiropractic pelvic listings are strongly influenced by positioning of the subject. A few degrees of axial rotation create apparent misalignments/listings of several millimeters.



Paravertebral Surface Electromyography of an Adolescent Idiopathic Scoliosis Patient During a Novel Multifactorial Treatment Regimen

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The purpose of this case study was to report the paraspinal muscle response during a novel multifactorial treatment regimen used on a 13-year-old female patient with adolescent idiopathic scoliosis.

METHODS

Eight bilateral paraspinal locations were tested by surface electromyography (SEMG) in a seated posture following each of four treatment interventions. The interventions included: unweighted gait training (UWGT) wearing a torso vest, which permitted horizontal traction to the scoliotic curve; stretching (S); vertical traction in a seated posture, followed by unilateral resistance exercises (URE) on the convex side of the curve/s; and cervical curve compression, followed by spinal manipulation (SM).

RESULTS

The initial pretreatment resting position identified hyperactivity on the convex and concave sides of the multicurve

scoliosis. Unweighted gait training and stretching produced the lowest SEMG readings, resistance exercises produced the highest readings, and spinal manipulation most frequently produced the best balance of the paraspinal readings. Paired *t* tests for each spinal level for intertreatment measurements demonstrated $p < .05$. This was considered significant for the treatment interventions. Over a 12-week period, the multifactorial treatment produced 16.7° of improvement in the lateral curves. In the sagittal plane, the cervical and lumbar curves demonstrated improved lordosis by 18° and 7°.

CONCLUSION

SEMG identified the muscular responses to four treatment interventions, all of which had components that contributed to lower hyperactivity, increased hypoactivity, improved paraspinal balance, and moderately reduced the lateral curves in a child with idiopathic scoliosis. SEMG is a well-developed instrument that can be used to assess paraspinal muscle response to each component of a multifactorial treatment strategy.