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Editorial Staff

Effects of spinal manipulative therapy on autonomic activity and the cardiovascular system: A case study using the electrocardiogram and arterial tonometry.

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Objective: To determine if there is alteration in the autonomic nervous and cardiovascular systems following chiropractic manipulative therapy (CMT). A novel approach was used to quantitatively probe for changes in the activity of the autonomic nervous system, in blood pressure and in pressure pulse transmission time. This approach utilizes electrocardiogram (ECG) and arterial tonometry (AT) equipment.

Design: This case study involves one subject treated over a period of six weeks (two visits/wk). Respiration, ECG, and left and right radial artery blood pressures were measured during the baseline (two visits) and treatment (10 visits) phases. Measurements were obtained before (n=3) and after (n=3) either a break period (baseline), or before and after CMT. CMT was of the high-velocity, low-amplitude type that produced joint cavitation.

Setting: The study was performed at the Parker College Research Institute in a temperature-controlled laboratory.

Main Outcome Measures: Fourier analysis was performed on the ECG-determined R-R intervals. The low-frequency (LF) power between 0.04 to 0.15 Hz. and the high-frequency (HF) power between 0.15 to 0.40 Hz represents the activity of the sympathetic (SNS) and parasympathetic nervous system (PNS), respectively. The main outcome measure was the sympathovagal index which is determined from the ratio of LF/HF. The arterial pressure, and the time for pressure pulses to travel from the heart to the radial artery recording sites (pressure pulse transmission time), were studied. Differences (average of three post-measurements minus pre-measurements) for each variable were calculated.

Results: After the 1st CMT treatment, the difference between treatment and baseline decreased for both the LF/HF (-2.804 ± 1.273) and LF power (-0.135 ± 0.056). These findings indicated that the PNS predominated over the SNS. After the 3rd, 4th, 6th and 9th treatment, the difference between treatment and baseline increased for LF/HF (0.908 ± 0.338 , 2.313 ± 0.300 , 2.776 ± 1.102 and 0.988 ± 0.269 , respectively) and indicated that the SNS predominated over the PNS. Also, the difference between treatment and baseline for the pressure pulse transmission time decreased bilaterally following the 4th (left: -13.52 ± 3.70 milliseconds [ms], right: -9.75 ± 3.76 ms) and 6th (left: -9.53 ± 3.60 ms, right: -9.24 ± 3.50 ms) treatment which indicated that arterial compliance had decreased. Moreover, following the 6th treatment, the difference between treatment and baseline for the R-R

interval time decreased (-0.084 ± 0.014 s). The difference between treatment and baseline for the systolic, diastolic and mean arterial pressure for the above-mentioned treatments were not considered significant.

Conclusion: This case study is the first to attempt to use ECG and AT data to study the effects of CMT on the autonomic nervous and cardiovascular systems over an extended period of time. These devices allowed a more in-depth study of the cardiovascular and autonomic changes associated with CMT. While changes in the autonomic nervous and cardiovascular systems can be detected, further development of a reliable and reproducible experimental protocol is required prior to validating the effects of CMT on these systems.

Key Indexing Terms: Chiropractic; Autonomic Nervous System; Electrocardiogram; Blood Pressure.

Highlighting of intervertebral movements and variations of intradiscal pressure during lumbar spine manipulation. A feasibility study.

Jean-Yves Maigne, MD, and Francois Guillon, MD, PhD.

Objectives: To demonstrate relative movement of the vertebrae and variations in intradiscal pressure during two different lumbar spinal manipulations, in flexion or extension, in two unembalmed cadavers.

Design: A pressure sensor was inserted into the L3-4 disc in cadaver 1, and in the L1-2 to L4-5 discs in cadaver 2. Two adjacent vertebrae (L3 and L4 in cadaver 1, and L4 and L5 in cadaver 2) were each equipped with two monoaxial accelerometers recording acceleration in the caudocranial axis, and a biaxial accelerometer recording acceleration in the "horizontal" anatomical plane.

Setting: Laboratory study.

Results: During the thrust, relative intervertebral movements were demonstrated; movements differed with the type of manipulation (in flexion or extension). Intradiscal pressure initially increased, then decreased.

Conclusions: Lumbar spinal manipulations have a biomechanical effect on the intervertebral discs, producing a brief but marked change in intradiscal pressure. This effect is the consequence of movements of the adjacent vertebrae. It differs slightly with the different types of manipulation studied.

Key Indexing Terms: Chiropractic Manipulation; Intradiscal Pressure; Low Back Pain.

In Vivo transient vibration assessment of the normal human thoracolumbar spine.

Tony S. Keller, PhD, Christopher Colloca, DC and Arlan Fuhr, DC.

Objective: The objective of this study was to quantify the mobility (dynamic stiffness and mechanical impedance) characteristics of the normal human thoracolumbar spine using a transient vibration

analysis technique.

Design: This study is a prospective clinical investigation to obtain normative biomechanical data from the human male and female spine *in vivo*.

Setting: Musculoskeletal research laboratory, university setting.

Subjects: Twenty asymptomatic subjects (age range 20 - 60 yrs.) with no recent history of musculoskeletal complaints.

Main Outcome Measures: Mechanical impedance, effective stiffness, and resonant frequency analyses were used to quantify the dynamic stiffness of the thoracolumbar spine in this subject population. Data was obtained from posteroanterior (PA) mechanical thrusts delivered with an Activator(r) Adjusting Instrument (AAI) equipped with a load cell and accelerometer by means of a portable computer.

Results: In response to the AAI thrusts, the thoracolumbar spine typically exhibited an impedance minimum at frequencies ranging between 30-50 Hz. The maximum PA impedance and corresponding maximum effective stiffness of the thoracolumbar spine and sacrum was roughly two to eight times greater than the magnitude of the impedance minimum. Statistically significant differences in mobility between males and females were noted, particularly for frequencies corresponding to the maximum mobility (c. 40 Hz) and minimum mobility (10-20 Hz, 70-80 Hz). For most subjects (both males and females) the lumbar region exhibited a higher impedance and stiffness (less mobility) when compared to the thoracic region.

Conclusions: The PA mechanical behavior of the human thoracolumbar spine was found to be sensitive to mechanical stimuli frequency and showed significant region specific and gender differences. In the frequency range of 30-50 Hz, the lumbar spine of this subject population is the least stiff and therefore has the greatest mobility. From a biomechanical point-of-view, the results of this study indicate that dynamic spinal manipulative therapy (SMT) procedures will produce more spinal motion for a given force, particularly when the PA manipulative thrust is delivered in frequency ranges at or near the resonant frequency. In this regard, SMT procedures designed to target the resonant frequency of the spine require less force application. Both magnitude and frequency content of manual and mechanical thrusting manipulations may be critical elements therapeutic outcome.

Key Indexing Terms: Biomechanics; Manipulation-Chiropractic; Mechanical Impedance; Spine; Stiffness.

The role of spinal tissues in resisting posteroanterior forces applied to the lumbar spine.

Raymond Y.W. Lee, PhD, and John H. Evans, PhD.

Objective: To determine the effects of dissection of spinal tissues on the mechanical behavior of motion segments under the application of posteroanterior forces.

Design: A cadaveric motion segment study.

Setting: A tissue mechanics research laboratory.

Procedure: Anterior shear and extension moment were applied to 10 motion segments to simulate the clinical situation when posteroanterior forces were applied to the spine. The movements of the specimens in the sagittal plane were studied by a camera. Spinal tissues were dissected sequentially, and the mechanical testing was repeated after dissection of each tissue.

Results: The most significant movements produced were extension and superior translation of the anteroinferior corner of the superior vertebral body. Translational movements in the other directions were small. Dissection of the posterior ligaments and zygapophyseal joints did not lead to significant changes in the movements.

Conclusion: Injuries of the posterior ligaments are unlikely to alter the mechanical response of the spine to posteroanterior forces. However, these posterior tissues are pain-sensitive, and may be subjected to large strains and elicit symptoms.

Key Indexing Terms: Back; Lumbar Spine; Biomechanics.

Chiropractic patients in the Netherlands: A descriptive study.

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Background: Despite the worldwide popularity of chiropractic in Anglo-Saxon countries, there is still relatively little known about the patients that visit chiropractors in the Netherlands and other European countries.

Objective: To describe in-depth the patient population of new patients presenting to chiropractors in the Netherlands.

Design: Study population consisted of 10 new consecutive patients per participating chiropractor. A retrospective-type questionnaire was used.

Setting: Private practice.

Main outcome measures: Mode of referral, area and nature of the complaint(s). Related to the chief complaint: previous treatments, examinations, type of referral, days lost at work, level of pain and treatment expectations.

Main results: Of the 130 registered chiropractors with the Netherlands Chiropractors' Association, 94 (78%) participated. 833 Patients (89%) returned questionnaires. By far, the greatest reason why patients visit chiropractors in The Netherlands is for neuromusculoskeletal (NMS) complaints. At the time of presentation, 86% of the patients had spinal-related complaints, of which 12% involved multiple areas of the spine. Non-NMS complaints are minimal (<2%). Seventy-seven percent of NMS patients have chronic (>12 weeks) complaints. Three-quarters have had previous conservative therapy for their complaint, which includes physical and manual therapy, postural correction and exercise therapy. Despite the chronic nature of their complaint, patients have high expectations that their treatments will be effective.

Conclusions: The majority of patients that present to chiropractors in the Netherlands have chronic

NMS-related complaints. Chiropractors are not a part of the normal referral system in this country, with the result that patients have rather long histories, including prior evaluations by medical specialists and other previous forms of (conservative) care.

Key Indexing Terms: Chiropractic; Netherlands; Surveys; Patients.

Upper cervical chiropractic management of a parkinson's disease patient: A case report.

Erin L. Elster, DC

Objective: To discuss the use of upper cervical chiropractic management in managing a single patient with Parkinson's disease (PD) and to describe the clinical picture of the disease.

Clinical Features: A 60-year-old male was diagnosed with PD at age 53, after a twitch developed in his left fifth finger. He later developed rigidity in his left leg, body tremor, slurring of speech, and memory loss, among other findings. Intervention and Outcome: This subject was managed with upper cervical chiropractic care for nine months. Analysis of precision upper cervical radiographs determined upper cervical misalignment. Neurophysiology was monitored using paraspinal digital infrared imaging. This patient was placed on a specially designed knee-chest table for adjustment, which was delivered by hand to the first cervical vertebrae according to radiographic findings. Evaluation of Parkinson's symptoms occurred by doctor's observation, the patient's subjective description of symptoms, and use of the Unified Parkinson's Disease Rating Scale. Reevaluations demonstrated a marked improvement in both subjective and objective findings.

Conclusion: Upper cervical chiropractic care aided by cervical radiographs and thermal imaging had a successful outcome for a patient suffering from Parkinson's Disease. Further investigation into upper cervical injury as a contributing factor to Parkinson's Disease should be considered.

Key Indexing Terms: Cervical Spine; Chiropractic; Parkinson's Disease; Trauma; Thermography.

Non-operative treatments for sciatica: a pilot study for a randomized clinical trial.

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Objectives: To assess the feasibility of patient recruitment, the ability of patients and clinicians to comply with study protocols, and the utility of data collection instruments to collect cost-effectiveness data. Finally, to obtain variability estimates for sample size calculations for a full-scale trial.

Study Design: Prospective, observer-blinded, pilot randomized clinical trial.

Setting: Primary contact chiropractic and medical clinics.

Patients: Ages 20-65 with low back-related radiating leg pain (sciatica).

Outcome Measures: Self-report questionnaires were administered at baseline, 3 and 12 weeks post-

randomization. The measures included leg and back pain severity, frequency and bothersomeness of symptoms, leg/back disability, medication use, global improvement, satisfaction and health care utilization.

Interventions: Medical care, chiropractic care and epidural steroid injections.

Results: A total of 706 persons were screened by phone to determine initial eligibility. Of these, over 90% did not meet the entrance criteria. The most common reason for disqualification was that the duration of complaint was longer than three months. Twenty patients were randomized into the study. All three groups showed substantial improvements in the main patient-rated outcomes at the end of the 12 weeks intervention phase. For leg pain, back pain, frequency and bothersomeness of leg symptoms, and Roland-Morris disability score, the percent improvement varied from 50 to 84%, and the corresponding effect sizes ranged from 0.8 to 2.2. Bothersomeness of leg symptoms was the most responsive outcome associated with the largest magnitude of effect size. All within group changes from baseline were statistically significant ($p < 0.01$). No between-group comparisons were planned or performed due to the insufficient sample size and high risk of committing Type I and Type II errors.

Conclusion: Pilot studies such as these are important for determining the feasibility of conducting costly, larger scale trials. Recruitment for a full-scale study of sciatica of 2 to 12 weeks duration is not feasible given the methods used in this pilot study. Our results do indicate, however that there are substantial numbers of patients with sciatica more chronic in nature that would be interested in participating in a similar study. In addition, collaboration with a local health maintenance organization would likely facilitate clinician referrals and optimize the recruitment process. Patient and provider compliance was high in the pilot study, indicating that the majority of study protocols are feasible. Additionally, we were able to collect complete outcomes data including those regarding health care utilization. A suggested modification by investigators and outside consultants has resulted in replacement of the medication group with a minimal intervention control group (i.e. self-care advice). As a result, a second pilot study of patients with sciatica of more than four weeks duration has been planned before proceeding to a full-scale trial.

Key Indexing Terms: Lumbar Spine; Sciatica; Chiropractic Manipulation; Drug Therapy.

The role of the g-motor system in increasing muscle tone and muscle pain syndromes; a review of the Johansson/Sojka hypothesis.

Gary A. Knutson, DC

Objective: To review literature pertaining to the Johansson/Sojka hypothesis that positive feedback loops in the g-motor system are responsible for chronic muscle pain and increases in muscle tone.

Data Sources: Articles were selected from Medline searches and from manual library searches.

Results: Normal, static and ischemic muscle contractions and/or chemical mediators of inflammation excite intramuscular group III and IV chemo-nociceptors. Group III and IV afferent firing stimulate gamma-motorneurons causing firing of Ia and II muscle spindle afferents and increased extrafusal resistance to stretch (muscle tone). Some criticism of involvement of the gamma-motor system in muscle tone were found to be dated or based on data from noncomparable research. Most of these

studies, pro and con, were done on prepared test animals and the results may or may not translate to humans.

Conclusion: There exists a sizable body of research establishing a link between the activation of intramuscular chemoreceptors, increased g-motor activity and increased Ia and II spindle output as proposed by the hypothesis of Johansson and Sojka. However, due to the lack of sufficient data on human subjects, their hypothesis should not be considered proven. Further research into the effects of metabolites of muscle contraction and their effects on muscle tone is recommended. Research into subluxation/joint dysfunction in light of the Johansson/Sojka hypothesis is recommended.

Key Indexing Terms: Skeletal Muscle; Pain.

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