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Editorial Staff

Vertebral arteries and cervical movement: Doppler ultrasound for premanipulative screening.
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Objective: It has been proposed that Doppler velocimetry, which is noninvasive, quick, and relatively inexpensive, should be used in the premanipulative screening of vertebral arteries to reduce the risk of cervical-manipulation-related injury to these vessels. The objective of this analysis of the literature is to study the evidence related to this proposal in terms of the suitability of Doppler velocimetry for this purpose.

Data selection: Studies were examined that dealt with the incidence of postmanipulation stroke, the proposed mechanisms for this clinical entity, the validity of the provocational tests that have been used in premanipulative screening, the validity and reliability of Doppler velocimetry of vertebral arteries, and the biomechanics of vertebral arteries.

Results: There is a high index of suspicion related to increased risk of vertebrobasilar stroke for vertebral arteries that have markedly reduced patency in the neutral position, and/or stenosis during cervical rotation. There is evidence that the provocational tests lack validity, and that Doppler velocimetry is valid in assessing the patency of vertebral arteries in the neutral position and during cervical rotation. Inter-examiner reliability of the Doppler technique has also been shown to be high. Doppler ultrasound also seems to be able to provide an indirect assessment of the mechanical stresses to the artery during cervical movements.

Conclusion: Overall, there is strong evidence to suggest that Doppler velocimetry should be included in the premanipulative screening of vertebral arteries.

Key indexing terms: Vertebral artery; cervical vertebrae; cerebrovascular disorder; dissection; chiropractic manipulation.

Evaluation of a specific home exercise program for low back pain.

Martin Descarreaux, DC, MSc; Martin Normand, DC, PhD; Louis Laurencelle, PhD; Claude Dugas, PhD

Background: The prescription of exercise as a conservative treatment for lumbar pain is frequent and seems effective for the chronic cases of nonspecific low-back pain. However, there is no evidence favoring one type of exercise over another. Often, exercise programs are prescribed without adequate evaluation of individual characteristics like posture, muscular force and extensibility. Patients with totally different causes of low-back pain will often be given the same type of exercises.

Objective: To compare the effectiveness of two home exercise programs in decreasing disability

and pain related to subacute and chronic nonspecific low-back pain. To do so, we compared a specific (individualized) exercise program to a program of commonly prescribed exercises for low-back pain.

Method: In a control group study, 20 patients with chronic or subacute nonspecific low-back pain participated in this study after giving their informed consent. All subjects were evaluated (physical evaluation of lumbar and pelvic muscle [1] force and [2] extensibility, and [3] trunk range of motion) and then divided in two groups: Ten patients received specific exercises (experimental group) based on their evaluation, and 10 patients received a commonly prescribed exercise program for low-back pain (control group). Six weeks later, a second physical evaluation was conducted. Pain (visual analog pain scale) and a disability (modified Oswestry) questionnaire were also completed by each subject at both evaluations.

Design: A randomized experimental study.

Results: Both groups had similar age, weight and sex characteristics. The experimental group showed significant improvements for some components targeted by the program. The control group significantly improved some physical characteristics not related to their initial deficits. Even if both groups showed some improvements in muscular force and extensibility, only the group who received specific exercises significantly reduced their level of pain and disability. Both groups showed a similar rate of participation in the program.

Conclusion: The results of this study suggest that applying a specific physical evaluation and exercise prescription is an appropriate treatment for people having subacute or chronic nonspecific low-back pain. Thus, clinicians should prescribe exercise programs based on individual muscular deficits, rather than most commonly prescribed exercise programs.

Key indexing terms: Exercise; low-back pain; muscle; disability.

Internal forces sustained by the vertebral artery during spinal manipulative therapy.

Bruce Symons,DC, Tim Leonard, Walter Herzog,PhD

Background: SMT has been established as a clinically effective modality for the treatment of several musculoskeletal disorders. One major issue with the use of SMT is its safety, especially with respect to neck manipulation and the risk of stroke in the vertebrobasilar system.

Objectives: To quantify the strains and forces sustained by the vertebral artery (VA) in situ during spinal manipulative therapy (SMT).

Study design: Cadaveric study.

Methods: Six VAs were obtained from five unembalmed, postrigor cadavers. The cephalad/distal (C0-C1) and caudal/proximal (C6-subclavian artery) loops of the VA were carefully exposed and instrumented with a pair of piezoelectric ultrasonographic crystals. The strains between each crystal pair were recorded during range-of-motion (ROM) testing, diagnostic tests and a variety of SMT procedures. The VA was then dissected free and strained on a materials testing machine until mechanical failure.

Results: SMT performed on the contralateral side of the cervical spine resulted in an average strain of 6.2 percent, \pm 1.3 percent to the distal (C0-C1) loop of the VA, and 2.1 percent, \pm 0.4 percent strain to the proximal (C6) loop. These values were similar or lower than the strains recorded

during diagnostic and ROM testing. Failure testing demonstrated that the VAs could be stretched to 139-162 percent of their resting length before mechanical failure. Therefore, the strains sustained by the VA during SMT represent about one-ninth of the strain at mechanical failure.

Conclusions: SMT resulted in strains to the VA that were almost an order of magnitude lower than the strains required to mechanically disrupt it. We conclude that under normal circumstances, a single, typical (high-velocity, low-amplitude) SMT thrust is very unlikely to mechanically disrupt the VA.

Key indexing terms: Chiropractic manipulation; vertebral artery; stroke.

A rigid body model of the dynamic posteroanterior motion response of the human lumbar spine
Tony Keller, PhD, Christopher Colloca, DC

Background: Clinicians apply posteroanterior (PA) forces to the spine for both mobility assessment and certain spinal mobilization and manipulation treatment. Commonly applied forces include low-frequency sinusoidal oscillations (<2 Hz) as utilized in mobilization, single haversine thrusts (<0.5 seconds) as imparted in high-velocity, low-amplitude (HVLA) manipulation, or very rapid impulsive thrusts (<5 milliseconds), such as those delivered in mechanical-force, manually-assisted (MFMA) manipulation. Little is known about the mechanics of these procedures. Reliable methods are sought to obtain an adequate understanding of the force-induced displacement response of the lumbar spine to PA forces.

Objective: To investigate the kinematic response of the lumbar spine to static and dynamic PA forces.

Design: A two-dimensional modal analysis was performed to predict the dynamic motion response of the lumbar spine.

Methods: A five-degree-of-freedom, lumped equivalent model was developed to predict the PA motion of the lumbar spine. Lumbar vertebrae were modeled as masses, massless-spring and dampers, and the resulting equations of motion were solved using a modal analysis approach. The sensitivity of the model to variations in the spring stiffness and damping coefficients was examined, and the model validity was determined by comparing the results to oscillatory and impulsive force measurements of vertebral motion associated with spine mobilization, and two forms of spinal manipulation.

Results: Model predictions, based on a damping ratio of 0.15 (moderate damping) and PA spring stiffness coefficient ranging from 25-60 kN/m, showed good agreement with in vivo human studies. Quasi-static and low-frequency (<2.0 Hz) forces at L3 produced L3 segmental and L3-L4 intersegmental displacements up to 8.1 mm and 3.0 mm, respectively. PA oscillatory motions were over 2.5 times greater for oscillatory forces applied at the natural frequency. Impulsive forces produced much lower segmental displacements in comparison to static and oscillatory forces. Differences in intersegmental displacements resulting from impulsive, static and oscillatory forces were much less remarkable. The latter suggests that intersegmental motions produced by spinal manipulation may play a prominent role in eliciting therapeutic responses.

Conclusions: The simple analytical model presented in this study can be used to predict the static, cyclic and impulsive-force PA displacement response of the lumbar spine. The model provides data on lumbar segmental and intersegmental motion patterns that are otherwise difficult to obtain

experimentally. Modeling of the PA motion response of the lumbar spine to PA forces assists in understanding the biomechanics of therapeutic PA forces applied to the lumbar spine, and may ultimately be used to validate chiropractic technique procedures and minimize risk to patients receiving spinal manipulative therapy.

Key indexing terms: Biomechanics; dynamic simulation; manipulation; modeling; spine.

Differences between the cutaneous two point discrimination thresholds of chiropractic students at different stages in a five-year course.

Prabhjot Chandhok, Jeffery Bagust, PhD

Objective: To investigate differences between the tactile acuity of the fingers measured at different stages in a chiropractic training course.

Methods: Two-point discrimination (2-PD) thresholds for the skin of the dominant and nondominant index fingers, and the dominant forearm, were measured in 74 subjects taken from the five years of a chiropractic degree course. Measurements were made using modified electronic engineering calipers mounted on a lever-arm, which allowed the points to be lowered onto the skin using a constant pressure.

Analysis: Differences in the 2-PD measurements recorded between the year groups were analysed using one-way ANOVA, and between the dominant and non-dominant index fingers using the paired T-test.

Results: Students in years four and five of the course had significantly smaller 2-PD mean threshold values ($p < 0.05$) for both dominant (year five - $1.39 \pm 0.06\text{mm}$) and nondominant ($1.50 \pm 0.08\text{mm}$) index fingers, compared to students in year one (dominant mean - $1.66 \pm 0.09\text{mm}$; nondominant mean - $1.80 \pm 0.10\text{mm}$). There was no significant difference between the 2-PD thresholds measured on the forearm of any group. When the data from all five years was grouped, the 2-PD thresholds for the dominant index finger (mean $1.52 \pm 0.035\text{mm}$) was found to be significantly smaller (paired T-test, $p < 0.0001$) than for the nondominant finger (mean $1.65 \pm 0.038\text{mm}$, $n=74$).

Conclusion: The results demonstrate that the tactile acuity of students in the later years of the course at the Anglo-European College of Chiropractic is greater than that of first-year students. This may be a result of the intensive training in palpatory techniques the students receive during their course, but this requires confirmation by further investigation.

Key indexing terms: Cutaneous; tactile sensitivity; two-point discrimination; training; chiropractic.

Views on x-ray use for patients with acute low back pain among chiropractors in an Ontario community.

Carlo Ammendolia, DC, Claire Bombardier, MD, Sheilah Hogg-Johnson, PhD, Richard Glazier, MD, MPH

Background: Recent studies suggest chiropractors continue to widely use x-rays for assessing patients with acute LBP. This is contrary to growing evidence that suggests only a small percentage of patients who present with ALBP require x-ray evaluation.

Objectives: To assess quantitatively and qualitatively the views of chiropractors in a selected

community in Ontario on the use of x-rays for evaluating patients with acute low back pain (LBP).

Study design: Mailed surveys and focus group interview.

Method: Surveys were mailed to all chiropractors (n=26) in a selected community in Ontario, followed by a focus group session with local chiropractors (n=7). Surveys requested information on personal and practice characteristics and the management of LBP, including x-ray use. The focus group discussed issues surrounding practice guidelines and x-ray use, led by a facilitator (first author).

Results: There was a 76-percent response rate to the mailed surveys. Of those who responded, 63 percent stated they would x-ray patients who present with uncomplicated acute LBP of one week duration; 68 percent felt that x-rays were useful in the diagnostic work-up of patients with acute LBP of less than one month duration. Most reasons given for x-ray use in this patient population are not supported by existing evidence.

Conclusions: There appears to be a high x-ray use rate among chiropractors in the study community consistent with that found in previous studies. Many of the reasons given for x-ray use are not supported by existing evidence, and may contribute to the large gap between current chiropractic practice and available evidence with respect to x-ray use for acute LBP.

Key indexing terms: Chiropractic; x-ray; survey; focus group; low back pain.

Spinal reflex excitability changes following lumbar spine passive flexion mobilization.

Ronald Bulbulian, PhD, Jeanmarie Burke, PhD, J. Donald Dishman, DC

Background: Flexion distraction has gained increased credibility as a therapeutic modality for treatment of low back pain. Although important work in the area has elucidated the intradiscal pressure profiles during flexion distraction, the accompanying neural responses have yet to be described.

Objective: The purpose of this pilot study was to assess neural reflex responses to motion with three degrees of freedom applied to the lumbar spine, and to evaluate H-reflex responses of the soleus.

Methods: Subjects (n=12) were measured for Hmax reflexes determined from stimulus response recruitment curves measured in neutral prone position. The mean of 10 evoked H-waves (at Hmax stimulus intensity) were measured in neutral position; flexion; left and right lateral flexion; and axial rotation of the trunk on a Cox adjusting table. H-reflexes were expressed as a percentage of maximal M-wave for the criterion measure. Spinal range of motion was quantified by Metrecom digitization.

Results: The data showed variation in some movement ranges notwithstanding identical table positioning for all subjects. Mean H-reflex amplitude was decreased (15.2 ± 5.8 to 13.8 ± 5.8 mV) and the H/M ratio was also decreased in flexion when compared to neutral (55.0 ± 19.1 to 50.3 ± 19.4 percent; $p < .05$).

Conclusions: Trunk flexion is accompanied by inhibition of the motor neuron pool. Slight perturbations in numerous afferent receptors are known to significantly alter the H-reflex. The absence of measurable changes in lateral flexion and trunk rotation may indicate that both slow and fast-adapting receptors could be involved in lumbar motion. These preliminary findings

suggest the need for further dynamic motion studies of the flexion distraction neurophysiology.

Key indexing terms: H-reflex; motor neuron; neurophysiology; low back pain; chiropractic.

Porcelain gallbladder: A case report.

Kenneth Young,DC, Jessica Johnson,BS (Hons)

Objective: To discuss the case of a porcelain gallbladder found incidentally in a patient suffering from low back and heel pain.

Clinical features: A 70-year-old female suffered from low-back pain, numbness in the left lower leg and sharp pain in her left heel. Plain films of the lumbar spine necessitated diagnostic abdominal ultrasound, the findings of which were consistent with porcelain gallbladder.

Intervention and outcome: The patient has been recommended for prophylactic cholecystectomy, and is concurrently being treated for mechanical low back and heel pain.

Conclusions: Porcelain gallbladder is an uncommon finding; however, due to the greatly increased chance of malignancy, it must be considered in patients who have cystic type calcification in the right upper abdominal quadrant.

Key indexing terms: Gallbladder; carcinoma; low back pain.

Chronic low back pain: A study of the effects of manipulation under anesthesia.

Nicholas Palmieri,DC, Shirley Smoyak,RN,PhD

Objective: The objective of this project was to evaluate the efficacy of using self-reported questionnaires to study manipulation under anesthesia (MUA) for chronic low back pain. Self-reported outcomes assessment instruments were used to evaluate changes in patients receiving the MUA procedure versus those not receiving the MUA procedure.

Setting: Two ambulatory surgical centers and two chiropractic clinics.

Subjects: Eighty-seven subjects participated in this study. The intervention group consisted of 38 patients, and the nonintervention group consisted of 49 patients. Selection was made from a convenience sample of patients selected from doctors who perform the MUA procedure at two centers participating in the study.

Intervention: Patients in the intervention group received MUA. Patients in the nonintervention group received traditional chiropractic treatment.

Outcome measures: A numeric pain scale (NPS) and the Roland-Morris Questionnaire (RMQ) were administered at baseline, postprocedure and four weeks later. Results were documented and compared.

Results: The average NPS scores in the MUA group decreased by 50 percent, and the average RMQ scores decreased by 51 percent. The average NPS changes in the nonintervention group decreased by 26 percent, and in the RMQ group, mean scores decreased by 38 percent.

Conclusions: In this sample of patients with chronic low back pain, self-reported outcomes

improved after the procedure and at follow-up. There was more improvement reported in the intervention group than the nonintervention group. This study supports the need for large-scale studies on MUA. It also revealed that self-reported outcome assessments are easily administered and a dependable method to study MUA.

Key indexing terms: Chiropractic manipulation; low-back pain; outcome measures; chronicity.

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