Mechanisms and effects of spinal high-velocity, low-amplitude thrust manipulation: previous theories.

David Evans, BSc(Hons) Ost.

Objectives: When the clinical efficacy of spinal manipulative treatment for spinal pain has been assessed, high-velocity, low-amplitude thrust (HVLAT) manipulation and mobilization have been regarded as a clinical intervention giving identical and equivalent biological effects.

The objective of this review is to critically discuss previous theories and research of spinal HVLAT manipulation, highlighting reported neurophysiological effects that seem to be uniquely associated with cavitation of synovial fluid.

Data Source: The biomedical literature was searched for research and reviews on spinal manipulation. MEDLINE and EMBASE databases were utilized to help find relevant articles.

Study Selection: All articles relevant to the objectives were selected.

Data Extraction: All available data were used.

Data Synthesis: The main hypotheses for lesions that respond to HVLAT manipulation are critically discussed: 1) release of entrapped synovial folds or plica; 2) relaxation of hypertonic muscle by sudden stretching; 3) disruption of articular or periarticular adhesions; and 4) unbuckling of motion segments that have undergone disproportionate displacements.

Results: There appear to be two separate modes of action from zygapophyseal HVLAT manipulation. Intra-articular ‘mechanical’ effects of zygapophyseal HVLAT manipulation seem to be absolutely separate from, and irrelevant to, the occurrence of reported ‘neurophysiological’ effects. Cavitation should not be an absolute requirement for the mechanical effects to occur, but may be a reliable indicator for successful joint gapping.
Conclusions: It is hoped that identification of these unique neurophysiological effects will provide enough theoretical reason for HVLAT manipulation and mobilization to be assessed independently as individual clinical interventions.

Key Indexing Terms: chiropractic manipulation; synovial fluid; zygapophyseal joint; low back pain; neurophysiology.

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Missed cervical spine fracture dislocations: The importance of clinical and radiographic assessment.  
*Steven King, DC; Bryan Hosler, DC; Mark King, DC; Eric Eiselt, DC.*

**Objective:** To review the case of a patient who suffered a cervical spine fracture-dislocation missed at a hospital emergency room.

**Clinical Features:** A 77 year-old male involved in a motor vehicle accident was transported to a local emergency hospital, where cervical spine x-rays taken were reported as demonstrating no evidence of acute injury. The patient visited a chiropractic clinic six days later, where x-rays were again taken, finding that the patient sustained fractures of C5 and C6, and a bilateral facet dislocation at C5/C6. CT confirmed the fractures, and MRI findings demonstrated cervical spinal cord compression and posterior spinal cord displacement.

**Intervention and Outcome:** The patient was referred for preoperative medical evaluation. He underwent C5-6 closed reduction and anterior/posterior fusion surgery and was released without complication. Patient follow-up indicated full recovery with minimal neurological symptoms.

**Conclusion:** Cervical spine fracture-dislocations are often missed during standard radiographic examinations in emergency room settings. Chiropractors are encouraged to perform comprehensive evaluations of patients presenting with cervical trauma, even if they have had prior x-rays reported as normal. Standard x-rays, taken at emergency room facilities, are not entirely reliable for detecting or revealing cervical spine fracture-dislocations. This case stresses the importance of careful clinical assessment and imaging procedures on patients who have encountered cervical spine trauma.
Key Indexing Terms: chiropractic; cervical spine; fracture; dislocation; radiology; intervertebral disc.

Practice-based randomized controlled-comparison clinical trial of chiropractic adjustments and brief massage treatment at sites of subluxation in subjects with essential hypertension: A pilot study.

Gregory Plaugher, DC; Cynthia Long, PhD; Joel Alcantara, DC; Alyssa Silveus; Herbert Wood, DC; Kapildeo Lotun, MD; J. Michael Menke, DC; William Meeker, DC, MPH; Stephen Rowe, DC.

Objective: The primary purpose of this pilot study is to determine the feasibility of conducting a randomized clinical trial in the private practice setting to examine short and long-term effects of chiropractic adjustments in the care of subjects with essential hypertension, compared to a brief soft tissue massage, and a nontreatment control group.

Design: Randomized controlled-comparison trial using three parallel groups. After an initial one-week (three visits) baseline, subjects were randomized into either "chiropractic adjustments," "brief massage" or "no-treatment" control groups. Treatment/control visits were over a two-month period, with follow-up visits at two weeks, one month and two months. Evaluations were obtained in a blinded fashion with a random-0 sphygmomanometer. Examiner reliability of the BP evaluations was determined prior to the initiation of the trial. The intra-examiner ICC coefficients were >.92.

Setting: Private practice outpatient chiropractic clinic.

Patients: Twenty-three subjects between the ages of 24 and 50, with systolic and/or diastolic essential hypertension.

Interventions: Two months of full-spine chiropractic care (i.e., Gonstead) consisting primarily of specific-contact, short-lever-arm adjustments delivered at motion segments, exhibiting signs of subluxation. The massage group had a brief effleurage procedure delivered at localized regions of the spine thought to be exhibiting signs of subluxation. The no-treatment control group rested alone for a period of approximately five minutes in an adjustment room.

Main Outcome Measures: Cost per enrolled subject, as well as systolic and diastolic blood pressure measured with a random-0 sphygmomanometer and patient reported health status (SF-36). Blood pressure
evaluations were obtained at each clinic visit and at follow-up evaluations. Pilot study outcome measures also included an assessment of cooperation of subjects to randomization procedures and dropout rates; recruitment effectiveness; analysis of temporal stability of blood pressures at the beginning of care; and the effects of inclusion/exclusion criteria on the subject pool.

**Results:** There were 86 subjects screened; 30 were eligible and enrolled, yielding a cost of $161 per enrolled subject. One subject was later determined ineligible, and six others dropped out. The average age of the remaining 23 subjects was 39 years, and 65 percent were female; in both the chiropractic and massage therapy groups, all subjects were classified as either overweight or obese; in the control group there were only two classified as such. SF-36 profiles for the groups were similar to that of a normal population. The mean change in diastolic blood pressure was -4 (95-percent confidence interval (CI): -8.6, 0.5) in the chiropractic care group; 0.5 (95-percent CI: -3.5, 4.5) in the brief massage treatment group; and -4.9 (95-percent CI: -9.7, -0.1) in the no-treatment control group. At the end of the study period, this change was -6.3 (95-percent CI: 13.1, 0.4); -1.0 (95-percent CI: -7.5, 15.6); and -7.2 (95-percent CI: -13.3, -1.1) in the three study groups. The mean improvements in the chiropractic care and no-treatment control groups remained consistent over the follow-up period.

**Conclusions:** This pilot study elucidated several procedural issues that should be addressed before undertaking a full-scale clinical trial on the effects of chiropractic adjustments in patients with essential hypertension. A multidisciplinary approach to recruitment may need to be used in any future efforts, due to the limited subject pool of patients who have hypertensive disease, but are not taking medication for its control. A one-week run-in period may be necessary prior to randomization, in order to exclude subjects who may only be exhibiting "white-coat" hypertension. In addition, measures need to be used to assure comparable groups regarding prognostic variables such as weight. Studies such as these demonstrate the feasibility of conducting a full-scale, three-group randomized clinical trial in the private practice setting.

**Key Indexing Terms:** Cervical vertebrae; chiropractic; hypertension; lumbar vertebrae; pelvis; pilot study; randomized clinical trial.

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**Back pain reporting in children and adolescents: The impact of parents’ educational level.**

*Charlotte Leboeuf-Yde, DC, MPH, PhD; Niels Wedderkopp, MD; Lars Bo Andersen, DMSc; Karsten*
**Background:** Social class, including educational level, is a strong predictor for health-related perceptions, behavior, and health outcomes in general. It is not known if parental education has an effect on back pain in their offspring.

**Objectives:** To establish whether parents’ educational level is associated with back pain reporting and consequences of back pain in their children.

**Design:** A cross-sectional survey.

**Data Collection:** Information on parental education was obtained through questionnaires to parents and back pain information through standardized interviews with the children.

**Participants:** Children aged 8-10 years (n=481) and adolescents aged 14-16 years (n=325) obtained through a proportional two-stage cluster sample.

**Setting:** Local schools in Odense, Denmark

**Main Outcome Measures:** The strength of association and dose-response connection were studied between parental educational level (high/medium/low) and the outcome variables (back pain in the preceding month, and consequences of back pain) in their children.

**Results:** There was a significant modest negative association between the level of parental education and back pain in children, but not in adolescents. There was no significant association between parental educational level and back pain consequences.

**Conclusions:** Further research in this area requires a more ingenious approach, such as using more socially heterogeneous study populations than those usually found in Denmark.

**Key Indexing Terms:** Back pain; health care; education; social class; children; adolescents; survey.
Objective: To explore the current health education behaviors of chiropractors, ascertain their willingness to provide patient counseling, and compare this with topics of interest to chiropractic patients.

Methods: This study involved a postal survey of 400 randomly selected members of the Chiropractic Association of Australia (35-percent response rate) and a semistructured interview of 316 patients attending one of 20 purposively selected chiropractic practices. Data were collated and the current health information practices of chiropractic respondents and their willingness to undertake counseling on various topics was identified and compared with the information interests of participating patients. Particular emphasis was placed upon injury prevention, both with respect to patient counseling and chiropractic practice risk.

Results: Respondents expressed varying degrees of willingness to provide health information on diverse topics, but no clear health education/chiropractic practice pattern emerged. Although expressing willingness to undertake counseling, respondents were more likely to provide health information brochures than develop a tailored health promotion contract. Health education topics ranged from exercise (91 percent) to osteoporosis prevention (23 percent). Seventy-eight percent of chiropractors were prepared to offer counseling on injury prevention, yet 45 percent of respondents themselves reported having some work-related injury. Maintenance care failed to emerge as a global term for describing a common core of topics or chiropractic health education practices.

Conclusion: This study demonstrated an interest by chiropractors in providing, and by chiropractic patients in obtaining, health information that extends beyond spinal health. The range of relevant topics covered and modes used for health information transmission in chiropractic practice require clarification. The prevalence of work-related injury among chiropractors suggests a need to develop safe chiropractic clinical practice protocols.

Key Indexing Terms: Chiropractic; health information; injury prevention.

Evaluation of transforaminal ligaments by magnetic resonance imaging.

Gregory Cramer,DC,PhD; Dennis Skogsbergh,DC; Barclay Bakkum,DC, PhD; James Winterstein,DC; ShiWei Yu,MD; Nathaniel Tuck, Jr.,DC.
Objectives: Three-part study to (1) identify and describe transforaminal ligaments (TFLs); (2) determine the best low-field-strength magnetic resonance imaging (MRI) technique for TFLs; and (3) determine the ability of low-field-strength MRI to image TFLs.

Design: Part I - descriptive anatomic study; Part II - descriptive MRI study; and Part III - blinded comparison of diagnostic test against gold standard (MRI vs. anatomic dissection).

Setting: Chiropractic college gross anatomy laboratory and MRI facilities.

Specimens: Three anatomic specimens of male cadavers aged 60 - 85 years; a fourth specimen was used for training radiologists in Part III.

Main Outcome Measures: Part I - number and size of TFLs; Part II - subjective grading of highest quality MRI images; and Part III - specificity; sensitivity; positive predictive value; negative predictive value; percent agreement; and accuracy of identifying TFLs from MRI scans.

Main Results: Part I - 19 TFLs identified in 30 intervertebral foramina (IVF) (60 percent of IVF had TFLs), thick = 4 (21 percent), medium thickness = 12 (63.2 percent) and thin = 3 (15.8 percent); Part II - TFLs demonstrated to best advantage with pure sagittal plane, T1 MRI; and Part III - average: specificity = 88.9 percent, sensitivity = 45.6 percent, positive predictive value = 86.7 percent, negative predictive value = 50.8 percent, percent agreement = 78 percent, and accuracy = 62.4 percent.

Conclusions: The number of TFLs was, in general, in agreement with previous research. Transforaminal ligaments can be successfully imaged with low-field-strength MRI. If a trained radiologist identifies a TFL, there is an 87-percent chance that one is present, and if a trained radiologist does not identify a TFL in an IVF, there remains a 51-percent chance that one is present.

Key Indexing Terms: Transforaminal ligaments; corporotransverse ligaments: spinal anatomy; intervertebral foramina.

Endogenous opioid effects on motoneuron pool excitability: Potential analgesic effect of acute exercise.

Ronald Balbulian, PhD.
**Background:** Metabolic and/or thermal stresses of exercise mediate the release of endogenous opioids, depressing motoneuron activation (MNA). While exercise is routinely presented as a co-equal treatment for management of acute and chronic low-back pain, it is not clear that exercise-induced endogenous opioid release can play a role in the analgesic and treatment outcomes for low-back pain patients. Further, if opioid involvement is present, it is not clear what level of exercise might be beneficial in the suppression of MNA and possibly low-back pain.

**Objectives:** To determine whether exercise-induced endogenous opioid release can play a role in the analgesic and treatment outcomes for low-back pain patients, and to determine what level of exercise might be beneficial in the suppression of MNA and possibly low-back pain.

**Methods:** To test this hypothesis, male (n=3) and female (n=3) normal and healthy volunteers were tested six times over a four-week period. The six trials included high-intensity treadmill exercise at 75 percent $O_{2\text{max}}$ with placebo (P) or naloxone (N), low-intensity exercise at 40 percent $O_{2\text{max}}$ (P or N) and no exercise control (P or N). The evoked spinal Hoffmann H-reflex (soleus muscle) was measured as the criterion for MNA before and after exercise, and expressed with the maximal M-wave as the maximal $H_{\text{max}}/M_{\text{max}}$ percent ratio. Naloxone (10 mg) or isovolumic saline were administered double-blind (1 ml bolus) after recovery from exercise and prior to H-reflex measurement.

**Results:** The results show a significant reduction in the $H_{\text{max}}/M_{\text{max}}$ percent ratio for both exercise conditions (40.0 image - Copyright â Stock Photo / Register Mark 7.1 to 33.9 image - Copyright â Stock Photo / Register Mark 9.1 percent for 75 percent $O_{2\text{max}}$ and 37.4 image - Copyright â Stock Photo / Register Mark 4.8 to 33.0 image - Copyright â Stock Photo / Register Mark 5.3 percent for 40 percent $O_{2\text{max}} ; p < 0.01$). Naloxone treatment did not attenuate the exercise-induced $H_{\text{max}}/M_{\text{max}}$ percent ratio suppression.

**Conclusion:** Endogenous opioids do not appear to modulate motoneuron responses to exercise under the present experimental conditions.

**Key Indexing Terms:** H-reflex; beta-endorphin; aerobic exercise; naloxone.

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Reliability and measurement error of the BioTonix video posture evaluation system. Part I:
Inanimate objects.

Martin Normand, PhD, DC; Deed Harrison, DC; Rene Cailliet, MD; Pierre Black, MS; Donald Harrison, PhD, DC, MSE; Burt Holland, PhD.

Objective: To investigate the reliability, concurrent validity, and error of a new video digitizing system for evaluating posture when applied to inanimate objects.

Design: Delayed repeated measures of digital images of inanimate objects.

Setting: University laboratory.

Methods: Digital video images of inanimate objects (five parallelograms) of different sizes and shapes were obtained with the BioTonix postural evaluation system. Three examiners digitized video images of inanimate objects twice; the second data collection was one week after the first set. The objects were digitized with both high and low-resolution settings of the video screen. The BioTonix system measurements were statistically compared to the actual object dimensions. Statistical evaluations of reliability and validity were conducted.

Results: For distances, both intra-class and inter-class correlation coefficients were very high, 0.99 for the estimate. The low vs. high-resolution settings were comparable for distances. For angles, on the low-resolution setting, both intra-class and inter-class correlation coefficients were very high: 0.969 and 0.953. On the high-resolution setting, for angles, both intra and inter-class coefficients were well above 0.99. The difference of the actual size and the means of the digitized measurements of the means were small: at most, 1.5° for angles and 3.3 mm for distances. The standard deviations were small, and the confidence intervals were narrow.

Conclusions: Our results demonstrate that the BioTonix’s video system has high degrees of reliability and validity. Thus, this system would seem suitable for clinical use in the analysis of posture.

Key Indexing Terms: Posture; reliability; validity; rehabilitation; video recording; photogrammetry

Delayed posttraumatic vertebral collapse with intravertebral vacuum cleft: A case report.

Melanie Osterhouse, DC, and Norman Kettner, DC, DACBR.
**Objective:** To discuss the case of a 79 year-old male who suffered a delayed post-traumatic vertebral collapse and an intravertebral vacuum cleft. The patient had been on long-term corticosteroid therapy. A discussion of Kummell’s disease and the controversy surrounding the etiology of the condition is also presented.

**Clinical Features:** Six weeks before presenting to the clinic, the patient remembered twisting, hearing a pop, and experiencing severe low-back pain. Two weeks after the incident, while in the hospital for bacterial cellulitis, he underwent lumbar spine radiography. The radiographs revealed degenerative changes and remote (healed) compression fractures, but did not demonstrate any deformity of L-2. Four weeks later, he sought care for persistent low back pain. Radiographs revealed marked compression of the L-2 vertebral body with an intravertebral vacuum phenomenon.

**Intervention and Outcome:** The patient was referred to his geriatrician for evaluation as a candidate for vertebroplasty or other stabilization procedures. He required a moderately high dose (60mg) of prednisone daily to combat the symptoms of myasthenia gravis; therefore, the prognosis did not appear favorable for this patient.

**Conclusion:** Clinical research is needed to determine the definitive etiology and pathophysiology of Kummell’s disease. This case demonstrates that the intravertebral vacuum is a dynamic entity, subject to changes in size and shape. Previous case reports have suggested that Kummell’s disease only presents as a linear, horizontal cleft. This disease needs further investigation to determine the true correlation between radiographic signs and the underlying pathophysiology.

**Key Indexing Terms:** osteonecrosis; intervertebral disc; Kummell’s disease; compression fracture.

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**Chiropractic and Pilates therapy for the treatment of adult scoliosis.**

*Charles Blum, DC, FICS.*

Surgical intervention for adult scoliosis is fraught with serious considerations. The obvious question is, does the benefit outweigh the possible side-effects of surgery? The decision to proceed with surgical treatment must be based on a thorough understanding of the anticipated benefits from surgical treatment and results that can be less desirable than the original condition. Complications of surgery on an adult patient with
scoliosis are relatively common occurring, according to published research, 30-53 percent of the time. Chiropractic therapy and (specifically) sacro-occipital technique (SOT) can be effective conservative alternatives to surgical intervention. A case report of an adult female with severe scoliosis treated using SOT methods and Pilates therapeutic exercises is presented.

**Key Indexing Terms:** MeSH terms: scoliosis; chiropractic; nonMeSH terms: sacro-occipital technique; Pilates; Major B. DeJarnette.

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