Dynamic Chiropractic

BACK PAIN

Journal of Manipulative Physioligical Therapeutics

ABSTRACTS FOR NOVEMBER/DECEMBER 2003 • VOLUME 26 - NUMBER 9

Editorial Staff

Biomechanical measure validation for spinal manipulation in clinical settings.
Carolyn Rogers, MS; John Triano, DC, PhD

Objective: To evaluate the validity and fidelity of the Leander 900 Z Series treatment table with an imbedded AMTI force plate as a sensing system and to test its ability to quantify small, statistically significant changes in biomechanical parameters of spinal manipulative therapy.

Setting: Technology bench testing and chiropractic college.

Methods: Complex forces and moments were applied to the modified treatment table, including standardized static and dynamic loads and those exerted by chiropractic students when delivering spinal manipulative therapy (SMT). Manipulation data was post-processed by a second order Butterworth filter with a 5 Hz cutoff frequency. Changes in lumbar spinal manipulative therapy procedures performed by chiropractic students were digitally recorded using the sensing system at approximately 1-month intervals throughout the course of a trimester of training.

Results: The system frequency response remained relatively consistent over the interval of test loads from 89-222 N and from 53-133 nm with fundamental frequencies 5.9 Hz and higher. Change in biomechanical parameters, including peak amplitude, slope, and duration over time and training, was observed in student chiropractic manipulations. Results show a minimum of 18% [p=.0723] increase during interval 1 in mean peak amplitude and slope parameters. Only a slight (3%) mean reduction of the procedure duration was seen.

Conclusions: The results support the fidelity of the sensing system and its ability to quantify small, statistically significant changes in biomechanical parameters. With this type of instrumentation, it is feasible to assess the skill of chiropractic physicians performing spinal manipulative therapy.

Key indexing terms: biomechanics; chiropractic manipulation.

Three-dimensionality of direct contact forces in chiropractic spinal manipulative therapy.
Gerrit GJM van Zoest; Guy Gosselin, DC, FCC

Objective: To perform three-dimensional (3-D) manual contact force measurements of chiropractic adjustments at the patient-chiropractor interface.

Methods: A new palm-held computerized 3-D force measuring system was used to collect 3-D force data at the doctor-patient interface (direct measurement) during cervical, thoracic and sacroiliac adjustments by 2 chiropractors on 10 healthy subjects.

Results: 3-D forces were significantly greater than matching 1-D perpendicular forces. As well, 3-D forces were significantly different between adjustment levels, suggesting different dynamics (kinetics) of adjustment techniques. Force magnitudes and significant statistical differences between loading rates and adjustment levels fit in the existing body of knowledge of chiropractic adjustment forces.

Conclusion: To our knowledge, this is the first study that presents 3-D force-time histories of chiropractic adjustments recorded at the doctor-subject interface. Direct 3-D contact force data seem to have the potential to contribute to chiropractic research, because of a more complete description of this biomechanical aspect of daily practice. Results can be used to study novice and experienced chiropractors' techniques and permit to develop training and evaluation protocols in teaching institutions.

Key indexing terms: biomechanics; chiropractic manipulation.

Validity of compressive leg checking in measuring artificial leg length inequality.
Robert Cooperstein, DC; Elaine Morschhauser, DC; Anthony Lisi, DC; Todd Nick, PhD

Objective: To determine the accuracy of instrumented prone compressive leg checking.

Design: Repeated measures (n=26) on single subjects (n=3).

Setting: Chiropractic college research clinic.

Methods: A pair of surgical boots were modified to permit continuous measurement of leg-length inequality (LLI). Multiple prone leg-check observations of a blinded examiner on 3 subjects were tested against artificial LLI that was created by randomly inserting 0-6 1.6 mm shims in either boot. Accuracy was assessed both within- bservations (observed vs. artificial LLI) and between observations (observed vs. artificial changes in LLI). The ICC, Lin's concordance correlation coefficient (CCC), Bland-Altman limits of agreement, and linear regression statistics were obtained to determine the reliability and validity of compressive leg checking compared to a reference standard.

Results: For each shim condition, test-retest reliability was excellent (ICC=.85 and CCC=0.95). The 95% confidence interval for the limits of agreement for observed vs. artificial change in LLI was -5.44 to 5.67. The observed and artificial LLI shared 87% of their variation within observations (n=78) and 88% between observations (n=75). The mean examiner error was 1.72 mm and 2.01 mm, respectively.

Conclusion: Compressive leg checking seems highly accurate, detecting artificial changes in leg length ±1.87 mm, and thus possesses concurrent validity assessed against artificial LLI. Pre- and post leg-check differences should exceed 3.74 mm to be confident a real change has occurred. It is unknown whether compressive leg checking is clinically relevant.

Key indexing terms: leg length inequality; chiropractic; validity.

Neuromechanical characterization of in vivo lumbar spinal manipulation. Part I: Vertebral motion.
Tony Keller, PhD; Christopher Colloca, DC; Robert Gunzburg, MD, PhD

Objective: To quantify in vivo spinal motions and coupling patterns occurring in human subjects in response to mechanical-force manually-assisted short-lever spinal manipulative thrusts (SMTs) applied to varying vertebral contact points and utilizing various excursion (force) settings.

Methods: Tri-axial accelerometers were attached to intraosseous pins rigidly fixed to the L1, L3 or L4 lumbar spinous process of 4 patients (2 male, 2 female) undergoing lumbar decompressive surgery. Lumbar spine acceleration responses were recorded during the application of 14 externally applied posteroanterior (PA) impulsive SMTs (4 force settings and 3 contact points) in each of the 4 subjects. Displacement-time responses in the PA, axial (AX) and medial-lateral (ML) axes were obtained as were intervertebral (L3-L4) motion responses in 1 subject. Statistical analysis of the effects of facet joint (FJ) contact point and force magnitude on peak-to-peak displacements was performed. Motion coupling between the 3 coordinate axes of the vertebrae was examined using a least-squares linear regression.

Results: SMT forces ranged from 30 N (lowest setting) to 150 N (maximum setting). Peak-to-peak ML, PA and AX vertebral displacements increased significantly with increasing applied force. For thrusts delivered over the FJs, pronounced coupling was observed between all axes (AX-ML, AX-PA, PA-ML) (linear regression, $R2 = 0.35 - 0.52$, $P<0.001$), whereas only the AX and PA axes showed a significant degree of coupling for thrusts delivered to the SPs (linear regression, $R2 = 0.82$, $P<0.001$). The ML and PA motion responses were significantly ($p<0.05$) greater than the AX response for all SMT force settings. PA vertebral displacements decreased significantly ($p<0.05$) when the FJ contact point was caudal to the pin compared to FJ contact cranial to the pin. FJ contact at the level of the pin produced significantly greater ML vertebral displacements in comparison to contact above and below the pin. SMTs over the spinous processes produced significantly ($p<0.05$) greater PA and AX displacements in comparison to ML displacements. The combined ML, PA and AX peak-to-peak displacements for the 4 force settings and two contact points ranged from 0.15-0.66 mm, 0.15-0.81 mm and 0.07-0.45 mm, respectively. Intervertebral motions were of similar amplitude as the vertebral motions.

Conclusions: In vivo kinematic measurements of the lumbar spine during the application of SMTs over the FJs and SPs corroborate previous spinous process measurements in human subjects. Our findings demonstrate that PA, ML and AX spinal motions are coupled and dependent upon applied force and contact point.

Key indexing terms: acceleration; biomechanics; chiropractic; kinematics; lumbar spine; manipulation.

Neuromechanical characterization of in vivo lumbar spinal manipulation. Part II: Neurophysiological response.
Christopher Colloca, DC; Tony Keller, PhD; Robert Gunzburg, MD, PhD

Objective: To simultaneously quantify vertebral motions, neuromuscular and spinal nerve root responses to mechanical-force, manually-assisted short-lever spinal manipulative thrusts (SMTs).

Methods: Four patients underwent lumbar laminarthrectomy to decompress the central spinal canal and neuroforamina as clinically indicated. Prior to decompression, finely threaded, 1.8 mm diameter intraosseous pins were rigidly fixed to the lumbar spinous process (L1 or L3) using fluoroscopic guidance, and a high-frequency, low-noise, 10 g, tri-axial accelerometer was mounted to the pin. Following decompression, 4 needle electromyographic (nEMG) electrodes were inserted into the multifidus musculature adjacent to the pin mount bilaterally, and 2 bipolar platinum

electrodes were cradled around the left and right S1 spinal nerve roots. With the spine exposed, SMTs were delivered internally to the lumbosacral spinous processes and facet joints and externally by contacting the skin overlying the respective spinal landmarks using two force settings (30 N, < 5 msec; 150 N, < 5 msec) and 2 force vectors (posteroanterior and superior; posteroanterior and inferior).

Results: SMTs resulted in positive EMG and CAP responses that were typically characterized by a single voltage potential change lasting several milliseconds in duration. However, multiple EMG and CAP discharges were observed in numerous cases. The temporal relationship between the initiation of the mechanical thrust and the neurophysiological response to internal and external SMTs thrust ranged from 2.4 - 18.1 ms and 2.4 - 28.6 ms for EMG and CAP responses, respectively. Neurophysiological responses varied substantially between patients.

Conclusions: Vertebral motions and resulting spinal nerve root and neuromuscular reflex responses appear to be temporally related to the applied force during SMT. These findings suggest that inter-segmental motions produced by spinal manipulation may play a prominent role in eliciting physiologic responses.

Key indexing terms: biomechanics; electromyography; low back pain; chiropractic manipulation; neurophysiology; sciatica.

Cervical radiculopathy treated with chiropractic flexion distraction manipulation: a retrospective study in a private practice setting.
Jason S. Schliesser, DC; Ralph Kruse, DC; L. Fleming Fallon, MD, DrPH

Background: Although flexion distraction performed to the lumbar spine is commonly utilized and documented as effective, flexion distraction manipulation performed to the cervical spine has not been adequately studied.

Objective: To objectively quantify data from the visual analogue scale to support the clinical judgment exercised for the use of flexion distraction manipulation to treat cervical radiculopathy.

Design and setting: A retrospective analysis of the files of 39 patients from a private chiropractic clinic that met diagnostic criteria for inclusion. All patients were diagnosed with cervical radiculopathy and treated by a single practitioner with flexion distraction manipulation and some form of adjunctive physical medicine modality.

Main outcome measures: The visual analogue scale (VAS) was used to objectively quantify pain. Of the 39 files reviewed, 22 contained an initial and post-treatment VAS score and were therefore utilized in this study.

Results: This study revealed a statistically significant reduction in pain as quantified by visual analogue scores. The mean number of treatments required was 13.2 ± 8.2 with a range of 6 to 37. Only 3 persons required more treatments than the mean plus 1 standard deviation.

Conclusion: The results of this study show promise for chiropractic and manual therapy techniques such as flexion-distraction, as well as demonstrating that other, larger research studies must be performed for cervical radiculopathy.

Key indexing terms: Cervical spine; radiculopathy; chiropractic manipulation.

Efficacy of spinal manipulative therapy for low back pain of less than 3 months' duration.
Manuela Ferreira, MSc; Paulo Ferreira, MS;, Jane Latimer, PhD; Robert Herbert, PhD; Christopher Maher, PhD

Objectives: To review the efficacy of spinal manipulation for low back pain of less than 3 months duration.

Data Sources: Randomized clinical trials on spinal manipulative therapy for low back pain were identified by searching EMBASE, CINAHL, MEDLINE and PEDro.

Study selection: Outcome measures of interest were pain, return to work, adverse events, disability, quality of life, and patient satisfaction with therapy.

Data extraction: Methodological assessment of the trials was performed using the PEDro scale. Trials were grouped according to the type of intervention, outcome measures and follow-up time. Where there were multiple studies with sufficient homogeneity of interventions, subjects and outcomes, the results were analyzed in a meta-analysis using a random effects model.

Data synthesis: Thirty-four papers (27 trials) met the inclusion criteria. Three small studies showed spinal manipulative therapy produces better outcomes than placebo therapy or no treatment for nonspecific low back pain of less than 3 months duration. The effects are, however, small. The findings of individual studies suggest that spinal manipulative therapy also seems to be more effective than massage and short-wave therapy. It is not clear if spinal manipulative therapy is more effective than exercise, usual physiotherapy or medical care in the first 4 weeks of treatment.

Conclusions: Spinal manipulative therapy produces slightly better outcomes than placebo therapy, no treatment, massage and short-wave therapy for nonspecific low back pain of less than 3 months duration. Spinal manipulative therapy, exercise, usual physiotherapy and medical care appear to produce similar outcomes in the first 4 weeks of treatment.

Key indexing terms: Chiropractic manipulation; meta-analysis; low back pain.

A suspected case of ulnar tunnel syndrome relieved by chiropractic extremity adjustment methods.
Brent Russell, DC

Background: There has been little published about ulnar tunnel syndrome (UTS) as it relates to the practice of chiropractic, despite chiropractors' apparent interest in nerve compression syndromes and a growing trend toward providing chiropractic extremity care. This syndrome is not very common and could be mistaken for carpal tunnel syndrome by practitioners who are not aware of the differences.

Objective: To discuss the case of a patient with ulnar tunnel syndrome (UTS), whose symptoms were resolved by chiropractic extremity adjustment.

Clinical features: A 45-year-old female patient complained of numbness in her little finger. Standard orthopedic testing procedures for the wrist and hand reproduced the symptom, but tests for the cervical spine and thoracic outlet region were negative.

Intervention and outcome: Care for this patient consisted of adjustment procedures directed to the

wrist, primarily the hamate and pisiform articulations with the triquetrum. Her symptoms were resolved in 4 office visits, with corresponding improvement in examination findings.

Conclusions: This case report represents what a patient could expect during a typical chiropractic treatment. The examination and the care given were simple and cost-effective, but might not be sufficient for a more complicated or persistent case. The costs for the care in this case were borne solely by the patient and were affordable. Hard conclusions cannot be reached without more sophisticated diagnostic procedures, additional similar cases, and controlled research conditions.

Key indexing terms: ulnar tunnel syndrome; nerve compression; chiropractic, manipulation.

FEBRUARY 2004