# Demonstration of continuous multimodality peripheral vascular flow parameter changes following controlled digital vertebral pressure

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**Hypothesis:** Vertebral pressure and manipulation is frequently deployed in Osteopathic Manipulative Procedures (OMP). Although it is well recognized that vertebral pressure affects autonomic activity, the precise mechanisms of these responses are not well understood. It was the goal of this study to demonstrate modulation of Photo-Pulse Plethysmograph (PPG) and Laser Doppler Flow (LDF), in the upper extremity of asymptomatic human subjects, following controlled pressure, applied to select vertebral locations by an experienced osteopathic physician. These peripheral vascular parameters were recorded bilaterally to illustrate inherent asymmetry in the signals on the two sides in a subset of the subjects.

**Methods:** A multi-channel signal acquisition system (Biopac$^{TM}$) was used to assess the peripheral vascular effects from controlled pressure on select sites along the vertebral column. The set up was customized to record the bilateral PPG and LDF signals, whereby the acquisition was triggered by the subject's EKG signal, providing 5 channels of physiologic data, bilaterally from the upper extremities. Clinically asymptomatic subjects with no apparent pathologies were enrolled for this IRB-approved preliminary study (9 females, 4 males). Patients lay supine, undisturbed, while controlled physiological provocations such as transient occlusion of one forearm as well as hyperthermia (42 – 45 degrees Celsius), were applied to establish the baseline responsiveness of the set up for each subject. Following these tests, an experienced osteopathic physician applied controlled digital pressure sequentially, on OA-C2, T1-T4, T8-L2, and L5-S vertebral regions. Quiescent phase of approximately 10 minutes each was inserted between maneuvers, leading to an overall duration of the session being between 100 – 140 minutes. The EKG triggered PPG and LDF signals were logged continuously during this procedure. Post-evaluation for this data entailed time and frequency domain analysis.

**Results:** This investigation establishes a technique to monitor modulation of LDF and PPG signals following controlled physiologic stimuli, including sequential vertebral pressure. Post-analysis of data in time and frequency domain demonstrated increased flow characteristics in the upper extremities following controlled vertebral pressure. A bilateral asymmetry of LDF and PPG signals was noted in 25% of the subjects even during the quiescent phase of the experimental session.

**Conclusion:** Continuous bilateral recoding and post analysis of LDF and PPG signals demonstrated increased flow characteristics in the upper extremities indicative of an autonomic response, following spinal manipulation.