The Effect of Cranial Manipulation on the Traube-Hering-Mayer Oscillation as Measured by Laser-Doppler Flowmetry

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Context
A correlation has been established between the Traube-Hering-Mayer oscillation in blood-flow velocity, measured by laser-Doppler-flowmetry, and the cranial rhythmic impulse.

Objective
To determine the effect of cranial manipulation on the Traube-Hering-Mayer oscillation.

Design
Of 23 participants, 13 received a sham treatment and 10 received cranial manipulation.

Setting
Osteopathic Manipulative Medicine Department, Midwestern University, Downers Grove, Illinois.

Participants
Healthy adult subjects of both sexes participated (N=23).

Intervention
A laser-Doppler flowmetry probe was place on the left earlobe of each subject to obtain a 5-min baseline blood flow velocity record. Cranial manipulation, consisting of equilibration of the global cranial motion pattern and the craniocervical junction, was then applied for 10 to 20 minutes; the sham treatment was manipulation only.

Main Outcome Measure
Immediately following the procedures, a 5-min posttreatment laser-Doppler recording was acquired. For each cranial treatment subject, the 4 major components of the blood-flow velocity record, the thermal (Mayer) signal, the baro (Traube-Hering) signal, the respiratory signal, and the cardiac signal, were analyzed, and the pretreatment and posttreatment data were compared.

Results
The 10 participants who received cranial treatment showed a thermal signal power decrease from 47.79 dB to 38.490 dB (P < .001) and the baro signal increased from 47.40 dB to 51.30 dB (P < .021), while the respiratory and cardiac signals did not change significantly (P > .05 for both).

Conclusion
Cranial manipulation affects the blood-flow velocity oscillation in its low-frequency Traube-Hering-Mayer components. Because these low-frequency oscillations are mediated through parasympathetic and sympathetic activity, it is concluded that cranial manipulation affects the autonomic nervous system.

**Introduction**

Cranial manipulation is a form of broadly practiced alternative, manual medicine. A fundamental component of cranial manipulation is the primary respiratory mechanism (PRM). It is described as an oscillation that is palpable; the cranial rhythmic impulse (CRI) has an agreed-upon frequency of 10-14 cycles per minute (cpm). The PRM/CRI is a subtle phenomenon that is readily palpable only by experienced individuals, making its very existence subject to debate. 4,5

The Traube-Hering-Mayer (THM) wave is a complex oscillation in blood pressure and blood-flow velocity. The Traube-Hering (TH) component of this oscillation has a frequency of 6 to 10 cpm. Analysis of the TH was first described in 1865, when Ludwig Traube reported the measurement of a fluctuation in pulse pressure that occurred with a particular frequency of respiration but persisted after respiration had been arrested. Fourier-transform analysis applied to blood physiologic parameters shows that this fluctuation consists of 3 principal spectral peaks: the thermal or Mayer (M) wave (1.2-5.4 cpm), the baro or TH wave (6.0-10.0 cpm), and the respiratory wave, which shifts in frequency with changes in the respiratory rate. Multiple authors have commented on the similarity between the TH wave and the CRI. 4,5

By comparing cranial manipulation with laser-Doppler flowmetry, we have demonstrated that the PRM/CRI is congruous with the TH component of the THM oscillation in blood flow velocity. A question, therefore, logically arises: can cranial manipulation affect the THM oscillation?

**Method**

Healthy adult subjects (both sexes, N=23, institutional review board-approved informed consent obtained) were divided randomly into cranial palpation (n=13) and cranial manipulation groups (n=10). A laser-Doppler probe (BLF 21 Perfusion Monitor, Transonic Systems, Inc. Ithaca, NY) was placed on the left earlobe of each subject. After the subject was allowed to lie quietly on the examination table for 3 minutes of equilibration, a 5-minute baseline blood-flow velocity record was obtained. Cranial manipulation or manipulation, with the physician blinded to the flowmetry recording, was then performed for 10 to 20 minutes. Following palpation or treatment, a 5-minute postcontact laser-Doppler recording was acquired. During this entire procedure, the subject remained on the examination table, and the laser-Doppler probe was not disturbed.

Cranial palpation (simply counting the CRI but without intervention) and manipulation (therapeutic intervention) were performed while the subjects were supine. The individual performing the procedure was seated at the end of the examination table with his or her forearms resting upon it. The examiner's palms conformed to the curvature of the subject's head, contacting the lateral aspect of the great wings of the sphenoid bone and the temporal, occipital and parietal bones bilaterally. For this study, similar contact pressure, firm, but light enough not to ablate the sensation of the CRI, was employed for both palpation and manipulation. Manipulation was directed at modulation of the rate, rhythm, and amplitude of the CRI and perceived functional asymmetry through equilibration of the craniocervical junction and global anerioposterior cranial motion. Specific interventions were dictated by the physical findings of the individual's cranial pattern.
Results

For each subject, 4 component parts of the blood flow velocity record were analyzed: the thermal (M) signal, the baro (TH) signal and the respiratory signal of the THM, and the cardiac signal. The mean precontact and postcontact data for each group were compared using the paired-samples 2 tailed t statistic (see Table). After palpation only, the thermal signal power decreased 3 dB (42.93 to 39.58 Db, P < .054), while the baro (39.83 to 40.10 dB, P < .805), respiratory (27.54 to 27.20 dB, P < .715) and cardiac (37.92 to 37.14 dB, P < .511) signals did not change.

After cranial manipulation, the thermal signal power decreased 9 dB (47.40 to 51.30 dB, P < .021), while the respiratory (29.72 to 30.02 dB, P < .747) and cardiac (41.11 to 40.70 dB, P < .788) signals did not change.

The 2 examples illustrated (see Figure), though visually exceptional, illustrate the effects that can be obtained to varying degrees with any subject, provided the treating physician possesses the requisite skill.

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Comments

From the above data, we have drawn 3 conclusions. First, cranial manipulation has an effect on low-frequency oscillations observed in blood-flow velocity. It decreases the amplitude of the M wave and increases the amplitude of the TH wave. Second, we conclude that cranial manipulation affects the autonomic nervous system because it has been demonstrated that the M and TH waves are mediated through parasympathetic and sympathetic activity. Third, because palpation alone did not greatly affect blood-flow velocity oscillations, we conclude that there is a quantifiable difference between palpation and cranial treatment. This conclusion suggests that palpation alone may be used as a sham treatment in future research in the field of cranial manipulation.

| Traube-Hering-Mayer signal power comparison before and after palpation only and cranial manipulation |
|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| | Palpation only n=13 | Cranial manipulation n=10 | | | |
| | Doppler record segment | Mean signal power (dB) | Paired difference before-after +/- SD | P | Mean signal power (dB) | Paired difference before-after +/- SD | P |
| | | | | | | | |
| Thermal (M) | Before After | 42.93 39.58 | 3.36 +/- 5.69 | .054 | 47.79 38.49 | 9.30 +/- 5.65 | .001 |
| Baro (TH) | Before After | 39.83 40.10 | -.27 +/- 3.85 | .805 | 47.40 51.30 | -3.90 +/- 4.40 | .021 |
| Resp. | Before After | 27.54 27.20 | .34 +/- 3.23 | .715 | 29.72 30.02 | -.30 +/- 2.89 | .747 |
| Cardiac | Before After | 37.92 37.14 | .78 +/- 4.15 | .511 | 41.11 40.70 | .41 +/- 4.67 | .788 |

Laser Doppler blood flow recording of 2 individuals before and after cranial manipulation. Individual 1 is a 55-year-old man. Individual 2 is a 25-year-old woman. Neither individual had any physical complaint or medical condition requiring medication. The cranial examination
revealed decreased CRI amplitude, most notable in individual 1. Treatment for individual 1 consisted of equilibration of the craniocervical junction and global anterioposterior cranial motion, applied for approximately 10 minutes. Treatment for individual 2 consisted of equilibration of the craniocervical junction and the cranial base, applied for approximately 15 minutes.

References


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