This first-of-its-kind functional connectivity study opens the door to consider how what the osteopathic physician is thinking about while applying osteopathic manipulative treatment may affect patient outcomes. This study also illustrates possible empirical evaluation of the "body-mind-spirit" aspect of osteopathic philosophy in clinical practice, especially osteopathic manipulative treatment. (doi:10.7556/jaoa.2018.009)

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OMT May Be Helpful in the Management of Benign Paroxysmal Positional Vertigo

Papa L, Amodio A, Biffi F, Mandara A. Impact of osteopathic therapy on proprioceptive balance and quality of life in patients with dizziness. *J Bodyw Mov Ther.* 2017;21:866-872. doi:10.1016/j.jbmt.2017.03.001

In 2013, Fraix et al[1] reported that osteopathic manipulative treatment (OMT) for spinal somatic dysfunction improved balance in patients with chronic dizziness. Benign paroxysmal positional vertigo (BPPV) is an episodic spinning sensation with head repositioning arising from dysfunction of the inner ear. Pathophysiologically, BPPV is associated with calcium debris in the semicircular canal. It is typically successfully managed using repositioning maneuvers (eg, Epley maneuvers, Semont maneuvers, home exercises) and sometimes with medication.[2] Refractory BPPV can be managed surgically.[3] However, this study by Papa et al suggests that osteopathic manipulative therapy (OMTh; manipulative care provided by foreign-trained osteopaths) could be helpful for managing refractory BPPV.

To determine the effectiveness of OMTh to relieve dizziness associated with BPPV, the researchers measured patient stability and assessed their behavior. Patients were enrolled if they had dizziness 2 weeks after traditional clinical therapies. After a baseline assessment consisting of a Dizziness Handicap Inventory (DHI) and stabilometric examination, patients were randomly assigned to a treatment group (n=20) or sham group (n=20). Patients in the treatment group underwent an objective osteopathic evaluation and received 3 weekly 20-minute OMT sessions consisting of articulatory and muscle energy techniques, fascial unwinding, balanced membranous tension, and high-velocity, low-amplitude to the thoracic and lumbar spine. The sham group underwent light touch over areas of dysfunction, 10 minutes for evaluation and 10 minutes for treatment. Both the DHI and stabilometric assessments of all patients were taken before the first week and 1 week after the last intervention.

The treatment group had significant improvement in global, physical, and functional emotional aspects of DHI from baseline to follow-up (all $P<.001$). Compared with the sham group, the treatment group also showed statistically significant DHI improvements in global ($P=.02$), function ($P=.03$), and physical ($P=.03$) scores, but not emotional scores ($P=.62$). Regarding stabilometric assessment, the treatment group showed a significant decrease in velocity ($P=.007$), swinging of area ($P=.006$), and swinging on Y-axis-O ($P=.023$); the only difference between groups for stabilometric assessment was area measure ($P=.02$). Within the treatment group, there was a significant correlation between reduced swinging area and global DHI changes ($P=.02$), functional DHI subscale changes scores ($P=.03$), and physical DHI subscale variation scores ($P=.01$).

Having determined improvement in the treatment group in stability and behavior measures, the authors concluded that OMTh in combination with traditional therapy may be of clinical benefit for patients with BPPV. Manual techniques may assist in promoting proprioceptive inputs to the central nervous system, indirectly contributing to the observed improvement in body stability. The lack

of significant improvement of the emotional subscale between groups could result from either benefits of light touch or a lack of time to appreciate the full improvement in mood. One weakness in this study was the high dropout rate (40%) in the sham group (7 patients perceived a lack of efficacy).

In summary, this study suggests that OMT can benefit the integration of proprioception, vestibular information, and visual input. Osteopathic physicians should consider OMT in combination with traditional medical therapy for the management of BPPV. (doi:10.7556/jaoa.2018.010)

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CSF Flow Has a Significant Respiratory Component

Takizawa K, Matsumae M, Sunohara S, Yatsushiro S, Kuroda K. Characterization of cardiac- and respiratory-driven cerebrospinal fluid motion based on asynchronous phase-contrast magnetic resonance imaging in volunteers. *Fluids Barriers CNS*. 2017;14(1):25. doi:10.1186/s12987-017-0074-1

Neuroscientists at Tokai University Schools of Medicine in Kanagawa, Japan, used innovative imaging technology and Fourier analysis to analyze cerebrospinal fluid (CSF) velocities at the foramen magnum and Sylvian aqueduct. The purpose of this study was to characterize the cardiac- vs respiratory-driven motion of CSF. The prevailing consensus has been that the cardiac cycle is the dominant force in CSF flow, but this research from Takizawa et al suggests a significant contribution from the respiratory cycle.

Seven healthy volunteers (6 male, 1 female, aged 21-31 years) participated in a 55-second asynchronous 2-dimensional phase-contrast steady-state-free precession performed on a 3T magnetic resonance scanner. The frame rate was 4.6 images per second. Volunteers were asked to control their respiration according to audio guidance for inhalation and exhalation timing at cycles of 6, 10, and 16 seconds to cover the range of normal respiration. Respiration was monitored by a bellows-type pressure sensor placed around the abdomen. Electrocardiography was used to identify the frequency distribution of individual cardiac motion.

The motion of CSF was separated into cardiac and respiratory components. The amount of CSF displacement was found to be significantly larger in the respiratory component but at a slower rate than in the cardiac component. Likewise, the cardiac displacement was more rapid but with a smaller displacement than in the respiratory component in the Sylvian aqueduct area and to a lesser degree at the foramen magnum. Although cardiac-related CSF motion is predominant to maintain CSF pressure in the CSF cavity, the contribution of the respiratory component advances the process of understanding the pathogenesis of CSF circulatory disturbances as in hydrocephalus and Alzheimer dementia.

The application of osteopathic cranial manipulative medicine (OCMM) may affect CSF flow dynamics according to the postulated mechanisms of action, particularly compression of the fourth ventricle technique.[1] Technology used and data generated in this study have the potential to empirically demonstrate the effects of OCMM in clinical practice. (doi:10.7556/jaoa.2018.011)