

less healthy than Dr. Still's patients. Many of the medicines that we give to patients are also influencing the microbiome, so much so that a signature can be identified from certain medications and their associated diseases.⁵

Beginning last month (October 2018), in Austin, TX and Indianapolis, IN, 5G will begin to be rolled out.⁶ We, apparently, are the lab rats for the rest of the nation (sorry to Jenny and Sid and the folks at the AAO). If we couple what we learned that EMF's do to the body and the microbiome with what pesticides, fertilizers, environmental toxins, the continued nuclear exposure from Fukushima, stress, disease, even loud noises do together, we potentially have something more threatening to human existence as we know it than the current threat of global warming.

If anatomy and physiology are interrelated as we learned in school, then who, or what, is driving? The ENS (or gut brain) produces more than 30 neurotransmitters and has more neurons than the spine.⁷ Its main artery of communication with the brain and rest of the body is the vagus nerve. The brain-gut axis is becoming increasingly important as a therapeutic target for gastrointestinal and psychiatric disorders, such as inflammatory bowel disease (IBD), depression, and post-traumatic stress disorder (PTSD) in the allopathic world.⁷ Osteopathically we can do

even more. Courses such as the recent gut brain axis course presented by Canadian Benoit Champlain and the upcoming Osteopathic Cranial Academy conference on the gut brain axis in June can teach us more about what a specific microbiome issue might present as or feel like in a patient, allowing us as practitioners more precision in our treatment approaches.

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Impact of the Tent

R. Paul Lee, DO, FAAO, FCA

What is the relationship between Parkinson's disease and trauma?^{1 2 3} Why do some patients with concussions experience sound and light sensitivity?⁴ These two questions might be answered by examining the anatomical relationship between the midbrain and the free border of the tentorium cerebelli.

Osteopathic practitioners, using osteopathy in the cranial field (OCF), can capably treat specific effects of mild traumatic brain injury (mTBI): both Parkinson's disease (caused by TBI) and concussion-associated light and sound sensitivity, with the understanding that the edge of the free border of the tentorium can damage the midbrain.

Using OCF, I have successfully treated these dysfunctions caused by mTBI: symptoms of Parkinsonism (tremor, gait freeze, and unsteadiness) as well as sound and light sensitivity, by respectively treating the substantia nigra and the superior and inferior colliculi (corpora quadrigemina) of the midbrain.

We can easily envisage the mechanism of injury. Traumatic forces can whip the cerebrum, cerebellum, and brainstem, which have the consistency of custard, causing them to strike adjacent structures that are harder and less mobile, such as the tent. Some effects of mTBI appear

on MRI as hyperintensities of meninges and punctate vascular injuries where, for example, the temporal lobes impacted the wall created by the lesser wings and greater wings of the sphenoid (anterior to the temporal poles) or the frontal lobes impacted the frontal bone.^{5 6}

Anatomically, one discovers that the incisura, the posterior portion of the free border of the tent, is positioned adjacent to the pontomesencephalic sulcus of the brainstem, the indentation at the superior aspect of the pons where the mesencephalon (midbrain) begins. The incisura is the curve made by the free border of the tent anterior to the point where the two leaves of the tent meet each other and the falx cerebri. This is also where the straight sinus receives the inferior sagittal sinus and the Great Vein of Galen (great cerebral vein). The incisura marks the transition between the posterior and middle cranial fossae and serves as well as a marker for the transition between the pons and the midbrain, just as the foramen magnum marks the transition between the spinal cord and the medulla.

Caudal to the tent we find the pons, ventrally (residing posterior to the clivus) and the tectum, dorsally (the roof over the aqueduct of Silvius). The two pairs (superior and inferior) of colliculi are situated dorsal to the aqueduct as part of the tectum. Caudal to the colliculi, the tectum is

continuous with the thin superior medullary velum forming the roof of the fourth ventricle and connecting to the cerebellum. The cerebellum nestles beneath the tent, mostly posterior to the incisura.

The neurological tissue at the pontomesencephalic sulcus in the midbrain, adjacent to the incisura includes the superior and inferior colliculi (collectively known as the corpora quadrigemina) on the posterior aspect of the brainstem, and the tracts of the cerebral peduncles bilaterally on the anterolateral aspect, with the substantia nigra located immediately internal to these tracts. The substantia nigra and the corpora quadrigemina find themselves in precarious positions relative to the tense, sharp edge of the free border of the tent.

The performance of the substantia nigra and corpora quadrigemina carries great importance for our wellbeing. The substantia nigra along with four other nuclei (caudate, putamen, globus pallidus, and subthalamus) compose the basal ganglia. The substantia nigra, a pair of melanin-colored, relatively flat, thin, and semi-transverse nuclei are critical for reward and movement functions. Each of these bilateral nuclei is composed of two parts. More medially, the pars compacta sends the excitatory neurotransmitter (dopamine) to the striatum (caudate and putamen). When deficient (i.e., cell death), Parkinson's disease results. More laterally is the pars reticulata; it is an important processing center for the basal ganglia. The pars reticulata conveys the final processed signal of the basal ganglia through inhibitory GABAergic neurons to the thalamus and the superior colliculus.^{7 8}

The superior and inferior colliculi are reflex centers involving vision and hearing. The superior colliculus orients the head towards something seen and heard. It receives auditory information from the inferior colliculus. Superior and inferior colliculi connect through two pairs of brachia that serve to exchange information with the thalamus. The superior colliculi communicate with the lateral geniculate bodies and the inferior colliculi with the medial geniculate bodies, located on the posterior and inferior limit of the thalamus, just anterior and superior to the colliculi. The geniculate bodies receive primary visual (lateral) and auditory (medial) information from the optic radiations and auditory pathways respectively. The colliculi integrate these sensory inputs to coordinate muscular responses.^{9 10 11}

The inferior colliculus is the largest nucleus in the auditory pathway and processes multiple audio signals to integrate them and filter out the sound of vocalizing, breathing, and chewing. It also localizes the source of sound, known as binaural hearing. It is the central processing center for not only audio but also many other sensory inputs. It responds to loud sounds with the startle reflex, for example. The superior colliculus is responsible for stereoscopic vision. Because of colliculi, one can hold a gaze, follow a home run, or visually investigate to discern fine detail.^{12 13}

One can appreciate how damage to the colliculi makes for sensitivity to sound and light making difficult such activities as driving at night, watching television or computer screens, and listening to music or noise. A sense of compression or congestion often distinguishes what one feels when tissue has been injured and is not functioning well. Often the tissue feels deflated, compressed, and lacking motility and vitality. In the case of a mechanical injury from the free border of the tent, the injured tissue in the midbrain is quite obvious. Injured tissue, like a soldier out of step, draws one's attention.

One patient displayed an obvious injury to only the left substantia nigra on the lateral side of the midbrain. The right side felt vital, full, and breathed well with primary respiration. He had tremors only in his right hand and foot. He had been in an auto accident 18 months earlier and had never been "right" since then, but experienced progressive tremor, unsteadiness, and gait freezes over the six months prior to his first visit with me. As I worked to balance the left and right sides of his midbrain, his symptoms responded remarkably. I had never before seen a Parkinson's patient respond to osteopathic manipulative treatment with improved symptoms. His symptoms have nearly resolved with one month of weekly treatments.

I have many more patients with concussion who experience sensitivity to noise and light than I have patients with Parkinson's disease. Concussion patients likewise recover well from light and sound sensitivity with attention to the colliculi. Improving fullness, fluidity, and vitality of motility seems to be the key, as it does anywhere we apply OCF.

To find these structures, orient yourself to the tent as an extension of the petrous temporal bones, more familiar and easily visualized through bony contacts. Now visualize the sweep of the leaves of the tent superiorly and posteriorly towards the straight sinus that points from inion to bregma at the coronal suture in the midline. Follow the line from the inion towards bregma (the initial segment of this imaginary line being the straight sinus) and visualize the intersection of this line with the two lines of the edges of the petrous temporals that come to mind best with a bilateral temporal contact. Fill in this *picture of normal anatomy* (from which Dr. Still instructs us to always operate) with the free borders of the tent (incisura). Feel Sutherland's fulcrum oscillating up and down the suspended fulcrum represented by the straight sinus. Look inside the curve of the incisura to the lateral and posterior aspects of the midbrain for the nuclei in question. See if your attention is attracted by a sense of heaviness and compression from any injured tissue. Once you find this injured tissue, your memory for such a sense of congestion will direct you more easily to other injured tissue the next time.

Treatment requires the injured tissue to be identified. Once the operator recognizes the congested and devitalized tissue, he or she simply watches the primary respiratory mechanism work to foster healing activity. Sometimes it takes many minutes, but the time is a small price to pay for the valuable benefits. The healing function becomes evident in your perception as the injured tissue begins to blend in with its surroundings, becoming homogeneous with the whole. Wait for the formerly injured tissue to breathe with the neighboring tissue. This is integration. Once a stillpoint occurs and normal motion resumes at a quieter pace we know that the job is finished.

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An Osteopathic Approach to Ophthalmic and Optometric Disorders: Part 10

Anthony Capobianco, DO, FCA

This is the final article in a series exploring the application of a comprehensive traditional Osteopathic approach to visual perception system disorders. Many detailed cases, visit by visit, have been presented. All serve to illustrate how case management, including various visual system OMT techniques, taken in whole or part, could be integrated into a day to day general osteopathic manipulation– based practice. This part will serve to summarize in sequence form the most widely used techniques applied in those case studies.

The first three articles discussed the anatomical and physiological basis for the techniques presented throughout the series. The local treatment of the visual system refers to the globe, orbit, and, because of the close proximity to the visual sensory processing occipital lobes, the occiput, and all contiguous soft and osseous tissues, and forces, immediately related to them. Over three and a

half decades of clinical application coalesced to form this cohesive and concise visual system OMT sequence (referred henceforth as the "sequence") utilizing various techniques, acquired and developed, discernable in the case studies. This can be applied as a whole, or, can provide a cache, from which the operator can select when time is limited, to complement, or even frame, personally preferred techniques or approaches. These time limitations may be due to a multiplicity of reasons, including numerous patient medical complaints or an office visit time constraint. As discussed in earlier segments, the local eye sequence is considered in the context of the adjacent cranial mechanism, termed regional, and further afield in the context of the remaining body, or what is termed global, approaches. That being said, this sequence can and usually is applied solely, intermittently or over a series of visits, with remarkably consistent results.