Summary of Research Findings for Osteopathic Treatment in the Cranial Field: An Annotated Bibliography

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**Please note:** This summary was undertaken by clinicians. It attempts to be illustrative rather than an exhaustive literature review (although some of those are referenced in this paper). It has not included:

- some of the more recent work relating palpatory findings and clinical changes to quantum phenomena, because that area is beyond the technical expertise of the authors;

- much of the older work done by researchers such as Sutherland, Magoun, Frymann, Retzlaff and Greenman, because we did not have access to the full text of their work at the time of writing.

Version 2.0
It has been understood by anatomists for many years that there is movement at cranial sutures

The Structure and Development of Cranial and Facial Sutures

“The histology of the suture suggests that it has two main functions, viz. that it is a site of active bone growth, and that it is at the same time a firm bond of union between the neighbouring bones, which nevertheless allows a little movement. That sutures have this dual function has been expressly stated by Bernstein (1933), Giblin & Alley (1944), Massler & Schour (1951), Moss (1954), Baer (1954), and Scott (1954).”

“Considered as articulations, the sutures possess the means for resisting gross separation of the bones, while at the same time permitting slight relative movement.”

“The central zone, however, with its weak fibre bundles running in all directions and its sinusoidal blood vessels, could well allow some slight movement of one bone against the other, and so could be regarded as analogous to a synovial joint cavity.”

Detection of skull expansion with increased intracranial pressure.

“A technique is described which uses standard strain-gauge technology to detect skull expansion associated with increased intracranial pressure.”

Role of cranial bone mobility in cranial compliance.

“Data reported here indicate that the movement of the cranial bones at their sutures is an additional factor defining total cranial compliance. Using controlled bolus injections of artificial cerebrospinal fluid into a lateral cerebral ventricle in anesthetized cats and a newly developed instrument to quantify cranial bone movement at the midline sagittal suture where the bilateral parietal bones meet, we show that these cranial bones move in association with increases in ICV along with corresponding peak intracranial pressures and changes in intracranial pressure. External restraints to the head restrict these movements and reduce the compliance characteristics of the cranium. We propose that total cranial compliance depends on the mobility of intracranial fluid volumes of blood and cerebrospinal fluid when there is an increase in ICV, but it also varies as a function of cranial compliance attributable to the movement of the cranial bones at their sutures.”

Radiographic evidence of cranial bone mobility.

“Twelve adult patient charts were randomly selected to include patients who had received cranial vault manipulation treatment with a pre- and post-treatment x-ray taken with the head in a fixed positioning device. The degree of change in angle between various specified cranial landmarks as visualized on x-ray was measured. The mean angle of change measured at the atlas was 2.58 degrees, at the mastoid was 1.66 degrees, at the malar line was 1.25 degrees, at the sphenoid was 2.42 degrees, and at the temporal line was 1.75 degrees. 91.6% of patients exhibited differences in measurement at 3 or more sites.”
Cranial sutures are intimately related to dysfunctions and strain patterns throughout the skull and brain

The pathogenesis of premature cranial synostosis in man.⁵

"Instead of directing our attention exclusively to the affected sutural area, we may consider the resulting neurocranial malformation as an expression of some lack of coordination with the functional unity of the inter-related neurocranial components." "It is maintained that premature sutural synostosis is a symptom and not a cause, and that the changes in neurocranial sutural synostosis are easily understood in terms of the the growing, functionally related cephalic components."

Phenotypic integration of neurocranium and brain.⁶

"Our comparative analysis of phenotypic integration of brain and skull in premature closure of the sagittal and the right coronal sutures demonstrates that brain and skull are strongly integrated."

Pulsatile movement of the cerebro-spinal fluid and the brain itself can be instrumentally measured, and there are flow patterns within the CSF. Multiple drivers of these movements have been identified, and these operate at different frequencies.

Human brain motion and cerebrospinal fluid circulation demonstrated with MR velocity imaging.⁷

"In this study, in vivo, quantitative magnetic resonance (MR) imaging methods were developed to show reproducible magnitudes and directions of CSF flow." "Observations of pulsatile brain motion, ejection of CSF out of the cerebral ventricles, and simultaneous reversal of CSF flow direction in the basal cisterns toward the spinal canal, taken together, suggest that a vascular-driven movement of the entire brain may be directly pumping the CSF circulation. The authors describe what they believe to be the first observations and measurements of human brain motion, which occurs in extensive internal regions (particularly the diencephalon and brain stem) and is synchronous with cardiac systole."
Pulsatile brain movement and associated hydrodynamics studied by magnetic resonance phase imaging. The Monro-Kellie doctrine revisited.⁸

“The resultant movement occurred in a funnel-shaped fashion as if the brain were pulled by the spinal cord. This may be explained by venting of brain and cerebrospinal fluid (CSF) through the tentorial notch and foramen magnum. The intracranial volume is assumed to be always constant by the Monro-Kellie doctrine. The intracranial dynamics can be viewed as an interplay between the spatial requirements of four main components: arterial blood, capillary blood (brain volume), venous blood and CSF. “

“The arterial expansion causes a re-moulding of the brain that enables its piston-like action. The arterial expansion creates the prerequisites for the expansion of the brain by venting CSF to the spinal canal. The expansion of the brain is, in turn, responsible for compression of the ventricular system and hence for the intraventricular flow of CSF.”

Oscillatory motion of the normal cervical spinal cord.⁹

“The cervical spinal cord moves with an oscillatory pattern in the craniocaudal direction.”

Noninvasive measurement of pulsatile intracranial pressure using ultrasound.¹⁰

“The technique is based upon detecting skull movements which are known to occur in conjunction with altered intracranial pressure.”

“Frequency analyses (fast Fourier transformation) clearly demonstrate the correspondence between the pulsed phase locked loop output and intra-cranial pressure pulse cycles.”

Slow oscillations of cytochrome oxidase redox state and blood volume in unanesthetized cat and rabbit cortex. Interhemispheric synchrony.¹¹

“Continuous oscillations of CYT [cytochrome oxidase redox state] and CBV [cranial blood volume], unrelated to pulse or respiration, were always observed in each animal. Frequency (FFT) analysis over time revealed a nonstationary distribution of frequencies below 0.4 Hz, with most of the spectral power being contained in the 0-0.25 Hz band during both waking and sleep. Although the time-frequency plots of the CYT and CBV signals were similar, an occasional dissociation between the CYT and CBV oscillations was found. Analysis of simultaneous bilateral cortical optical recordings revealed a significant and sustained interhemispheric cross-correlation over time between the CYT as well as the CBV oscillations during stable recordings as long as 60 min. We conclude that: 1) CYT and CBV levels normally oscillate at < 0.4 Hz in the unanesthetized cat and rabbit cortex; 2) these complex oscillations, whose frequencies are non-stationary over time, nevertheless show sustained interhemispheric synchrony between 50 mm² homotopic cortical regions; and 3) these oscillations may in part represent fluctuations of the metabolic rate.”
Cranial rhythmic impulse related to the Traube-Hering-Mayer oscillation: comparing laser-Doppler flowmetry and palpation.\textsuperscript{12}

*The primary respiratory mechanism (PRM) as manifested by the cranial rhythmic impulse (CRI), a fundamental concept to cranial osteopathy, and the Traube-Hering-Mayer (THM) oscillation bear a striking resemblance to one another. Because of this, the authors developed a protocol to simultaneously measure both phenomena. Statistical comparisons demonstrated that the CRI is palpably concomitant with the low-frequency fluctuations of the THM oscillation as measured with the Transonic Systems BLF 21 Perfusion Monitor laser-Doppler flowmeter.*

Cranial diameter pulsations measured by non-invasive ultrasound decrease with tilt.\textsuperscript{13}

*We have developed an ultrasonic device that monitors changes in cranial diameter pulsation non-invasively so that we can evaluate ICP dynamics in astronauts during spaceflight.*

Physiological Background of the Cranial Rhythmic Impulse and The Primary Respiratory Mechanism\textsuperscript{14}

*This means that slow fluctuations of CV parameters could have two different origins - one intracranial and the other extracranial. For central circulation, slow fluctuations are of three groups:

A – waves with period 2-20/min, named “plateau waves” are characteristic of pathology.

B – waves with period 1-2 cycles/min.

C - waves fluctuations of central arterial pressure namely Traube-Hering waves.*

MR imaging and quantification of the movement of the lamina terminalis depending on the CSF dynamics.\textsuperscript{15}

*Brain pulsation is a well-known observation in neurosurgery, but methods for its visualization on MR imaging, like phase imaging, do not provide a detailed structural view. We prospectively investigated electrocardiographic (ECG)-gated cine true fast imaging with steady-state precession (FISP) sequence on volunteers to test a sequence for demonstrating brain pulsation and movements of intracranial structures related to CSF dynamics.*

*The lamina terminalis was chosen to study the pulsatility of the brain, and the optic recess diameter was chosen for means of objective quantification of the degree of pulsatility.*

*Pulsatile motion of the lamina terminalis was apparent in all volunteers on the cine mode. The mean diameter of the optic recess was 2.5 mm. The greatest change in diameter in 1 volunteer was 1.5 mm. The mean change in diameter was 40% during 1 cardiac cycle.*

*Cine true-FISP sequence is a well-suited method for investigations of passive movements of the ventricular system. It shows pulsations of the brain as well as passive changes caused by CSF dynamics with high temporal and spatial resolution.*
Anatomy and physiology of cerebrospinal fluid.\textsuperscript{16}

*CSF circulation from sites of secretion to sites of absorption largely depends on the arterial pulse wave. Additional factors such as respiratory waves, the subject’s posture, jugular venous pressure and physical effort also modulate CSF flow dynamics and pressure.*
*The CSF space is a dynamic pressure system.*

Pulsatility in CSF dynamics: pathophysiology of idiopathic normal pressure hydrocephalus.\textsuperscript{17}

*The pulsatility curve was not modified by shunt surgery, while the baseline position was shifted along the curve. Observed differences between gait improvers and non-improvers support cardiac related ICP [intracranial pressure] pulsations as a component of INPH [idiopathic normal pressure hydrocephalus] pathophysiology.*

A new look at cerebrospinal fluid circulation.\textsuperscript{18}

*The CSF circulation comprises not only a directed flow of CSF, but in addition a pulsatile to and fro movement throughout the entire brain with local fluid exchange between blood, interstitial fluid, and CSF. Astrocytes, aquaporins, and other membrane transporters are key elements in brain water and CSF homeostasis. A continuous bidirectional fluid exchange at the blood brain barrier produces flow rates, which exceed the choroidal CSF production rate by far. The CSF circulation around blood vessels penetrating from the subarachnoid space into the Virchow Robin spaces provides both a drainage pathway for the clearance of waste molecules from the brain and a site for the interaction of the systemic immune system with that of the brain. Important physiological functions, for example the regeneration of the brain during sleep, may depend on CSF circulation.*
The skull, its sutures and dural membranes, like other parts of the human body, appears to function as a tensegrity structure (a "sping-laded" structure, held together by tension forces)

A "tensegrity structure" is one which is held together by reciprocal tension, rather than one which is locked rigidly in place. Think of a bicycle wheel, held together by tension on the spokes, as opposed to a wagon wheel (pushed apart my rigid spokes. Most parts of the body are tensegrity structures; for example, the sacrum is suspended between the ilia by ligamentous tension, rather than being locked there. Even individual cells are thought to be held together by tensegrity. The cranium appears to be no exception. Tensegrity structures can be spring-like.

Cellular harmonic information transfer through a tissue tensegrity-matrix system.19

"Cells and intracellular elements are capable of vibrating in a dynamic manner with complex harmonics, the frequency of which can now be measured and analyzed in a quantitative manner by Fourier analysis. Cellular events such as changes in shape, membrane ruffling, motility, and signal transduction occur within spatial and temporal harmonics that have potential regulatory importance. These vibrations can be altered by growth factors and the process of carcinogenesis. It is important to understand the mechanism by which this vibrational information is transferred directly throughout the cell. From these observations we propose that vibrational information is transferred through a tissue tensegrity-matrix which acts as a coupled harmonic oscillator operating as a signal transducing system from the cell periphery to the nucleus and ultimately to the DNA. The vibrational interactions occur through a tissue matrix system consisting of the nuclear matrix, the cytoskeleton, and the extracellular matrix that is poised to couple the biologic oscillations of the cell from the peripheral membrane to the DNA through a tensegrity-matrix structure. Tensegrity has been defined as a structural system composed of discontinuous compression elements connected by continuous tension cables, which interact in a dynamic fashion. A tensegrity tissue matrix system allows for specific transfer of information through the cell by direct transmission of vibrational chemomechanical energy through harmonic wave motion."

A model of the cranial vault as a tensegrity structure, and its significance to normal and abnormal cranial development.20

"In a tensegrity structure, a change in any one tension or compression element causes the whole shape to alter or distort, through reciprocal tension, distributing the stresses to all other points of attachment."

Living bone is pliable, not rigid.

One of the arguments sometimes used to reject the idea of working with cranial rhythmic motion, is the fact that the spheno-basilar symphysis becomes ossified. Using this fact as an assumption that therefore the bone will be rigid is to assume that bone is a rigid material.
The mechanics of cranial motion—the sphenobasilar synchondrosis (SBS) revisited^21

*This article suggests that the apparent motion of the SBS instead takes place by a change in shape of the anterior body of the sphenoid, and that this motion is accommodated by the superior orbital fissure. This new model can be used to derive cranial bone motion patterns directly from the assumption that the cranium changes its lateral diameter, and elegantly explains the well-known 'four interlinked gears' description of the occiput–sphenoid–vomer/ethmoid train. The model does not require sutures to be patent or membranous, since it applies equally well to ossified suture relics.*

The role of collagen in bone strength^22

*Bone is a... viscoelastic material.*
*Bone matrix is a two-phase system in which the mineral phase provides the stiffness and the collagen fibres provide the ductility and ability to absorb energy (i.e., the toughness). Alterations of collagen properties can therefore affect the mechanical properties of bone and increase fracture susceptibility.*

Even on a cadaver, force applied to the frontal bone will stretch the falx cerebri.

Changes in Magnitude of Relative Elongation of the Falx Cerebri During the Application of External Forces on the Fontal Bone of an Embalmed Cadaver^23

*In conclusion this study demonstrated that when an external force is applied on the frontal bone of an embalmed cadaver, this force may be transmitted to the falx cerebri causing a relative elongation of it. According to this study a relative elongation of 0.366 mm was recorded when weight of 242 gr. was applied. The maximum relative elongation was 1.371 mm. A relative elongation of 1.097 mm, which was the outcome of the application of 642 gr, constituted the critical point where the elastic deformation of the membranes stops and a plastic deformation begins.*

There is radiographic confirmation that external manipulation of the cranium can alter cranial bone movements
Twelve adult patient charts were randomly selected to include patients who had received cranial vault manipulation treatment with a pre- and post-treatment x-ray taken with the head in a fixed positioning device. The degree of change in angle between various specified cranial landmarks as visualized on x-ray was measured. The mean angle of change measured at the atlas was 2.58 degrees, at the mastoid was 1.66 degrees, at the malar line was 1.25 degrees, at the sphenoid was 2.42 degrees, and at the temporal line was 1.75 degrees. 91.6% of patients exhibited differences in measurement at 3 or more sites.

Radiographic evidence of cranial bone mobility.

Externally applied forces and increases in intracranial pressure can result in measurable cranial motion across the cranial sutures in adolescent and adult mammalian animal species, and measurable changes in cranial vault diameter in post-mortem and living adult humans. However, the amount of cranial motion may vary by subject, the region of the head to which forces are applied, and the method of force application. Given that the forces required to generate reported cranial deflections in living humans are within the range of forces likely to be used during CO, it is reasonable that small amounts of cranial deflection can occur as a result of the forces applied to the skull during CO.

An investigation of cranial motion through a review of biomechanically based skull deformation literature

The cranial rhythmic motion consists of multiple, overlapping wave forms.

This is consistent with the fact that multiple drivers of cranial rhythmic activity have been radiologically identified.

A study of the rhythmic motions of the living cranium

If the neural networks are developed by attention and practice to filter out all but the lowest frequency, the sense of touch will experience the illusion that a repetitive motion is clearly felt at a frequency which is the difference between the two frequencies actually present. In palpation, the fingertips are subjected to cyclic motions of different frequency, one each from the pulse and the respiratory cycles of the operator and of the subject. It may be contended with some force of argument that the apparent sensation of a slow cranial rhythm represents only a ‘beat’ frequency between, say, the two pulse cycles. Because exceptions of this sort can be taken as evidence perceived by palpation alone, it was essential to devise an instrument program to demonstrate whether the tactile observations of cranial motility are, in fact, valid.

The few examples presented here, and many more that have been recorded permit the assertion that there is a cranial mobility which is slower than and distinguishable from the motility of the vascular pulse and thoracic respiration. It has been demonstrated also that this motion can be mechanically recorded.

Grosser experiments have shown that movement of cerebrospinal fluid occurs not only synchronously with cardiac and respiratory movement but with a rhythmic periodicity similar to but slower than respiration.
Osteopathy in the Cranial Field²⁷

[This fact was highlighted by Magoun in his text in 1976, based on numerous studies (which have not been included here, because the original text was not available at the time of writing) but most subsequent researchers who were looking for "inter-examiner reliability" seem to have assumed that they should be looking for agreement about the velocity of a single rhythm. His findings were confirmed by Myers based on photographic evidence (see below).]
A new look at cerebrospinal fluid movement.\textsuperscript{31}

*Our findings as well as some clinical data and experimental results obtained from different animal species, do not support unidirectional CSF circulation but strongly suggest that there are cardiac cycle-dependent systolic-diastolic to-and-fro cranio-spinal CSF movements. These are based on: a) physiological oscillations of arterial and venous blood during cranio-spinal blood circulation; b) respiratory activity, and c) body activity and posture. That kind of complex CSF movement could explain the observed distribution of many different substances in all directions along the CSF system and within central nervous system tissue. It seems that efflux transport systems at capillary endothelium may be more important for brain homeostasis than the removal of metabolites by CSF flow. Thus, when discussing the CSF dynamics we suggest that a more appropriate term would be CSF movement rather than CSF circulation.*

We are capable of focusing on one particular wave form within multiple overlapping wave forms; human selective attention is very powerful.

This is most easily demonstrated by our ability to focus on, and interpret, the speech of one particular person in a crowded room with a lot of conversations. (Sound itself being a series of overlapping wave forms). We can then refocus to listen to a different conversation.

Characterization of the Cranial Rhythmic Impulse in Healthy Human Adults\textsuperscript{32}

*A total of 274 CRI cycles were recorded on twenty-four (24) subjects by twelve (12) examiners; these data are summarized in Table I. The most remarkable finding from these experiments is the relatively long average cycle length and the correspondingly low average CRI frequency of 3.7 cycles/min, considerably lower than previously published values. The range of average cycle lengths among the twenty-four (24) subjects was 11.7-22.3 seconds. Flexion occupied 46.5% of the average CRI cycle, and little variation in this percentage was seen over the range of cycle lengths observed in these experiments.*

The role of working memory in tactile selective attention.\textsuperscript{33}

*We examine the extent to which tactile selective attention also depends on working memory. In Experiment 1, participants focused their attention on continuous target vibrations while attempting to ignore pulsed distractor vibrations. In Experiment 2, targets were always presented to a particular hand, with distractors being presented to the other hand. In both experiments, a high (vs. low) load in a concurrent working memory task led to greater interference by the tactile distractors. These results establish the role of working memory in the control of tactile selective attention, demonstrating for the first time that the principles of load theory also apply to the tactile modality.*
Cortical dynamics of selective attention to somatosensory events.  

"We examined attentional effects on human somatosensory oscillations during median nerve stimulation by conducting time-frequency analyses of neuromagnetic recordings in healthy adults. We found that selective attention modulated somatosensory oscillations in the alpha, beta, and gamma bands that were both phase-locked and non-phase-locked to the stimulus."

Principles of part-whole selective perception by dynamic touch extend to the torso.  

"The haptic subsystem of dynamic touch expresses a novel form of part-whole selective perception."

As expected from what we know, studies of inter-examiner reliability in palpating the frequency of the cranial rhythmic impulse have shown that different people palpate different rhythms.  

When there is as much going on as their with the cranial rhythmic impulse, asking for two people to agree that they are focussing on the same thing is a lot like asking two people to view an expansive panorama, talk about one thing they see, and then dismissing their ability to see anything at all because they don't describe the same thing.

Interrater reliability of craniosacral rate measurements and their relationship with subjects' and examiners' heart and respiratory rate measurements.

"Measurements of craniosacral motion did not appear to be related to measurements of heart and respiratory rates, and therapists were not able to measure it reliably."

Craniosacral rhythm: reliability and relationships with cardiac and respiratory rates.

"The results indicated that a single examiner may be able to palpate the rate of the CSR consistently"  
"The rate of the CSR palpated by two examiners is not consistent. The results of the regression analysis of one examiner offered no validation to those of the other. It appears that a subject’s CSR is not related to the heart or respiratory rates of the subject or the examiner."

Simultaneous palpation of the craniosacral rate at the head and feet: intrarater and interrater reliability and rate comparisons.

"The results did not support ... claims that craniosacral motion can be palpated reliably."
Intraexaminer and interexaminer reliability for palpation of the cranial rhythmic impulse at the head and sacrum.  

*Intrarater reliability for examiners at either the head or the sacrum was fair to good, significant intraclass correlation coefficients ranging from +0.52 to +0.73. Interexaminer reliability for simultaneous palpation at the head and the sacrum was poor to nonexistent, ICCs ranging from -0.09 to +0.31. There were significant differences between rates of CRI palpated simultaneously at the head and the sacrum.*

**Clinical conditions can be correlated with a failure of tissues to move appropriately**

Fixed spinal cord: diagnosis with MR imaging.

*Pulsatile motion of the spinal cord was examined with phase imaging techniques. Sagittal images of the spinal cord were obtained at different times of the cardiac cycle in healthy volunteers, as well as in patients in whom the spinal cord either was tethered, was compressed, or contained an intramedullary lesion. Pulsatile velocity changes of the spinal cord, observed on the phase images, were most marked at the cervical-upper thoracic level. Cord motion was found to be significantly decreased in cases in which the cord was either tethered or compressed.*

The cranial rhythmic impulse and excessive crying of infancy.

*Excessive crying was associated with an abnormal CRI at 2 weeks (p<0.001)*

Suture restriction of the temporal bone as a risk factor for acute otitis media in children: cohort study

*Occurrence of AOM [acute otitis media] diagnosed by physicians blinded to temporal bone status was the main outcome.*
*Severe suture restriction of the temporal bone was identified in 23 children (35.9%). At least one AOM episode was diagnosed in 14 (48.3%) of the ears associated with temporal bones previously identified as having severe suture restriction and in 28 (28.3%) of those without severe suture restriction. Higher risk for AOM was explained by severe suture restriction of the temporal bone (adjusted relative risk (RR), 2.26, 95% CI 1.43 to 2.91, p<.01), pacifier use (RR, 2.59, 95% CI 1.51 to 3.22, p<.01) and younger age (RR, 0.22, 95% CI 0.10 to 0.52, p=.001).*
*The study results indicate that severe suture restriction of the temporal bone is a risk factor for AOM in young children.*

Cranial treatment can bring about physiological changes
A case is reported in which cooperation between a dentist and an osteopathic physician schooled in cranial osteopathy improved the treatment of a patient with severe traumatic malocclusion. The patient appeared with a severe headache. Although there had been no recent trauma, the patient had sustained fractures in the foot in a parachute jump several years before. The osteopathic physician found that the parachute jump had compressed the patient's left side into various lesions. He also noted malocclusion to the left at the midline of the mandible. The dentist confirmed the presence of severe malocclusion, with open bite and deviation of the median line to the left during retraction to hinge centric jaw relation. Treatment by occlusal equilibration and osteopathic adjustment for six months brought relief of pain and established centric jaw relation. Serial measurements of models of maxillary teeth showed the maximum lateral dimensional change between permanent maxillary second molars was 0.0276 inch, which is about nine times the possible error in measurement. The patient’s head bones moved along their sutures.

Cranial Manipulation Induces Sequential Changes in Blood Flow Velocity on Demand

*Methods: Using laser-Doppler flowmetry to quantify the TH and other components of the blood flow velocity oscillation, we compared flowmetry records of 15 subjects before and immediately following cranial manipulation. The timing of the treatment/non-treatment sequence was established prior to manipulative inter-vention. Results: Selected continuous record segments from within treatment and non-treatment portions of the experimental flowmetry records were converted to frequency-domain spectra via a Fourier-transformation (FT). From the FT data, difference spectra were computed by subtracting the spectrum acquired during a non-treatment segment from the spectrum of adjacent treatment-period records. The resultant difference showed that cranial manipulative treatment enhanced the magnitude of the 0.1 Hz component and increased the fundamental heart rate. No other prominent changes with treatment were observed. Conclusions: Flowmetry shows that cranial manipulation may be used to alter the 0.1 Hz blood flow component of the TH oscillation according to a pre-determined protocol. Thus, cranial manipulation may be used to alter blood flow according to specific interventional directives.*

Cranial manipulation can alter sleep latency and sympathetic nerve activity in humans: a pilot study.

*The current study is the first to demonstrate that cranial manipulation, specifically the CV4 [compression of the 4th ventricle] technique, can alter sleep latency and directly measured MSNA [muscle sympathetic nerve activity] in healthy humans. These findings provide important insight into the possible physiologic effects of cranial manipulation.*
The effect of an alternative medical procedure upon low-frequency oscillations in cutaneous blood flow velocity. 46

"Human subjects were paired with 28 individual physicians for application of the CV-4 [compression of the 4th ventricle], and the duration of the application was recorded. Flowmetry records tracking the course of the procedure were obtained."
"The CV-4 procedure specifically affected the low-frequency oscillations in blood flow velocity. After application, the amplitude of the TH, 0.10 Hz, frequency wave increased (relative area units: control minus treatment [0.08010 units) compared with control minus response [-0.03358 units]; P = .011)."
"This study showed that CV-4 has an effect on the TH frequency component of blood flow velocity. The practitioners of cranial manipulation who participated in this study affected their subjects in a quantifiable manner with the application of the CV-4 procedure."

Physiological effects of a CV4 cranial osteopathic technique on autonomic nervous system function: A preliminary investigation 47

"Heart rate variability, respiration rate, galvanic skin resistance and skin temperature were measured in ten subjects (six females, four males) in an experiment consisting of five generic phases"
"On examination of heart rate variability, it became apparent that three subjects may have responded in a manner that was consistent with an increase in parasympathetic activity during the treatment phase. This identification leads to the notion that there may be both ‘responders’ and ‘non-responders’ to cranial treatment."

Effect of Osteopathy in the Cranial Field on Visual Function—A Pilot Study 48

"Several variables in the present study demonstrated statistically significant postintervention effects within both the treatment (ie, osteopathy in the cranial field) group and the control group. Postintervention pupillary size in bright illumination OD showed a statistically significant effect in the treatment group vs the control group."

Effect of cranial osteopathic manipulative medicine on cerebral tissue oxygenation. 49

"Cranial OMM [osteopathic manipulative medicine] augmentation and suppression techniques and sham therapy were randomly applied to healthy adults. During cranial OMM and sham therapy, S(CT)O(2) of the prefrontal cortex was determined bilaterally by using near-infrared spectroscopy. Heart rate, blood pressure, and systemic arterial blood oxygen saturation (SaO(2)) were also measured."
"The cranial OMM suppression technique effectively and progressively reduced S(CT)O (2) in both prefrontal lobes with the treatment time."

15
Changes in alpha band activity associated with application of the compression of fourth ventricular (CV-4) osteopathic procedure: a qEEG pilot study.⁵⁰

"Participants were randomly distributed in control, sham-CV4 and CV4 conditions using a cross-over design. qEEG activity was recorded for each of the 10 subjects in each of the 3 conditions. There was a significant increase in the alpha absolute power between pre and post in the CV-4 condition."

Osteopathic manipulative treatment for facial numbness and pain after whiplash injury.⁵¹

"Whiplash injury is often caused by rear-end motor vehicle collisions. Symptoms such as neck pain and stiffness or arm pain or numbness are common with whiplash injury. The author reports a case of right facial numbness and right cheek pain after a whiplash injury. Osteopathic manipulative treatment techniques applied at the level of the cervical spine, suboccipital region, and cranial region alleviated the patient’s facial symptoms by treating the right-sided strain of the trigeminal nerve. The strain on the trigeminal nerve likely occurred at the upper cervical spine, at the nerve's cauda, and at the brainstem, the nerve's point of origin. The temporal portion of the cranium played a major role in the strain on the maxillary."

There are a number of outcome studies evaluating the effectiveness of cranial treatment for a wide range of clinical conditions and patient types.

There are a number of outcome studies evaluating the effectiveness of cranial treatment for a wide range of clinical conditions and patient types. These range from individual cases through to replicated, placebo-controlled, double-blind trials. Some involve just testing cranial techniques, while others involve treating osteopathically, including cranial techniques in the mix of modalities used.

A successful use of cranial-sacral osteopathy in the treatment of post-traumatic headache following subarachnoid hemorrhage⁵²

Case study,

"In this case the physical medicine approach, including osteopathic manipulative medicine, was a benefit to the patient in the treatment of a posttraumatic headache."
A pilot study: Osteopathic treatment of infants with a sucking dysfunction

"A pilot study of six infants".
"At the time of first measurement, the difference between pre- and post fed fat estimations of breast milk was small in infants with a dysfunctional suck. Following osteopathic treatment, the difference between pre- and post fed fat estimations were comparable with the fat estimations from the breast milk of infants who were feeding normally."

The effectiveness of CV-4 and resting position techniques on subjects with tension-type headaches

"Sixty adults between the ages of 21 and 65 (X=36, SD=12) who were experiencing a TTH [tension-type headache] were randomly assigned to groups. Subjects in the first group received a 10-minute session wherein multiple still points were induced using the CV-4 craniosacral technique. Subjects in the second group were placed supine in a resting position with the head and neck positioned for ten minutes in the most comfortable points in the ranges of protraction-retraction and flexion-extension. Subjects in the third group received no treatment; they lay quietly for 10 minutes. Pain intensity and the affective component of pain were measured before and after the treatments using visual analog scales. To determine if significant differences existed between the groups, a one-way multivariate analysis of covariance (MANCOVA) was used, followed by univariate tests and post-hoc tests. The MANCOVA was significant (F=3.59; df=4, 108; p<0.05). Analysis of covariance for the variables of pain intensity and affect revealed significant differences among the groups (F=5.38; df=2,56; p<0.05 for intensity and F=4.45; df=2,56; p<0.05 for affect). Tukey tests revealed a significant improvement, in both intensity and affect scores, between the group receiving the CV-4 treatment and the no-treatment group and no significant difference between the group using only the resting position and the group receiving no treatment. The CV-4 technique is an effective technique for treating patients with TTH."

Osteopathic treatment of an infant with a failure to suck

"The predominant complain was inability to suck either at breast or bottle."
"The baby was being fed with a nasogastric tube."
"Osteopathic treatment addressing the cranial and extracranial structures, with particular emphasis on the condylar and sacroiliac compressions, was carried out."
"Immediately following second treatment, he sucked 60ml of formula on his own. The amounts sucked progressed erratically after that next week."
"By that time, Baby X was almost 8 weeks old. He presented on this occasion without the nasogastric tube."
"At five months of age... he is continuing to thrive. Developmental milestones were age appropriate. Solids were gradually introduced at approximately four months of age."
The use of osteopathic manipulative treatment as adjuvant therapy in children with recurrent acute otitis media.56

*Adjusting for the baseline frequency before study entry, intervention patients had fewer episodes of AOM (mean group difference per month, -0.14 [95% confidence interval, -0.27 to 0.00]; P =.04), fewer surgical procedures (intervention patients, 1; control patients, 8; P =.03), and more mean surgery-free months (intervention patients, 6.00; control patients, 5.25; P =.01). Baseline and final tympanograms obtained by the audiologist showed an increased frequency of more normal tympanogram types in the intervention group, with an adjusted mean group difference of 0.55 (95% confidence interval, 0.08 to 1.02; P =.02). No adverse reactions were reported.*

"The results of this study suggest a potential benefit of osteopathic manipulative treatment as adjuvant therapy in children with recurrent AOM [acute otitis media]; it may prevent or decrease surgical intervention or antibiotic overuse."

*Treatments were gentle techniques on areas of restriction consisting of articulation, myofascial release, balanced membranous tension (according to teachings of William Garner Sutherland, DO, and others25), balanced ligamentous tension, facilitated positional release, and/or counterstrain treatments. *

A preliminary assessment of the impact of cranial osteopathy for the relief of infantile colic57

*All 26 infants who completed the study remained healthy throughout, with normal development. In the treatment group all 14 infants improved following cranial osteopathic manipulation; 4 (29%) required no further treatment after week 2 and a further 6 (43%) did not require any further treatment after week 3. All continued in the study. The remaining 4 (29%) infants in the treated group still showed mild levels of colic at the end of the study.

By comparison, only 2 (14%) infants in the control group showed a spontaneous improvement within the first 2 weeks of the study. The symptoms of colic worsened for two infants in the control group and each was admitted to hospital; one withdrew after 22 days in the study because of developing pneumonia, and the other after day 20 because of the deteriorating colic condition (there were no other study withdrawals). Of the remaining 10 infants, 1 (10%) had improved by week 3, and a further 4 (40%) by week 4; however, a continuing pattern of colic behaviour was present in 5 (50%) at the end of the study..

"A progressive, highly significant reduction between weeks 1 and 4 in crying (hours/24 h), was detected (p<0.001) in treated infants; similarly there was a significant improvement in the time spent sleeping (p<0.002). By contrast, no significant differences were detected in these variables for the control group. Overall decline in crying was 63% and 23%, respectively, for treated and controls; improvement in sleeping was 11% and 2%. Treated infants also needed less parental attention than the untreated group."
Osteopathic manipulative treatment of a 26-year-old woman with Bell’s palsy.\textsuperscript{58}

*Case study, a range of modalities used including cranial.*

“Bell’s palsy is caused by a lesion of the facial nerve and results in unilateral paralysis or paresis of the face. The condition affects approximately 23 in 100,000 persons, with onset typically occurring between the ages of 10 and 40 years. The authors report the case of a 26-year-old woman with Bell’s palsy, whom they treated with osteopathic manipulative treatment that was focused on the enhancement of lymphatic circulation. The osteopathic manipulative procedures used involved reducing restrictions around four key diaphragms (thoracic outlet, respiratory diaphragm, suboccipital diaphragm, cerebellar tentorium), as well as applying the thoracic pump, muscle energy, primary respiratory mechanism, and osteopathy in the cranial field. The authors, who were guided by the four principles of osteopathic philosophy, report that the patient’s symptoms resolved within 2 weeks, during which two sessions of osteopathic manipulative treatment, each lasting approximately 20 minutes, were held. Patient recovery occurred without the use of pharmaceuticals.”

The impact of acupuncture and craniosacral therapy interventions on clinical outcomes in adults with asthma.\textsuperscript{59}

*Full study, placebo control, randomisation, blinded participants, incorporated statistics, $P$ value calculated, confidence interval calculated, objective measures used, only treatment was cranial.*

“When treatment was compared with the control group, statistically treatment was significantly better than the control group in improving asthma quality of life, whereas reducing medication use with pulmonary function test results remained the same.”

“Acupuncture and/or craniosacral therapy are potentially useful adjuncts to the conventional care of adults with asthma, but the combination of the two does not provide additional benefit over each therapy alone.”

“Having a longer, more intensive treatment protocol with a single practitioner was associated with better reductions of anxiety on the BAI [Beck Anxiety Index].”

Effectiveness of osteopathy in the cranial field and myofascial release versus acupuncture as complementary treatment for children with spastic cerebral palsy: a pilot study.\textsuperscript{60}

*Pilot, blinded examiners, incorporated statistics, $P$ value calculated, a range of modalities used including cranial.*

“Fifty-five patients were included in the study. Individual analyses of the 11 outcome variables revealed statistically significant improvement in two mobility measures for patients who received OMT—the total score of Gross Motor Function Measurement and the mobility domain of Functional Independence Measure for Children ($P<.05$). No statistically significant improvements were seen among patients in the acupuncture treatment arm.”
Craniosacral still point technique: exploring its effects in individuals with dementia

Pilot, incorporated statistics, P value calculated, only treatment was cranial.

A mixed methodology was used to explore the effects of craniosacral still point technique (CSPT) in 9 older adults with dementia. Participants were monitored at baseline (3 weeks), intervention (6 weeks), and postintervention (3 weeks) using the modified Cohen-Mansfield Agitation Inventory (M-CMAI). CSPT [craniosacral still point technique] was implemented daily for 6 weeks by a certified craniosacral therapist. Findings indicated a statistically significant reduction in M-CMAI total and subscale scores during the intervention period. This reduction continued during postintervention for subscale scores of physical nonaggression and verbal agitation. Staff and family interviews provided convergent validity to the quantitative findings. Participants were also more cooperative during caregiving activities and displayed meaningful interactions.

Osteopathic support for a survivor of gastric cancer: A case report

Case study, a range of modalities used including cranial.

An older male patient received eight consultations over a period of 10 months, some three years after his cancer diagnosis and treatment. Osteopathic management included manual treatment to improve musculoskeletal mobility, cranial osteopathic treatment to release tension in the deeper fascia, discussion of dietary strategies and advice and education about the origin of his symptoms due to a total gastrectomy and cancer chemotherapy. After treatment his physical symptoms were reduced. His neck pain was reduced. Nausea and discomfort after eating disappeared. Frequency of diarrhoea, breathlessness and fatigue were improved. He gained weight and resumed social activities.

Osteopathic consultations provide time to engage in complex problems that may benefit from a holistic approach. The touch and body work involved in osteopathy can help the patient come to terms with altered body image and to talk openly about anxieties. The Hay approach to diet appeared to be valuable in improving the quality of life for this particular patient after his gastrectomy.
Effect of craniosacral therapy on lower urinary tract signs and symptoms in multiple sclerosis

*Full study, incorportated statistics, P value calculated, objective measures used, only treatment was cranial.*

"Inclusion criteria were: (1) diagnosis of definitive MS; (2) LUTS [lower urinary tract symptoms] duration of at least 3 months; (3) failure of past antimuscarinic treatment for LUTS; and (4) OAB-V8 questionnaire score 8 (see below). Exclusion criteria were: (1) antimuscarinic treatment within the last 3 months; (2) indwelling or intermittent urinary catheter; (3) post voiding residual volume (PVR) >200 cc; and (4) ultrasonographic evidence of upper urinary tract decompensation (hydronephrosis)."

"One hundred consecutive MS patients followed at the Sheba Medical Center MS Center were assessed for participation in this study. Twenty four MS females and four men met eligibility criteria and were included in this study."

"Mean PVR decreased from 15 [post voiding residual] 0.9 ml before CST to 66.1 ml after CST (p < 0.01, t-test). Both voiding frequency and urinary urgency episodes were significantly reduced from 5.1 0.9 and 5.4 1.1, respectively, before intervention, to 3.1 1.0 and 3.4 1.4, respectively after CST (p < 0.001 for both, t-test). Twenty two patients (79%) reported improved quality of life, while six patients (21%) reported no change. Mean QoL score improved from 5.7 1.0 pre- to post-treatment 3.6 1.6 (p < 0.001, t-test) (Fig. 1). No side effects of CST were observed, and compliance to treatment was 100%." 

"Comparison of post voiding residual volume, lower urinary tract symptoms and quality of life before and after craniosacral therapy revealed a significant improvement (0.001>p>0.0001). CST [cranio sacral therapy] was found to be an effective means for treating lower urinary tract symptoms and improving quality of life in MS patients."


*Full study, only treatment was cranial.*

"Outcome by diagnostic groups suggested that UCST [Upledger craniosacral therapy] is particularly effective for patients with headaches and migraine, neck and back pain, anxiety and depression, and unsettled babies. Seventy percent (70%) of patients on medication decreased or discontinued it, and patients' average general practitioner consultation rate fell by 60% in the 6 months following treatment."
A randomized controlled trial investigating the effects of craniosacral therapy on pain and heart rate variability in fibromyalgia patients.  

*After 20 weeks of treatment, the intervention group showed significant reduction in pain at 13 of the 18 tender points (P < 0.05). Significant differences in temporal standard deviation of RR segments, root mean square deviation of temporal standard deviation of RR segments and clinical global impression of improvement versus baseline values were observed in the intervention group but not in the placebo group. At two months and one year post therapy, the intervention group showed significant differences versus baseline in tender points at left occiput, left-side lower cervical, left epicondyle and left greater trochanter and significant differences in temporal standard deviation of RR segments, root mean square deviation of temporal standard deviation of RR segments and clinical global impression of improvement.*

*Craniosacral therapy improved medium-term pain symptoms in patients with fibromyalgia.*

Therapeutic effects of cranial osteopathic manipulative medicine: a systematic review.

*Of the 8 studies that met the inclusion criteria, 7 were randomized controlled trials and 1 was an observational study. A range of cranial OMM techniques used for the management of a variety of conditions were identified in the included studies. Positive clinical outcomes were reported for pain reduction, change in autonomic nervous system function, and improvement of sleeping patterns. Methodological Downs and Black quality scores ranged from 14 to 23 points out of a maximum of 27 points (overall median score, 16).*

Exploring the impact of osteopathic treatment on cranial asymmetries associated with nonsynostotic plagiocephaly in infants.

*These clinical findings support the hypothesis that osteopathic treatments contribute to the improvement of cranial asymmetries in infants younger than 6.5 months old presenting with NSOP [nonsynostotic occipital plagiocephaly] characteristics.*
Effects of comprehensive osteopathic manipulative treatment on balance in elderly patients: a pilot study.\textsuperscript{68}

*Pilot, incorporated statistics, $P$ value calculated, objective measures used, a range of modalities used including cranial.*

"The OMT protocol consisted of the following elements: Soft-tissue and myofascial release at T1 to L5 and sacral "rock" (patient prone) (3-4 minutes); myofascial release in the shoulders and scapulae bilaterally (patient lateral recumbent) (4-5 minutes); Cervical spine myofascial, counterstrain, muscle energy, or soft-tissue techniques for release and correction (patient supine) (3-4 minutes); Occipitoatlantal and condylar decompression (1-2 minutes); Venous sinus technique (5-6 minutes); V-spread, frontal and parietal lifts, or both (2-3 minutes); CV4 technique\textsuperscript{26} (3-4 minutes); Recheck for other key tender points (2-3 minutes) and treat according to findings."

"The OMT group had significantly reduced sway for the eyes-open test after 4 visits ($P=.001$)."

"The OMT protocol used in the present study improved the postural stability of healthy elderly patients, as measured by changes in sway values."

Effect of osteopathic manipulative treatment on gastrointestinal function and length of stay of preterm infants: an exploratory study\textsuperscript{69}

*Full study, incorporated statistics, $P$ value calculated, confidence interval calculated, a range of modalities used including cranial.*

"Osteopaths performing OMT [osteopathic manipulative treatment] were trained to use only indirect and fluidic techniques which included: indirect myofascial, sutural spread, balanced membranous tension and balanced ligamentous tension (according to teachings of William Garner Sutherland, DO, and others)."

"The study suggests that osteopathic treatment may reduce a high occurrence of gastrointestinal symptoms and the rates of long-term stays."

A systematic review to evaluate the clinical benefits of craniosacral therapy.\textsuperscript{70}

*Systematic review.*

"Only seven studies met the inclusion criteria, of which three studies were RCTs and four were of observational study design. Positive clinical outcomes were reported for pain reduction and improvement in general well-being of patients. Methodological Downs and Black quality scores ranged from 2 to 22 points out of a theoretical maximum of 27 points, with RCTs showing the highest overall scores."

"This review revealed the paucity of CST research in patients with different clinical pathologies. CST assessment is feasible in RCTs and has the potential of providing valuable outcomes to further support clinical decision making. However, due to the current moderate methodological quality of the included studies, further research is needed."
Craniosacral therapy in chronic neck pain patients—a randomised sham-controlled trial.\textsuperscript{71}

*Preliminary intention-to-treat analysis revealed significant less pain intensity in the CST group compared to the sham group (\(p = 0.017\)). With time, group differences on neck-pain-specific disability and pressure pain thresholds showed a positive trend, but did not achieve the level of significance. CST patients reported also strong global improvement, while the sham group rated between "no change" and only "a little better".*

Effect of osteopathic manipulative treatment on length of stay in a population of preterm infants: a randomized controlled trial.\textsuperscript{72}

*The term osteopathic manipulative treatment (OMT) currently encompasses more than twenty types of osteopath-performed manual treatments. The OMT techniques of choice in treating preterm infants are myofascial release, balanced ligamentous/membranous tension, indirect fluidic and v-spread.*

*In the present study, 8 osteopathic practitioners were involved and randomly divided in two groups: 4 osteopaths performing the evaluation (group A), and 4 osteopaths performing the evaluation and the treatment (group B). Osteopaths from group A and B entered to the NICU in different hours of the schedule days, to provide blinding and to avoid possible confounding. None of the osteopathic practitioners were involved in the study design, data entry or statistical analysis. In addition all practitioners, except for the treating osteopath, were unaware of patients allocation.*

*Results showed a significant association between OMT [osteopathic manipulative therapy] and LOS [length of stay] reduction (mean difference between treated and control group: -5.906; 95% C.I. -7.944, -3.869; \(p<0.001\)). OMT was not associated to any change in daily weight gain.*

*The present study suggests that OMT may have an important role in the management of preterm infants hospitalization.*

Is craniosacral therapy effective for migraine? Tested with HIT-6 Questionnaire.\textsuperscript{73}

*Immediately after treatments and one month afterwards there was significant lowering in HIT-6 scorings compared with prior to treatment. There was also significant difference in HIT-6 scorings between Times 1 and 4 (\(p = 0.004\)). The effect size was 0.43-0.55.*

*The results indicate that craniosacral treatment can alleviate migraine symptoms.*
Comparison of gait training versus cranial osteopathy in patients with Parkinson’s disease: a pilot study.\textsuperscript{74}

\textit{Pilot, randomisation, incorporated statistics, $P$ value calculated, only treatment was cranial.}

“A physiotherapy subtype is gait training (GT), which aims on correction of posture and gait re-education in patients with Parkinson's disease (PD). Osteopathy in the cranial field (OCF) is a gentle manual method to treat dysfunctions of the central nervous system.”

“GT improves walking behaviour with a specific focus on an optimised performance of the necessary movement sequences regarding their accuracy and amplitude. As OCF decreased the interval, it ameliorates speed of motion execution during gait. GT and OCF enhance different aspects of gait in PD.”

Sensations Experienced and Patients’ Perceptions of Osteopathy in the Cranial Field Treatment.\textsuperscript{75}

\textit{Pilot, incorporated statistics, $P$ value calculated, confidence interval calculated, only treatment was cranial.}

“The Patient Perception Measure–Osteopathy in the Cranial Field was internally consistent (Cronbach’s $\alpha = .85$). The most frequently experienced sensations of osteopathy in the cranial field patients were “relaxed,” “releasing,” and “unwinding.” Satisfaction With Life and Meaningfulness of Daily Activity were positively associated with Patient Perception Measure–Osteopathy in the Cranial Field scores. Negative associations were observed between the Patient Perception Measure–Osteopathy in the Cranial Field and depression.” [Note: a negative association with depression, in this context, means that the depression decreased as the Patient Perception Measure increased.]

Application of osteopathy in the cranial field to treat left superior homonymous hemianopsia\textsuperscript{76}

\textit{Case study,}

“This case involves a patient seen in the Osteopathic Manipulative Medicine (OMM) Clinic with sudden, painless onset of loss of visual field five weeks following craniotomy for meningioma removal.”

“The patient’s loss of visual field resolved completely immediately following the application of osteopathy in the cranial field. While the synchronicity may suggest that the two events are causally linked, further clinical evidence is required before such an effect can be attributed to osteopathic intervention.”
The effect of cranial osteopathic manual therapy on somatic tinnitus in individuals without otic pathology: Two case reports with one year follow up

Case series,

"The following case reports present the effect of treating proposed cranial bone dysfunctions on chronic somatic tinnitus, following head trauma, with one year follow up. Both cases were suffering from chronic tinnitus on the right side without any otic pathology or temporomandibular dysfunctions. Temporary and limited effects of medications and other treatments on their persistent tinnitus had a negative effect on their social interactions and quality of life. Both patients were considered to demonstrate marked sphenoid, temporal and occipital bone dysfunctions, based on manual cranial treatment. Active tender points were also identified with intra-oral palpation and examination on the lateral pterygoid muscle on the right side. Manual therapy of the cranial bones for restoration of normal alignment and cranial rhythm and myofascial release technique to deactivate tender points on the lateral pterygoid had a significant effect on reducing the persistent tinnitus in both patients. At one-year follow up, both patients reported significant improvement in their quality of life and social interactions without recurrence of their tinnitus symptoms. The findings of this study suggest that cranial manual therapy and myofascial release technique could be a potential treatment for somatic tinnitus in patients with no otic pathology or temporomandibular disorders."

Osteopathic manipulative treatment for postural orthostatic tachycardia syndrome.

Case study, objective measures used, a range of modalities used including cranial.

"Postural orthostatic tachycardia syndrome (POTS) is associated with many symptoms including orthostatic intolerance, fatigue, palpitations, and cognitive dysfunction. Treatment, which typically consists of exercise, increased dietary sodium and fluids, compression garments, and medications for orthostatic intolerance, frequently produces unsatisfactory results. The authors report the case of a 26-year-old woman who presented with a 6-year history of severe fatigue, orthostatic intolerance, heat intolerance, cognitive dysfunction, and diffuse pain. She had previously injured her jaw on an obstacle course. Results of a standing test were consistent with POTS. After standard medical therapy was unsuccessful, the patient was referred for osteopathic manipulative treatment. At her 18-month follow-up, the patient's symptoms had improved dramatically. Physicians should consider osteopathic evaluation and manipulative treatment when caring for patients with POTS."
Clinical effectiveness of osteopathic treatment in chronic migraine: 3-Armed randomized controlled trial.\(^7^9\)

**Full study, placebo control, randomisation, blinded participants, blinded examiners, incorporated statistics, \(P\) value calculated, confidence interval calculated, a range of modalities used including cranial.**

*Patients were randomly divided into three groups: (1) OMT [osteopathic manipulative therapy] + medication therapy, (2) sham+medication therapy and (3) medication therapy only. Patients received 8 treatments in a study period of 6 months.*  
*Techniques used were myofascial release, balanced ligamentous tension, balanced membranous tension and cranial-sacrum*  
*Tukey post hoc analysis showed that OMT group had a statistically significant reduction compared to control (−8.40; −11.94, −4.86; \(p < 0.001\)) and sham (−4.83; −8.36, −1.29; \(p < 0.001\)). Sham group did not demonstrate any significant difference compared to control (−3.12; −6.61, 0.32; \(p = 0.08\)). At the end of the study period, ANCOVA showed that OMT is independently associated to a change in the overall HIT-6 score [\(M = −9.07\); 95% CI −12.54, −5.60; \(p < 0.001\)].*  
*The principal finding of this three armed RCT was that OMT is effective in reducing the HIT-6 score by 8 and 6 units compared to control and sham therapy respectively.*  
*Migraine attacks, use of drugs, pain and disability scores were significantly reduced in the OMT group.*  
*Taking the MID value\(^2^5\) as a benchmark to interpret our results, OMT showed a significant improvement in the migraineurs’ quality of life.*  
*These findings suggest that OMT may be considered a valid procedure for the management of migraineurs.*

**The difference between the impact of work in the cranial field, and the placebo effect, can be measured.**

*This relates to a study on a study; the actual study results are reported above. This study reported on the possibility that other factors were at work.*

*Credibility of a comparative sham control intervention for Craniosacral Therapy in patients with chronic neck pain.*\(^8^0\)

*Patients’ expectancy, credibility and therapeutic alliance did not appear to affect study outcomes, blinding patients to group allocation was possible, and sham intervention was tolerable and safe.*


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