Osteopathic Medicine in the era of chronic diseases: Re-examining the Therapeutic Mechanisms Behind OMT; a narrative review

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Abstract

Introduction: Osteopathic medicine has a distinct philosophy that is summarized by four tenets that recognize the body as a unit capable of self-regulation, self-healing, and health maintenance, and suggest that normal structural alignment is important in optimizing the body's natural homeostatic abilities. These tenets shape our current understanding of a therapeutic mechanism behind osteopathic manipulative therapy (OMT). The interrelationship of structure and function is largely mediated by the nervous system, and that is the dynamic that we would like to better understand.

Objectives: To identify literature regarding the therapeutic mechanisms behind OMT and discuss perspectives and trends in the understanding of this complex landscape of function.

Method: Clinical keywords "osteopathic", "OMT", and "osteopathic manipulative treatment" AND "therapeutic mechanism were searched in CINAHL with full text, MEDLINE Complete, and PUBMED. A total number of 654 records were identified by utilizing this screening method. A total of 42 records fit the inclusion criteria after accounting for 46 duplicates and 566 that were excluded based on the criteria that studies needed to have an effect that was physiologic and could be objectively measured.

Results: At first glance, there seems to be many different perspectives on the therapeutic mechanisms underlying the application of OMT. Further review reveals a myriad of factors that all coincide as the body responds to the physical osteopathic intervention that is OMT. Looking at the trail of insight that has developed with each generation of emerging and supporting scientific evidence we can see a progression of knowledge regarding the therapeutic mechanisms at play in the body when OMT is utilized. We noted three paradigms in our review: Structural/Mechanical, Functional/Neurofascial, and Resonance/Homeostatic.
Earlier studies surrounding OMT and somatic dysfunction considered pain and inflammation as central factors in the role of osteopathic medicine. Trends that became evident from these studies include the correlation between somatic dysfunction and inflammatory cytokines. These biochemicals were increased in the presence of pain and somatic dysfunction, and improvements toward baseline were observed following OMT. Subsequent authors shifted towards appreciating a more 'global' perspective of the person as the community began to recognize the importance of biotensegrity and how this principle can transfer the effect of restrictive tension from one somatic dysfunction throughout the whole-body system. The relationship between cellular functions and the biotensegrity of posture and movement is an important aspect of the person that contributes to their potential response to OMT.
Digging further, we find evidence of a mechanism within our physiology that plays the crucial role of organizing the body's internal communications into a unified and coherent response of cellular and metabolic activity that aim to support the health of the body.

Conclusions: More than a century after the beginning of Osteopathic medicine, we continue to discern the intricacies of the interrelationship of structure and function, as this is the fulcrum of osteopathic manipulative therapy. While different paradigms for the therapeutic mechanism of OMT have evolved with each generation of Osteopaths, it is the proven efficacy of OMT that remains the common thread.

Introduction

Osteopathic medicine has a distinct philosophy that is summarized with four simple tenets.[1] These tenets recognize the body's natural ability for self-healing and self-regulation. The osteopathic tenets also recognize a unification in the functions of the body, and suggest that normal structural alignment is crucial in optimizing the body's natural homeostatic abilities. The interrelationship of structure and function is largely mediated by the nervous system, and that is the dynamic that we would like to better understand.

The osteopathic tenets provide a baseline philosophy to establish the essential core elements – body unity, together with self-healing/self-regulation, and the structure/function relationship – to shape our current understanding of a therapeutic mechanism behind OMT.

Methods

Data Sources: Clinical keywords "osteopathic" AND "therapeutic mechanism", as well as "OMT" AND "therapeutic mechanism", and "osteopathic manipulative treatment" AND "therapeutic mechanism" were searched in CINAHL with full text, MEDLINE Complete, and PUBMED.

Study Selection: A total number of 654 records were identified by utilizing this screening method. A total of 42 records fit the inclusion criteria after accounting for the 46 duplicates and the 566 that were excluded by the criteria described below. One record was identified as an additional source because it discusses proposed mechanisms and also serves as the national standard in teaching guides for osteopathic students. Studies that were included focused on a therapeutic and/or physiologic mechanism behind the specified OMT procedure. However, studies that had been followed and expanded were excluded if the information became redundant. Studies that reported "effects" of OMT were split into two categories; one being an effect that was physiologic, or could be measured (objective), and the other being an effect that was symptom, or outcome, based (subjective). Those reporting an effect with a physiologic (objective) basis were included in this review, while those reporting an effect with a subjective basis were excluded from this review. Articles whose focus is on the mechanism of methodology of OMT were also excluded because this review is examining the physiologic therapeutic effect. Similarly, articles that discuss underlying therapeutic mechanisms, but are not centered on the physiologic therapeutic mechanism specifically were also excluded. The rationale for this is that subjective outcomes do not specifically describe the underlying therapeutic mechanism. However, a physiologic effect does provide insight regarding the therapeutic mechanism behind the OMT procedure.
Grey sources were included mostly by happenstance and association with the reviewed literature. More likely than not, there is a plethora of additional grey sources that may provide useful insight but will not be reached through this conventional method.

Results

Structural/Mechanical Paradigm:
'Somatic Dysfunction' is the term used by physicians utilizing OMT as a diagnosis that depicts qualities of tissue function and body movement that are deviations from normal and deemed to be disruptive to the body's health processes. Diagnosing somatic dysfunction involves noting findings within a region of the body that demonstrate restriction of normal movement, tenderness, gross asymmetries, and altered tissue texture. Although pain is not specifically a component of diagnosing somatic dysfunction, pain is a usual symptom which leads to the physical evaluation of the soma. Earlier studies surrounding OMT and somatic dysfunction considered pain as a central factor in the role of osteopathic medicine. Inflammation is also considered to be congruent with both pain and somatic dysfunction. Trends that became evident from these studies include the correlation between somatic dysfunction and inflammatory cytokines IL-1B, IL-6, and TNF-a.[4,6,8,9] These biochemicals were generally increased in the presence of pain and somatic dysfunction. Improvements toward baseline were observed following OMT.[6,8,9,10] Phenethylamine (PEA) was noted to increase following OMT, which depicts a favorable response in the nervous system's ability to regulate pain as well as many other functions.[7] Nitric oxide (NO) has also been studied regarding cell tension and OMT.[4,5] Fibroblasts have also been studied regarding their activity relative to the tension in the cell membrane.[4,6,8,10,11,12] Fibroblast cells are key to signaling and regulating both inflammation and growth in tissues. Stiffness and strain of fibroblasts increases the healing time for wounds by decreasing fibroblast responsiveness and increasing inflammatory markers.[4,6,11] Utilizing OMT to combat tissue stiffness results in an overall decrease in the proinflammatory cytokine production. More specifically, utilizing direct myofascial release technique for a sustained period of several minutes showed an amplified effect of decreasing TGF-B1, which may have otherwise contributed to scarring and fibrosis.[11] Additionally, utilizing the indirect myofascial release technique showed an increase in Fractalkine (FKN) which contributes to cell messaging and is considered a positive anabolic factor.[8] Aside from the roles of inflammation and fibrosis, pain-pressure thresholds at the dorsal horn of the spinal cord showed statistically significant improvements following OMT performed on visceral structures within the sympathetic distribution of that spinal level.[13] Another hallmark of OMT is the effect on lymphatic flow within the body. Research on this practice has noted both inhibition of undesirable bacterial colony growth and a general enhancement of immune function.[14, 15] The lymphatic system relies on various body movements to propel its fluid towards the lymph nodes and eventually back into the venous system. Breathing is a pattern of movement within the body that carries a significant role in the flow of lymph. Fluid-like movements similar to a breathing pattern that are introduced have also shown a remarkable increase in NO concentration in blood and vasculature.[5]

Inflammation, pain, lymphatics, and structural alignment are coming into focus with one another as we see evidence for generally positive benefits from OMT. Amid these elements, the autonomic nervous system (ANS) has a central role in supporting and mediating the coordination of the molecular and cellular responses that have been observed following OMT. A study assessing an autonomic response to OMT has reported improvements in pain, quality of life, sleep, motor function, and autonomic function following the CV-4 technique. The general comment from this study is that the CV-4 technique helps to "restore flexibility of the autonomic response."[24] A similar study also showed a favorable autonomic response to the CV-4 technique by observing an immediate decrease in blood pressure coupled with an increase in heart rate variability (HRV).[25] Another report demonstrated that cranial techniques, such as CV-4, produce favorable responses in both vagal functions and cardiac muscle contractility when compared to sham treatments.[26] These studies assess the neurologic response to OMT and are essential in bringing together the broader structural and functional elements of the body. The autonomic nervous system (ANS) is the involuntary nervous system that regulates homeostatic functions in the body. Centrally, the processing of signals that pass through the brainstem and integrating centers of the midbrain-brain interface involve a web of interconnectedness where the somatic components of the body and the functional components of the ANS communicate. The evidence seen with cranial techniques, including the CV-4 technique, are important data points that suggest positive functional outcomes to structural considerations and the application of OMT.

Resonance/Homeostatic paradigm:
Digging further, we find evidence of a mechanism within our physiology that plays the crucial role of organizing the body's internal communications into a unified and coherent response of cellular and metabolic activity that aim to support the health of the body. First, let's consider the role of the endocannabinoid system (ECS) in body physiology. The endocannabinoid system of the body plays a functional role in coordinating and regulating physiologic processes starting in the first days following gestation of the human.[34] Endocannabinoids are responsive to receptors throughout the body from the periphery to the deepest aspects of the CNS, and are implicated in modulating pain, decreasing inflammation, improving psychology, improving bowel function, protecting against neurodegenerative processes, and maintaining health. The endocannabinoid system is implicated in helping to regulate biorhythms and biologic oscillators such as cardiac, respiratory, gastrointestinal peristalsis, and perhaps the cranial rhythmic impulses.[34] There are small oscillatory pressures of contraction and relaxation running through the central nervous system and connective tissue of the body with periods as slow as 100 seconds per cycle.[23,35] This activity may be contributing to normal fluid and lymphatic flow of both intra and extra cellular matrices, and thus an integral part of optimal homeostasis. This involuntary and rhythmic contraction and relaxation occurring throughout the body has been likened to 'tissue respiration' due to the effect on both nutrient delivery and cellular waste removal, or cellular lymphatics. This generalized wave that fluctuates through the extracellular matrix (ECM) is synchronous with the primary respiratory mechanism (PRM) and contributes to a subtle state change of the ECM between gelation and solation.[36] A "change of state" has also been noted in patients who are receiving treatment with Frequency Specific Microcurrent (FSM). The change of state is observed as a generalized softening within the patient that occurs globally throughout the patients' tissues and is a routine outcome with this treatment modality.[37] It is postulated that there is a resonance occurring within the patient when the body synchronizes to the specific frequencies being used. When the resonance is achieved, the tonality of the nervous system shifts, and the global normalization of tissue is observed. OMT is an effective method of removing restrictive tensions that are impeding these subtle oscillatory pressures. OMT is also an effective method of dealing with connective tissue restrictions that are associated with mild to severe clinical presentations. However, due to the dynamic nature of the person it is nearly impossible to predict what the response to OMT will be.

Functional/Neurofascial Paradigm:
As we move on to discussing the functional neurofascial understanding of the body regarding the application of OMT, it is important to bring a perspective of biotensegrity. The biotensegrity of the body is a concept that accounts for the tension within the whole system, how the system is functionally balanced, and how the tension at the tissue and cellular level becomes a mechanical signal that creates biochemical changes within the cell.[16] This helps to further support and explain the forward momentum of favorable effects when mechanical forces are aptly applied through utilization of OMT.
The relationship between cellular functions and the biotensegrity of posture and movement is an important aspect of the person that contributes to their potential response to OMT. The biotensegrity of the body can be appreciated as both a means of conserving energy through structural alignment and efficient movements as well as a means of creating neurofascial signaling in the body's complex web of internal communication.
Consideration of postural mechanics is a way of approaching OMT that will optimize the individual's response to the existing allostatic load. However, practitioners are recognizing the necessity for the patient to be mindfully engaged in the process to accomplish and sustain the desired results.[17] Whether due to pain or some functional issue that is hindering the person from performing at their optimum level, the conditions that afflict a person will demand their attention throughout the day. The way that pain and other medical conditions occupy the attention creates a negative effect on memory and neurogenesis which can lead to atrophy in the hippocampus over time.[18] OMT has been shown to decrease these long-term effects.[18] OMT has also shown positive outcomes for anxiety and depression as well as increasing the functional connectivity in descending pain modulating networks.[18] The hippocampus plays a central role in processing the moments of the day and coordinating functions based on our previous experiences. For example, the lack of touch for an infant may lead to increased stress response as an adult which can lead to negative effects in the hippocampus considering that lower circulating cortisol in the hippocampus is associated with increased cell development and memory.[19] Touch is an essential component to performing OMT due to both the obvious role of the hands in OMT and to the non-verbal aspects of touch as communication. Touching alone has been shown to have long-term cognitive benefits for an infant through effects in visual and brain development.[19] Interestingly, touch as a proprioceptive manual contact has been observed to have a greater positive effect on balance in Parkinson's patients than with visual cues.[21] A gentle and slow-moving touch stimulates c-tactile afferent fibers which project to the insular cortex where both the interoceptive sense of the body and the afferent properties of touch are processed.[19] Beyond touch alone, OMT can be considered to effect interoceptive tropism to the autonomic neurologic functions of the body through insula-related networks that coordinate emotions with autonomic function and homeostasis.[20] This convergence of touch and bodily influence with cognitive states at the insula brings additional perspective to the necessity of mindful engagement of the patient. Moreover, OMT has been shown to create specific responses within interoceptive areas of the brain, as well as enhanced corticospinal excitability, which supports the therapeutic potential of the post-treatment resting state.[20] Neurologically speaking, somatic dysfunctions can be recognized as a 'tensional signature' that is part of the "biological transmission of forces and information" through the tissues that facilitates structural and functional interactions between the musculoskeletal, neurologic, endocrine, and immune systems.[20] OMT has been shown to effect concentrations of serotonin, arginine, vasopressin, cortisol, oxytocin, and endocannabinoids as well as neuroplastic changes in motor function and descending pain modulation pathways.**20** The patient's awareness of the limiting tendencies of somatic dysfunction and pain through altered behavior, movement, and proprioception as well as awareness of their own therapeutic potential becomes significant for their health capacity and response to OMT.[22] The tissue response to OMT is organic and predictable while the patient's response depends on the relationship between body, mind, and spirit.**23** Somatic dysfunction creates restrictive and restraining tensions within the connective tissue as well as neurologic "noise" in homeostatic feedback loops. The restriction can vary from mild to severe in its effect on the person and their health capacity.

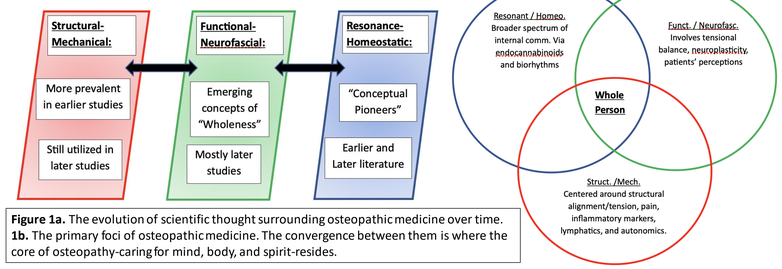

Figure 1a. The evolution of scientific thought surrounding osteopathic medicine over time.
1b. The primary foci of osteopathic medicine. The convergence between them is where the core of osteopathy-caring for mind, body, and spirit-resides.

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