# Hypertension: An Osteopathic Perspective

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## Introduction

Current estimates report that approximately 65 million people (about 1 in 3 adults) in the United States live with hypertension (HTN), of which only 44% have achieved target blood pressure (BP) ranges below 140/90 mmHg.[1] The impact of HTN on heart disease, myocardial infarction, stroke, nephropathy, and retinopathy, makes BP one of the most critical conditions to treat with better success than currently achieved. Just one of the sequelae of hypertension is heart disease, which is the number one cause of death in the US.[2]

Despite advances in pathophysiology and pharmacotherapy, we have not been able to systemically control hypertension and stop heart disease as a leading killer. We need to understand why current methods or implementations of treatment are falling short and what the tools are that may be underutilized. Osteopathic manipulative treatment (OMT) has been used to help treat hypertension for more than 100 years. This article examines what is known about OMT and hypertension, how the cumulative knowledge can influence an osteopathic treatment, and what areas need further examination.

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## Review of Literature

The information contained in this manuscript was obtained by searching databases in June 2017, including: OSTMED-DR, PubMed, Scopus, Mantis, ProQuest Health and Medicine, CINAHL, and ScienceDirect. Keywords included osteopathic manipulative medicine, osteopathic manipulative treatment, OMT, OMM, manual medicine, and chiropractic plus hypertension, cardiovascular disease, or heart disease. Additionally, the Touro University (California) archives were accessed for osteopathic texts published in the 19th and early 20th centuries on the topic of treating hypertension. Extensive research into citations found in articles led to a thorough compilation of published material on this topic within osteopathic medicine. While a broad search of the literature was performed, the references were narrowed down, and those ultimately used for this manuscript were the ones most directly related to this text. Research was again updated December 2018 to take into account newly published work. Only articles published in English were considered.

## Framework

To facilitate ease of understanding and ease of adoption for clinical practice, this article employs the framework of the ABCs of osteopathic medicine, as outlined by Nuño et al in this journal in June 2018.[3] In using this model, the student or physician is invited to consider autonomics, biomechanics, circulation, and screening of the overall patient. Autonomics generally consider both sympathetic and parasympathetic systems; biomechanics include muscle, fascia and joints; and circulation involves lymphatic, venous, and arterial systems. The screen looks at the global picture and includes all mind, body, spirit components. The ABCs of osteopathic medicine are not a prescriptive application of osteopathic principles, but rather a framework for organizing a clinical approach and facilitating communication with colleagues on a basis of anatomy and physiology.

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### Functional Anatomy/Pathophysiology

While causality is incompletely understood, the vascular remodeling that alters circulatory fluid dynamics has been well researched. Endothelial cell hypertrophy, apoptosis, vascular fibrosis, and low-grade inflammation all lead to increased velocity of blood flow over a smaller area of vessel wall, which then causes an increased pressure and tissue hypoxia.[4-6] Furthermore, the strong interrelationship between the renal system and cardiovascular system cannot be underappreciated. It has been shown that much of hypertension and cardiovascular burden can be attributed to first abnormalities in the renal system.[7] The biochemical connection between systemic inflammation and coronary heart disease, for example, is well-reviewed by DeJongste and Horst, who describe the toxic effects of shear stress, oxidized low-density lipoprotein (LDL), sensitized lymphocytes, and infections, viruses and bacteria have on the cardiovascular system, and the body's response in terms of increased C-Reactive Protein (CRP), acute-phase proteins, IL-1, IL-6, and other immunological markers of inflammation.[8] Recently, systemic inflammation has been gaining momentum as a contributor to chronic disease.[9]

### S: Screen

The source of this inflammation can be within the body or driven by external environmental factors. For example, Clearfield et al recently explored the connection between climate change on the inflammation of cardiovascular disease.[10] To go even further, inflammation and hypertension have been linked via studies of the human gut microbiome.[11, 12] For example, researchers recently discovered that patients with hypertension have decreased microbial richness and diversity; in turn, gut dysbiosis, permeability, and leakiness have been linked with increased sympathetic activity. This seems to be related to the gut dysbiosis contributing to chronic inflammation and increased sympathetic activity, leading to increase in blood pressure.[11, 12] Furthermore, oral dysbiosis is connected to the nitrate-nitrite-nitric oxide signaling pathway because we rely on bacteria in our mouth to reduce nitrate to nitrite, which later becomes nitric acid and thus helps promote blood vessel relaxation and many other important autocrine and paracrine functions.[11, 12] Clinical hypertension may be one of the ways the body self-regulates changing demands from a variety of influences, including lifestyle and environmental factors.

### A: Autonomics

The autonomic nervous system (ANS) has been consistently implicated in hypertension, and it is generally divided into the sympathetic (SNS), parasympathetic (PNS), and enteric portions.[13] The efferent pathway of both the SNS and PNS consist of a preganglionic and a postganglionic neuron. The SNS has its origin in the lateral horn of the spinal cord in segments T1-L2, while the PNS exists in cranial nerves III, VII, IX and X, as well as in spinal segments S2-4.[14] The major relevant parasympathetic nerve for the cardiovascular system is the vagus nerve, CN X, which emerges from the medulla in the brainstem, exits the cranium through the jugular foramen between the occipital and temporal bones, descends the neck inside the carotid sheath, and enters the mediastinum posterior to the sternoclavicular joint and brachiocephalic vein.[15] There it integrates into the pulmonary plexus, esophageal plexus, and cardiac plexus. The cardiac plexus consists of these portions of the vagus nerve, as well as the sympathetic trunk postganglionic nerves from T1-T4. The right vagus portion of the cardiac plexus innervates the sinoatrial (SA) node and, during times of excess stimulation, causes sinus bradycardia, while the left Vagus portion innervates the atrioventricular (AV) node, and in extreme stimulation can cause AV block.[15,16] Cell bodies of postganglionic neurons of the PNS are located near the SA and AV nodes, as well as in the atrial wall and interatrial septum. Hormonally, acetylcholine aids in decreasing atrial contractility and slowing of pacemaker cell contraction. The sympathetic postganglionic nerves have cell bodies in the cervical and superior thoracic paravertebral ganglia of the sympathetic trunk. Stimulation from these nerves causes increased heart rate, impulse conduction, contractility, and increased coronary blood flow. Contractility is further stimulated by neurochemical signals from the adrenal organs via B2 receptors.[15] Additionally, the cardiac plexus carries the visceral afferent fibers with reflexive and nociceptive input from the heart itself.

Foundational research by Burns demonstrated the connection between the structures of the thoracic spine with heart rate and rhythm.[17] This research was built upon by Korr and Patterson, who connected increased sympathetic stimulation with facilitation of thoracic spinal segments, resulting in higher coronary blood flow and higher sympathetic tone of the heart, eventually leading to the model of viscerosomatic reflexes.[18] Some of the earliest mentioning of the viscerosomatic relationship was documented in 1905, when Tasker proposed the interscapular region as referring pain from heart, pericardium, lungs and pleura.[19] More recently, research has looked at centralization of pain, which underlines this bidirectional connection between the central nervous system and the periphery.[20] While this specific research looks at the modulation of pain messages from the brain and spinal cord, it again highlights the ongoing self-regulation and modulation between center and periphery, between viscera and soma.

### B: Biomechanics

The heart is physically enveloped in the pericardium, which is attached anteriorly to the sternum and is composed of the parietal and visceral layers. The parietal pericardium has an external fibrous

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layer that is continuous superiorly with the great vessels and visceral fascia of the neck and inferiorly with the central tendon of the diaphragm and a serosal layer composed of simple squamous epithelium. The visceral layer, also known as the epicardium, lies directly on the heart itself. The diaphragm is innervated by afferent fibers of the left and right phrenic nerve which emerges from the anterior rami of C3, 4 and 5 before continuing on to the diaphragm with efferent fibers.[15] The pericardium's attachment just superior to the diaphragm at the central tendon via the pericardiophrenic ligaments gives the heart and diaphragm a very real, firm, and direct connection.[21] During inspiration, the heart descends along with the diaphragm's decent and flattening as the ribcage widens in anterior-posterior and lateral views. The diaphragm descends 1.5 cm with normal inspiration, and as much as 7 cm with deep inspiration, something that is taken advantage of for obtaining quality chest x-rays.[21] Furthermore, major fluid structures such as the inferior vena cava and the aorta pass through the diaphragm in their connection between the thorax and abdomen. Overall, the diaphragm acts as a piston, the motion of which accounts for 75% of intrathoracic volume changes during quiet inspiration.[21]

### *C: Circulation*

Sutherland also described the diaphragm as functioning like the "piston" to the "combustion engine" of the body, which helps illustrate the effect of the pressure changes caused by diaphragmatic motion, and acting on the body fluids.[22] The effect of breathing on venous return has been well established, wherein the negative pressure during inspiration greatly increases the venous and lymphatic flow returning to the heart, and vice versa during expiration.[21, 23] Frymann describes the excursion of the diaphragm as "utmost important" in cardiovascular function since the diaphragm has "sphincter-like function for the inferior vena cava," and dysfunction can "increase the burden on the left ventricle or decrease the venous return into the right side of the heart."[24] Furthermore, in the second edition of *Foundations of Osteopathic Medicine*, Ettlinger notes his experience of congestive heart failure patients in the hospital setting consistently develop fluid congestion in the liver and lower extremities in part due to this exact mechanism, with improvement once the restricted diaphragm is addressed osteopathically.[25] The central portion of the diaphragm is the most mobile part of the diaphragm, while the periphery consists of fixed muscles. These attach to the posterior portion of the xyphoid process, the internal surface of ribs 6 through 12, and the anterior portions of lumbar vertebral bodies 1 through 3 via the right and left crura.[15] Again, the diaphragm intimately relates to fluid dynamics of the body and correct breathing is literally vital for proper cardiovascular function.

The above highlight a few portions of anatomy and physiological function as they contribute to hypertension. However, blood pressure is not controlled by a single organ, but instead, by a complex orchestration of the whole person.[13]

## Patient Assessment

Physicians come to understand their patients in the context of their lives. Ideally, this includes an understanding generally of the patient population, level of poverty, access to medical care, and environmental factors, as these variables all correlate to mortality of cerebrovascular and hypertensive disease.[26] Furthermore, the osteopathic principles guide us to also consider spiritual aspects of patients' lives, such as feeling a sense of connection to their community, a sense of purpose, or a connection to a god and nature.

While hypertension typically presents asymptomatically, clinicians can observe level of distress, gait, and posture to help assess overall health and function. Ideally, the blood pressure reading is performed under proper circumstances including patient resting for 5 minutes prior to measurement with feet resting on the floor. In 2017, a surprise finding showed that only 1 out of 159 students demonstrated all 11 skills of correct blood pressure measurements *(see Table 1)* at the American Medical Association (AMA) House of Delegates Meeting.[27] Additional physical exam components may include direct visualization of blood vessels via a fundoscopic exam to look for arteriolar light reflex, AV nicking, hemorrhage, and exudates, possibly even Hollenhorst plaques. Checking for edema, jugular venous distention (JVD), and auscultation for bruits will help assess the CV system, as well as auscultating the heart and lungs at every encounter.

An abbreviated integrated structural exam can give the osteopathic physician a wealth of additional information in assessing a patient's health and compensation ability. At its briefest, this may simply include a scan looking at autonomics and biomechanics for TART (tissue texture abnormalities, asymmetry, restricted range of motion, tenderness) of the cervical and thoracic spine in order to identify any areas of somatic dysfunction and possible facilitated segments. TART in the thoracic and upper lumbar region may give the clinician information regarding the functioning of the sympathetic nervous system (SANS). Further structural evaluation of the ribs, sternum, and diaphragm add to the assessment of the SANS, as well as the biomechanics of the diaphragm and ribcage in order to feel the quality of the heart's encasement. Assessment of the occipitomastoid (OM) suture between the temporal and occipital bones to feel for the jugular foramen's freedom of passage for CN IX and X, can demonstrate potential restrictions affecting

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the parasympathetic nervous system and ability for the heart to effectively relax. In fact, Magoun writes that in his experience, head trauma as manifested by a "jammed occiput" and locked temporal bones has been linked to be the ultimate cause of "vagal syndromes" involving especially the heart.[28]

Thus, in addition to a targeted cardiovascular exam, structurally we can especially focus on assessing the OM suture, cervical spine, T1-4, sternum, ribs 6-12, xyphoid, L1-3, and restriction of the diaphragm. It is worth mentioning that Barral has found a strong connection specifically with C4-6 and T4-6 in patients with cardiac problems.[29]

***Table 1.*** *Proper blood pressure measurement protocol.*[27]

1. Patient rests for 5 minutes prior to measurement
2. Legs uncrossed
3. Feet on floor
4. Arm supported at heart level
5. Correctly size the cuff to equal at least 40% of arm circumference & length of cuff bladder encircle at least 80% of arm circumference
6. Cuff placed over bare arm
7. No talking, reading, mobile phone use
8. Deflate the cuff at a steady rate of 2 mmHg/s
9. Measure BP in both arms
10. Identify the more clinically relevant BP reading as that from the arm with the higher reading. (This is also the arm used in future BP measurements.)
11. When evaluating for hypertension, clinicians also should measure BP in supine and standing positions to check for postural hypotension.

If patient is less than 30 years old, also measure BP in at least 1 leg.

## Treatment

No matter what we chose for treatment, a pertinent reminder from S. Hitch in the 1950s holds true even today, that "instead of endeavoring to get the patient to conform to whatever treatment may be available, the treatment is given in conformation with the needs of the patient."[30] Today, we might call this patient-centered care and shared decision-making. The 8th Joint National Commission suggests that blood pressure above 140 mmHg systolic or 90 mmHg diastolic in patients less than 60 years of age needs to be clinically addressed.[31] In patients above 60 years, the threshold for treatment of hypertension has an increase in the systolic value to 150 mmHg while the diastolic value remains at 90 mmHg.

One of the most common tools for HTN treatment is pharmaceuticals. There are a large number of effective agents, and most reportedly lower systolic BP by about 7mmHg to 13 mmHg and diastolic BP by 4mmHg to 8 mmHg.[32] The main first line agents include angiotensin converting enzyme inhibitors (ACEI), angiotensin receptor blockers (ARBs), calcium channel blockers (CCBs), and diuretics. Choice of agent typically depends on side effect profile, insurance, and preference by provider. For example, other systemic effects such as the reno-protective effects of ACE-inhibitors can factor into treating patients with diabetes. Further nuances of the pharmacologic approach to hypertension are well documented elsewhere.[33]

Aside from pharmaceutical interventions, best practices in the management of hypertension includes lifestyle modifications, which also helps complete the osteopathic ABCs with a screen of the overall patient picture. Healthy diet and exercise have been recommended against hypertension for more than 100 years.[34] We are coming full circle now. After recommending lifestyle changes only briefly in the final remarks of the JNC7 report in 2014, the updated 2017 JNC8 devotes 5 pages with detailed guidelines for not only diet and exercise, but also encouraging a societal approach to increase activity levels and access to healthy food.[33] Essentially, the recommendations include following a Dietary Approaches to Stop Hypertension (DASH) diet, while also reducing salt and alcohol consumption. Other topics in lifestyle modifications typically include regular moderate to vigorous aerobic exercise, weight reduction, even if small amounts, and stress reduction. Exercise alone has been shown to reduce blood pressure by 5mmHg to 7 mmHg over time.[35] Furthermore, a pilot study in 2011 suggests possibly favorable effects just on deep breathing exercises of an average 10 mmHg for patients with hypertension and obstructive sleep apnea (OSA) after 8 weeks.[36]

For a variety of reasons, lifestyle changes continued over a lifetime can be difficult for patients to commit to. We also know that pharmaceuticals carry risks and side effects that accompany their benefits. How else can osteopathic physicians manage hypertensive patients? The scope of OMT has always been greater than simply treating musculoskeletal complaints.

## Clinical Trials

Despite the non-invasiveness and speed of measuring blood pressure, there are surprisingly few clinical trials looking at manipulative techniques' ability to address hypertension. Of course, studies on OMT encounter a number of barriers, including issues related to blinding, sham treatments, paucity of financial interest, time

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involvement per treatment, and so on. Additionally, while it is easier to set up, measure, and reproduce a treatment protocol study, this does not actually reflect how we treat individual patients, where we treat what we find specific to the individual's somatic dysfunction. If an OA is not restricted, then OMT at the OA is not indicated on the basis of no somatic dysfunction existing there.

In 2003, Spiegel published a thorough review of published studies looking at osteopathic manipulative medicine in the treatment of hypertension.[37] He examined 8 studies published mainly in the 1960s and 1970s, and readers are referred to his text for an examination of earlier works. Since then few studies have been published to greatly expand that list. See Appendix for details.

The highest quality modern study was conducted by Cerritelli and his team in Italy. The researchers recently studied the effect of blood pressure on subjects wherein OMT was used as an "approach," not as an isolated technique.[38] The researchers used myofascial release, craniosacral, high-velocity low-amplitude (HVLA), balanced ligamentous tension (BLT), muscle energy, biodynamic, counterstrain, and other modalities based on what the "operator" chose as "the more appropriate to apply on a patient in a given moment." With 63 eligible participants, the number of subjects is fairly low. All participants received routine care by a cardiologist, with half receiving OMT. There was no sham treatment offered, and patients were not randomized. Specific endpoints included systolic and diastolic blood pressure, as well as intima media thickness, and were measured at baseline and after 12 months, after bi-monthly OMT. Significantly, the participants all had diagnosed essential hypertension, and the study showed treating their bodies osteopathically did decrease blood pressure measurements as compared to baseline and as compared to the control. The researchers reasoned the effect as due to the decrease of inflammatory factor production and improvement in autonomic nervous system function.

Another 2 studies used active techniques, such as vigorous lymphatic pumping, on normotensive volunteers without an assessment of somatic dysfunction.[39, 40] Both of these showed short-term increases in diastolic blood pressure. This leads to the question of the role actual somatic dysfunction plays on the effects of blood pressure through manipulation. Perhaps manipulating a structure that does not display dysfunction causes an increase in allostatic load and stress on the body, thus increasing blood pressure? Perhaps also the modality of intervention matters, as conceivably, direct and active manipulation can act in a stimulatory manner, in contrast to indirect and passive manipulation. This question has not been examined experimentally.

The anti-inflammatory effects of OMT mentioned by Cerritelli appear to be a relatively new observation. A thought-provoking study using human fibroblasts with modeled strain and OMT published in 2007 by Meltzer and Standley demonstrated the inflammatory effect of induced cellular strain and the reduction of this inflammatory response after application of counterstrain or myofascial release technique.[41] When examining cytokine changes after OMT for low back pain, as part of the OSTEOPATHIC trial, Licciardone et al found a decrease in TNF-a correlating with the OMT intervention group.[42] While more clinical research connecting OMT with anti-inflammatory effects is needed, this was considered a landmark finding. Considering the clear connection between inflammation and cardiovascular disease, a better understanding of OMT's effect on the immune system and the inflammatory response in particular may help us understand and distinguish what OMT can accomplish for hypertensive patients.

A different line of inquiry that bears mentioning is the examination of Chapman reflex points for the adrenal gland in subjects with low renin–high aldosterone level hypertension in 1979.[43] Aldosterone levels significantly and reproducibly decreased, though the researchers unfortunately measured blood pressure only immediately after treatments, without tracking the BP to check for a hormonally induced reduction in blood pressure.[43] Considering that aldosterone measurements took about 36 hours to shift post-treatment, a slower response in blood pressure changes is a reasonable question to pursue.[43] A clinical study of diagnosing and treating cardiac Chapman points has also not been formally studied, despite observational evidence.[44] A revisit of a blood pressure study focusing on Chapman reflex points may be worthwhile. While this study examined a variety of secondary hypertension, further exploration may expand on our understanding of neuro-hormonal responses to blood pressure and give us further tools for intervention.

The limited research should encourage the osteopathic profession to expand their examination of the connection between osteopathic manipulation and hypertension. Ideally, participants would be divided into treatment group, sham treatment group that includes non-therapeutic touch (such as ultrasound), and a control receiving no touch. Researchers can create blinding in having treatment provided by osteopathic physicians who are unaware of the research question. And considerations would have to be given into protocol types, modality types, number and frequency of treatments, and length of follow-up.

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**Appendix.** *A brief review of studies examining relationship between osteopathic manipulative treatment and hypertension.*

| Article | Summary | Strengths | Weaknesses | Findings |
|---|---|---|---|---|
| Cerritelli F, Carinci F, Pizzolorusso G, et al. Osteopathic manipulation as a complementary treatment for the prevention of cardiac complications: 12-months follow-up of intima media and blood pressure on a cohort affected by hypertension. *J Bodw Mov Ther.* 2011;15(1)68-74. doi:10.1016/j.jbmt.2010.03.005 | • Ultrasound measurement of intima-media thickening (IMT) at carotid and femoral arterial bifurcations and measuring systolic and diastolic blood pressure on hypertensive patients<br>• OMT consisting of individualized treatment based on TART and exam findings<br>• 12-month follow-up | • Treatment consistent with OMT practice (pragmatic design)<br>• 1-year follow-up | • No randomization<br>• Unsure of strength of causal relationship | • Treatment arm improved in endpoints: reduction in IMT and systolic BP |
| Rivers WE, Treffer KD, Glaros AG, Williams CL. Short-term hematologic and hemodynamic effects of osteopathic lymphatic techniques: a pilot crossover trial. *J Am Osteopath Assoc.* 2008;108(11):646-651. | • Experimental study arm had 10 minutes of active lymphatic treatment; control arm had 10 minutes of rest for total of 15 healthy male subjects | • Randomized<br>• Repeat measurements at baseline, 20 min, 50 min, and 80 min after baseline<br>• No adverse effects or complications | • Healthy male subjects<br>• Single event<br>• Chiropractic | • Increased diastolic BP after treatment<br>• No change in systolic BP |
| Yates RG, Lamping DL, Abram NL, Wright C. Effects of chiropractic treatment on blood pressure and anxiety: a randomized, controlled trial. *J Manipulative Physiol Ther*. 1988;11(6):484-488. | • N = 21<br>• Chiropractic adjustment device used to adjust T1-5<br>• Patients had elevated BP and anxiety | • Randomized<br>• 3 arms: active tx, placebo tx, no tx (control) | • Chiropractic device | • Intervention decreased BP |
| McGuiness J, Vicenzino B, Wright A. Influence of a cervical mobilization technique on respiratory and cardiovascular function. *Man Ther.* 1997;2(4):216-220. doi:10.1054/math.1997.0302 | • Whether posterioranterior mobilization over spinal process of C 5/6 affects sympathetic nervous system in healthy young volunteers | • Randomized, controlled trial<br>• Double-blind<br>• 3 groups: mobilization (joint movement), placebo (light touch), control (no touch) | • Single event<br>• No follow-up<br>• Chiropractic | • Increased respiratory rate, heart rate, systolic and diastolic BP |
| Johnston WL, Kelso AF. Changes in presence of a segmental dysfunction pattern associated with hypertension: part 2. A long-term longitudinal study. *J Am Osteopath Assoc.* 1995;95(5):315. | • 61 subjects followed up on after 3-10 years<br>• Presence/absence of C6/T2/T6 somatic dysfunction pattern correlated with hypertension<br>• No treatment/intervention | • Long-term follow-up (years) | • No treatment intervention | • Somatic dysfunction pattern persisted in hypertensive patients, but had resolved in non-hypertensive patients at multiple-year follow-up |
| McKnight ME, DeBoer KF. Preliminary study of blood pressure changes in normotensive subjects undergoing chiropractic care. *J Manipulative Physiol Ther.* 1988; 11(4):261-266. | • 75 healthy students separated based on cervical spine somatic dysfunction who were treated (experimental branch), and those students without the dysfunction who had no manipulation (control). Pre- and post-interventional BP measurements were taken. | • BP-measuring doctors were blinded. | • No long-term effects or cumulative effects measured | • Statistical decrease in systolic (10-20 mmHg) and diastolic BP in experimental but not control group |

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## Conclusion

In summary, what can osteopathic physicians offer patients with hypertension? Osteopathic manipulative medicine recognizes the unity of body, mind, and spirit, which helps point to the importance of a good patient-doctor relationship. What does the future of osteopathic medicine look like? A 2018 study by Rizkalla found a correlation between empathy and interest/use of OMT.[45] This study theorizes that the hands-on patient approach is a vital component of what helps hands-on physicians maintain more open hearts and connections to patients. Further, osteopathic medicine recognizes the structure and function interrelationship, which is where offering OMT and lifestyle modifications, including exercise programs, can help guide patients towards optimal health along with standard of care using appropriate pharmaceutical agents. Thirdly, continuous encouragement of patients towards healthier diet, and avoiding/minimizing toxins such as tobacco, alcohol, and other drugs strengthen the self-healing properties of the body.[11] Perhaps even a bigger look at environmental pollutions and climate change as they affect our long-term health is worth examining with patients. Finally, to assure that treatments remain rational, the profession should continue to pursue high-quality research of OMT, beginning with case studies of what practicing DOs encounter, as well as clinical trials examining larger effects, and systematic reviews to examine overall risks and benefits.

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