REVIEW ARTICLE

OSTEOPATHIC CONSIDERATIONS IN PAIN MANAGEMENT

Param Dave, PGY-3

Good Samaritan Medical Center, West Islip, NY

KEYWORDS

Pain management

Chronic pain

Myofascial release

Counterstrain

Tenderpoint

ABSTRACT

Chronic pain is defined as pain that has persisted for greater than 6 months. This type of pain may last longer than 6 months and can continue even after the injury or illness that has caused it has healed or resolved. Pain signals can remain active in the nervous system for weeks to months and even years. Individuals with a chronic pain syndrome can experience severe negative effects on their activities of daily living and their mental well-being. The osteopathic philosophy and osteopathic manipulative treatment (OMT) set the osteopathic physician up to provide a comprehensive treatment plan to manage patients with chronic pain. To direct osteopathic techniques to address pain, it is imperative to understand the anatomy and physiology of the way pain is signaled to the central nervous system. Pain can also be classified into multiple categories based on the origin of the signal, which is essential to decipher to direct therapy. The goal of osteopathic care in chronic pain syndrome is to relieve musculoskeletal somatic dysfunctions and to normalize sympathetic and parasympathetic neural tone. This would create the optimal environment to induce the body's own self-healing capabilities.

INTRODUCTION

Chronic pain is defined as persistent pain signals that continue to fire in the nervous system from weeks, months, to even years as defined by the National Institute of Neurological Disorders and Stroke[1]. Chronic pain persists even after the causative injury or illness has resolved or healed. While acute pain subsides within 3–6 months, some people may develop chronic pain without any causative or past injury that can last more than 6 months[2]. Chronic pain often interferes with work or other activities of daily living. The stress on the body from chronic pain may cause physical conditions, such as tense muscles, limited range of motion, decreased energy, and even changes in appetite. The Institute of Medicine reports that chronic pain is a biopsychosocial condition that often requires a multifaceted and integrated approach in which all the components should be evidence-based.[3]

EPIDEMIOLOGY

The US Centers for Disease Control and Prevention (CDC) reports that an estimated 20.4% (50 million) of US adults have chronic pain and 8.0% of US adults (19.6 million) have high-impact chronic pain with higher prevalence associated with advancing age.[4]

CORRESPONDENCE:
Param Dave, PGY-III | pdave95@gmail.com

ISSN: 1877-573X doi:10.33181/13093

PRINCIPLES OF OSTEOPATHY

Approaching chronic pain from an osteopathic perspective allows for physicians to not only address the patient's physiologic concerns but also their psychosocial apprehensions. The four tenets of osteopathic medicine allow the osteopathic physician to understand pathology, not only as a medical problem affecting human anatomy and physiology but also affecting the body as a whole unit considering the body's innate ability to self-regulate.[5] The four tenets of osteopathy are: the body is a unit, the body is capable of self-healing and regulation, structure and function are reciprocally interrelated, and treatment is based upon the previous three tenets.[6]

Osteopathic physicians should also consider the interrelationship of structure and function to best direct the treatment modality. Conventional medical therapies for chronic pain generally consist of medications and treatments targeting the physiologic aspects of the pain and neglect the psychosocial aspects that are clearly affected by this pathology.

In osteopathic medicine, therapy can be targeted through different models of illness. Osteopathy teaches the treatment of the body as a whole unit through the application of these five models: biomechanical, neurological, respiratory-circulatory, metabolic, and behavioral.[7] When treating chronic pain, the most beneficial model for therapy would be the biomechanical lens, which aims to alleviate muscular and structural somatic dysfunctions, thus allowing the body to restore its function and facilitate its innate ability to self-heal. This, however, does not mean that the other

models cannot be used as supplementary therapy for chronic pain. All five models should be used to facilitate the most effective and well-rounded treatment for chronic pain.

The biomechanical model of osteopathy teaches that there are correct positions for each structure in the body, allowing for the body to maintain homeostasis. Any change in these positions would cause changes in alignment and interrupt the homeostasis of the physiology in that structure. Due to this, external forces that can be applied with precision can return the body to proper alignment of the structure. This would restore homeostasis and allow the body's innate ability to heal itself.[8]

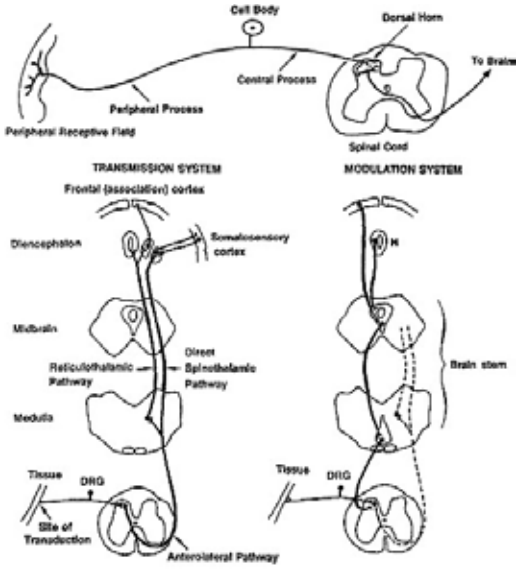
PATHOPHYSIOLOGY

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage. Pain serves to prevent tissue damage and protect the body while it is healing. Painful stimuli are detected by nociceptors, which are free nerve endings located in tissues and organs. They have high thresholds and, under normal circumstances, only respond to noxious stimuli. There are two types of nociceptors: High threshold mechanoreceptors, which stimulate small myelinated fast-conducting Aδ fibers that transmit a well-localized sharp or pricking sensation that lasts as long as the stimulus, and polymodal nociceptors that stimulate small unmyelinated slow-conducting C fibers.[9] C fibers are unmyelinated slow-conducting fibers that transmit a less well-localized, persistent aching pain that lasts after the initial stimulus has gone. Aβ fibers conduct low-intensity mechanical stimuli that convey touch and not pain; however, in chronic pain states, they are involved in the transmission of pain.[10]

The transmission of pain involves a pathway by which an inciting injury or stimulus excites nociceptors on peripheral nerve endings. This triggers a cascade of chemical reactions and impulses that are directed toward the central nervous system (CNS). This is the route by which the CNS is informed of impending or actual tissue damage. Its peripheral process runs in peripheral nerves, and its peripheral terminals are present in most body structures. These terminals are sensitive to noxious heat, mechanical stimulation, and or pare-producing chemicals. The central process enters the spinal cord via the dorsal root and terminates on central pain-transmission cells that relay the information to higher centers. Both peripheral and central processes are maintained by the cell body in the dorsal root ganglion, which is near, but not in, the spinal cord.

FIGURE 1:

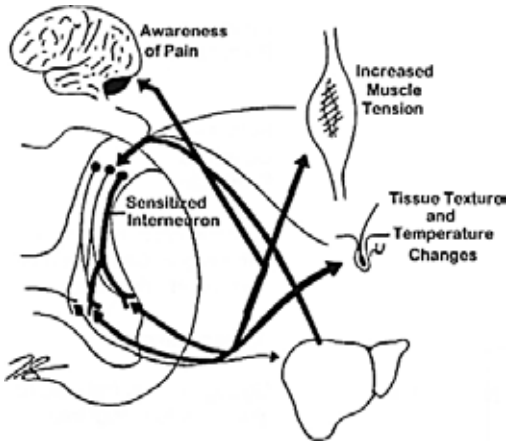
Adapted from Institute of Medicine (US) Committee on Pain, Disability, and Chronic Illness Behavior; Osterweis M, Kleinman A, Mechanic D, eds. *Pain and Disability: Clinical, Behavioral, and Public Policy Perspectives* Figure 7-1 showing a diagrammatic outline of the major neural structures relevant to pain.[3]



To direct osteopathic manipulation using the biomechanical model, osteopathic physicians must understand the concept of facilitation. Facilitation is the maintenance of a pool of neurons (premotor neurons, motor neurons of preganglionic sympathetic neurons in one or more segments of the spinal cord) in a state of partial or subthreshold excitation.[11] In this state, less afferent stimulation is required to trigger the discharge of impulses, therefore causing pain without any substantial triggers or inciting events. Facilitation may be due to a sustained increase in afferent input or changes in the affected neurons themselves. Once this has been established, facilitation can be sustained by normal CNS activity (Figure 1).

FIGURE 2:

Adapted from Savarese RG. *OMT Review* 3rd edition depicting the process of spinal segmental facilitation.[12]



If this form of facilitation occurs at an individual spinal level, it is termed segmental facilitation. To determine how a segment becomes facilitated, physicians must address the areas from which a spinal cord segment can receive neurologic input. These areas are the brain, the viscera via sympathetic or parasympathetic visceral afferents, and from somatic afferents (muscle spindles, Golgi tendons). Any abnormal stimuli from these areas can cause the neurons of the spinal cord to become sensitive to the stimulus and can therefore become "facilitated" if the signal is persistent or large in magnitude. (Figure 2). This facilitated pool of neurons can then affect the initiating site of the stimulus or any surrounding areas such as the neighboring muscles and or organs via autonomic afferents.[13]

An example of this is a trapezius muscle strain that can cause facilitation of the spinal segments of C1–C6. When a patient strains his or her trapezius muscle, abnormal and continuous sensory input from the overstretched muscle spindle sensitizes the interneurons of the C1–C6 spinal levels. This reflex causes muscle tension, pain, and tightness at the area of the trapezius, which will result in restriction of motion and tenderness upon palpation. Prolonged muscle tension causes continuation of the stimulus and therefore maintains the facilitation of these segments. Muscle tension of the trapezius causes nociceptor activation in the neighboring areas and a release of prostaglandins, bradykinin, and other cytokines. These chemicals can cause local vasodilation and tissue texture changes. This cycle of sensitization of these facilitated segments can cause increased muscle tension of the local paraspinal muscles. The increased tension of the paraspinal muscles can cause the cervical spinal segments to rotate and side bend, which can cause asymmetry. This asymmetry can cause the dysfunction and strain of more muscle groups that can then, in turn, cause further facilitation of more distal spinal segments.

In addition to facilitation, understanding the mechanisms of viscerosomatic and somatovisceral reflexes is crucial to directing osteopathic therapy. A viscerosomatic reflex occurs when a visceral stimulus of some sort can produce a response to its related spinal segments and surrounding somatic structures.[14] Conversely, a somatovisceral response is one where a somatic stimulus of some sort can produce a response in segmentally related visceral structures.[15] An example of a viscerosomatic reflex would be how the pain of acute cholecystitis may present as right-sided thoracic back pain. This is because the segmental sympathetic innervation of the gallbladder and upper gastrointestinal tract come from the T5–T9 spinal cord levels. An example of a somatovisceral reflex would be the concept of trigger points. A trigger point located at the right side of the chest between the fifth and sixth ribs can cause tachyarrhythmias.[12]

TYPES OF CHRONIC PAIN SYNDROMES

Chronic pain can be subdivided into two broad categories: nociceptive and neuropathic. Nociceptive pain is caused by short-lasting noxious stimuli in intact tissue in the absence of peripheral or central sensitization. In chronic pain, these nociceptors can malfunction and remain turned on. This therefore causes the sensation of pain even though the inciting injury has resolved. Neuropathic pain results from nerve injury.[16] Instead of an injury to an organ causing receptors to fire pain signals, neuropathic pain occurs when the nerve itself is damaged. Examples of neuropathic pain include diabetic neuropathy, multiple sclerosis, herpes zoster, and spinal injuries. Unlike nociceptive pain, neuropathic pain may not respond as effectively to conventional pain-relieving medicines such as anti-inflammatories or opiates.[17] In neuropathy, since the damage is to the nerve itself, different modalities must be used to alleviate the symptoms. As mentioned earlier, these types of pain signaling pathways are not mutually exclusive and therefore warrant a more holistic approach to their management.

Since chronic pain can be so diverse in its presentation and location, osteopathic therapy should be tailored to the entire autonomic nervous system in addition to the musculoskeletal system. Knowing the information about the sympathetic innervations and segmental facilitation, osteopathic physicians are equipped with treatment modalities that can normalize sympathetic tone by focusing on specific segments and areas of the body that may be the cause of abnormal nervous signaling. Besides addressing the sympathetic nervous system, osteopathic physicians can also direct therapy to regulate the parasympathetic nervous system. This entails regulating parasympathetic tone by normalizing the vagus nerve and the pelvic splanchnic innervation. Deciphering where the pain is located and where it originates from can help indicate which part of the parasympathetic nervous system should be targeted for therapy.

MUSCULOSKELETAL OSTEOPATHIC TREATMENTS

Patients suffering from chronic pain often have somatic dysfunctions. Whether it results from facilitated segments that cause referred pain to the surrounding musculature or from the actual site of injury, osteopathic manipulation has shown to be effective in relieving or decreasing the intensity of the pain after the intervention. A randomized controlled trial of osteopathic treatment techniques was performed in 2012 on military personnel with acute low back pain. The results of the trial showed that the patients reported significantly less pain during the osteopathic treatment visits and with every subsequent follow-up visit compared to patients who only received allopathic treatment.[18]

Myofascial release (MFR) includes several types of osteopathic manipulative treatment (OMT) to stretch and release muscular and fascial restrictions. Myofascial release can be direct, indirect, active, or passive. This treatment can be performed anywhere on the body, especially on the cervical, thoracic, or lumbar paraspinal musculature. To successfully execute this technique, it is important to localize and palpate a restriction. A restriction can present as muscle tension, decreased range of motion, or tenderness. Once the restriction is identified, the physician must decide what type of MFR to perform, whether it be direct, indirect, passive, or active (Table 1). If the patient being evaluated is elderly with multiple comorbidities or other skeletal pathology, such as osteoporosis or arthritis, a more indirect and passive approach may be preferred. In an indirect approach to MFR, the physician should move the myofascial structures away from the restrictive

barrier. This can be done by using either the upper or lower limbs as a lever or by using compression along the long axis of the muscle being treated.[19] In a direct approach to MFR, the physician should move the myofascial tissues toward a restrictive barrier or by using traction along the long axis of the muscle being treated.

This treatment modality may be more suited to an otherwise healthy individual with no other comorbidities and with acute musculoskeletal complaints. Physicians can also fine-tune MFR by adding a twisting component in a clockwise or counterclockwise fashion to the affected muscle. Transverse forces perpendicular to the long axis of the muscle can also aid in the fine-tuning aspect of MFR. Physicians may also ask the patient to breathe or to make certain eye movements in conjunction with the MFR to enhance the treatment. For example, the physician may increase the force of the traction on the muscle incrementally, with each exhalation that the patient might take. The goal of the treatment is to serve in both a diagnostic and therapeutic role. The physician must continue to palpate for restrictions as the technique is being performed to feel for muscle tension release, changes in temperature, or changes in color due to increased blood flow. All these changes can indicate restoration of the musculoskeletal system's functional balance. A recent study in January 2022 examined breast cancer survivors who had upper torso misalignment and muscular imbalance after surgical intervention. The study showed that patients who had MFR earlier postop experienced improvement in their torso malalignment and increased range of motion.[20]

TABLE 1:

TREATMENT	INDIRECT	DIRECT	ACTIVE	PASSIVE
MET		x	x	
MFR	x	x		x
Counterstrain	x			x

Counterstrain is a passive indirect technique in which the tissue being treated is positioned at a point of balance or slightly away from the restrictive barrier. Moving the muscles into a position of ease for a certain period can "reset" the affected muscles into their normal state as opposed to the inflamed or hypertonic state. Counterstrain, much like MFR, can be performed anywhere on the body and can also serve as a very effective treatment modality for patients in which MFR might be too intense. Patients who are elderly and have chronic musculoskeletal pain may benefit from a less-intense and indirect treatment such as counterstrain. In order to perform counterstrain, the identification of tenderpoints is crucial. Tenderpoints are small hypertense areas of tenderness that can usually be found in the region of the patient's complaint. Tenderpoints usually reside near bony attachments of ligaments, tendons, or in the belly of the affected muscle.[21] After the physician has located the tenderpoint, they must palpate the tenderpoint with the fingertip and maintain contact with the tenderpoint to monitor it throughout the entirety of the treatment. Once a tenderpoint is palpated, a new pain scale must be established. Usually, the physician must explain that the tenderpoint being palpated and causing pain while the patient is in a neutral position will now be referred to as a 10/10 or a dollar's worth of pain. The goal is for the physician to tell the patient that they will try to move the patient to the position where the tenderpoint becomes at least a 3/10 pain level, with the ultimate goal of having no pain at all or a 0/10 pain level. Once the patient has understood the goal of treatment, the physician can now maneuver the surrounding musculature and bony structures of the tenderpoint to the position of most relief. While maintaining light contact with the tenderpoint, the physician makes a gross adjustment to shorten the muscle being treated. If the technique is effective, no more than 30% of the tenderness should remain. There are many tenderpoints that can be present on a patient; however, the one that is most tender should be treated first. Usually, if the first tenderpoint is treated effectively, the subsequent tenderpoints can be relieved as well.

Muscle energy is traditionally an active and direct technique. However, it can also be used as an indirect form, although this is rare. As a result, patients who have more acute musculoskeletal complaints and are otherwise healthy may benefit more from this technique as opposed to an elderly patient with chronic complaints and multiple comorbidities. There are two main forms of muscle energy, which are the post-isometric relaxation and the reciprocal inhibition techniques. The post-isometric relaxation technique is the more commonly used technique. This involves the diagnosis of somatic dysfunctions in the area the physician is about to treat. For example, a correct and accurate vertebral spinal somatic dysfunction must be established in order for the treatment to be efficacious. The treatment is effective when the physician rechecks the somatic vertebral dysfunction and notes an improvement in the position along with improved range of motion of the spinal segment. Reciprocal inhibition muscle energy is a technique that utilizes the reflex mechanism of reciprocal inhibition when antagonist muscles are contracted.[22] By contracting the antagonistic muscle, signals are transmitted to the spinal cord through the reciprocal inhibition reflex arc, therefore forcing the agonist muscle to relax. A recent study has shown that muscle energy techniques have improved musculoskeletal nonspecific neck pain. The study has shown that the technique improved cervical range of motion in patients with chronic pain and reduced the intensity of the pain in people with neck pain as well.[23]

SYMPATHETIC NERVOUS SYSTEM TREATMENTS

In addition to directing osteopathic treatment toward the musculoskeletal system, OMT can also be directed toward the autonomic system using the neurologic model of treatment. Specifically, in chronic pain, the autonomic nervous system can be in a hypersympathetic state where facilitated segments can cause increased neuronal firing. This would then cause increased sensation of pain that would not necessarily respond to purely musculoskeletal treatment modalities. To address the hypersympathetic tone of the autonomic nervous system, there are osteopathic treatments that can be directed toward the sympathetic chain ganglion and Chapman's points in order to normalize sympathetic tone. Most of these techniques can be repeated multiple times until a soft tissue release is felt or when sympathetic tone has been normalized.[24]

One of the techniques that may be used to normalize sympathetic tone is rib raising. The thoracic ganglia are located anterior to the corresponding rib. Anterior pressure on the rib head will put pressure on the ganglia, causing a short-term increase in sympathetic activity, followed by a long-term decrease in sympathetic activity.[25]

The upper lumbar sympathetic ganglia are also continuous with the thoracic paraspinal sympathetic ganglia. However, due to the lack of ribs, a technique known as direct paraspinal inhibition can also be used to produce the same autonomic response as that of rib raising. This is achieved by applying anterior pressure to the paraspinal area of the upper lumbar region. By doing this, the upper lumbar sympathetic ganglia can be stimulated in an effort to normalize sympathetic tone.[26]

Several treatment modalities can be employed to treat the sympathetic tone to the head and neck structures. Treatment such as paraspinal inhibition, muscle energy, and MFR can also be applied to the C1–C3, which comprise the superior ganglia, C6–C7, which comprise the middle ganglia, and C7–T1, which comprise the inferior ganglia.

Chapman points are small ganglion form contractions that present as smooth, firm, palpable nodules that are approximately 2 to 3 millimeters in diameter. A Chapman's point represents the somatic manifestation of its visceral dysfunction.[27] Therefore, treating Chapman's points or Chapman's reflexes can also decrease sympathetic tone to the associated visceral tissues. Chapman's points are treated by using a small circular motion with the fingertip either in a clockwise or counterclockwise fashion over the point itself. The treatment is completed once either the point is no longer tender or sympathetic tone is normalized.

PARASYMPATHETIC NERVOUS SYSTEM TREATMENTS

Since the parasympathetic nervous system is primarily found via vagal tone or through sacral innervation, most of the osteopathic treatment modalities that treat the parasympathetic nervous system are aimed at manipulating cranial structures or sacral structures.

Cranial manipulation techniques, such as condylar decompression, can help free parasympathetic responses to structures stimulated by cranial nerves IX and X by freeing the passage through the jugular foramen.[28] For example, people who may have chronic migraines may benefit from condylar decompression as it can normalize parasympathetic firing of the nervous system with the added benefit of MFR to the surrounding musculature. Manipulation of the occipito-atlantal, atlantoaxial, and the C2 joints can also influence parasympathetic tone via the vagus nerve. Treatment of sacral somatic dysfunctions with sacral inhibition can also normalize hyperparasympathetic tone such as pain from constipation. A recent comparative study in 2013 evaluated the efficacy of OMT on postop ileus patients. The study found that patients who had OMT performed on them had decreased time to flatus and a decreased hospital length of stay.[29] As well as normalizing parasympathetic tone, both these techniques would also enable myofascial stretching to the surrounding musculature, which would, in turn, decrease pain.

CONCLUSION

Chronic pain is a condition that affects millions of people throughout the US and the world. It requires a multifactorial approach to treatment and alleviation of pain. Doctors of osteopathic medicine are presented with a unique opportunity to implement their osteopathic training and principles to patients with chronic pain. A fundamental understanding of chronic pain and the different types of chronic pain is essential to direct therapy.

In addition to traditional medical therapy, osteopathic physicians can use multiple models of treatment to direct their therapy toward musculoskeletal dysfunctions as well as neurologic autonomic nervous system imbalances. Due to the variety of modalities present in osteopathic medicine, it can serve as an effective supplement to conventional therapy in the treatment of chronic pain.

REFERENCES

1. National Institute of Neurological Disorders and Stroke. Chronic Pain. Accessed October 30, 2021. https://www.ninds.nih.gov/Disorders/All-Disorders/Chronic-Pain-Information-Page
2. Goldman L, Schafer AI, Cecil RL. In: Goldman L, Schafer AI. *Goldman-Cecil Medicine*. 26th ed. Elsevier; 2020:128–137.
3. Institute of Medicine (US) Committee on Pain, Disability, and Chronic Illness Behavior; Osterweis M, Kleinman A, Mechanic D, eds. *Pain and Disability: Clinical, Behavioral, and Public Policy Perspectives*. National Academies Press (US); 1987. Accessed October 30, 2021. http://www.ncbi.nlm.nih.gov/books/NBK219254/
4. Dowell D, Haegerich T, Chou R. CDC guideline for prescribing opioids for chronic pain – United States, 2016. *MMWR Recomm Rep*. 2016; 65(1):1–49. doi: 10.15585/mmwr.rr6501e1.
5. Licciardone JC, Schultz MJ, Amen B. Osteopathic manipulation in the management of chronic pain: current perspectives. *J Pain Res*. 2020;13:1839–1847. doi:10.2147/JPR.S183170
6. Kim HS. Chapter 8 – Complementary and integrative health. In: Pangarkar S, Pham QG, Eapen BC, eds. *Pain Care Essentials and Innovations*. Elsevier; 2021:113–121. doi:10.1016/B978-0-323-72216-2.00008-9
7. Christian L, Torsten L. Models and theoretical frameworks for osteopathic care – a critical view and call for updates and research. *Int J Osteopath Med*. 2020;37:48–51. doi:10.1016/j.ijosm.2020.07.004
8. Jerome JA. An osteopathic approach to chronic pain management. *J Am Osteopath Assoc*. 2017;117(5):306–314. doi:10.7556/jaoa.2017.056
9. Skirven TM, Osterman AL. In: Skirven TM, Osterman AL, Fedorczyk J, Amadio PC, Felder S, Shin EK, eds. *Rehabilitation of the Hand and Upper Extremity*. 7th ed. Elsevier; 2021:1323–1331.
10. Schug SA, Daly HCS, Stannard KJD. Pathophysiology of pain. In: Fitridge R, Thompson M, eds. *Mechanisms of Vascular Disease: A Reference Book for Vascular Specialists*. University of Adelaide Press; 2011:20. Accessed October 30, 2021. http://www.ncbi.nlm.nih.gov/books/NBK534269/
11. Bath M, Owens J. Physiology, viscerosomatic reflexes. In: *StatPearls*. StatPearls Publishing; 2021. Accessed October 30, 2021. http://www.ncbi.nlm.nih.gov/books/NBK559218/

12. Savarese RG, Capobianco JD, Cox JJ. *OMT Review: A Comprehensive Review in Osteopathic Medicine*. 3rd ed. OMT Review. 2003.

13. Liem T. A.T. Still's osteopathic lesion theory and evidence-based models supporting the emerged concept of somatic dysfunction. *J Am Osteopath Med*. 2016;116(10):654–661. doi:10.7556/jaoa.2016.129

14. Speelman DS. Use of Osteopathic Principles for Nonpharmacologic, Therapeutic Interventions in Women With Polycystic Ovary Syndrome. ClinicalTrials.gov identifier: NCT03383484. Updated December 26, 2017. Accessed October 28, 2021. https://clinicaltrials.gov/ct2/show/NCT03383484

15. Özerkan KN. Electrical characteristics of acupuncture points and the relation with the body organs. *Eur J Integr Med*. 2016;8(suppl 1):14. doi:10.1016/j.eujim.2016.08.034

16. Apkarian AV. 10 – Pain and Brain Changes. In: Benzon HT, Rathmell JP, Wu CL, Turk DC, Argoff CE, Hurley RW, eds. *Practical Management of Pain*. 5th ed. Mosby; 2014:113–131.e4. doi:10.1016/B978-0-323-08340-9.00010-4

17. Daroff RB, Jankovic J, Mazziotta JC, Pomeroy SL, Katirji B. In: *Bradley's Neurology in Clinical Practice*. 8th ed. Elsevier; 2016:1854–1860.

18. Cruser dA, Maurer D, Hensel K, Brown SK, White K, Stoll ST. A randomized, controlled trial of osteopathic manipulative treatment for acute low back pain in active duty military personnel. *J Man Manip Ther*. 2012;20(1):5–15. doi:10.1179/2042618611Y.0000000016

19. Ajimsha MS, Al-Mudahka NR, Al-Madzhar JA. Effectiveness of myofascial release: systematic review of randomized controlled trials. *J Bodyw Mov Ther*. 2015;19(1):102–112. doi:10.1016/j.jbmt.2014.06.001

20. Rao MS, Pattanshetty RB. Effect of myofascial release, stretching, and strengthening on upper torso posture, spinal curvatures, range of motion, strength, shoulder pain and disability, and quality of life in breast cancer survivors. *Physiother Res Int*. 2022;27(2):e1939. doi:10.1002/pri.1939

21. Wong CK, Abraham T, Karimi P, Ow-Wing C. Strain counterstrain technique to decrease tender point palpation pain compared to control conditions: a systematic review with meta-analysis. *J Bodyw Mov Ther*. 2014;18(2):165–173. doi:10.1016/j.jbmt.2013.09.010

22. Waxenbaum JA, Lu M. Physiology, muscle Energy. In: *StatPearls*. StatPearls Publishing; 2022. Accessed January 3, 2023. http://www.ncbi.nlm.nih.gov/books/NBK559029/

23. Sbardella S, La Russa C, Bernetti A, et al. Muscle energy technique in the rehabilitative treatment for acute and chronic non-specific neck pain: a systematic review. *Healthcare*. 2021;9(6):746. doi:10.3390/healthcare9060746

24. Rechberger V, Biberschick M, Porthun J. Effectiveness of an osteopathic treatment on the autonomic nervous system: a systematic review of the literature. *Eur J Med Res*. 2019;24(1):36. doi:10.1186/s40001-019-0394-5

25. Magoun HI. Effects of rib raising on the autonomic nervous system: a pilot study using noninvasive biomarkers. *J Am Osteopath Assoc*. 2010;110(10):608. Accessed January 3, 2023. https://doi.org/10.7556/jaoa.2010.110.10.608

26. Chin AJ, Fischione AD, Shilian R, et al. Tolerance of rib raising among hospitalized patients: a pilot study. *J Am Osteopath Assoc*. 2019;119(1):19–23. doi:10.7556/jaoa.2019.003

27. Bath M, Nguyen A, Bordoni B. Physiology, Chapman's points. In: *StatPearls*. StatPearls Publishing; 2021. Accessed September 6, 2021. http://www.ncbi.nlm.nih.gov/books/NBK558953/

28. Pierce-Talsma S, Peña N. Condylar decompression technique for infants. *J Am Osteopath Assoc*. 2017;117(11):e136. doi:10.7556/jaoa.2017.139

29. Baltazar GA, Betler MP, Akella K, Khatri R, Asaro R, Chendrasekhar A. Effect of osteopathic manipulative treatment on incidence of postoperative ileus and hospital length of stay in general surgical patients. *J Am Osteopath Assoc*. 2013;113(3):204-209.