# The Integration of Osteopathic Approaches on Visceral Health

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## Introduction

This thesis emphasizes the connection between somatic dysfunction and visceral disease in osteopathic care. Understanding viscerosomatic reflexes is vital, as it demonstrates how issues in internal organs can present as physical symptoms, aiding practitioners in uncovering underlying health problems. Detailed assessments encompassing patient history and environmental factors are essential for revealing these relationships. Incorporating visceral techniques into Osteopathic Manual Therapy (OMT) has been shown to enhance treatment effectiveness and improve overall patient outcomes. By embracing a holistic approach that views the body as an interconnected system, osteopathic practitioners can more effectively address the complexities of patient's health concerns and promote patient-centered care. Research on animal anatomy has been extensive; however, studies on viscerosomatic reflexes, somatic dysfunction, and osteopathic evaluations and treatment approaches primarily focus on humans. Given that the studies may present similar indications, this thesis utilizes findings from both animal and human research to develop its conclusions.

## 1.0 Understanding Visceral Function & Anatomy

"Viscera" encompasses the soft internal organs within the thorax, abdomen, and pelvic cavities, excluding those of the central nervous system, head and neck, skin, or musculoskeletal components. The viscera's functions include respiratory, circulatory, digestive, and reproductive processes, are regulated involuntarily, and crucial for maintaining homeostasis and health. To understand visceral dysfunction from an osteopathic perspective, it is necessary to examine the anatomical structures of the viscera. The organ system is a vast topic and extends beyond the overall scope of this thesis. For simplicity, the basic anatomy is outlined below.

### 1.0.1 Development of Viscera

An organ is a collection of two or more tissues that work together to form larger functional units. Organ development begins early in embryonic growth as cells organize germ layers. These germ layers contain active cell populations for forming essential vertebrate organ systems (MacCord, 2013). The layers are further categorized into somatic layers, which create body walls, and splanchnic layers, which develop into internal organs (O'Neill, 2024).

### 1.0.2 Tissues of the Viscera

An organ comprises various types of tissues organized into distinct layers. Most organs primarily consist of a main tissue corresponding to their primary function and additional supportive tissues. Although each organ has a specific type of tissue linked to its primary function, all organs are surrounded by muscles, connective tissue, and nervous tissues that contribute to their overall function. Smooth muscle fibers are present in the walls of hollow visceral organs, except for the heart, which comprises cardiac muscle. These smooth muscle fibers are one of the viscera's most essential components when discussing organ tissue. Smooth muscle differs from skeletal muscle in several fundamental ways, the most notable being its capacity to contract involuntarily. This ability is crucial for maintaining homeostasis within the organs. Moreover, smooth muscle exhibits greater elastic properties than skeletal muscle, allowing the organs to tense and relax while preserving their contractile tone continuously (Hafen, 2023). Without smooth muscle, the body could not perform its most fundamental functions.

Fascia is another essential part of the connective tissue system, consisting of interwoven membranous tubular layers of collagen and elastic fibers rich in fluid. It encapsulates every muscle, bone, gland, and cell within the organism, including the tissues that enclose the nervous system, vascular structures, and all visceral organs (Horton, 2015). Functionally, the fascia operates as a mechanical support system and a communication network within the body (Langevin, 2006). Additionally, it attaches to and stabilizes visceral and somatic structures, providing robust support and strength (Gatt et al., 2023). It also functions as a neural, lymphatic, and vascular systems channel (Horton, 2015). Furthermore, fascia facilitates the separation of body cavities and muscles, envelopes various organs, and establishes sliding surfaces that promote movement while minimizing friction (Horton, 2015). In addition to fascia, muscle and nervous tissue, all organs in the body receive blood and have lymphatic components from the vascular system, ensuring that tissues remain healthy and alive.

### 1.0.3 Structure of Visceral Spaces

The viscera are housed and organized within specific spaces in the body known as cavities. These cavities are filled with fluid, contain various internal organs and are categorized based on the cavity they occupy, such as the pleura (thoracic cavity), pericardium (surrounding the heart and blood vessels), peritoneum (abdominopelvic cavity) and the pelvic cavity.

The structure of visceral spaces is characterized by an outer layer of fibrous fascia that encases each organ, referred to as parietal fascia (Gatt et al., 2023). This outer layer is complemented by a serous membrane composed of specialized cells. The serous layer adheres to the parietal fascia, creating a structure that acts as a "wall" for the visceral space and extends inward to form the "skin" of the organ, known as visceral fascia (Gatt et al., 2023; Hedley, 2023). Nestled between the organ's "skin" and its "wall" is a delicate layer of serous fluid produced by the serous membrane (Hedley, 2023). This fluid facilitates differential movement, fosters a connection among organs, minimizes friction, facilitates gliding motion, and permits high mobility within the space (Horton, 2015). This structural arrangement is consistent across various visceral spaces within the body's cavities (Figure 1 and Figure 2).

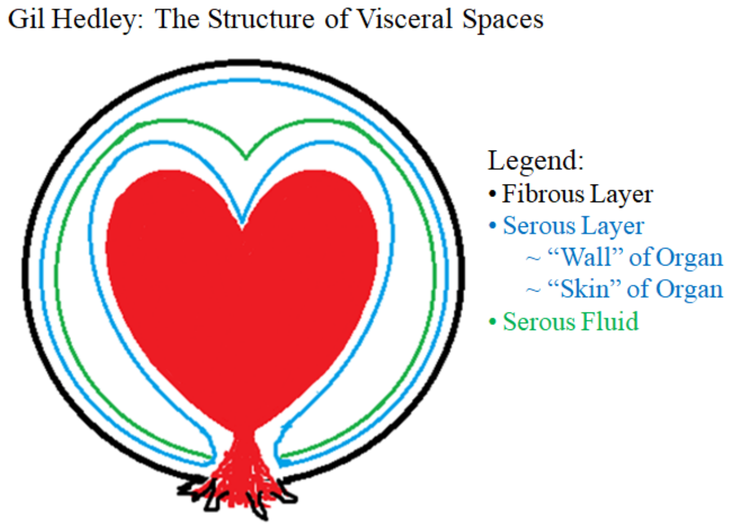


*Figure 1. Recreation of Gil Hedley's drawing of visceral spaces (Hedley, 2023).*

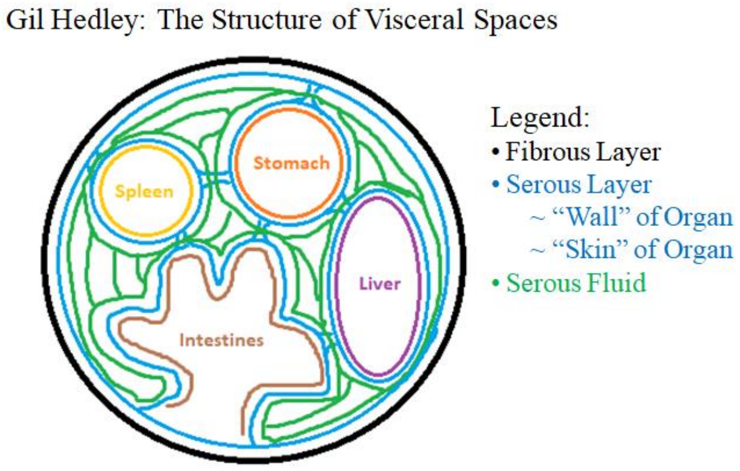


*Figure 2. Recreation of Gil Hedley's drawing of visceral spaces (Hedley, 2023).*

### 1.0.4 Innervation of Viscera

The body's organs are intricately linked to the autonomic nervous system, which controls involuntary muscle functions. Every organ is controlled by two distinct nervous systems: the sympathetic system, which governs the fight or flight response, and the parasympathetic system, which manages the rest and digest response. Most organs receive parasympathetic signals through the vagus nerve and sympathetic signals via the greater and lesser splanchnic nerves. Both branches contain nociceptors that detect harmful stimuli and relay signals to the brain and spinal cord. Together, these elements of the autonomic nervous system continuously regulate bodily functions, playing an essential role in maintaining physiological balance and homeostasis.

## **2.0 Visceral-Somatic Interactions**

### 2.0.1 Visceral Attachment to the Somatic Frame

The viscera are interconnected with the somatic structure via various connective tissue forms, including fascia and suspensory ligaments. Collectively, the tissues collaborate to ensure stability by anchoring organs to the skeletal framework, which acts as a support system. Besides attaching body cavities to the somatic structure, fascia and ligaments link various organs within each cavity. For example, a fibrous fascial pouch encases the heart's parietal pericardium and connects to ligaments that link bones and other organs (Figure 3) (Barral et al., 2006). Furthermore, the hepatogastric ligament connects the liver to the stomach (Birchard, 2006). This connective tissue enables the movement of neural, lymphatic, and vascular structures, thereby ensuring effective communication and support among the internal organs and their association with the skeletal system.

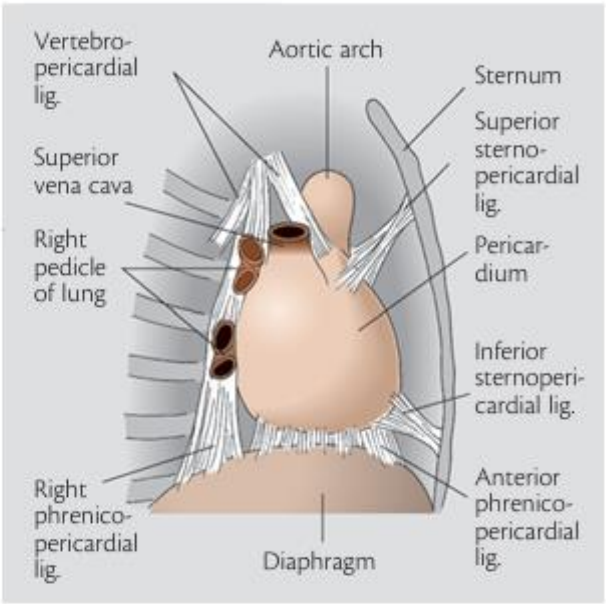


*Figure 3. T he Pericardial Ligaments (Barral et al., 2006).*

### 2.0.2 Myofascial Kinetic Lines

The skeletal system has a strong visceral connection through myofascial kinetic lines, which are continuous strands of fascia and connective tissue linking the cranium to the distal limbs and connecting muscles, joints, and organs. The lines run cranially and caudally, connecting movements and providing stability, support, and compensatory posture.

A comparative dissection study has revealed the complex fascial connections between humans and horses, emphasizing the importance of suspensory ligaments as vital links bridging the visceral and parietal systems (Elbrønd et al., 2021). This connection is facilitated by a deep fascial line that traverses the body cavities, establishing a link between the somatic body and the viscera, linked to the stomatognathic system. The findings in horses resemble those in humans, but the unique quadrupedal structure leads to the term Deep Ventral Line (DVL). The DVL begins at the hindlimbs and tail, extending cranially through the pelvic cavity, into the abdominal cavity, enveloping the gastrointestinal tract, then moving into the thoracic cavity and along the neck to the cranium (Figure 4). This pathway includes the nasal and oral cavities within the skull. It surrounds the vessels and nerves that supply the organs, forming a continuous network linking the inner organs, muscles, vessels, nerves, and skeletal system (Figure 5) (Elbrønd et al., 2021).

In the realm of osteopathy, if one segment of a myofascial line becomes tight, that tension can create a cascading effect throughout the interconnected cavities and organs, ultimately affecting the entire skeletal structure and its function.

*Figure 4. An overview of the deep equine myofascial kinetic lines - DDL (purple) and DVL (red) myofascial kinetic lines painted on a horse (Elbrønd et al., 2021).*

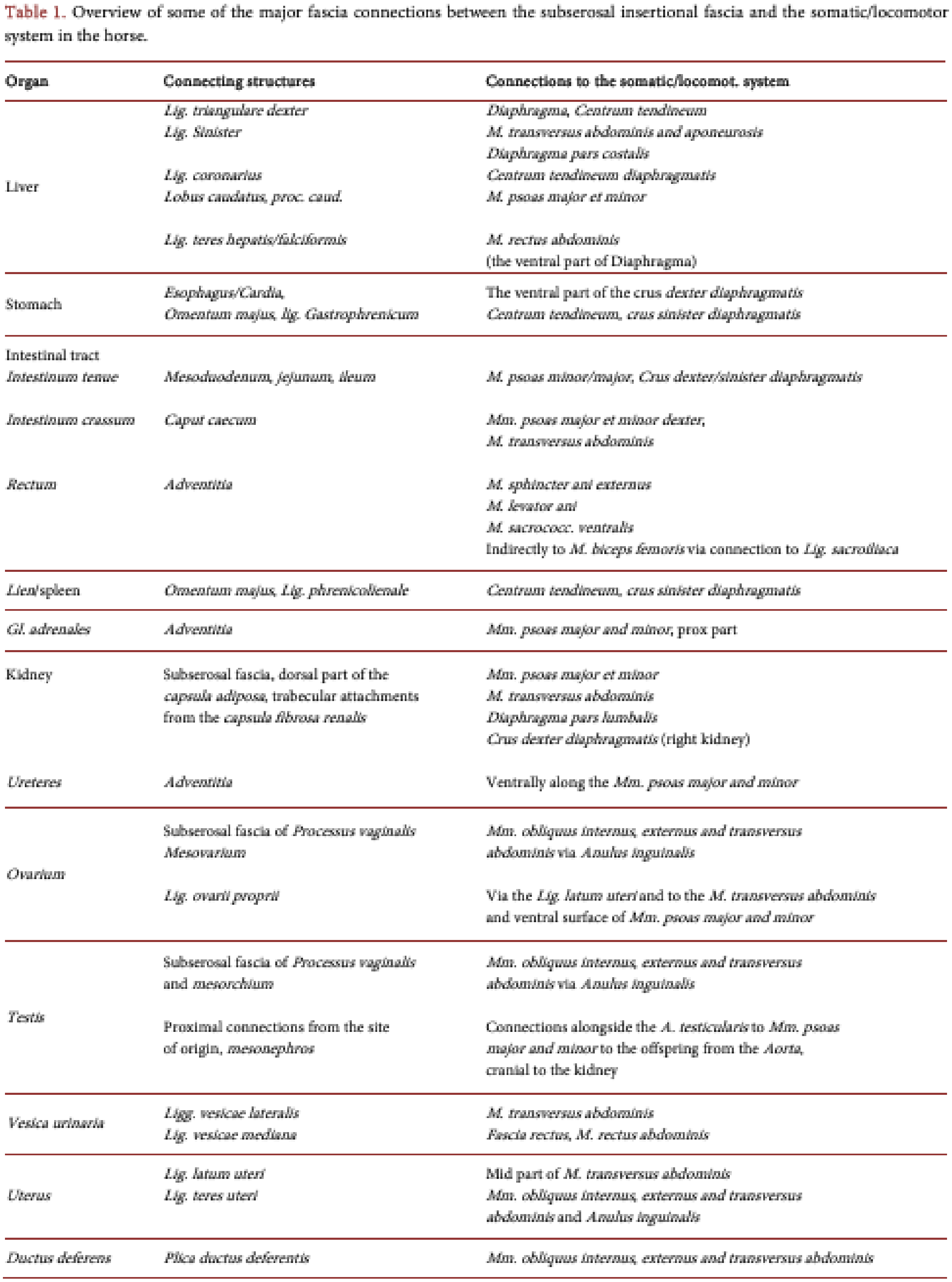


Table 1. Overview of some of the major fascia connections between the subserosal insertional fascia and the somatic/locomotor system in the horse.

| **Organ** | **Connecting structures** | **Connections to the somatic/locomot. system** |
|---|---|---|
| Liver | *Lig. triangulare dexter* | *Diaphragma, Centrum tendineum* |
| | *Lig. Sinister* | *M. transversus abdominis and aponeurosis*<br>*Diaphragma pars costalis* |
| | *Lig. coronarius* | *Centrum tendineum diaphragmatis* |
| | *Lobus caudatus, proc. caud.* | *M. psoas major et minor* |
| | *Lig. teres hepatis/falciformis* | *M. rectus abdominis*<br>(the ventral part of Diaphragma) |
| Stomach | *Esophagus/Cardia,*<br>*Omentum majus, lig. Gastrophrenicum* | The ventral part of the crus *dexter diaphragmatis*<br>*Centrum tendineum, crus sinister diaphragmatis* |
| Intestinal tract | | |
| *Intestinum tenue* | *Mesoduodenum, jejunum, ileum* | *M. psoas minor/major, Crus dexter/sinister diaphragmatis* |
| *Intestinum crassum* | *Caput caecum* | *Mm. psoas major et minor dexter,*<br>*M. transversus abdominis* |
| *Rectum* | *Adventitia* | *M. sphincter ani externus*<br>*M. levator ani*<br>*M. sacrococc. ventralis*<br>Indirectly to *M. biceps femoris* via connection to *Lig. sacroiliaca* |
| *Lien*/spleen | *Omentum majus, Lig. phrenicolienale* | *Centrum tendineum, crus sinister diaphragmatis* |
| *Gl. adrenales* | *Adventitia* | *Mm. psoas major and minor*, prox part |
| Kidney | Subserosal fascia, dorsal part of the *capsula adiposa*, trabecular attachments from the *capsula fibrosa renalis* | *Mm. psoas major et minor*<br>*M. transversus abdominis*<br>*Diaphragma pars lumbalis*<br>*Crus dexter diaphragmatis* (right kidney) |
| *Ureteres* | *Adventitia* | Ventrally along the *Mm. psoas major and minor* |
| *Ovarium* | Subserosal fascia of *Processus vaginalis*<br>*Mesovarium* | *Mm. obliquus internus, externus and transversus abdominis* via *Anulus inguinalis* |
| | *Lig. ovarii proprii* | Via the *Lig. latum uteri* and to the *M. transversus abdominis* and ventral surface of *Mm. psoas major and minor* |
| *Testis* | Subserosal fascia of *Processus vaginalis* and *mesorchium* | *Mm. obliquus internus, externus and transversus abdominis* via *Anulus inguinalis* |
| | Proximal connections from the site of origin, *mesonephros* | Connections alongside the *A. testicularis* to *Mm. psoas major and minor* to the offspring from the *Aorta*, cranial to the kidney |
| *Vesica urinaria* | *Ligg. vesicae lateralis*<br>*Lig. vesicae mediana* | *M. transversus abdominis*<br>*Fascia rectus, M. rectus abdominis* |
| *Uterus* | *Lig. latum uteri*<br>*Lig. teres uteri* | Mid part of *M. transversus abdominis*<br>*Mm. obliquus internus, externus and transversus abdominis* and *Anulus inguinalis* |
| *Ductus deferens* | *Plica ductus deferentis* | *Mm. obliquus internus, externus and transversus abdominis* |

*Figure 5. Key facial links between the viscera and the somatic system in horses (Elbrønd et al., 2021).*

### 2.0.3 How Fascia Impacts Movement

Fascia is a web-like tissue that envelops and supports blood vessels, muscles, bones, and organs, facilitating bodily movement. It is rich in nociceptors and mechanoreceptors, responsible for detecting various stimuli and delivering sensory feedback to both the autonomic and somatic nervous systems. This network of sensory information provides proprioception and body awareness by relaying information to the brain about the position and movement of body parts. When unrestricted, fascia allows for effective force transmission and coordinated movement. However, adhesions within the fascia can restrict mobility and interfere with physical activities.

Fascia exhibits a remarkable ability to adapt in response to various mechanical stimuli such as contraction, stretching, and distension. It alters its tension to counteract external forces, thus maintaining an intra- and intramuscular balance throughout the body. Research indicates that myofascial tension generated by contracting muscles can significantly impact related tissues, potentially imposing limitations on the mobility of adjacent tendons and ligaments (Ajimsha et al., 2020; Krause et al., 2016; Leonard, 2013).

Consequently, given that fascia encompasses the entire body, it operates similarly to a pulley system; alterations in tension within one region can influence other areas, thereby facilitating optimal posture and motion. Under normal physiological conditions, myofascial lines interact smoothly, allowing for free movement among body structures. This harmonious interaction is important for maintaining functional integrity and mobility within the musculoskeletal and visceral system.

### 2.0.4 Viscerosomatic & Somaticvisceral Reflexes

Reflexes are vital for maintaining homeostasis, balance, and the body's overall functioning. They allow rapid adaptation to adverse situations, aiding in protection from harm through nerve involvement.

Myron C. Beal defines a viscerosomatic reflex as an autonomic response to stimuli from a visceral disorder that affects somatic tissues (Beal, 1985). The reflex arc begins with afferent sensory impulses from visceral receptors, sending information to an integrating center in the spinal cord through a spinal segment (Figure 6). This center then relays the sensory information to motor efferents, leading to responses in skeletal muscles, viscera, blood vessels, and skin. Somatic-visceral reflexes occur when somatic stimulation affects related viscera. Somatic reflexes involve skeletal muscles, while visceral reflexes involve soft tissue organs, with the former mediated by the somatic nervous system and the latter by the autonomic nervous system (Beal, 1985).

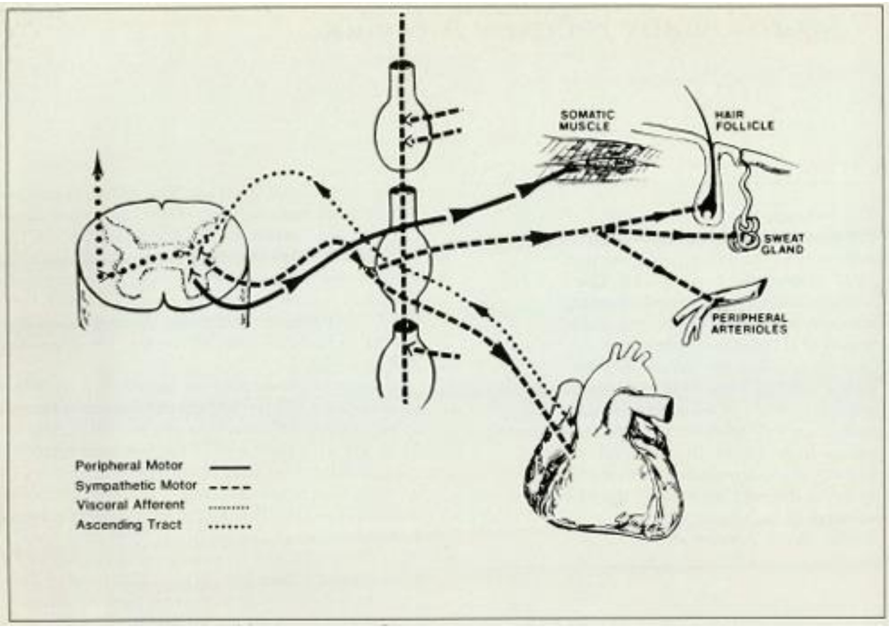


*Figure 6. Schematic representation of the viscerosomatic reflex (Beal, 1985).*

## **3.0 Integrative Approaches to Evaluation and Treatment**

The osteopathic profession emphasizes a holistic approach, viewing patients as dynamic units where somatic disturbances can affect local and distant areas. Key concepts include viscerosomatic and somatovisceral interactions, though the approach to understanding these interactions between somatic dysfunction and visceral disease remains debated. Additionally, much of the existing evidence is based on studies conducted in humans rather than animals. Nevertheless, it is believed that in the field of animal osteopathy, findings from human studies may have similar implications for animals.

### 3.0.1 Osteopathic Evaluation of Viscera-Somatic Dysfunction

For centuries, osteopathic neurophysiology has revolved around osteopathic lesions, a concept introduced by Dr. Andrew Taylor Still, the founder of osteopathy (Liem, 2016). He suggested that disruptions in the flow of life can lead to disease processes, which he described as lesions—changes in tissue texture, structure, or position (Liem, 2016). Over time, our understanding of these lesions has progressed into what we currently recognize as somatic dysfunction, a complex and multidimensional phenomenon.

Today, the concept of somatic dysfunction is characterized by impaired function in the skeletal, arthrodial, and myofascial structures, along with their vascular, lymphatic, and neural components, as well as physiological adaptation (Consorti et al., 2023). Despite the evolving definitions, the osteopathic profession has consistently emphasized the structural-function relationships between the musculoskeletal and visceral systems. Some osteopathic theorists believe visceral diseases might manifest in the somatic system even before symptoms emerge, providing diagnostic clues about visceral abnormalities within musculoskeletal structures. This phenomenon is believed to arise from segmental facilitation, changes in muscular activity, alterations in tissue texture, and changes in circulation (Bath et al., 2023; Beal, 1985; Eble, 1960; Kelso, 1971; Korr, 1947; Liem, 2016). Ultimately, segmental facilitation occurs through viscerosomatic convergence, emphasizing the biological connections between visceral and musculoskeletal components in cases of somatic dysfunction. This understanding can assist in diagnosing underlying visceral diseases when clinical signs are unclear— a topic that often sparks debate in contemporary osteopathic care.

Historically, manual practitioners believed that many cases of visceral disease or injury could lead to common somatic reflex patterns that can be identified through palpation. Early studies by J. Stedman Denslow, DO, and Irvin Korr, PhD, focused on examining sympathetic reflex responses involving somatic structures in humans, aiming to validate a spinal facilitation theory with a straightforward cause-and-effect model (Beal, 1985; Denslow et al., 1947; Korr, 1947). This concept has further been challenged over time. However, historical evidence shows that visceral stimulation can cause localized neurologic and functional changes in somatic structures due to segmental effects. Abnormal sensory signals originating from damaged or pathological areas of internal organs travel through afferent pathways to the spinal cord via viscerosomatic reflexes (Bath et al., 2023). This process alters neuronal activity in the corresponding vertebral segments and can also affect adjacent areas where the nerve supply to that organ or muscle originates. Additionally, it may lead to referred muscle pain (Giamberardino, 1999).

For instance, Beal and Wilson's research indicated that somatic dysfunction in the T1-T5 region was associated with cardiac disease, while dysfunction in the T5-T12 region was linked to gastrointestinal issues in humans (Beal, 1983; Beal, 1985). Beal also proposed that facilitation could occur when a reflex arc responds abnormally due to sustained overstimulation; if the involved neurons are already partially excited, less stimulation would be required to trigger an impulse (Beal, 1985). The reflex arc receives input from muscle somatic resources, such as Golgi tendons, but can also be influenced by signals from the brain. Additionally, these alterations could affect other spinal segments that may not be directly connected to the original injury. Therefore, through multiple studies, Korr, Beal, and Klieber observed that presymptomatic signs emerging from changes in viscerosomatic reflexes in individuals with diseases or developing visceral conditions were present (Beal, 1985; Beal et al., 1985; Korr, 1947). This leads to an important question for evaluation and treatment. Given that our understanding of anatomy shows a link between somatic dysfunction and the viscera, the theory of viscerosomatic relationships is likely valid, and patterns of palpatory fixation should be evident.

Motion palpation is typically recognized as the most widely used technique by manual therapists for differentiating abnormal from normal spinal mobility. Researchers in manual medicine have been investigating the reliability of various diagnostic tests based on palpation for many years. Previous clinical studies conducted on humans and small animals indicated that spinal facilitation associated with visceral diseases is connected to the autonomic nervous system's innervation and organ supply (Figure 7) (Beal, 1985). When plotting the autonomic reference sites, somatic reference areas related to the viscera were also identified (Figure 8) (Beal, 1985).

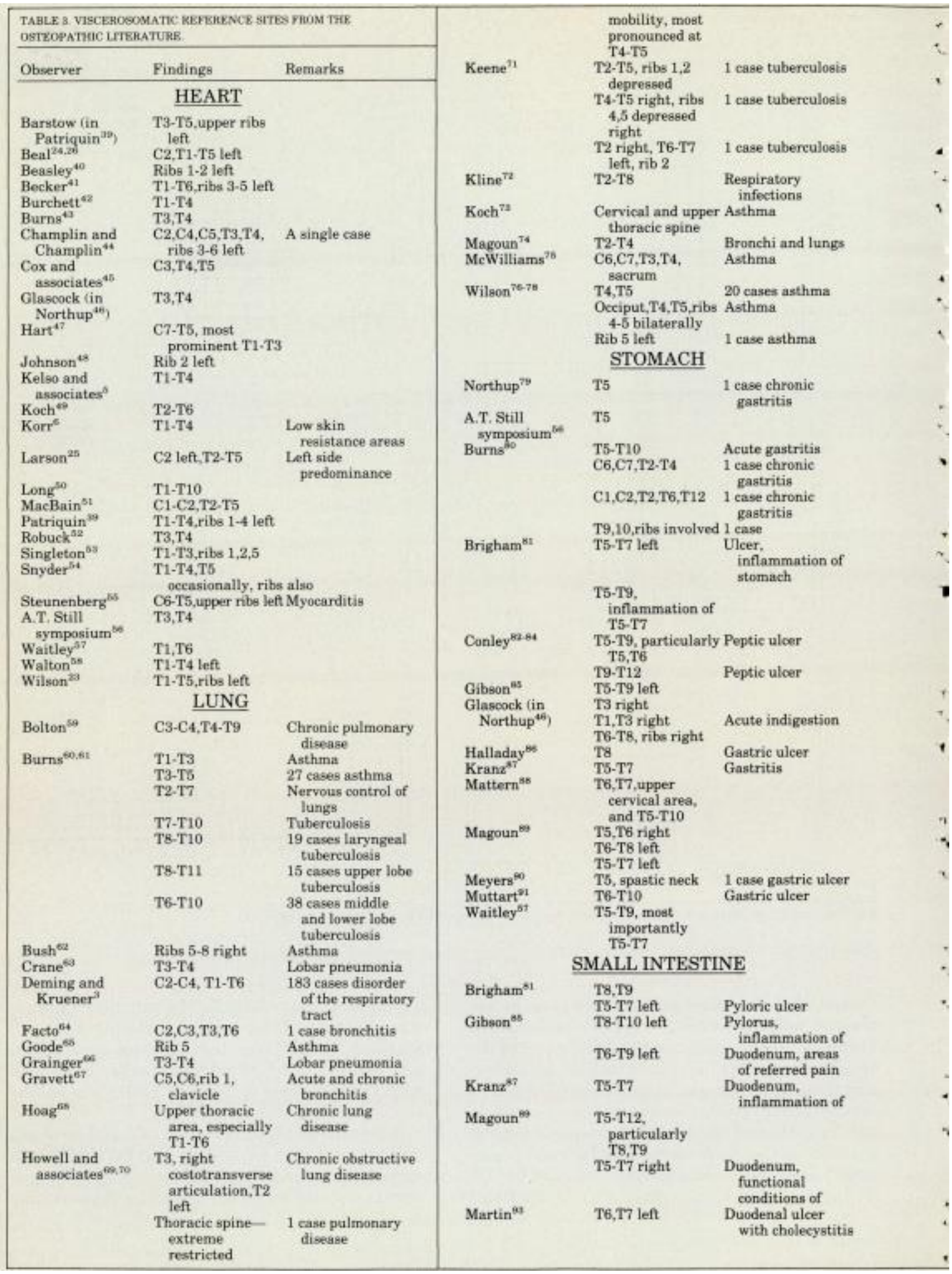
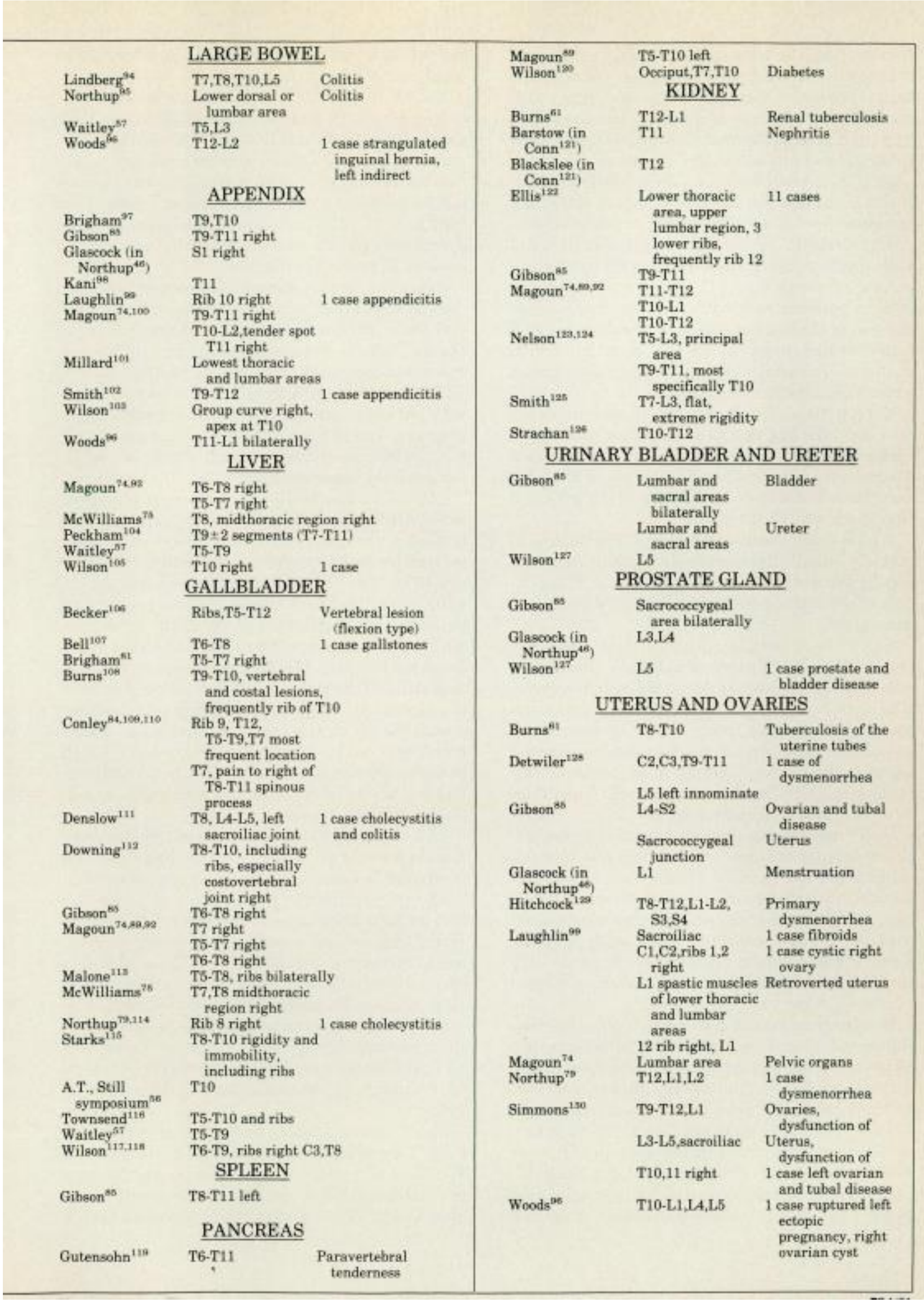


TABLE 3. VISCEROSOMATIC REFERENCE SITES FROM THE OSTEOPATHIC LITERATURE.

| Observer | Findings | Remarks |
|---|---|---|
| | **HEART** | |
| Barstow (in Patriquin[39]) | T3-T5,upper ribs left | |
| Beal[24,26] | C2,T1-T5 left | |
| Beasley[40] | Ribs 1-2 left | |
| Becker[41] | T1-T6,ribs 3-5 left | |
| Burchett[42] | T1-T4 | |
| Burns[43] | T3,T4 | |
| Champlin and Champlin[44] | C2,C4,C5,T3,T4, ribs 3-6 left | A single case |
| Cox and associates[45] | C3,T4,T5 | |
| Glascock (in Northup[46]) | T3,T4 | |
| Hart[47] | C7-T5, most prominent T1-T3 | |
| Johnson[48] | Rib 2 left | |
| Kelso and associates[5] | T1-T4 | |
| Koch[49] | T2-T6 | |
| Korr[6] | T1-T4 | Low skin resistance areas |
| Larson[25] | C2 left,T2-T5 | Left side predominance |
| Long[50] | T1-T10 | |
| MacBain[51] | C1-C2,T2-T5 | |
| Patriquin[39] | T1-T4,ribs 1-4 left | |
| Robuck[52] | T3,T4 | |
| Singleton[53] | T1-T3,ribs 1,2,5 | |
| Snyder[54] | T1-T4,T5 occasionally, ribs also | |
| Steunenberg[55] | C6-T5,upper ribs left | Myocarditis |
| A.T. Still symposium[56] | T3,T4 | |
| Waitley[57] | T1,T6 | |
| Walton[58] | T1-T4 left | |
| Wilson[23] | T1-T5,ribs left | |
| | **LUNG** | |
| Bolton[59] | C3-C4,T4-T9 | Chronic pulmonary disease |
| Burns[60,61] | T1-T3 | Asthma |
| | T3-T5 | 27 cases asthma |
| | T2-T7 | Nervous control of lungs |
| | T7-T10 | Tuberculosis |
| | T8-T10 | 19 cases laryngeal tuberculosis |
| | T8-T11 | 15 cases upper lobe tuberculosis |
| | T6-T10 | 38 cases middle and lower lobe tuberculosis |
| Bush[62] | Ribs 5-8 right | Asthma |
| Crane[63] | T3-T4 | Lobar pneumonia |
| Deming and Kruener[3] | C2-C4, T1-T6 | 183 cases disorder of the respiratory tract |
| Facto[64] | C2,C3,T3,T6 | 1 case bronchitis |
| Goode[65] | Rib 5 | Asthma |
| Grainger[66] | T3-T4 | Lobar pneumonia |
| Gravett[67] | C5,C6,rib 1, clavicle | Acute and chronic bronchitis |
| Hoag[68] | Upper thoracic area, especially T1-T6 | Chronic lung disease |
| Howell and associates[69,70] | T3, right costotransverse articulation,T2 left | Chronic obstructive lung disease |
| | Thoracic spine—extreme restricted mobility, most pronounced at T4-T5 | 1 case pulmonary disease |
| Keene[71] | T2-T5, ribs 1,2 depressed | 1 case tuberculosis |
| | T4-T5 right, ribs 4,5 depressed right | 1 case tuberculosis |
| | T2 right, T6-T7 left, rib 2 | 1 case tuberculosis |
| Kline[72] | T2-T8 | Respiratory infections |
| Koch[73] | Cervical and upper thoracic spine | Asthma |
| Magoun[74] | T2-T4 | Bronchi and lungs |
| McWilliams[75] | C6,C7,T3,T4, sacrum | Asthma |
| Wilson[76-78] | T4,T5 | 20 cases asthma |
| | Occiput,T4,T5,ribs 4-5 bilaterally | Asthma |
| | Rib 5 left | 1 case asthma |
| | **STOMACH** | |
| Northup[79] | T5 | 1 case chronic gastritis |
| A.T. Still symposium[56] | T5 | |
| Burns[80] | T5-T10 | Acute gastritis |
| | C6,C7,T2-T4 | 1 case chronic gastritis |
| | C1,C2,T2,T6,T12 | 1 case chronic gastritis |
| | T9,10,ribs involved | 1 case |
| Brigham[81] | T5-T7 left | Ulcer, inflammation of stomach |
| | T5-T9, inflammation of T5-T7 | |
| Conley[82-84] | T5-T9, particularly T5,T6 | Peptic ulcer |
| | T9-T12 | Peptic ulcer |
| Gibson[85] | T5-T9 left | |
| Glascock (in Northup[46]) | T3 right | |
| | T1,T3 right | Acute indigestion |
| | T6-T8, ribs right | |
| Halladay[86] | T8 | Gastric ulcer |
| Kranz[87] | T5-T7 | Gastritis |
| Mattern[88] | T6,T7,upper cervical area, and T5-T10 | |
| Magoun[89] | T5,T6 right | |
| | T6-T8 left | |
| | T5-T7 left | |
| Meyers[90] | T5, spastic neck | 1 case gastric ulcer |
| Muttart[91] | T6-T10 | Gastric ulcer |
| Waitley[57] | T5-T9, most importantly T5-T7 | |
| | **SMALL INTESTINE** | |
| Brigham[81] | T8,T9 | |
| | T5-T7 left | Pyloric ulcer |
| Gibson[85] | T8-T10 left | Pylorus, inflammation of |
| | T6-T9 left | Duodenum, areas of referred pain |
| Kranz[87] | T5-T7 | Duodenum, inflammation of |
| Magoun[89] | T5-T12, particularly T8,T9 | |
| | T5-T7 right | Duodenum, functional conditions of |
| Martin[93] | T6,T7 left | Duodenal ulcer with cholecystitis |

*Figure 7. Viscerosomatic reference sites with associated visceral diseases (Beal, 1985).*



| | | |
|---|---|---|
| **LARGE BOWEL** | | |
| Lindberg[94] | T7,T8,T10,L5 | Colitis |
| Northup[95] | Lower dorsal or lumbar area | Colitis |
| Waitley[57] | T5,L3 | |
| Woods[96] | T12-L2 | 1 case strangulated inguinal hernia, left indirect |
| **APPENDIX** | | |
| Brigham[97] | T9,T10 | |
| Gibson[85] | T9-T11 right | |
| Glascock (in Northup[46]) | S1 right | |
| Kani[98] | T11 | |
| Laughlin[99] | Rib 10 right | 1 case appendicitis |
| Magoun[74,100] | T9-T11 right | |
| | T10-L2,tender spot T11 right | |
| Millard[101] | Lowest thoracic and lumbar areas | |
| Smith[102] | T9-T12 | 1 case appendicitis |
| Wilson[103] | Group curve right, apex at T10 | |
| Woods[96] | T11-L1 bilaterally | |
| **LIVER** | | |
| Magoun[74,92] | T6-T8 right | |
| | T5-T7 right | |
| McWilliams[75] | T8, midthoracic region right | |
| Peckham[104] | T9±2 segments (T7-T11) | |
| Waitley[57] | T5-T9 | |
| Wilson[105] | T10 right | 1 case |
| **GALLBLADDER** | | |
| Becker[106] | Ribs,T5-T12 | Vertebral lesion (flexion type) |
| Bell[107] | T6-T8 | 1 case gallstones |
| Brigham[81] | T5-T7 right | |
| Burns[108] | T9-T10, vertebral and costal lesions, frequently rib of T10 | |
| Conley[84,109,110] | Rib 9, T12, T5-T9,T7 most frequent location | |
| | T7, pain to right of T8-T11 spinous process | |
| Denslow[111] | T8, L4-L5, left sacroiliac joint | 1 case cholecystitis and colitis |
| Downing[112] | T8-T10, including ribs, especially costovertebral joint right | |
| Gibson[85] | T6-T8 right | |
| Magoun[74,89,92] | T7 right | |
| | T5-T7 right | |
| | T6-T8 right | |
| Malone[113] | T5-T8, ribs bilaterally | |
| McWilliams[75] | T7,T8 midthoracic region right | |
| Northup[79,114] | Rib 8 right | 1 case cholecystitis |
| Starks[115] | T8-T10 rigidity and immobility, including ribs | |
| A.T., Still symposium[56] | T10 | |
| Townsend[116] | T5-T10 and ribs | |
| Waitley[57] | T5-T9 | |
| Wilson[117,118] | T6-T9, ribs right C3,T8 | |
| **SPLEEN** | | |
| Gibson[85] | T8-T11 left | |
| **PANCREAS** | | |
| Gutensohn[119] | T6-T11 | Paravertebral tenderness |
| Magoun[89] | T5-T10 left | |
| Wilson[120] | Occiput,T7,T10 | Diabetes |
| **KIDNEY** | | |
| Burns[61] | T12-L1 | Renal tuberculosis |
| Barstow (in Conn[121]) | T11 | Nephritis |
| Blackslee (in Conn[121]) | T12 | |
| Ellis[122] | Lower thoracic area, upper lumbar region, 3 lower ribs, frequently rib 12 | 11 cases |
| Gibson[85] | T9-T11 | |
| Magoun[74,89,92] | T11-T12 | |
| | T10-L1 | |
| | T10-T12 | |
| Nelson[123,124] | T5-L3, principal area | |
| | T9-T11, most specifically T10 | |
| Smith[125] | T7-L3, flat, extreme rigidity | |
| Strachan[126] | T10-T12 | |
| **URINARY BLADDER AND URETER** | | |
| Gibson[85] | Lumbar and sacral areas bilaterally | Bladder |
| | Lumbar and sacral areas | Ureter |
| Wilson[127] | L5 | |
| **PROSTATE GLAND** | | |
| Gibson[85] | Sacrococcygeal area bilaterally | |
| Glascock (in Northup[46]) | L3,L4 | |
| Wilson[127] | L5 | 1 case prostate and bladder disease |
| **UTERUS AND OVARIES** | | |
| Burns[61] | T8-T10 | Tuberculosis of the uterine tubes |
| Detwiler[128] | C2,C3,T9-T11 | 1 case of dysmenorrhea |
| | L5 left innominate | |
| Gibson[85] | L4-S2 | Ovarian and tubal disease |
| | Sacrococcygeal junction | Uterus |
| Glascock (in Northup[46]) | L1 | Menstruation |
| Hitchcock[129] | T8-T12,L1-L2, S3,S4 | Primary dysmenorrhea |
| Laughlin[99] | Sacroiliac | 1 case fibroids |
| | C1,C2,ribs 1,2 right | 1 case cystic right ovary |
| | L1 spastic muscles of lower thoracic and lumbar areas | Retroverted uterus |
| | 12 rib right, L1 | |
| Magoun[74] | Lumbar area | Pelvic organs |
| Northup[79] | T12,L1,L2 | 1 case dysmenorrhea |
| Simmons[130] | T9-T12,L1 | Ovaries, dysfunction of |
| | L3-L5,sacroiliac | Uterus, dysfunction of |
| | T10,11 right | 1 case left ovarian and tubal disease |
| Woods[96] | T10-L1,L4,L5 | 1 case ruptured left ectopic pregnancy, right ovarian cyst |

*Figure 7. Viscerosomatic reference sites with associated visceral diseases (Beal, 1985).*

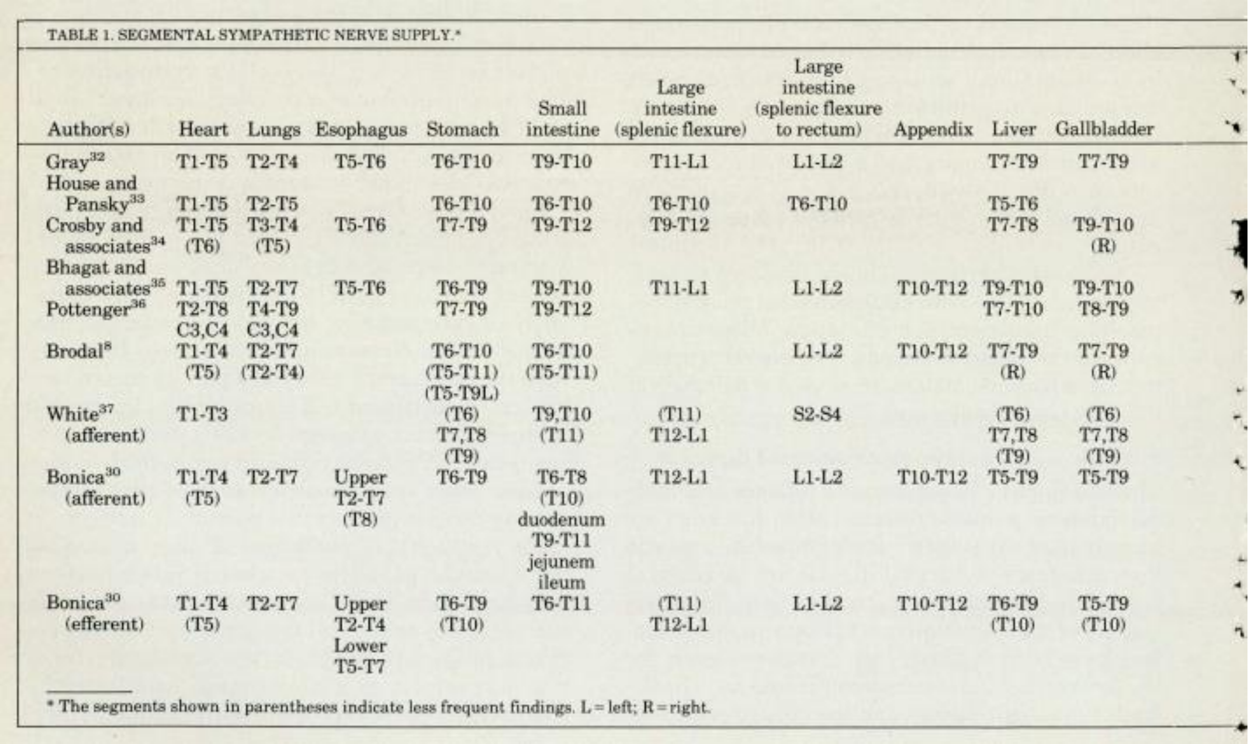
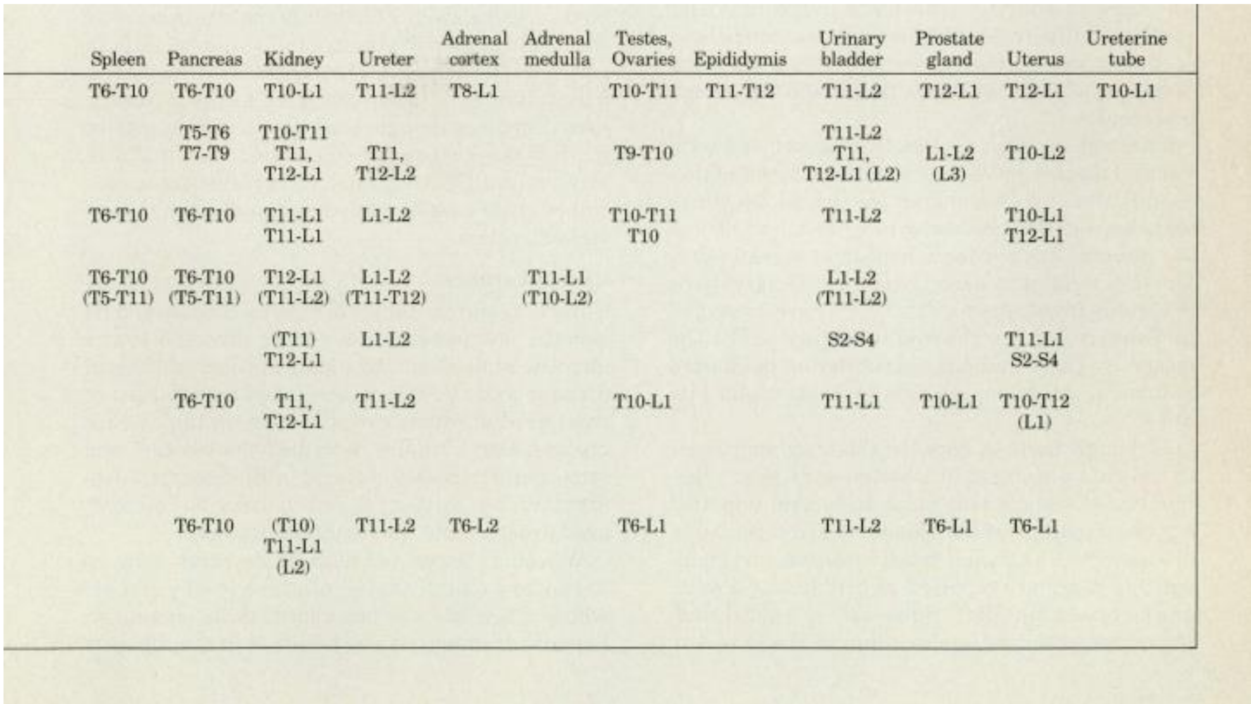


TABLE 1. SEGMENTAL SYMPATHETIC NERVE SUPPLY.*

| Author(s) | Heart | Lungs | Esophagus | Stomach | Small intestine | Large intestine (splenic flexure) | Large intestine (splenic flexure to rectum) | Appendix | Liver | Gallbladder |
|---|---|---|---|---|---|---|---|---|---|---|
| Gray[32] | T1-T5 | T2-T4 | T5-T6 | T6-T10 | T9-T10 | T11-L1 | L1-L2 |  | T7-T9 | T7-T9 |
| House and Pansky[33] | T1-T5 | T2-T5 |  | T6-T10 | T6-T10 | T6-T10 | T6-T10 |  | T5-T6 |  |
| Crosby and associates[34] | T1-T5<br>(T6) | T3-T4<br>(T5) | T5-T6 | T7-T9 | T9-T12 | T9-T12 |  |  | T7-T8 | T9-T10<br>(R) |
| Bhagat and associates[35] | T1-T5 | T2-T7 | T5-T6 | T6-T9 | T9-T10 | T11-L1 | L1-L2 | T10-T12 | T9-T10 | T9-T10 |
| Pottenger[36] | T2-T8<br>C3,C4 | T4-T9<br>C3,C4 |  | T7-T9 | T9-T12 |  |  |  | T7-T10 | T8-T9 |
| Brodal[8] | T1-T4<br>(T5) | T2-T7<br>(T2-T4) |  | T6-T10<br>(T5-T11)<br>(T5-T9L) | T6-T10<br>(T5-T11) |  | L1-L2 | T10-T12 | T7-T9<br>(R) | T7-T9<br>(R) |
| White[37] (afferent) | T1-T3 |  |  | (T6)<br>T7,T8<br>(T9) | T9,T10<br>(T11) | (T11)<br>T12-L1 | S2-S4 |  | (T6)<br>T7,T8<br>(T9) | (T6)<br>T7,T8<br>(T9) |
| Bonica[30] (afferent) | T1-T4<br>(T5) | T2-T7 | Upper<br>T2-T7<br>(T8) | T6-T9 | T6-T8<br>(T10)<br>duodenum<br>T9-T11<br>jejunem<br>ileum | T12-L1 | L1-L2 | T10-T12 | T5-T9 | T5-T9 |
| Bonica[30] (efferent) | T1-T4<br>(T5) | T2-T7 | Upper<br>T2-T4<br>Lower<br>T5-T7 | T6-T9<br>(T10) | T6-T11 | (T11)<br>T12-L1 | L1-L2 | T10-T12 | T6-T9<br>(T10) | T5-T9<br>(T10) |

* The segments shown in parentheses indicate less frequent findings. L = left; R = right.

*Figure 8.* A summary of viscerosomatic referral zones according to segmental nerve distribution *(Beal, 1985).*



| Spleen | Pancreas | Kidney | Ureter | Adrenal cortex | Adrenal medulla | Testes, Ovaries | Epididymis | Urinary bladder | Prostate gland | Uterus | Ureterine tube |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T6-T10 | T6-T10 | T10-L1 | T11-L2 | T8-L1 |  | T10-T11 | T11-T12 | T11-L2 | T12-L1 | T12-L1 | T10-L1 |
|  | T5-T6<br>T7-T9 | T10-T11<br>T11,<br>T12-L1 | T11,<br>T12-L2 |  |  | T9-T10 |  | T11-L2<br>T11,<br>T12-L1 (L2) | L1-L2<br>(L3) | T10-L2 |  |
| T6-T10 | T6-T10 | T11-L1<br>T11-L1 | L1-L2 |  |  | T10-T11<br>T10 |  | T11-L2 |  | T10-L1<br>T12-L1 |  |
| T6-T10<br>(T5-T11) | T6-T10<br>(T5-T11) | T12-L1<br>(T11-L2) | L1-L2<br>(T11-T12) |  | T11-L1<br>(T10-L2) |  |  | L1-L2<br>(T11-L2) |  |  |  |
|  |  | (T11)<br>T12-L1 | L1-L2 |  |  |  |  | S2-S4 |  | T11-L1<br>S2-S4 |  |
|  | T6-T10 | T11,<br>T12-L1 | T11-L2 |  |  | T10-L1 |  | T11-L1 | T10-L1 | T10-T12<br>(L1) |  |
|  | T6-T10 | (T10)<br>T11-L1<br>(L2) | T11-L2 | T6-L2 |  | T6-L1 |  | T11-L2 | T6-L1 | T6-L1 |  |

*Figure 8.* A summary of viscerosomatic referral zones according to segmental nerve distribution *(Beal, 1985).*

The research demonstrates that dysfunction in thoracic cavity organs is reflected in the lower cervical to upper thoracic vertebrae, abdominal organs through the mid-thoracic vertebrae, large colons via the lower thoracic vertebrae, and pelvic cavity organs through the lumbar and sacral regions. In addition to changes in spinal segments, Korr, Larson, and Eble found that continuous hyperirritability of stimulated viscera is reflected in altered muscular activity, leading to changes in the texture of muscles, paravertebral tissues, connective tissue, and skin, along with temperature variations (Beal, 1985; Eble, 1960; Korr, 1947; Larson, 1976). The location of the muscular response also varies depending on the stimulated organ (Beal, 1985; Eble, 1960). Additionally, Kelso's examination showed that many visceral diseases exhibit multiple areas with more segmental findings (Kelso, 1971). It was also noted that unpaired organs would likely show more findings on one side (Kelso, 1971). Furthermore, the extent of affected spinal segments correlates with the disease duration, and reflex patterns may intensify over time (Beal, 1985). Common physical stress responses are seen in acute cases, while chronic cases may show increased muscle contraction, skin thickening, and hypersensitivity (Beal, 1985).

From history, one might assume irrefutable evidence supports palpation as a diagnostically valuable tool for identifying direct visceral dysfunctions. However, this assumption is not currently substantiated. The ability of manual therapists to accurately identify true visceral dysfunction remains controversial. This may be due to studies that have found significant associations between spinal TART (Tissue, Asymmetry, Restriction, Tenderness) dysfunction and visceral dysfunction, yet the absence of standard control groups makes it challenging to establish meaningful relationships between specific visceral abnormalities and somatic dysfunction in various body regions. As a result, these studies are considered to be inadequately researched.

Moreover, somatic dysfunction can create overt signs and symptoms that mimic or simulate internal organ disease, even though the source may be elsewhere in the body (Nansel, 1995). For example, in a horse, a fascial line runs from the stifle to the kidney on the same side. If dysfunction originates at the stifle, it can lead to restrictions in the fascia that extend up to the lower back, which may also cause a pain response in this area. This restriction may hinder the proper movement of the kidneys, leading to an abnormal dysfunction in visceral movement. However, the root cause of this dysfunction would be the stifle, not a visceral disease. Although there may not be a neurological explanation for the stifle's impact on the vertebrae, there is a valid fascial reason for this connection.

Additionally, strains in the connective tissue of the viscera can result from various factors, including surgical scars, adhesions, illnesses, posture, or injury. These strains lead to tension patterns within the deep fascial network of the body, which can create far-reaching effects and necessitate compensatory mechanisms. This compensation produces fixed, abnormal points of tension that the body must navigate around, and the resulting chronic irritation can lead to both functional and structural issues, potentially simulating organ disease.

Somatic responses to visceral disease can also vary uniquely among individuals. These include the location and number of spinal segments involved, the intensity of muscle contractions and tissue changes, pain levels, and whether the involvement is unilateral or bilateral (Beal, 1985). There are also phenomena that science cannot fully explain. This may be why several theories correlating somatic dysfunction patterns with visceral dysfunction have been proposed in an attempt to elucidate the possible mechanisms behind patients presumed to be suffering from various internal organ diseases.

Consequently, the osteopathic profession emphasizes a holistic approach, viewing the patient as a dynamic unit where disturbances in the somatic system can have local and distant effects. Thus, considering the concepts of viscerosomatic and somatovisceral interactions are key elements that reinforce this holistic perspective.

### 3.0.2 Osteopathic Approaches to Treatment

Differentiating somatic and visceral dysfunction is challenging for osteopathic physicians and manual therapists, with ongoing debate about its clinical relevance. While simplistic cause-and-effect models are often criticized, it may be wise to stick to osteopathic principles until more substantial evidence is available, despite the anatomical connections between somatic dysfunction and visceral organs. Arguably, manual therapy can be divided into two primary conceptual approaches: 1) specific adjustments to correct anatomical or biomechanical issues that affect function through established musculoskeletal or nerve compromises, and 2) specific adjustments intended for physiological regulation that may involve alterations in internal organ function.

Musculoskeletal issues are common patient complaints in osteopathy and can be either a primary issue or a secondary effect of other conditions. How these treatments are applied involves an understanding of various specialties and integrating OMT methods, enabling practitioners to see the body as a complete entity. Among the multiple approaches, the Cranial Sacral method involves practitioners who believe they can feel and influence the intrinsic rhythmic movements of the brain, which leads to fluctuations in cerebrospinal fluid and specific changes among dural membranes, cranial bones, and the sacrum (Guillaud, et al. 2016). However, the structural approach is arguably the most widely recognized aspect of osteopathy for addressing musculoskeletal issues, focusing on the musculoskeletal system to correct structural problems in joints, muscles, and tissues through techniques such as massage, stretching, and manipulation.

Low back pain is commonly seen in horses, and specific treatment methods have been shown to manage biomechanical disorders of the spine and alleviate pain effectively (Haussler et al., 2021). A study examined the effects of musculoskeletal mobilization in horses suffering from disease-related back pain, measuring thoracolumbar pain sensitivity, trunk stiffness, spinal reflexes, joint range of motion, thermographic imaging, and muscle hypertonicity. The results indicated low to moderate-quality evidence that structural manipulation could alleviate pain, stiffness, and muscle hypertonicity. However, among actively competing horses with acute back pain, using a precision thrust technique alone proved less beneficial than combining various structural treatment methods (Haussler et al., 2021). Therefore, osteopaths often employ additional assessment and treatment approaches to enhance patient outcomes.

Core osteopathic principles emphasize that an integrated approach to patient evaluation and treatment involves understanding structural connections between the viscera and the musculoskeletal system. In the past fifty years, newer treatment modalities focusing on assessing and managing visceral organs have emerged (Guillaud et al., 2018; Roberts et al., 2022). While structural OMT significantly influences internal organ function by manipulating the musculoskeletal system, Osteopathic Visceral Manipulation (VOMT) specifically addresses the functioning of visceral organs and their surrounding environments. This technique can impact structural and physiological dysfunction across various body systems, including the musculoskeletal, vascular, nervous, urogenital, respiratory, digestive, eliminatory, neuroendocrine, and lymphatic systems (The Barral Institute, (n.d.)). Research on VOMT in animals remains limited, but many human studies have been conducted that could also inform practices with animals. Evidence suggests that visceral techniques have a positive effect on conditions such as irritable bowel syndrome, constipation, and gastroesophageal reflux (Fleischmann et al., 2020; Ignatowicz et al., 2017; Lotfi et al., 2023; Snider et al., 2016). Additionally, research has explored the impact of visceral techniques on musculoskeletal issues like low back pain, concussion, pregnancy-related back pain, and cervical spine pain (Franke et al., 2017; Horton, 2015; Tamer et al., 2017; Verhaeghe et al., 2018; Wetzler et al., 2017).

Each of the osteopathic treatment approaches show benefits for somatic dysfunction when applied individually. Still, their combined use, especially with an emphasis on visceral function, has significantly enhanced outcomes in pain relief, physical functionality, and overall health. A study by Tamer, Oz, and Ugler evaluated the effectiveness of OMT against VOMT for chronic non-specific low back pain (Tamer et al., 2017). The results suggested that OMT influences corticospinal changes related to somatic function and pain by altering the sensitivity of reflex pathways due to biomechanical stress on muscle spindles. This response quickly reduces pain, aligning with the gate control theory (Dickenson, 2002). Moreover, research on VOMT revealed that muscle contractions between the thoracic vertebrae and the lumbosacral joint occur due to internal organ stimulation (Tamer et al., 2017). Thus, the added stimuli from visceral applications may assist in easing spasms in associated segments and modulate both peripheral and central pathways through the visceral-somatic reflex arc, promoting healing. Utilizing VOMT techniques alongside visceral interventions improved blood and fascial circulation, aided in removing bodily fluids, and boosted overall energy levels, leading to favorable physiological changes (Tamer et al., 2017). Therefore, when examining the relationship between visceral function, fascial limitations, and musculoskeletal dysfunction, the integrative approach of OMT paired with a focus on VOMT proves beneficial.

## Conclusion

In conclusion, the various influences on somatic findings indicate that facilitation, recruitment, variation in visceral-afferent innervation, and learning physical signs should be part of osteopathic theories of disease. Recognizing the connection between somatic dysfunction and visceral disease is essential for a holistic approach to patient care. The interplay of viscerosomatic reflexes highlight how issues within internal organs can lead to physical manifestations, guiding practitioners to pinpoint underlying health concerns. Practitioners can enhance treatment effectiveness and improve patient outcomes by conducting thorough assessments and employing various osteopathic techniques focused on visceral health. Embracing these principles reinforces the commitment to patient-centered care and aligns with ongoing research to deepen our understanding of complex health challenges. Ultimately, combining visceral techniques into OMT promotes a comprehensive view of the body as an interconnected system, optimizing patient care.

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