Osteopathy and Canine Tail Biomechanics

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Introduction

The purpose of this paper is to address the importance of the canine tail not only in terms of biomechanics, but overall wellbeing, and how osteopathic modalities can be applied to reduce the incidence of tail docking or other procedures that may have a negative impact on the canine's overall function. The author is a kinesiologist who specializes in pain management for humans and has a vested interest in researching best practices with regard to the difference in biomechanics of bipedal humans and quadrupedal canines, with special interest in a structure not found in humans, the canine tail.

First a review of the history of osteopathy and its application in humans will be discussed, followed by the anatomical and biomechanical difference in humans and canines, with an emphasis on the canine tail and the myofascial lines that affect tail biomechanics. Lastly, the relevance of animal osteopathy will be addressed as a treatment modality to reduce fascial restrictions and restore function.

History of Osteopathy

Osteopathy is a modality that was first introduced by Dr. Andrew Taylor Still in the late 1800s as a means to treat the cause of dysfunction rather than the symptoms that result from it. Still's osteopathic approach is based on four main tenants; the body functions as a whole, there is a direct correlation between structure and function, the body is capable of self-regulation and self-healing (under the proper conditions), and circulation of fluids is necessary for the removal of waste products and transportation of oxygen and nutrients to damaged tissue. While this logic may seem obvious to some practitioners, the implementation of osteopathic modalities is still somewhat controversial, but is becoming more mainstream in both human and animal health and wellness practices.

A 2018 study from St.Petersburg Russia noted the efficacy of Osteopathic Manual Therapy (OMT) in the "prevention, diagnosis, treatment, and rehabilitation…not only for chronic, but acute pain in the spine" (Potekhina, Tregubova, & Mokhov, p.561-562, 2018). This study further notes that OMT resulted in significant pain reduction and improved range of motion over both short and long-term follow ups, one month to one year respectively, leading to a reduction in pain medication by participants, as well as improved function and recovery time in post-operative patients. The authors noted a reduction in blood and serum cytokines in participants receiving OMT versus the control group, reducing inflammatory response throughout the lymphatic system and musculoskeletal systems (Potekhina et al., 2018)

In order to understand how osteopathy can help rehabilitate and maintain proper biomechanics in canines, we must first break down the anatomical difference between a bipedal human and quadrupedal canine, with the canine tail being one of the most obvious and significant differences.

Canine Tail Anatomy and Biomechanics

The human coccyx is often referred to as the tailbone, as it is the remnant of our primate ancestor's full-length tail, which continued to diminish throughout bipedal evolution. The coccyx is located at the base of the spine, consists of three to five vertebrae, articulates with the sacrum, and acts as an attachment point for several important pelvic floor muscles. The pelvis as a whole is certainly an important structure to provide stability for balance during locomotion and force transmission between the upper and lower body, and the coccyx does play an important role in weight distribution, posture, and pelvic floor function. However, damage to the coccyx in humans, while painful, does not have the same detrimental effects as damage to the canine tail.

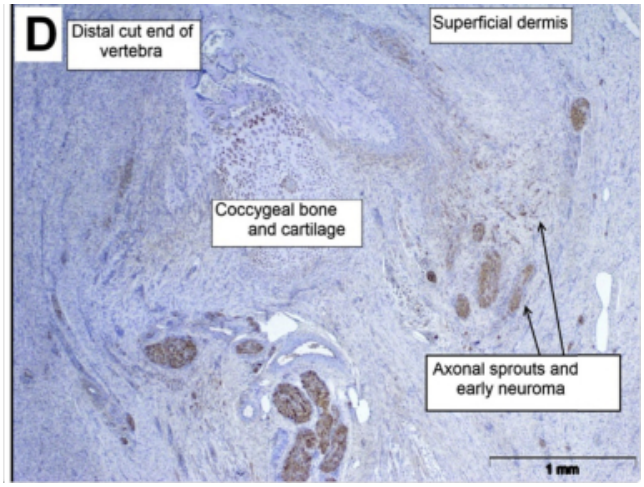
The anatomy of the canine tail differs from breed to breed and can include up to 23 vertebrae. Numerous vertebrae provide the animal with an abundance of mobility for various functions including; non-verbal communication with their owners and other canines, stability during various movements to maintain balance, expression of mood, insulation from the cold, scent marking, and rudders for swimming (Koss, 2024). Because the tail is as crucial to canine function as any of the limbs, comprehensive knowledge of canine tail anatomy is vital to any practitioner in order to properly assess and treat dysfunctions to alleviate pain and restore proper biomechanics.

Tail biomechanics are controlled by the medial and lateral sacrocaudalis muscles located on the dorsal and ventral aspects of the body (IVALA Learn), are innervated by up to seven pairs of nerves (Koss, 2024), and supplied oxygen and nutrients via the coccygeal arteries which branch off of the internal pudendal artery (Sciedge, 2026). Injury to, or impairment of, any one of these structures can lead to an inflammatory response that could cause pain in the animal and lead to compensation that may alter movement and affect other areas of the body.

These effects can be seen in canines who have been subjected to tail docking, whether for medical or aesthetic purposes. Tail docking is a procedure in which the length of the tail is surgically shortened or removed entirely, historically performed proactively on hunting and herding dogs to prevent injuries (Muse, 2025). Veterinarian Dr. Jamie Whittenburg states "Removing a dog's tail can affect its communication and hinder the ability to express and convey emotions. I believe that tail docking is an unnecessary and cruel cosmetic procedure that negatively impacts dogs…deeming it medically unnecessary and a cause of pain and distress for the dog (Muse, 2025).

Furthermore, Mellor (2018) concludes that “tail behavior is so embedded in canine communication that docking can markedly impede unambiguous interactions between different dogs and between dogs and people…[including] the expression of wide ranges of both negative and positive emotions, moods and interactions that are of daily significance for dog welfare” (p2). Mellor (2018) also concluded that tail docking results in increased sensitivity to pain as well as chronic and persistent pain in canines, referring to docking as the "unnecessary removal of a necessary appendage” (p3).

One of the most concerning effects of docking is the development of neuromas, a bundle of nerve fibers that adhere to the surrounding connective tissue when the nerve attempts to regenerate, creating an area of swelling that is often very sensitive to palpation. While humans can verbally express this sensation to their physician to obtain relief, canines rely on non-verbal communication, which is increasingly difficult with a compromised or missing tail. Unfortunately, the chronic pain of neuromas often results in self mutilation and complete amputation in canines (Mellor, 2018).



While the adverse effects of cosmetic tail docking can be completely avoided, what is the best practice to treat medically necessary docking or alterations to the canine tail due to injury or

disease? Dr. Whittenburg noted that one of the more common injuries in canines occurs when they wag their tail with excitement in close proximity to a hard object like a wall, leading to the tail splitting open or vertebral fractures (Muse, 2025). Injuries of this nature can result in nerve pain and open wounds that make the area vulnerable to infection. It is in the more severe cases in which the wound is unable to heal due to constant movement of the tail that docking is considered a reasonable treatment option (Muse, 2025).

From an osteopathic perspective how can this detrimental procedure be avoided utilizing a holistic approach? The answer may be in treating one of the most important structures in the body, fascia. Increased interest in the role fascia plays in human biomechanics has sparked research into the effects of canine and equine fascial biomechanics.

Myofascial Lines in Canines

The importance of fascia has gained recognition over the years for both athletic training and performance, as well as rehabilitation. Thomas Myers identifies ten fascial lines that support human biomechanics, and recently eleven myofascial lines were reported in horses (Elbrønd, 2024). Further research by Elbrønd revealed three distinct fascial lines not present in human or equine subjects; the superficial dorsal, ventral, and lateral lines. Before we attempt to understand the significance of these fascial lines we must first have working knowledge of what exactly fascia is.

While it was initially thought that fascia was simply just connective tissue that surrounded the muscles, bones, and organs to help keep these structures in their designated space within the body, recent research has discovered that it is a much more complex network that affects the entire body, both structurally and functionally. Fascia is described as viscoelastic connective tissue that can withstand high tensile loads due to its tightly woven and irregular

arrangement, while fascial planes are described as looser bands of connective tissue that permit gliding between fascial layers for mobility (Langevin, 2021). Some fascial layers have been found to provide sensory feedback for proprioception as well as nociceptive feedback in response to inflammation (Langevin, 2021). This implies that fascia likely plays a much more important role in movement asymmetries and compensation patterns than current assessment and treatment modalities consider. "Although we do not have a detailed map of the somatosensory areas of the brain that process sensations from fasciae, they play an important role in the overall sense of 'inner body awareness' that involves brain areas linked to emotions, such as the insula and cingulate cortices" (p. 4).

In addition to sensory awareness, fascia provides a full-body network of incredibly strong tissue fibers that can transmit mechanical force generated by muscle contractions to surrounding tissues. While tendon fibers are arranged in a linear fashion to efficiently transmit force from muscle to bone to alter the position of a joint, the irregular three-dimensional arrangement of fascial fibers results in a greater transmission of force to surrounding muscles (Langevin, 2024). "Current research shows that more than 30 percent of the force generated from the muscle is transmitted not along the tendons as previously thought, but rather by the connective tissue within the muscle and fascia, and both of these contain mechanoreceptors and proprioceptors. When a muscle is in use, the fascia that is connected to spindle cells stretches. The normal stretching of fascia communicates the force of the muscle contraction and the status of the muscle regarding its tone, movement, rate of change in muscle length and position of the associated body part to the central nervous system (CNS)" (Broadhurst, 2019 p.17).

Therefore, it can be inferred that the health of fascial tissue has a significant impact on overall biomechanics. Tissue that is too loose will be unable to generate force transmission

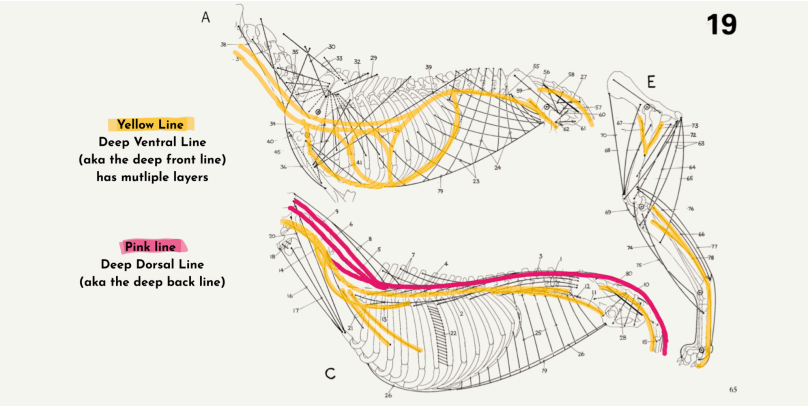
efficiently, and often results in hypermobility and joint instability that lead to injuries. Tissue that is too tight will restrict mobility, which often leads to chronic pain (Langevin, 2024).

We can now take a deeper dive into fascial lines to better understand the effect they have on overall body mechanics in canines. Histological examination by Ahmed et al. (2019) of fascial tissue found canine and human fascia exhibited more similarities to each other than that of equine and canine fascia. Horses are larger prey quadrupeds that rely on dense, stiff layers of fascia to provide stability to the body during endurance movements like galloping to evade predators, whereas canine and human fascia is looser to provide the mobility and agility necessary to change direction quickly for hunting.

Ahmed et al. (2019) further examine the difference between the superficial and deep layers of fascia in terms of sensory and motor function. The superficial layer is correlated with exteroception, aiding in the understanding of one's surroundings, while the deep layer is correlated with interoception in order to maintain homeostasis. As previously mentioned, Elbrønd (2024) noted three superficial fascial lines present in canines that are not present in human or equine studies, all of which function to provide increased mobility for predation. However, the three fascial lines to be investigated for the purpose of this paper include the Deep Dorsal Line (DDL), Deep Ventral Line (DVL), and Deep Lateral Line (DLL), all of which have a connection to the tail.

The DDL originates at the tip of tail, runs along the full length of the vertebral column, and terminates at the occiput, functioning as a stabilizer and extensor of the spine. The DLL extends to the tail via the superficial gluteal myofascia which connects to the intertransverse muscles of the vertebrae. This line aids in lateral flexion and balance. The DVL is the most complex of the three “due to its 3-dimensional flow and numerous branches into myofasciae and

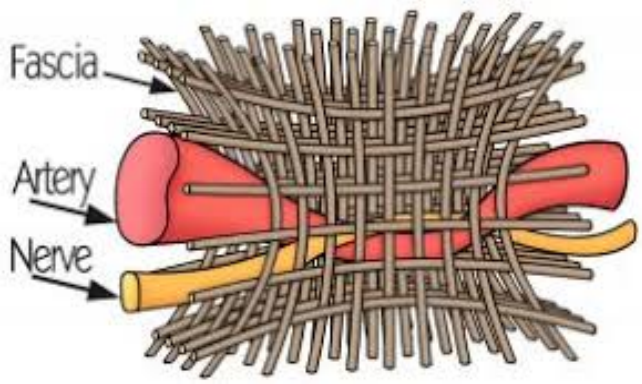
‘organ skeletons’ connecting to the somatic and visceral nervous system” (Elbrønd, 2024 p.251). The DVL plays a vital role in canine biomechanics to support spinal flexion, however the connection of this hypaxial fascia in and around the diaphragm is also of significant importance to canine wellbeing. “The diaphragm is central to the DVL due to its specific topography, which is the transverse septum in the body, and its role in encompassing vital structures transitioning from the thoracic to abdominal cavities. An important aspect is the overlap and interaction between the diaphragmatic crura and psoas muscles, establishing a ‘transitional zone’ of the trunk that biomechanically represents the transition of the spinal movements between the lumbar and thoracic regions, the anticlinal region. In the dog, this zone is specifically designated to one vertebra, the 10th thoracic, which possesses a high flexibility and biomechanical vulnerability" (Elbrønd, 2024 p.251). The complexity of the fascia of the DVL can not only impact locomotion of the spine and limbs, but affect autonomic functions such as respiration, heart rate, and digestion.



Osteopathic Effects on Fascia

In addition to scar tissue, previously mentioned neuromas are one of the more common impediments that can occur during the healing process due to trauma to the tail, whether from intentional docking or unintentional injury. In both cases, the fascia heals in a way that creates

tension and restricted movement. Fascial tissue is designed to allow surrounding structures like nerves and tendons to glide and stretch during locomotion, however neuromas and scars greatly hinder tissue mobility. “There is a strong hypothesis that impeded sliding of a nerve between its various layers and tissues that cross its fascial system will generate local and dysesthetic pain…Repetitive elongation of a nerve with reduced fascial elasticity properties brings about further inability of the nerve to slide, decreasing blood flow and likely leading to ischemic problems” (Bordoni & Bordoni, 2015 p.737). Bordoni & Bordoni’s investigation into the effects of osteopathic application to a localized area of peripheral nerve pain with a “low-load, long duration stretch” demonstrated favorable outcomes with regard to reduced inflammation and pain, noting that “improved sliding of the various fascial layers would allow resettling of the afferents of the free nerve endings, resulting in a physiological response of the efferents” (p739). The intention behind this type of approach is to alter the density of the fascia and return it to its more natural viscoelastic state, allowing it to better respond to the mechanical stress of locomotion.



A combined osteopathic approach utilizing both direct techniques, like Osteopathic Articular Balancing (OAB), and indirect techniques, such as Functional Technique are ideal for treating fascial restrictions in the tail that can have a global effect on both the somatic and autonomic nervous systems. OAB is a direct technique that evaluates the quantity of movement

by working through a joint's range of motion, while FT is an indirect technique that can be utilized to improve the quality of movement by accessing the "position of ease" to release tension, reset neural function, and reestablish structural integrity.

This approach offers not only a means to properly assess biomechanics, but a treatment application that ensures the causative source of pain and dysfunction are addressed. Correcting the structural alignment of a joint can alleviate tension on the surrounding soft tissue, reduce swelling which may impede blood flow and circulation of lymphatic fluid, as well as restore sensory and motor function by reducing compression on the nerves. As osteopathic practitioners it is imperative to understand how our approach to assessment and treatment can positively or negatively impact our patients' wellbeing. Treatment of the symptom can offer temporary relief, but cause more harm long-term by allowing the patient to continue their normal activities without the structural integrity to support locomotion, potentially leading to progression of the initial injury. An osteopathic approach on the other hand takes into consideration the systemic effects of pain and injury in one area on the entire body, thoroughly evaluates the body head to toe, and treats the root cause of the dysfunction, rather than just the symptom.

Another relevant aspect to rehabilitation and success of recovery to consider is the biopsychosocial perspective. Tail injuries that result in altered mechanics of the pelvis and/or hind limbs can affect somatic functions such as gait and posture, as well as physiological functions of the urogenital and reproductive systems, making the animal more reliant on their owner during the recovery process. Thomovsky & Ogata (2021) noted that psychological factors such as depression and anxiety, as well as a lack of social support from family and friends were statically significant barriers to the success of a patient's recovery in human models. The authors then examined this model from a canine perspective and found a similar correlation with regard

to the psychological effects that physical limitations can have on the success of recovery, noting a lack of independence as a limiting psychological and physical factor. Modern domesticated canines evolved from wolves in the wild, with a pack mentality and hierarchy that thrived on structure and consistency. Injuries can lead to pain, loss of function, and altered routines that dogs rely on to feel safe in their environment, therefore any altered physical capability could easily lead to altered mental state and behavior. All of these factors need to be considered during the assessment and treatment process to ensure optimal results. Implementation of a flag system was recommended by Thomovsky & Ogata (2021) in order to ensure all aspects of the patient's recovery were considered in an objective manner. This system allows the practitioner to consider every aspect of the patient's recovery in order to customize a rehabilitative treatment plan for that dog's specific needs.

Color flag	Description of the dog
Red	Biological perspective–Poor neurologic status (example, lacking deep pain sensation on examination to the pelvic limbs, tail, and/or perineum)
Orange	Behavioral and cognitive perspective–Patients who appear depressed or lack motivation. Those who do not participate during physical rehabilitation. Those for which there are no obvious ways to provide motivation (example patient is not food motivated)
Yellow	Behavioral and cognitive perspective–Patients who suffer from behavioral issues (separation anxiety, aggression, or destructive behavior) that prevent them from focusing on exercises or participating in PR. The same issues are further compounded by immobility. Meaning, the lack of mobility in patients who have underlying anxiety may lead to further frustration, depression, or poor motivation
Black	Social perspective–Owners lack the financial ability to have physical rehabilitation performed by a rehabilitation professional. Owners are unwilling to perform the necessary at-home PR exercises

The five osteopathic models of health; Biomechanical, Neurological, Behavioral, Respiratory/Circulatory, and Metabolic encompass all aspects of canine wellbeing, which makes an osteopathic approach to rehabilitation ideal in situations such as tail injuries that have a

profound effect not only the physical body, but a canine's ability to communicate their mental and emotional state to humans and other canines.

Conclusion

Fascia is a unique and complex structure that literally connects everything in the body, including the integumentary, musculoskeletal, nervous, respiratory, digestive, cardiovascular, and lymphatic systems. Restrictions in the fascial connections in one area of the body, such as the canine tail, can have negative systemic effects on the body's somatic and autonomic functions.

While further research into canine myofascial lines is warranted, it is clear that the health of fascial tissue has a profound effect on how the body functions as a whole, connecting head to tail, limb to limb, and providing intrinsic and extrinsic feedback between the body and nervous system. The three deep fascial lines discussed in this paper and their specific connection to the canine tail provide a unique insight into biomechanics not seen in human or equine fascia. The tail is not simply an accessory structure, but a vital appendage for communication and survival in canines. Through the application of osteopathic modalities, practitioners can have an immediate and long-lasting effect on locomotion, proprioception, inflammatory response, and pain reduction for their canine patients. This intervention could reduce or eliminate entirely the need for surgical tail docking or other tail alterations, allowing the dog to maintain full function and preventing life-long pain and potential behavioral issues related to miscommunication with humans and other canines.

A holistic approach such as osteopathy is an ideal modality to address the numerous body systems that can be affected by fascial restrictions. Animal osteopathy was curated in such a way from classic OMT to address the specific biomechanics of quadrupedal animals like dogs

and horses, compared to bipedal humans. Additionally, the five osteopathic models of health provide a detailed blueprint for practitioners to thoroughly evaluate a canine's wellbeing from multiple perspectives and curate a tailored treatment plan for that dog's particular needs to achieve the best possible outcome.

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