

# **The role of fascia in the pelvic diaphragm in small animals: comparative anatomy, fascia, and clinical application from an osteopathic perspective**

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## **Index**

### **1. Introduction**

- 1.1 Brief overview of osteopathy in animals
- 1.2 Importance of fascial systems in osteopathy
- 1.3 Define pelvic diaphragm in animals and relevance of study

### **2. Comparative anatomy of the pelvic diaphragm in dogs, horses, and humans**

- 2.1 Pelvic diaphragm in dogs
- 2.2 Pelvic diaphragm in humans
- 2.4 Fascial structures involved in the pelvic diaphragm

### **3. Clinical dysfunctions of the pelvic diaphragm in dogs**

- 3.1 Conditions that can affect dogs
- 3.2 Contributing factors: posture, trauma, spay/neuter, aging

### **4. Osteopathic manual techniques and their application in dogs and cats**

- 4.1 Osteopathic principles in manual fascia
- 4.2 Specific techniques used in osteopathy of the pelvic area

### **5. Conclusion**

### **6. Bibliography**

## **1. Introduction**

### **1.1 Brief overview of osteopathy in animals**

Animal osteopathy is a complementary manual therapy based on the same principles as human osteopathy. It seeks to improve physiological function and restore mobility in the musculoskeletal, fascial, and visceral systems through precise manual techniques. The core osteopathic belief is that structure and function are interrelated and that the body possesses inherent self-regulatory and self-healing mechanisms (Bordoni et al., 2020). In veterinary applications, osteopathy is primarily used to manage musculoskeletal dysfunctions, chronic pain, postural imbalances, and functional disorders in dogs, horses, and other species (Bordoni & Marelli, 2020).

In clinical practice, animal osteopathy is often integrated with conventional veterinary care and physiotherapy, especially in rehabilitation and performance medicine. Manual osteopathic techniques (OMT), such as myofascial release, craniosacral therapy, and visceral manipulation, are adapted to each animal species and condition (Bordoni et al., 2020).

### **1.2 Importance of fascial systems in osteopathy**

Fascia plays a central role in osteopathic philosophy, functioning as a continuous, adaptable connective tissue network that envelopes and links muscles, bones, organs, vessels, and nerves. It facilitates communication across different systems and contributes to force transmission, proprioception, and structural integrity (Schleip et al., 2012).

According to Bordoni (2020), the “five-diaphragm model” in osteopathy conceptualizes the fascial system as a continuous, interconnected chain linking key horizontal anatomical structures: the pelvic diaphragm, thoracic diaphragm, thoracic outlet (cervicothoracic diaphragm), the tongue and floor of the mouth (oral diaphragm), and the tentorium cerebelli (cranial diaphragm). These diaphragms are functionally and structurally connected through fascial, neurological, and

circulatory pathways, allowing compensations or dysfunctions in one region to affect the others (Bordoni & Morabito, 2020; Tozzi, 2015). This model supports a global, integrative approach in osteopathic assessment and treatment, emphasizing the importance of fascial continuity in restoring physiological balance.

This concept supports the osteopathic approach that restoring tension balance and mobility in one diaphragm, such as the pelvic diaphragm, can have cascading effects on posture, breathing, and organ function (Bordoni & Marelli, 2020). In animals, although the five-diaphragm model has not been explicitly validated, its clinical relevance is increasingly being recognized, particularly in complex cases involving spinal or visceral dysfunction (Bordoni, 2020).

### **1.3 Define pelvic diaphragm in animals and relevance of study**

The **pelvic diaphragm**, also known as the pelvic floor, is a musculo-fascial structure forming the caudal boundary of the pelvic cavity. In dogs, it primarily consists of the levator ani, coccygeus, and associated fasciae, which provide support to the rectum and pelvic organs, and assist in tail movement and continence (Ibrahim et al., 2021).

According to the anatomical study by Ibrahim et al. (2021), in the male dog, the levator ani muscle originates from the medial edge of the ilium and pelvic symphysis, inserting around the rectum and blending with the external anal sphincter. The coccygeus muscle lies lateral to the levator ani and originates from the ischial spine, inserting on the first few caudal vertebrae.

Both muscles are ensheathed in deep pelvic fascia, which merges dorsally with the sacrotuberous ligament and ventrally with the internal obturator fascia. These fascial components form an elastic, supportive network that maintains pelvic organ position and contributes to intra-abdominal pressure regulation (Ibrahim et al., 2021).

In animals, the integrity of the pelvic diaphragm is crucial for defecation, micturition, locomotion, and tail dynamics. Disruption—whether through trauma, aging, neurological injury, or surgical intervention—can lead to dysfunctions such as perineal hernia, urinary incontinence, or altered gait (Silva et al., 2023).

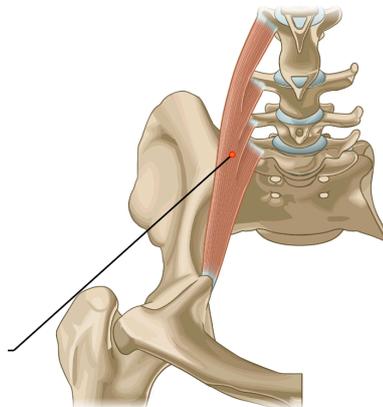
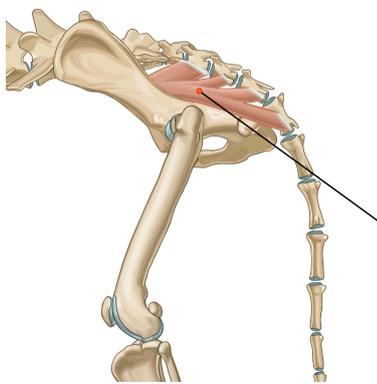
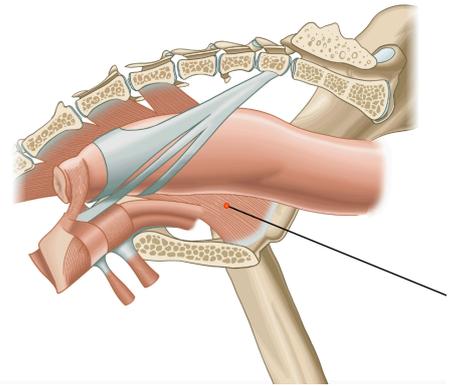
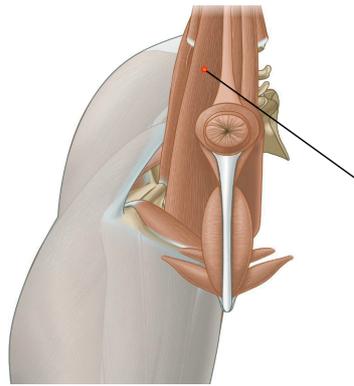
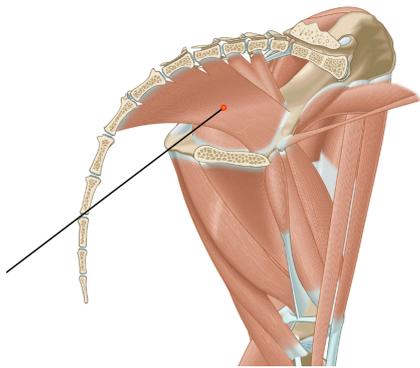
Understanding this anatomy and its fascial interconnections is essential for developing osteopathic strategies aimed at restoring function, reducing tension, and supporting healing processes.

## 2. Comparative anatomy of the pelvic diaphragm in dogs, horses, and humans

### 2.1 Pelvic Diaphragm in Dogs

In dogs, the **pelvic diaphragm** forms the muscular and fascial closure of the pelvic outlet. It consists of two main paired muscles: the levator ani and the coccygeus, along with associated fasciae and supportive connective tissue (Ibrahim et al., 2021).

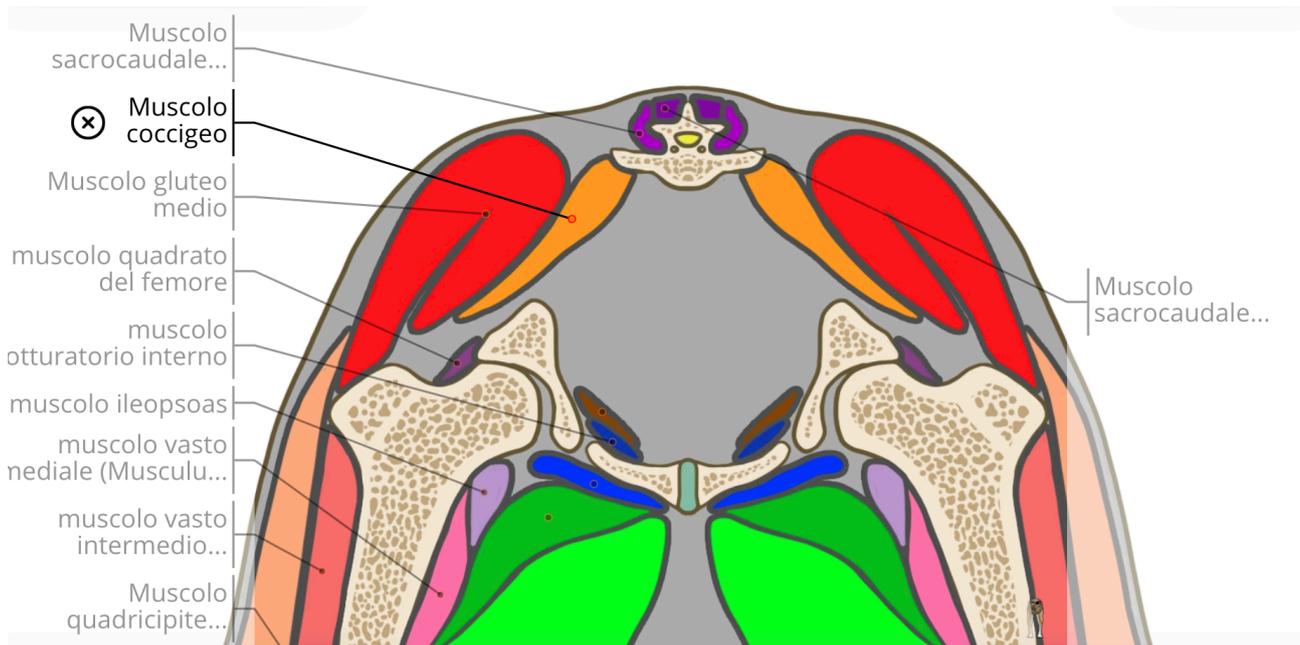
- The **levator ani muscle** in the dog originates from the medial ilium and pelvic symphysis, inserting around the rectum and contributing to the external anal sphincter.
- The **coccygeus muscle** is located lateral to the levator ani, arising from the ischial spine and inserting on the caudal vertebrae (Cd2–Cd4). It plays a key role in tail movement and defecation control.

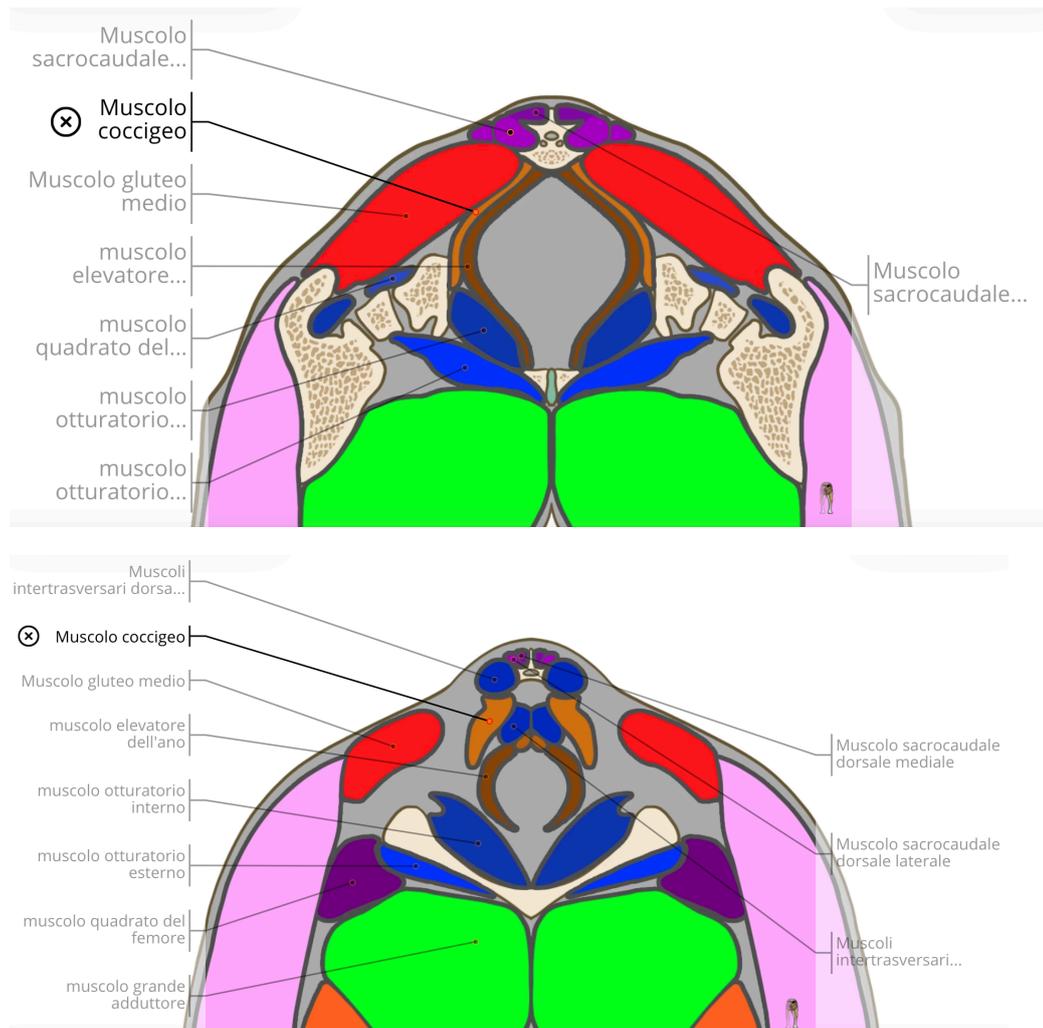


**Figure 1–3 (upper row):**  
Anatomical illustrations of the  
**levator ani muscle**

**Figure 4–5 (lower row):**  
Anatomical views of the  
**coccygeus muscle.**

*Images sourced from IMAIOS  
Web Anatomy.*



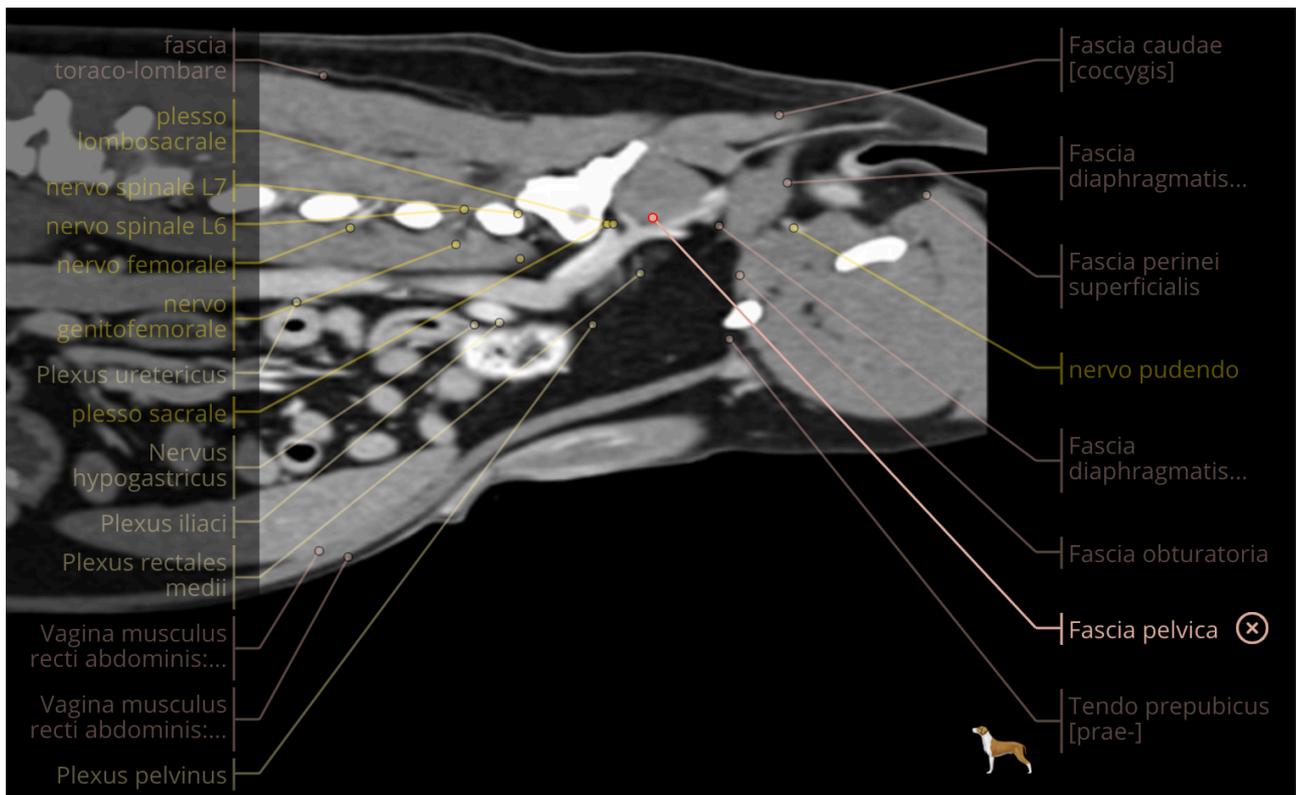


**Figure 6 (upper row):** Anatomical illustration showing the spatial relationships between the levator ani muscle (*brown*) and the coccygeus muscle (*orange*), emphasizing their relative positions within the canine pelvic diaphragm.

**Figures 7–8 (middle and lower row):** Anatomical views of the coccygeus muscle (*orange*), illustrating its orientation from the second to the fifth caudal vertebra (figure 6 progressing caudally to 7 and 8) and its role in forming the lateral boundary of the pelvic diaphragm.

*Images sourced from IMAIOS Web Anatomy.*

Both muscles are enveloped by deep pelvic fascia, which is connected dorsally to the sacrotuberous ligament and ventrally to the internal obturator fascia, forming a continuous myofascial support system for the pelvic organs (Ibrahim et al., 2021).



**Figure 9.** Sagittal CT anatomical section of a canine pelvis highlighting the fascial structures of the lumbosacral and pelvic regions and their spatial relationship with key components of the peripheral nervous system.

Visible fascial layers include the **thoracolumbar fascia**, **pelvic fascia**, **fascia obturatoria**, **fascia diaphragmatica pelvis**, and **fascia perinei superficialis**. These fasciae surround and compartmentalize pelvic organs and musculature, and provide support and anchoring points for neurovascular structures.

Major nerves and plexuses in proximity include the **lumbosacral plexus**, **sacral plexus**, **pudendal nerve**, **hypogastric nerve**, and **pelvic plexus**, demonstrating the close anatomical and functional integration between **connective tissue and neural pathways** in the pelvic region.

*Image source: IMAIOS Vet-Anatomy platform*

### **2.3 Comparison with Human Pelvic Diaphragm**

In humans, the pelvic diaphragm is composed of the levator ani group (pubococcygeus, puborectalis, iliococcygeus) and the coccygeus muscle. Like in dogs and horses, it supports pelvic organs, aids in continence, and stabilizes posture.

However, key differences exist:

- Bipedal posture in humans increases gravitational pressure on the pelvic diaphragm, requiring stronger muscular support.
- In animals like dogs and horses (quadrupeds), the pelvic diaphragm is oriented more horizontally, with less gravitational demand, but greater need for dynamic tail and hindlimb coordination.
- The levator ani in humans has a more defined and complex structure, including puborectalis, which contributes significantly to anorectal angle maintenance—less developed or absent in dogs (Bordoni et al., 2020).

Despite these anatomical differences, the myofascial continuity and neurological control of the pelvic diaphragm remain comparable across species, reinforcing the idea that osteopathic manual techniques, particularly fascial release, may have trans-species relevance when adapted appropriately (Bordoni & Marelli, 2020).

### **2.4 Fascial structures involved in the pelvic diaphragm in dogs**

The pelvic fascia in the dog is a complex, multilayered connective tissue system that envelops and compartmentalizes the muscles, nerves, and organs of the caudal abdomen and pelvic cavity. It serves both mechanical and neurovascular functions, offering support, suspension, and protection to

the pelvic contents, while maintaining functional continuity with the fasciae of the thoracolumbar and perineal regions.

In the sagittal CT section presented in *Figure 9*, key fascial layers and their anatomical relationships can be clearly visualized. The pelvic fascia comprises both parietal and visceral components, forming a continuum with several other fasciae:

The **pelvic fascia** proper is subdivided into:

- **Parietal pelvic fascia:** lines the walls of the pelvic cavity, covering the levator ani, coccygeus, internal obturator, and piriformis muscles. It is continuous dorsally with the sacral periosteum and laterally with the fascia obturatoria.
- **Visceral pelvic fascia:** envelops the pelvic organs (bladder, rectum, prostate/vagina), separating them from the muscular pelvic walls. It contains vascular and neural elements and connects ventrally to the pubic tendon (tendo prepubicus) and the deep perineal fascia (Ibrahim et al., 2021; Dyce et al., 2017).

The pelvic fascia acts as a suspensory and stabilizing structure for neurovascular bundles passing through the pelvic canal.

**The fascia obturatoria** covers the internal obturator muscle and extends medially toward the pelvic floor. It serves as an attachment for the parietal pelvic fascia, especially around the ischiatic arch, and helps form the ischiorectal fossa, a pathway for the pudendal nerve and internal pudendal vessels (Dyce et al., 2017).

**The pelvic diaphragm fascia** covers the levator ani and coccygeus muscles, which make up the muscular portion of the pelvic diaphragm. It is anchored dorsally to the sacrum and caudally to the

caudal vertebrae, and blends into the fascia perinei superficialis. It supports the rectum and contributes to the formation of the anal sphincter complex, particularly the external anal sphincter (Ibrahim et al., 2021).

**The superficial perineal fascia**, located caudally, this fascia forms part of the perineum, encasing superficial structures including the external anal sphincter, tail base, and perineal body. It is continuous with both the diaphragmatic pelvic fascia and the cutaneous lumbosacral fascia, contributing to the anchoring of the tail and perineal tissues.

**The fascia of the tail** covers the musculature of the tail, including the coccygeus and sacrococcygeal muscles, and connects to the diaphragmatic fascia and deep pelvic fascia, providing structural support to the tail base and assisting in tail mobility and continence control.

### **3. Clinical dysfunctions of the pelvic diaphragm in dogs**

#### **3.1 Conditions that can affect dogs**

The pelvic diaphragm plays a critical role in maintaining continence, supporting pelvic organs, and stabilizing the tail and perineum. Dysfunction of this structure can arise from trauma, neurological injury, surgery, or aging, and can be very frequent in veterinary rehab clinical practice.

*Incontinence* - Damage to the pelvic diaphragm or its innervation may lead to urinary or fecal incontinence. This is likely due to neurological lesions involving the pudendal nerve or pelvic plexus, affecting the external anal sphincter (Evans & de Lahunta, 2013).

Other causes could be related to Muscular atrophy of the levator ani in aging or post-partum females (Ibrahim et al., 2021) or spay-associated hormonal changes, reducing fascial tone and elasticity (de Bleser et al., 2011). Fascial dysfunction can interfere with pelvic pressure regulation, contributing to persistent incontinence (Bordoni & Marelli, 2020).

*Lumbosacral pain and posture* - The pelvic diaphragm integrates with the thoracolumbar fascia and plays a role in force transmission between the hindlimbs and spine. Fascial tension or muscular imbalance may contribute to lumbosacral and sacroiliac pain, particularly in active dogs (King et al., 2009). Altered posture, back stiffness, and tail dysfunction could be due to myofascial restriction.

*Tail trauma* - like tail pull injuries can damage the cauda equina or sacral nerves (S1–S3), leading to loss of bladder and anal tone, tail paralysis, coccygeus avulsion or fascial tearing (De Lahunta & Glass, 2009). This condition is particularly encountered in cats due to car accident or traumatic events. Tail deviation or perineal swelling may reflect deeper fascial or neural involvement.

*Rectal or anal disorders* - Conditions like perineal hernia, rectal prolapse, and maybe anal gland disease are often linked to levator ani or coccygeus weakness, especially in intact male dogs: Hormonal influences and chronic straining weaken muscular support (Hardie et al., 1983). Fascial laxity permits herniation of pelvic contents (Ibrahim et al., 2021).

*Post-traumatic and neurological weakness* - Pelvic trauma, IVDD, or sacroiliac injuries may cause: weakness of the pelvic floor muscles, loss of perineal reflexes, asymmetrical tail use or defecation issues. Healing often involves fascial fibrosis, which can entrap nerves and restrict movement (De Lahunta & Glass, 2009).

### **3.2 Contributing factors: posture, trauma, spay/neuter, aging**

Postural adaptations like pelvic tilt or hindlimb weakness, Spay/neuter-related that changes in fascial tension (de Bleser et al., 2011), aging or trauma can be determinant factors.

## **4 – Osteopathic manual techniques and their application in veterinary medicine**

### **4.1 Osteopathic principles in manual fascia**

Fascia is recognized as a key integrative structure connecting musculoskeletal, visceral, and neurological systems. In osteopathic practice, fascial dysfunctions are addressed using techniques aimed at restoring tissue mobility, modulating neural and vascular flow, re-establishing functional tensegrity of the pelvic and core system (Bordoni & Marelli, 2020; Chaitow, 2012)

These principles apply across species and form the basis for osteopathic manual therapy.

### **4.2 Specific techniques used in osteopathy**

#### **1. Osteopathic Articular Balancing (OAB)**

OAB is a low-force positional technique that corrects subtle joint and fascial misalignments by positioning the structure in a balanced tension point, allowing the body to self-correct. In patients with pelvic diaphragm affected, it can be applied to the sacroiliac joint, lumbosacral junction, and tail base in dogs and cats but in other species as well. OAB helps relieve compensatory tension in levator ani, coccygeus, and internal pelvic fascia. In humans ( less easy to do in animals) it is often combined with respiratory-assisted release

Balancing the SI joint in a dog with post-spay incontinence and sacroiliac strain could reduce strain on the pelvic floor fascia (Ibrahim et al., 2021; Bordoni & Marelli, 2020)

#### **2. Myofascial Release (Direct and Indirect)**

Direct MFR involves applying sustained pressure directly into fascial restrictions. It could be uncomfortable on certain conditions and on certain veterinary patients.

Indirect MFR gently follows the path of ease until a tissue release is felt. The fascia that could be targeted to apply this technique on a pelvic dysfunction could be the pelvic diaphragm fascia, the ischiorectal fossa fascia, the occygeal fascia and sacrotuberous ligament in dogs.

“Fascial continuity in the pelvic region influences visceral function, locomotion, and autonomic balance” – (Schleip et al., 2012)

### **3. Recoil Technique**

Recoil is a high-speed, low-amplitude impulse delivered after loading a tissue barrier. It is particularly useful in releasing deep fascial planes, stimulating neuromuscular reset and proprioception, enhancing autonomic balance in parasympathetically dominated areas like the pelvic diaphragm. This technique could be applied to the coccygeal region, the lumbosacral transition, the deep fascial planes between bladder/colon and pelvic wall. Recoil can be modulated according to tissue density and patient size (King et al., 2009; Chaitow, 2012)

### **4. Acupressure and Acupuncture Point Integration**

Acupressure on selected points can enhance osteopathic effects, especially in viscerosomatic reflex zones:

- **BL27–28:** Over sacrum, regulates pelvic organs
- **GV1 :** Between anus and tail base, harmonizes anal sphincter, good for continence
- **BL35:** Near coccygeus, supports local circulation and neural input
- **GB30:** For sacroiliac dysfunction and sciatic involvement

Combined fascial release with acupressure on BL27–28 supports pelvic autonomic rebalancing and may influence the hypogastric plexus (Xie et al., 2021)

## **5 - Conclusions**

The pelvic diaphragm plays a central role in the functional biomechanics, visceral support, and neuromuscular balance of canine patients. This thesis has explored its detailed anatomical composition, with special emphasis on the fascial system and its close proximity to key neurological, musculoskeletal, and visceral structures.

These integrated relationships help explain why dysfunctions in this region often manifest as urinary and fecal incontinence, lumbosacral pain, tail pull injuries, and postural imbalances.

The fascial architecture, in particular, stands out as a crucial connective interface—capable of transmitting forces, influencing proprioception, and modulating autonomic activity throughout the pelvic area.

Our investigation highlights how osteopathic manual techniques offer valuable therapeutic possibilities in addressing these dysfunctions. Approaches such as myofascial release, osteopathic articular balancing (OAB), recoil techniques, and both direct and indirect fascial strategies are increasingly being adapted for veterinary use.

These methods aim to restore tissue mobility, reduce mechanical restrictions, and enhance neuromuscular and visceral regulation—all through gentle, non-invasive manipulation of the connective tissue network. Additionally, integrating acupressure over relevant points may offer further benefits in modulating pelvic tone and autonomic function.

While these osteopathic techniques are well-documented in human medicine, their application in veterinary practice is still emerging. Careful anatomical adaptation, attention to patient positioning, and sensitivity to animal behavior are essential for safe and effective treatment.

The subjective nature of manual assessment and the challenges of compliance in animals remain limitations to be addressed.

Currently, the scientific literature on osteopathy and pelvic diaphragm dysfunction in dogs is limited, and much of the practice is based on anatomical plausibility compared to humans and clinical experience. However, the growing interest in integrative veterinary care presents an opportunity for further research.

Ultimately, osteopathy brings a valuable and complementary perspective to the diagnosis and management of pelvic diaphragm dysfunction in canine patients. Its focus on connective tissue dynamics, and its use of gentle, functional techniques make it particularly well-suited to cases that are chronic, complex, or resistant to conventional interventions.

Importantly, this approach offers a significant enhancement to the field of veterinary rehabilitation, where conditions such as incontinence, postural compensation, and pelvic weakness are frequently encountered. Osteopathy can definitely enrich the rehabilitative process and support the functional recovery and long-term well-being of patients.

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