Osteopathic Manual Therapy Effectiveness as a Treatment Option for Canines with Hip Dysplasia

Canine Thesis Research

Sonya Romanowski

Date: December 11 2024

London College of Animal Osteopathy

Table of Contents

Table of Figures

1.0 Introduction

Canine hip dysplasia (CHD) was first reported in the 1930's and in recent literature has been described as an inherited, non-congenital and multifactorial developmental disorder of the coxofemoral joint, particularly prevalent in large and giant breed dogs (Ginja et. al, 2010). Joint laxity, degeneration and osteoarthritis (OA) are the key elements identified with CHD. The condition affects essentially all breeds, with an estimated prevalence ranging from 1% to 80% depending on the breed according to the OrthopedicFoundation for Animals (Schachner, 2015).

With CHD being one of the most common diagnoses in medium to large breed dogs, common surgical and non surgical treatment protocols have been developed to reduce pain and facilitate mobility and strength (Schachner, 2015). In this paper, surgical techniques will be described. Additionally, the therapeutic effects and efficacy of manual therapy techniques will be examined with CHD. Limited research articles were found that specifically examined osteopathic manual therapy (OMT) techniques and CHD. The author of this thesis will outline the technique connections between OMT and the manual therapy techniques described in CHD research. To understand how manual therapy can help dogs with CHD, the pathophysiology, clinical testing, and diagnosis of CHD must first be examined.

2.0 Disease and Diagnosis

2.1 Pathophysiology

Canine hip dysplasia's exact etiology remains unknown but it is considered to involve both genetic and environmental sources. The laxity within the coxofemoral joint is understood to play a significant role for OA development due to repetitive subluxation and abnormal development of the acetabulum and femoral head (Dycus, 2017). Repetitive subluxation and

reduction leads to excessive cartilage damage to the dorsal acetabular rim. Synovial inflammation, osteophytes, and subchondral bone sclerosis and remodeling over time to the acetabulum and surrounding joint structures are thought to be one of the leading causes of OA with CHD (Dycus, 2017; Schachner, 2015).

In conjunction with genetic factors, lifestyle factors can exacerbate a genetic predisposition to hip dysplasia in dogs, especially during the puppy developmental stages. Improper nutrition and overweight puppies can increase the pressure put onto the canines' hips, which when predisposed to CHD, can increase the prevalence of the condition developing. With large to giant breeds, puppies have a relatively higher accelerated growth rate, which further stresses the coxofemoral joint when overweight. Activity levels also impact the developement of the canine's hips. Reduced levels of exercise can decrease the tonicity and strength of the muscles surrounding and attaching to the hips and pelvis. Excessive or incorrect play, such as young puppies exposed to stairs, or frantically chasing toys, increase the risk of developing hip dysplasia. Despite the recognized patterns of the joint degeneration characteristics of CHD, there is significant variability in the progression and severity of the disease, as well as inconsistent relationships between gross and radiographic joint changes and clinical signs (Dycus, 2017).

2.2 Testing and Clinical Signs

The vast majority of dogs show little to no clinical signs of canine hip dysplasia. The clinical presentation is very variable and sometimes does not correlate with joint morphological radiographic changes. Also for each canine the variety in the disease progression is prevalent and clinical signs can be due to other concurrent orthopedic and/or neurological concerns of the hind limbs (Ginja et. al., 2010). There are two common ages which dogs present with overt clinical signs of CHD:

1. Dogs younger than 1 years of age with hip instability and overloading of acetabulum and surrounding joint tissues causing pain.
2. Adult dogs with chronic pain from OA in the coxofemoral joints (Manley et al., 2007).

Typical clinical signs of CHD include gait abnormalities, such as back leg stiffness when walking, reduced height of step, bunny hopping, shortened stride length and difficulty in rising, climbing stairs or jumping over obstacles. Additional signs include, discomfort or pain with exercise, loss of muscle tone in the back legs or thighs, grinding of the joint during activity and lameness in the hind end (Ginja et. al., 2010). For a clinical diagnosis, veterinarians examine joint integrity, range of motion, signs of pain. Blood tests may be recommended to indicate inflammation as a result of joint disease. Gait analysis is also performed and the canine is observed at rest, walking and trotting. If possible, gait should be examined after vigorous exercise (Fry and Clark, 1992; Ginja et. al., 2010). Diagnostic orthopedic clinical tests are also used by veterinarians and the choice of tests used depend on the age of the canine.

For younger dogs, it is recommended to use special orthopedic testing such as the Ortolani, Bardens and Barlow tests, which will provide information on the severity of the coxofemoral joint laxity. Due to the tension placed on the hip joint, these clinical tests for CHD screening are done on sedated dogs as it can elicit discomfort and pain with the joint being manipulated past its normal end range of motion. For the adult dogs, palpation and range of motion tests are used to detect signs of osteoarthritis. Crepitus, a popping, clicking, or cracking sound of the joint, with passive and active movement and decreased range of motion, due to osteophytes, capsular fibrosis, subluxation or fixed luxation, may be detected during palpation of the hip joint with osteoarthritis and CHD. The normal range of motions (in degrees) of the canine hip joint are as follows (Fry and Clark, 1992; Ginja et al., 2010):

1. flexion 70–80
2. extension 80–90
3. abduction 70–80
4. adduction 30–40
5. internal rotation 50–60
6. external rotation 80–90

2.3 Radiographic Imaging

Diagnostic imaging through X-ray can be used in diagnosing the severity of the canine hip dysplasia as well as for treatment planning. The first signs of hip dysplasia can be shown by seven weeks of age where the femoral head is subluxed and there is a delay in the craniodorsal acetabular rim developement. The standard ventrodorsal extended view is the universal X-ray image technique used to evaluate CHD (Ginja et al., 2010). Under anesthesia or heavy sedation, the dog is placed in a dorsal recumbent position on the X-ray table, with its rear limbs extended parallel to each other and the stifles internally rotated. The positioning of the canine is extremely important for accurate radiographic interpretation. The pelvis needs to be positioned symmetrically with its femurs parallel to each other and the patella superimposed over the center of the femoral condyles (Ginja et al., 2008b). Although there is a universal view used for X-ray imaging, there are multiple hip dysplasia scoring systems used throughout the world.

Understanding clinical signs and CHD diagnosis, animal health care practitioners can follow therapeutic protocols as per based on severity of symptoms. Appropriate rehabilitation management strategies, whether surgical or conservative, can be implemented to help manage the canine's pain levels and mobility at its various progressive stages (Dycus et al., 2017).

Osteopathic manual practitioners can provide care to dogs pre/post hip dysplasia surgery, so it is essential to understand what the procedures entail to provide the safest manual therapy treatment.

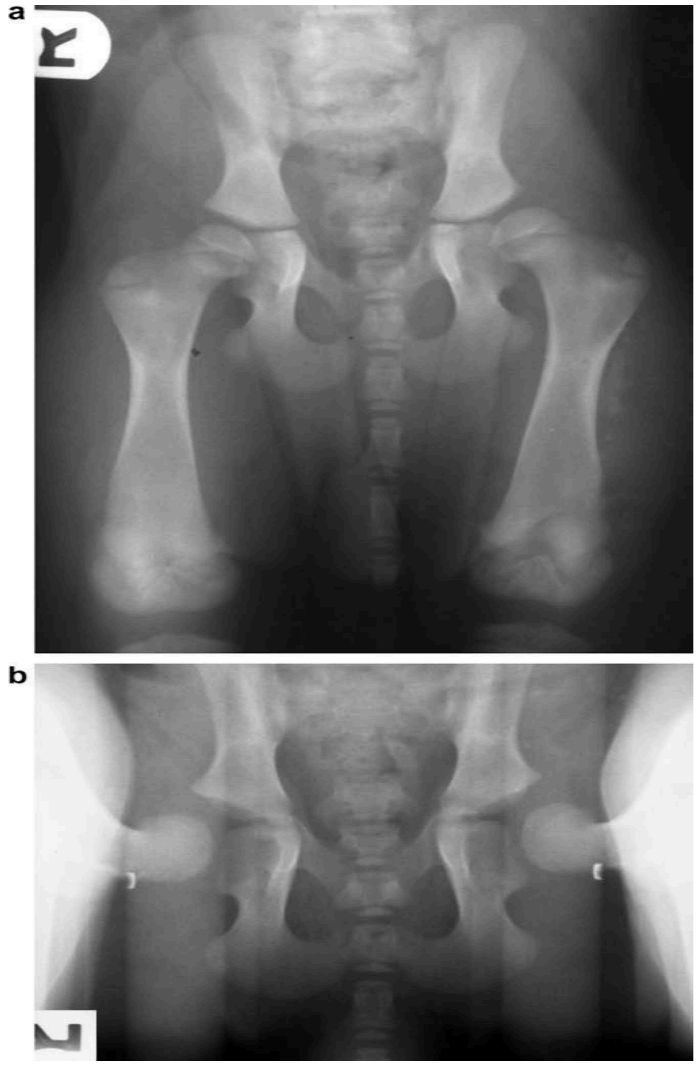

Figure 1: Standard ventrodorsal hip extended view of skeletally immature 8-week old female Estrela mountain dog puppy, which lateral developed severe hip dysplasia, demonstrating obvious bilateral incongruence between the femoral head and the acetabulum (Ginya et al., 2010).

3.0 Surgical Management Strategies

Surgical management of CHD takes into consideration the age and onset of clinical signs (Ginja et al., 2010). In young dogs, there are a number of preventive surgical procedures that change the joint alignment to improve joint stability and slow the progression of OA. The most common of these procedures are the triple pelvic osteotomy (TPO) and juvenile pubic symphysiodesis (JPS). In older dogs with severe osteoarthritis, secondary to hip dysplasia, total hip replacement surgery can be performed (Davidson & Kerwin, 2014).

3.1 Triple Pelvic Osteotomy

The triple pelvic osteotomy is the most popular surgical semi-preventive treatment for hip dysplasia in dogs (Vezzoni et al., 2005). It is performed on canines who tested positive for Ortolani sign, between 4 to 10 months of age, that have early signs of joint laxity and hip dysplasia but have not progressed to the point of having significant radiographic evidence of osteoarthritis. The dogs will usually have visible atrophy of the gluteal and thigh muscles (Ginja et al., 2010; Davidson & Kerwin, 2014).

Triple pelvic osteotomy results in a ventrolateral rotation of the acetabulum by osteotomies of the pubis, ischium and ilium, and rotation and fixation of the acetabular segment with plates and screws (Ginja et al., 2010). Post TPO surgery, dogs appear to have better stability, resolve lameness, and transmit more load through the dysplastic hips. However, dogs with higher joint laxity prior to surgery are likely to have less favorable outcomes and may not stop the progression of OA in the coxofemoral joints. Accurate selection and screening is essential for position outcomes (Manley et al., 2007).

Figure 2: X-ray of Post Triple Pelvic Osteotomy (Davidson & Kerwin, 2014).

3.2 Juvenile Pubic Symphysiodesis

Juvenile pubic symphysiodesis (JPS) is a minimally invasive surgery that does not involve internal fixation devices and is performed on puppies between ages of 15 to 20 weeks (Vezzoni et al., 2008). The growth plate of the pubis symphysis is surgically damaged by electrocautery which induces necrosis of the germinal chondrocytes (Davidson & Kerwin, 2014). The pubic growth plate prematurely closes, without affecting the ischial and acetabular growth patterns, which results in a ventrally underdeveloped pelvis. This increases the acetabular coverage and better coxofemoral articulation, resulting in a reduction of subluxation forces (Ginja et al., 2010).

Positive improvements in clinical signs, hip conformity and/or decreased development of CHD after JPS surgery have been observed post operative. Results are more variable for dogs with mild signs of canine hip dysplasia, so early evaluation is recommended (Vezzoni et al., 2008). Poor results can occur with dogs who are overfed and become overweight or undergo uncontrolled physical activity after surgery. This surgical technique has minimal or no clinical effectiveness in puppies with severe initial signs of CHD due to the slow formation of acetabular ventroversion and the femoral head slipping laterally. With these severe cases, coxofemoral congruence is never achieved post JPS surgery (Ginja et al., 2010).

3.3 Total Hip Replacement

Total hip replacement (THP) surgery is an option for older dogs who have lameness, disability and/or pain that cannot be adequately managed with conservative therapies due to osteoarthritis. THP surgery removes the structurally damaged joint and replaces it with a prosthetic, resulting in elimination of joint related pain. The femoral head is removed and the femoral prosthesis is implanted in the medullary canal of the femur. The acetabulum is also replaced with a prosthetic acetabular cap (Davidson & Kerwin, 2014).

Most canines can immediately bear weight post THP surgery and post operative care is crucial for long term success. One of the most common postoperative complications of total hip replacement surgery is hip luxation and within the first month. To avoid dislocation of the prosthesis, dogs can wear a supportive sling to prevent excessive abduction and/or adduction of the limb. Muscle strengthening through exercise therapy is top priority, especially with preexisting history of muscle atrophy (Davidson & Kerwin, 2014).

Figure 3: Cementless Total Hip Replacement (Davidson & Kerwin, 2014).

3.4 Post Operative Care

Depending on the surgical procedure completed and health of the canine, postoperative activity is restricted for 4 to 6 weeks to allow bone healing. To help manage swelling and pain, cryotherapy and medications such as NSAIDs can be incorporated, as prescribed by a veterinarian. After adequate bone healing has occurred, the focus of rehabilitation is to maintain joint congruency and strengthen the muscles of the hindquarters.

Strengthening activities should parallel tissue healing and tissue strength. Activities can include passive and active range of motion movement and assisted ambulation, followed by controlled, low-impact therapeutic exercises. Leash walking, sit-to-stand exercises, and aquatic walking may be useful to attenuate muscle atrophy while avoiding excessive stress on the repair (Davidson & Kerwin, 2014). Canines with hip dysplasia, whether non-surgical, pre- or post-

surgery, can greatly benefit from additional conservative management such as osteopathic manual therapy to help with pain management and joint health.

4.0 Conservative Management and Osteopathic Manual Therapy

Although not all canines with hip dysplasia and/or subsequent osteoarthritis require surgery, the majority of dogs can benefit from conservative management. The conservative approach should involve physical rehabilitation with multimodal treatments options with goals of providing pain relief through strengthening, maintaining range of motion, manual therapy, promoting optimal weight and environmental modifications (Dycus et al., 2017). There is a lack of research articles on the efficacy and outcomes of osteopathic manual therapy techniques on canines with hip dysplasia. Fortunately, there are research journals which indicate the positive impacts of manual therapy for this canine population. The author of this paper will describe the manual therapy techniques found within the available research and highlight parallels to osteopathic manual therapy principles and techniques.

4.1 Brief Summary of Osteopathy Principles

The concept of *Osteopathy* came to Andrew Taylor Still, the founder of Osteopathy, in 1874. His original concept was founded on the importance of anatomy and its relationships to the "flow of natural forces" in the body. Over the years, four tenets of osteopathic medicine were established.

1. The principle of body unity
2. Inter-relationship between structure and function
3. Self-regulatory and self-healing systems
4. The rule of the artery is supreme (Chila, 2019).

The principle of the body unity refers to how every system of the body relies on all other systems for its health and vitality. No part can function independent of the whole, highlighting the importance of the inter-relationships between structure and function.The systems coordinate to maintain the bodies integrity as a whole through homeostasis, which is the physiological act of self regulation back to the bodies set norms and health. Lastly, undistributed blood flow is essential for the health of an organism and with tissue damage, this can lead to poor nutrition to the surrounding tissue with poor waste removal. Ultimately leading to onset of disease (Chila, 2019).

Osteopathy focuses on the cause of dysfunction rather than concentrating solely on the symptoms, as the osteopathic philosophy focuses on the interrelationships and unity of structure (anatomy) and function (physiology) (Chila, 2019). By applying manual therapy techniques to the musculoskeletal system, the body's other systems are positively impacted. The body is able to deliver nutrients and clear waste products efficiently, resulting in a healthier individual. Osteopathic practitioners work on treatment of somatic dysfunction, which describes disease in specific bodily areas where changes in tissue have occurred. Somatic dysfunction can present four symptoms and at least two are required for diagnosis; tenderness, asymmetry, restriction of motion and tissue texture changes (Seffinger & Hruby, 2007).

The osteopathic philosophy states that the body has its self-healing properties. When the body, mind, and spirit are working efficiently, the body can maintain health and balance. With this philosophical approach to treatment, the patient is responsible for their own health while the osteopathic practitioner aids in facilitation (Chila, 2019). Canine Osteopathy draws similar parallels to the human approach where practitioners approach canine treatment by the manipulation and balance of the musculoskeletal system. Through various manual therapy

techniques, osteopathic practitioners can make positive improvements to canines with hip dysplasia joint health and pain management.

4.2 Osteopathic Techniques for Canines

Osteopathic techniques are classified in two different ways, based on the direction of the force applied by the therapist (direct, indirect, combination) and the activity level of the patient (passive or active). Direct techniques refer to the therapist moving the affected tissue in the direction of the restriction, also known as the barrier. Indirect techniques involve the tissue being taken away from the barrier; into the joints ease. The combination techniques either begin with an indirect technique and end with a direct technique, or vice versa. Active patient participation involves the person or animal moving on its own by activating various muscle groups in their body. Passive activity level requires the technique to be performed by the therapist or animal owner when the muscles are relaxed and the person or animal allows the movement to happen (London College, 2024). This paper will focus on research articles which highlight manual therapy techniques such as stretching, joint manipulation and mobilization, and soft tissue massage for CHD management and examine the osteopathic technique similarities.

4.2.1 Stretching

Osteopathic principles and stretching for animals share the promotion of well-being and physical balance, postural alignment, joint mobilization and diaphragmatic flexibility. Stretching also helps to increase the animal's capacity to maintain its health (Marcellin-Little & Levine, 2015). Stretching has been characterized as a movement applied by an external and/or internal force in order to increase muscle flexibility and to improve the joint range of motion. It aims to

increase muscle-tendon unit length and to improve joint flexibility and decrease the risk of soft-tissue injuries (Zvetkova et al, 2023). Stretching as a rehabilitation method improves the biomechanical parameters of the structure; the muscle, tendons, ligaments, fascia and joints; improving the function of the animal. A fundamental component of osteopathic treatment is the use of stretching techniques, whether passive or active involvement of the patient (Kron, 2003).

To help dogs with hip dysplasia and osteoarthritis, active and passive range of motion along with stretching exercises are important. Dysplastic hips seem to lose degrees in extension rather than flexion range of motion. While minor loss of joint motion is unlikely to impact the function of the limb, severe loss decreases the dog's inability to gallop, trot, jump up, or climb stairs or steps. It is significantly easier to maintain joint range of motion than it is to regain it when diminished. Additionally to stretching, canines with hip dysplasia benefit immensely from intermittent physical activity with enhanced joint extension (Dycus et al., 2017).

Stretching incorporated into the early phases of rehabilitation for CHD will help to increase flexibility, prevent soft tissue adhesions, remodel periarticular fibrosis, and improve extensibility. The success of stretching is very evident in literature and is strongly recommended to help regain joint motion. Additionally, ROM and stretching can be incorporated into part of the daily exercise program to maintain mobility between soft tissue layers, enhance blood and lymphatic flow, and improve synovial fluid production. Dycus et al., 2017, recommend performing ten to fifteen 20- to 40-second-long sustained stretches during each therapeutic session. Sessions may be performed 2 to 3 times per day. With chronic loss of motion, a weekly gain of 3 to 5 of joint motion is anticipated (Dycus et al., 2017).

Figure 4: Passive range of motion to hip (A) hip flexion (B) hip extension (Dycus et al., 2017).

4.2.2 Joint Manipulation and Mobilizations

Joint manipulation and mobilization incorporated into a canine hip dysplasia rehabilitation program to help increase joint ROM. Joint mobilization techniques can incorporate direct, indirect, or combination force to the tissue and involve the client to be passive (London college, 2024). Joint manipulation and mobilizations differ from stretching in that when a stretch is applied, a low load is placed on the tissues for a specified amount of time, usually 10–30. With joint manipulations and mobilizations, the force is applied in an oscillatory manner rather than in a sustained manner (Saunders et al., 2005). Osteopathic practitioners have various manipulations and mobilizations to choose from depending on the state of the client as well as the treatment goals.

Osteopathic articular balancing (OAB) assesses and improves joint and muscle function and utilizes direct pressure with passive involvement of the patent. The articulation aspect of this technique helps joint mobility and muscle function, facilitating proprioceptive change and balancing the biomechanics of the whole body. Functional technique encourages the joints to follow the direction of ease of movement, indirect force and passive involvement of the client,

and allows for muscle release and proprioceptive change. The ease direction of motion is followed in any direction that offers no resistance until a position of ease and comfort is reached. Myofascial release technique also treats soft-tissue and joint related restrictions and is a combination of direct-indirect and passive involvement of the patient. The therapist applies constant, penetrating pressure into the fascia resulting in reduced muscle and fascia tension, improved circulation and lymphatic drainage (London College, 2024). In Saunders et al., 2005, hip compressions were noted to be beneficial in treating dogs afflicted with hip dysplasia. The objective was to increase firing of the mechanoreceptors, increase ligament tension, muscle stability and proprioception, and enhance synovial fluid flow. As hip extension is one of the most affected ranges with CHD, cranial glides of the femoral head aim to maintain the movement.

4.2.3 Soft Tissue Massage

Soft tissue massage is a type of osteopathic manipulation that uses different techniques to mobilise the body's soft tissues. Techniques are applied to tendons, ligaments, muscle, fascia and connective tissue around joints. Application of soft tissue massage may decrease myofascial pain and muscle tension experienced by the canine. Various soft tissue techniques include effleurage, petrissage, percussion, acupressure and lymphatic drainage (valehealthclinic, 2020).

Effleurage involves the practitioner making broad horizontal sweeping motions with the flat of their palms on soft tissue to increase capillary dilation and blood flow, resulting in warming of the tissues. Petrissage uses more pressure than effleurage and involves kneading or rolling to the soft tissue which is ideal for treatment of tenser tissue. Petrissage increases blood flow and tissue extensibility as well as lowering tissue tone. Percussion involves tapping rapidly over soft tissue with the practitioner's hands to help stimulate nervous system activity and circulate lymphatic fluid to reduce tissue tone. Acupressure involves putting pressure on target

areas to release muscle tension to help with relaxation and elongation. It is an effective technique to relieve pain and improve circulation. Lastly, lymphatic drainage technique involves light directional strokes on the soft tissue to reduce swelling due to fluid build up; helping to relax the nervous system and muscular tension (valehealthclinic, 2020).

An unstable hip joint will negatively affect the canine's body as the tissue will have to compensate to be able to ambulate. This can lead to strains within the tissues of the immediate area as well as through the rest of the body. Over time, the soft tissues can become painful from hypertonicity, trigger points, strains, spasms or adhesions. As the area of pain increases, the canine will instinctively shift to use non-pained muscles. The chain of compensation and overuse is created throughout the body as it protects each dysfunctional area. The use of soft tissue techniques will depend on the CHD severity and associated compensations. Massage can reduce the pain cycle and overcompensation by working on the muscles to restore to normal function and elasticity. Although it cannot change the joint dysplasia, it can reduce the effects of it and the dog's pain levels (Courtnell, 2021). The practitioner or owner can apply massage techniques to their dog for 5-20 minutes depending on compliance. Treating the muscles along the spine, gluteals, quadriceps and hamstrings help to stimulate the sensory and proprioceptive receptors, as well as relax the tissues and release endorphins (Corral, 2018).

5.0 Conclusion

Canine hip dysplasia (CHD) is described as an inherited, non-congenital and multifactorial developmental disorder of the coxofemoral joint, particularly prevalent in large and giant breed dogs (Ginja et. al, 2010). Joint laxity, repetitive subluxation, degeneration and developement of osteoarthritis in adult years are the key elements identified with CHD (Schachner, 2015). The two most common ages for CHD are canines under 1 years old and adult

dogs with clinical signs such as gait abnormalities, difficulty in rising, discomfort or pain with exercise, loss of muscle tone in the back legs or thighs, grinding of the joint during activity and lameness in the hind end (Manley et al., 2007; Ginja et. al., 2010).

Range of motion, special orthopedic testing, and X-ray imaging are useful tools for understanding the diagnosis and severity of the CHD (Ginja et al., 2010). Appropriate rehabilitation management strategies, whether surgical or conservative, can be implemented to help manage the canine's pain levels and mobility at its various progressive stages (Dycus et al., 2017). The most common surgical procedures for younger canines are the triple pelvic osteotomy and juvenile pubic symphysiodesis. In older dogs with severe osteoarthritis, secondary to hip dysplasia, total hip replacement surgery can be performed (Davidson & Kerwin, 2014). Although not all canines with hip dysplasia and subsequent osteoarthritis require surgery, the majority of dogs can benefit from conservative management. Research has highlighted the positive effects of manual therapy treatment by the manipulation and balancing of the musculoskeletal system. Through various manual therapy techniques, such as stretching, joint manipulation and mobilization, and soft tissue techniques, osteopathic practitioners can make positive improvements to canines with hip dysplasia joint health and pain management (Marcellin-Little & Levine, 2015).

Bibliography

Chila, A. (2019). Osteopathic Philosophy. *Foundations of Osteopathic Medicine* (3rd ed., pp. 3–23), Wolters Kluwer Health.

Corral, C. (2018). Canine hip dysplasia: Rehabilitation. *The Veterinary Nurse*, *9*(6), 304–308. https://doi.org/10.12968/vetn.2018.9.6.304

Courtnell, S. (2023, April 18). *Hip dysplasia – why does massage help?*. Canine Massage Guild. https://www.k9-massageguild.co.uk/hip-dysplasia-why-does-massage-help/

Davidson, J. R., & Kerwin, S. (2014). *Common Orthopedic Conditions and Their Physical Rehabilitation. Canine Rehabilitation and Physical Therapy,* 558-559. doi:10.1016/b978-1-4377-0309-2.00032-6

Dycus, D. L., Levine, D., & Marcellin-Little, D. J. (2017). Physical Rehabilitation for the Management of Canine Hip Dysplasia. *Veterinary Clinics of North America: Small Animal Practice*, 47(4), 823–850. doi:10.1016/j.cvsm.2017.02.006

Fry, T.R., Clark, D.M., 1992. Canine Hip Dysplasia: Clinical Signs and Physical Diagnosis. *Veterinary Clinics of North America: Small Animal Practice* 22, 551– 558. doi: 10.1016/s0195-5616(92)50055-9

Ginja, M.M.D., Silvestre, A.M., Gonzalo-Orden, J.M., Ferreira, A.J.A. (2010). Diagnosis, Genetic Control and Preventive Management of Canine Hip Dysplasia: A Review. *The Veterinary Journal*, 184(3), 269–276. doi:10.1016/j.tvjl.2009.04.009

Ginja, M.M., Silvestre, A.M., Colaço, J., Gonzalo-Orden, J.M., Melo-Pinto, P., Orden, M.A., Llorens-Pena, M.P., Ferreira, A.J. (2008b). Hip Dysplasia in Estrela mountain dogs –

Prevalence and Genetic Trends 1991–2005. *The Veterinary Journal,* 182, 275–282. doi: 10.1016/j.tvjl.2008.06.014

Kron, J. (2003) Osteopathy. *The Journal of Complementary Medicine: CM.* Australian Pharmaceutical Publishing Company Ltd, 2(5). https://search.informit.org/doi/10.3316/informit.845476163778463.

London College of Animal Osteopathy. (2024). Introduction to Osteopathic Treatment of Animals - Philosophy and History of Animal Osteopathy. Lecture 3. *London College of Animal Osteopathy*.

Manley, P.A., Adams, W.M., Danielson, K.C., Dueland, R.T., Linn, K.A. (2007). Long Term Outcome of Juvenile Pubic Symphysiodesis and Triple Pelvic Osteotomy in Dogs with Hip Dysplasia. *Journal of the American Veterinary Medical Association,* 230, 206–210. doi: 10.2460/javma.230.2.206

Marcellin-Little, D. J., & Levine, D. (2015). Principles and application of range of motion and stretching in companion animals. *Veterinary Clinics of North America: Small Animal Practice*, *45*(1), 57–72. https://doi.org/10.1016/j.cvsm.2014.09.004

Saunders, D. G., Walker, J. R., & Levine, D. (2005). Joint Mobilization. *Veterinary Clinics of North America: Small Animal Practice,* 35(6), 1287–1316. doi:10.1016/j.cvsm.2005.07.003

Seffinger, M. A., & Hruby, R. J. (2007). CHAPTER 2 - Somatic Dysfunction Mechanisms. In *Evidence-Based Manual Medicine* (pp. 3–33). story. Retrieved from https://doi.org/10.1016/B978-1-4160-2384-5.50006-7.

Schachner, E., & Lopez, M. (2015). Diagnosis, Prevention, and Management of Canine Hip Dysplasia: A Review. *Veterinary Medicine: Research and Reports*, *6*, 181–192. doi: 10.2147/vmrr.s53266

Valehealthclinic. (2020, June 25). *Soft-tissue osteopathy techniques*. Vale Health Clinic. https://valehealthclinic.co.uk/soft-tissue-osteopathy-techniques/

Vezzoni, A., Dravelli, G., Vezzoni, L., De Lorenzi, M., Corbari, A., Cirla, A., Nassuato, C., & Tranquillo, V. (2008). Comparison of conservative management and juvenile pubic symphysiodesis in the early treatment of canine hip dysplasia. *Veterinary and Comparative Orthopaedics and Traumatology* 21, 267–279 doi: 10.1055/s-0037-1617372.

Zvetkova, E., Koytchev, E., Ivanov, I., Ranchev, S., & Antonov, A. (2023). Biomechanical, healing and therapeutic effects of stretching: A comprehensive review. *Applied Sciences*, *13*(15), 8596. https://doi.org/10.3390/app13158596