Osteopathic intervention in the management of canine osteoarthritis.

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Introduction

Osteoarthritis (OA) is highly prevalent in companion animals. It is the most common arthropathy in both humans and animals (Mele, 2007). In the United States, approximately 20% of pet dogs over one year old spontaneously develop OA (Anderson et al., 2020). Many of the fundamental disease characteristics of OA in humans and dogs are the same. The articular changes characteristic of OA, in both humans and animals, lead to joint stiffness, inflammation, pain and loss of mobility (Musumeci et al., 2015). Humans and pet dogs both cohabitate the same environments, share in the same activities and often receive very similar treatments like anti-inflammatories and joint replacement surgeries for OA (Meeson et al., 2019). In clinical trials, similar outcome assessment tools are used. Collectively, the focus of treatment is primarily pain reduction and improvement of function and quality of life, whilst minimising side effects of intervention (Altinbilek et al., 2018). Osteopathic intervention is well positioned to fit this criteria due to the focus on total patient care, and the rarely reported adverse effects.

Currently, there is minimal literature specific to osteopathic treatment for OA in the canine population. Studies concerning human OA and osteopathic treatment are more available, and it may be possible to apply these to the canine population. This paper will aim to outline canine OA, its current research and treatment approach, and apply fundamental osteopathic principles to canine OA management. Human and canine OA will be often discussed analogously throughout. Osteopathy will be referred to as osteopathic medicine (OM) and osteopathic treatment will be referred to as osteopathic manipulative treatment (OMT) for the purpose of this paper. The aim of this paper is to draw on the available literature to attempt to answer the research question of whether osteopathic intervention is effective in the management of canine OA.

Osteoarthritis

OA is a chronic and highly prevalent joint disorder involving all structures of the joint. In humans, OA is most commonly seen in the hand, knee, foot and hip (Wieland et al., 2005). In dogs, OA has been most often found in the elbow, shoulder, hip and knee (Mele, 2007). The articular changes characteristic of OA, in both humans and animals, lead to joint stiffness, inflammation, pain and loss of mobility (Musumeci et al., 2015). The disease process of canine OA, both macroscopically and microscopically, most closely imitates the complex characteristics of primary OA in humans (Meeson et al., 2019). Historically, it was viewed as a wear and tear disease leading to articular cartilage loss and joint disability. It has more recently been redefined as a very complex, multifactorial disease (Musumeci et al., 2015). Due to its high prevalence in animals and humans, it continues to be studied very extensively. The pathogenesis of OA in both species comprises change in all synovial tissues of the joint (Brown, 2017). Despite distinct similarities in human and canine anatomy, dogs are quadrupedal and so have a 60:40 split between forelimbs and hindlimbs of total joint forces when compared with bipedal humans (Meeson et al., 2019).

Articular cartilage loss is still regarded as the primary change in OA. A number of secondary changes have also been identified, through both cellular alteration and biomechanical stressors. These include the remodelling of subchondral bone, osteophyte formation, bone marrow lesion development, meniscal tears and change in the synovium, joint capsule, ligaments and periarticular muscles (Man & Mologhianu, 2014). Historically, cartilage damage has been at the centre of OA pain studies (Sofat et al., 2011). However, articular cartilage is avascular and aneural, rendering it unable to straightforwardly generate pain or inflammation. Surrounding non-cartilaginous structures such as bone, periosteum, local ligaments and muscles, synovium and the capsule of the joint are more physiologically capable of triggering a pain response due to their abundant vascular and neural supply (Hunter et al., 2008). Interestingly, studies in humans have shown substantial discrepancy between radiographically diagnosed OA of a joint and the severity of pain in that joint. The same is true in the canine population (Meeson et al., 2019) (Read et al., 1996). In some people, radiographic signs of structural change are asymptomatic, whereas others report joint pain where no radiographic structural change is evident (Wieland et al., 2005). This tells us that clinical symptoms do not always correlate with radiographic signs.

The painful experience of OA is well documented. The experience of OA pain is likely not dissimilar to the pain experience of numerous other chronic pain conditions (Sofat et al., 2011). The process involves four stages. The first stage, transduction, involves the activation of specific receptors in response to a painful stimulus. This is followed by transmission, where the message is carried from the peripheral site of the painful stimulus to the central system of the spinal cord and brain. The third stage is perception, the realisation of nociception produced by these sensory signals. Modulation is a more complicated process, involving the alteration of pain felt by the individual (Perrot, 2015). Essentially, it is apparent that the presence of peripheral inflammation triggers a nociceptive response. Further, it is known that the presence of inflammation for a sustained period can lead to central sensitization (Sofat et al., 2011). Human studies using functional MRI have shown the complexity of OA pain perception in the brain and demonstrated the plasticity of the central nervous system in the modulation of the pain experience (Baliki et al., 2008). OA pain is complex and involves multiple components in the peripheral and central nervous systems, making it difficult to pinpoint a precise source of nociception (Baliki et al., 2008). This must be considered in the osteopathic management of canine OA as a chronic pain condition and will be revisited in the context of the treatment approach later.

Canine osteoarthritis

A number of risk factors for the development of OA have been identified in the canine population. There are modifiable factors such as neuter status and body weight, with the ability for intervention. Other non-modifiable factors like breed, sex and age can be used in the identification of risk levels but are not open for intervention (Anderson et al., 2020). Like in humans, it is a multifactorial disease which is considerably influenced by genetics and also external factors such as diet and exercise levels (Anderson et al., 2018). OA in canines has further been categorised as either primary or secondary. Primary OA is largely idiopathic but can be influenced by risk factors like age and body weight. Secondary OA is identified as the most common form of OA in dogs and involves injury or underlying disease processes (Anderson et al., 2020). Common primary joint abnormalities leading to secondary OA include cruciate ligament rupture, patellar luxation and elbow or hip dysplasia (Anderson et al., 2018).

Primary canine osteoarthritis considerations

Weight/Diet

Increased body weight has been associated with an increased risk of OA. Simply put, higher body weight places higher load on weight bearing joints. Large breed dogs are at increased risk of OA but obesity, regardless of breed, is an even bigger risk factor (Anderson et al., 2020). In a study by Smith et al., (2006) using six bodyweight and sex-matched pairs of Labrador Retriever littermates, one of the pair was fed at libitum and the other diet restricted at 25% less. Hip OA was identified radiographically in 25% of control-fed dogs versus 4% of diet-restricted dogs by age two. This increased to 39% versus 13% at five years and 83% versus 50% at 15 years. This study demonstrates that dietary restriction reduces the development of OA, independent of breed predispositions (Smith et al., 2006).

There is less evidence for whether type of diet influences the development of OA, though high fat intake has been linked with an increased risk (Anderson et al., 2020). Studies on canine shoulder, hip, knee and elbow OA, the most commonly affected joints, have demonstrated that diet restriction reduces both disease prevalence and severity (Meeson et al., 2019). It is widely suggested that obesity and increased OA prevalence is due to increased loading on weightbearing joints. Despite this, there is a link between obesity and hand OA in human studies which could insinuate a more systemic influence (Yusuf et al., 2010). This divergence lends itself to another discussed process where excess adipose tissue leading to increased adipokine concentrations predisposes low-grade, systemic inflammation. This process is also true for the canine population and suggests a more complicated metabolic influence outside of the simple scenario of increased load on weight bearing joints predisposes OA development.

Although nutritional imbalances may result in developmental skeletal disease (Lauten, 2006) which, in turn, may lead to degenerative joint disease, the role of nutrition in the management of degenerative joint disease is less clear. Nutrition may aid in treatment of degenerative joint disease through optimizing body condition and body weight, by modifying degenerative or inflammatory processes, and by influencing pharmacologic therapy (Lauten, 2006).

Breeds/genetics

Canine OA is likely to have a considerable genetic influence, independent of whether it is primary or secondary in nature (Clements et al., 2006). This genetic influence includes inherited susceptibility to some of the injuries and conditions discussed in this section. A number of conditions known to increase the risk of secondary OA are also known to be genetic. These include hip and elbow dysplasia, cruciate instability, osteochondrosis dessicans and patellar luxation, among others. Breeds that have been identified to be most at risk of developing OA are large dog breeds including the Golden Retriever, Labrador Retriever, Rottweiler and German Shepherd Dogs (Anderson et al., 2018). Large breed dogs make up 45% of dogs diagnosed with OA (Mele, 2007). Further, there are certain breeds more predisposed to arthropathies that have been identified as risk factors for secondary OA. Larger breeds such as the Mastiff, Boxer, Italian Corso, German Shepherd Dog, Golden Retriever, Labrador Retriever and Bernese Mountain Dog are more predisposed to elbow and hip dysplasia (Anderson et al., 2020). Smaller breeds like the Dachshund and French bulldog are also susceptible due to their chondrodystrophic development (Michelsen, 2013). Rottweilers, Labrador Retrievers and Golden Retrievers, among others, have greater incidences of cruciate ligament rupture when compared with smaller breeds. Pomeranians, Chihuahuas, Yorkshire Terriers and French Bulldogs have higher chances of developing patellar luxation than crossbreed dogs (Anderson et al., 2020).

Pure breed dogs have an increased prevalence of OA and it must be considered that unintentional co-selection of unfavourable musculoskeletal traits in attempting to maintain preferred breed conformational appearance may play a role in this statistic (Anderson et al., 2020). The genetic component in OA may also predispose dogs to an inherited risk (Anderson et al., 2018). Increased inbreeding has been linked to increased risk of inherited disorders like joint dysplasia (Anderson et al., 2020). It has been shown that reducing inbreeding can reduce the prevalence of these inherited joint diseases which lead to secondary OA (Oberbauer et al., 2017).

It appears that male dogs are more predisposed to OA than females. There seems to be no definitive explanation why this is but rather, a number of theories. Factors such as sex hormones, activity differences and common body weight differences have been identified (Anderson et al., 2018). Some primary joint disorders, such as elbow dysplasia and patellar luxation, leading to secondary OA are more prevalent in male dogs also (Mele, 2007).

Neutering is also associated with an increased risk of OA but again, one clear explanation is not recognised. Neutering causes a decrease in gonadal hormones which may act as defenders against OA (Anderson et al., 2018). Weight gain is also associated with neutering, and this is a known modifiable risk factor. Additionally, statistically more older dogs are neutered than not and OA is considered a disease of aging so the link may be partly incidental (Anderson et al., 2020).

Age is a non-modifiable factor and a significant predictor for OA in dogs. Over 50% of OA diagnosis are suggested to be for dogs aged 8-13 years (Mele, 2007). Diagnosis may not be made until clinical signs are evident which can indicate a more advanced stage (Anderson et al., 2018). So, the process of OA may begin substantially earlier in the dog's life than when diagnosis takes place.

Levels of activity is another risk factor for OA. Sporting and working animals are at increased risk for OA due to frequent repetitive loading of joints and increased prevalence of injuries which lead to secondary OA (Alves, 2021). This includes greyhound racing dogs, farm working dogs, hunting dogs, agility dogs, amongst others. Racing or ex-racing greyhounds are at a higher risk of OA than unraced greyhounds. Traumatic injury in greyhound racing is common and fractures and other musculoskeletal injuries throughout their racing careers can predispose them to secondary OA (O'Neill, 2019). Exercising too young can increase the risk of OA also. As well as immature growth plates, puppies are also less coordinated and more likely to injure themselves. These injuries can lead to secondary OA. Links have been made also between a dog's birth month and an increased risk of developing OA. Dogs born and adopted as puppies in warmer months may be more predisposed to OA due to increased activity levels associated with this time of year (Worth, 2012). All these factors should be considered in the diagnosis and treatment of canine OA.

Secondary canine osteoarthritis considerations

Joint dysplasia

The term dysplasia has Greek origins with “dys” meaning abnormal and “plasia” meaning development (Kirberger & Fourie, 1998). Hip and elbow dysplasia are both common developmental conditions in dogs and have been identified as precursors for secondary OA. Canine joint dysplasia is highly prevalent, hereditary and environmentally influenced, and is most reported in young large and giant breeds (Michelsen, 2013). It widely affects dogs, whether they are purebred or not, however, some previously mentioned breeds have been identified as being more susceptible (Oberbauer et al., 2017).

Hip dysplasia was first recognised in dogs in 1935 (Clements et al., 2006). It is prevalent in both dogs and humans and is a known risk factor for the development of OA in both populations. The disease processes and clinical features are similar in both populations also (Meeson et al., 2019). This developmental condition is characterised by instability of the coxofemoral (hip) joint, leading to hip subluxation. Dogs are generally born with normal hips but develop this femoral head subluxation early in life (Oberbauer et al., 2017). The secondary consequence of hip dysplasia is OA (Zhou et al., 2010). As such, it clinically affects dogs in two phases. The characteristic hip subluxation can cause pain in a dog’s first year of life. Dogs experience pain again with age as a result of this repeated subluxation, associated with joint incongruity and laxity, having led to clinical OA (Clements et al., 2006). Hip dysplasia in dogs and humans share these phenotypic characteristics, however is significantly more prevalent in the canine population (Zhou et al., 2010). It is difficult to quantify an accurate prevalence of hip dysplasia in dogs however, reported estimates vary between 4.2% to 9.6% for clinical signs, and from 10% to 73% for radiographic signs (Clements et al., 2006). Some studies have demonstrated the frequency to be as high as 75% in Golden Retrievers and Rottweilers (Kaneene et al., 2009). The risk factors for hip dysplasia are similar to those involved in the development of dog OA. Obviously, with joint dysplasia being a big predictor for OA, there is significant overlap. Hip dysplasia is an inherited condition. Environmental variables don't cause hip dysplasia but they can influence whether the condition is clinically present, and to what extent (Fries & Remedios, 1995). These common risk factors for gene expression are similar to OA and include genetics/breeding, large size, nutrition and hormonal factors.

Elbow dysplasia is a similar developmental condition to hip dysplasia and is also a big predictor of secondary OA. As with hip dysplasia, it is often a combination of both genetic predisposition and environmental factors that result in elbow dysplasia (Michelsen, 2013). Defined by the International Elbow Working Group (Hazewinkel, 2014), elbow dysplasia is represented by a compound of characteristics. These include fragmented medial coronoid process, osteochondrosis or osteochondritis dissecans, ununited anconeal process and incongruity of the elbow joint (Hazewinkel, 2014). The result can be pain, limited elbow flexion or extension due to pain, and lameness in the forelimb (Oberbauer et al., 2017). Clinical signs of elbow dysplasia usually appear in a dog's first 6-12 months and present as persistent forelimb lameness (Michelsen, 2013). Mild cases can go undetected and may only be diagnosed later in life due to the presence of secondary OA. A 1996 study on 55 rottweilers found that 57% had radiographic signs of elbow dysplasia by 12 months old but only 15% had signs of lameness (Read et al., 1996). This low symptomatic presentation highlights the possibility of breeders being unaware of this hereditary condition being present in their breeding stock. Elbow dysplasia is most commonly diagnosed radiographically (Oberbauer et al., 2017).

Cruciate ligament injury

Cruciate ligament rupture can occur both in the canine and human population. A link between anterior cruciate ligament rupture in humans and the subsequent development of OA has been widely identified, regardless of reconstruction or conservative management (Wong et al., 2012). Cranial cruciate ligament (CCL) disease is a common reason for hindlimb lameness in dogs, and is linked to OA of the stifle joint (Comerford et al., 2011). Whilst rupture of the CCL is generally spontaneous, commonly occurring during usual activities, research suggests that the majority of ruptures are secondary to degenerative change associated with CCL disease (Comerford et al., 2011). Spontaneous CCL rupture is more prevalent in young large breed dogs and in older small breed dogs (Meeson et al., 2019). Approximately 50% of cases experience contralateral rupture within one year (Comerford et al., 2001). Spontaneous CCL rupture occurs mid substance and often shows prior degeneration and evidence of OA (Meeson et al., 2019). We know that CCL rupture and OA are linked but evidence suggests there could be signs of OA prior to rupture, and not just as a result of the rupture itself.

Canine pain measurement tools

The painful consequence of OA in animals is difficult to quantify. In the research, this is partially due to the limitations of using invasive techniques on companion animals. Neurophysiological likeness of OA among mammals, as previously discussed, strongly suggests a parallel experience of physical pain. Pain experiences in OA are complex and involve a large number of processes including peripheral and central nervous system sensitization, neuropathic pain, structural change to innervation of a joint, in addition to basic nociceptive input from compromised joint tissue (Meeson et al., 2019). Additionally, an ideal sole model for examining degenerative OA in animals does not exist (Lampropoulou-

Adamidou et al., 2014). A number of studies on rats and mice have used chemically induced methods to examine chronic OA pain. The pathological processes involved in these methods are not accurate representations of natural OA disease processes which reduces their clinical worth (Vincent et al., 2012).

One big limitation in dogs compared with humans is self-reported measures of pain. Self-reported measures, pain scale tools and other types of subjective pain measures often used in human studies are obviously challenged with animal studies. Subjective measures are readily available and quantifiable in human studies, oftentimes reducing the need for objective data (Meeson et al., 2019). Historically, reflex withdrawal responses have been widely used in canine pain studies. However, this method of evoked pain doesn't illustrate the spontaneity of OA pain (Brown, 2017). More recent methods involve a reward-conflict foundation where an animal decides between receiving a reward or evading an unpleasant stimulus (Neubert et al., 2008). This more closely resembles the ability to modify behaviour based on pain level, as known in human OA. These methods are not so commonly used due to the necessary increased resources and time (Brown, 2017). The presence of OA is easily detected radiographically in dogs. The limitations of using this as a sole measure in studies is that there are inconsistencies in the quantification or clear definition of radiographic OA (Wong et al., 2012). Additionally, as previously highlighted, it is well documented that there are discrepancies between radiographic signs of OA and clinical presentation, in both humans and dogs (Meeson et al., 2019). The use of radiography in the identification of OA is useful however, it must be used in conjunction with other measures when investigating the effect of any type of treatment on OA pain, as radiographic findings will likely not improve with intervention (Brown, 2017).

One systematic review explored the types of outcome measures most often used in studies of dogs with OA (Belshaw et al., 2016). This review found that visual lameness assessment, radiographic appearance and assessment of pain were the most commonly assessed outcomes in canine OA pain. Force plate gait analysis and radiography were the most common measures in studies using a single outcome (Belshaw et al., 2016). Both of these outcome measures are considered objective measures. A number of different types of visual lameness assessments occur in the literature (Hudson et al., 2004) (Oosterlinck et al., 2011). Many use variations of a visual analogue scale (VAS), a scale used widely in human studies also. VAS is often used in conjunction with other measures, such as force plate gait analysis or radiography, to increase objectivity (Oosterlinck et al., 2011). Force plate gait analysis is a quantitative, objective measure examining ground reaction forces during movement. It has been utilised in the identification of gait dysfunction and as an examination tool for testing different treatments. The measurements involve peak vertical force and vertical impulse on a force plate under a dog during locomotion. Its validity can be limited by factors such as handler variation, change in velocity and dog habituation to the force plate, so data must be collected with consistency (Beraud et al., 2010).

Veterinarians rely greatly on reports from dog owners to develop and alter their treatment plan. If an owner reports improvements in a dog’s condition, the veterinarian is likely to continue a similar management approach. If no improvements are reported, the veterinarian may try a different approach (Brown et al., 2007). In human orthopaedic studies, patient reported measures and outcomes are now considered to be the gold standard (Thorborg et al., 2010). Reliable and valid outcome measures for pain in canine OA remain infantile, and a definite area for further exploration. Veterinary assessments are beginning to incorporate more patient centred approaches through owners completing proxy assessments of their pets.

Recent efforts have been undertaken to corroborate a range of behaviour based, outcome assessment tools that represent the intensity of spontaneous pain and the impact it has on the daily activities of companion dogs (Brown, 2017). These include tools such as the Canine Brief Pain Inventory (CBPI), modelled off the human Brief Pain Inventory. The CBPI focusses on both pain severity and how pain may interfere with the usual activities of a dog (Brown et al., 2008). A double blind, randomized, placebo controlled trial involving 70 dogs with OA was conducted by Brown et al. (2008) with owners completing the CBPI on day 0 and 14 of the study. Significant improvement in pain severity and pain interference was reported in the control group, with the dogs receiving daily Carprofen, when compared with the placebo group (Brown et al., 2008). The results from this study support the use of the CBPI, or indeed owner-reported measures, in quantifying studies examining canine chronic pain. A study using 68 dogs with OA was then carried out by the same group to compare the efficacy of the CBPI with the more objective force plate gait analysis (FPGA). This again involved assessment on day 0 and 14 of the study and had a placebo group and control group receiving Carprofen. The group receiving Carprofen showed significant improvement in both the CBPI and FPGA measures (Brown et al., 2013). These outcomes further support the practice of owner assessment measures in canine OA. These types of studies will provide insight into the effects of OA on animal's daily lives and help aid practitioners, such as osteopaths, develop more accurate management plans and treatment approaches.

The accessibility to sound quantitative measures of chronic pain is key in developing and examining different types of pain intervention (Brown et al., 2008). Generally, this has centred around drugs and surgical intervention. However, these measures could extend to evaluating efficacy of manual therapy, such as OMT, also. The advantage to more subjective measures, such as the CBPI, means they can be carried out in an environment familiar to the dog and by their owner who is most familiar with their own dog's behaviour (Brown et al., 2008). Often objective measures are so specific, isolated to one limb or one moment in time, that the bigger picture cannot be considered. This bigger picture is important in a multifaceted topic like chronic pain and OA in dogs. The growth of new therapies for OA pain, or further research on existing therapies will require effective models that consider both pathophysiological and clinical symptoms (Meeson et al., 2019).

Osteopathic principles and practice

The four main osteopathic principles in practice are continuously being reviewed and renewed. Earlier versions of them were forged by Andrew Taylor Still (AT Still), the founder of OM (Kuchera & Kuchera, 1994). The current tenets of osteopathy and their application to treatment are considered in this section. These principles are "the body is a unit", "structure and function are reciprocally interrelated", "the body possesses self-regulatory mechanisms" and "Rational therapy is based upon and understanding of body unity, self-regulatory mechanisms and the interrelationship of structure and function" (Singleton et al., 2005). These philosophies are the foundation of OM and are consistent regardless of what species is being treated.

The body is a unit

This principle of functional unity refers to every body part being in communication, and the fact that one body part can be influenced by another – either local or peripheral (Bordoni & Escher, 2021). Each body component has its own role and its own challenges but it also dually functions for the benefit of the other body parts (Kuchera & Kuchera, 1994). This principle also considers the unity of mind-body-spirit. It is well documented that chronic pain is an influencing factor in depression and reduced quality of life. People dealing with chronic pain frequently discuss how their pain affects their lives, rather than the location and nature of the pain (Kuchera, 2007). Thorough case history taking additional to physical examination is important for osteopaths in considering body unity, as it broadens the treatment approach from just hands-on to including patient education and strategies to modify external factors (Kuchera, 2007).

Structure and function are reciprocally interrelated

Structure is largely concerned with an individual's capacity to perform in life. Equally, functional demands cause structural change in the body in order to meet those demands (Kuchera & Kuchera 1994). The form of a structure impacts the function of the same structure, and vice versa. Much of the research in OMT yielding positive results has involved the creation of movement in space (Bordoni & Escher, 2021). OMT to create space aims to allow the improved function of all anatomical structures in the area, with respect to the purpose of their anatomical positions. Osteopathic practitioners should consider the relationship of structure and function in their palpatory examinations. Palpatory insights lead to further investigation, in the form of questions and examinations, aimed at identifying a primary, pain generating tissue (Kuchera, 2007). The TART model is used to detect somatic dysfunction through palpation (Bergna et al., 2020). This model is looking for Tenderness to palpation, Asymmetry, Restriction in ranges of movement and Tissue texture. Often, identification of a primary pain generator is confirmed by an effective therapeutic reaction. Presently, tissue texture is the biggest guidance for osteopathic practitioners in their choice of treatment application (Kuchera, 2007). Functional demand has a big influence on chronic pain disorders and repeated somatic dysfunction. Persistent functional demand on body structures leads to repetitive strain disorders and subsequently pathological structural change to that body region (Kuchera, 2007). Osteopathic intervention is not just hands-on and should address occupational and environmental perpetuating factors, or otherwise-effective treatment will not be sustained.

The body possesses self-regulatory mechanisms

The body has protective mechanisms such as the production of specific antibodies in response to an antigen, or the detoxification process of certain substances. Often the body can compensate for injury well enough to continue productively (Kuchera & Kuchera 1994). These self-regulatory mechanisms allow the body to make constant adjustments in response to environmental stressors and thus, maintain body homeostasis. In any dysfunction or disease there is the presence of a neuromusculoskeletal element. Osteopathic practitioners are trained to find this neuromusculoskeletal indication of the dysfunction even before it has resulted in symptoms or disease (Kuchera & Kuchera 1994). OMT focusses on facilitating these own self-regulatory healing mechanisms. It has been shown to have positive outcomes in studies examining OMT and autonomic, circulatory, respiratory and postural systems (Kuchera, 2007). Practices involving these systems include fascial techniques, diaphragm techniques, lymphatic drainage and effleurage – most often aimed at fluid circulation aiding body homeostasis (Kuchera, 2007).

Rational therapy is based upon and understanding of body unity, self-regulatory mechanisms and the interrelationship of structure and function

AT Still determined that disease was the product of dysfunction, predominantly in structure, and that optimisation of structure could improve or reinstate proper function (Singleton et al., 2005). This theory highlights the whole body approach to osteopathic intervention. An osteopath's primary role has been identified as: addressing the primary origin of disease utilising an evidence-based approach; heightening the patient's own healing capabilities; developing personalised treatment plans focussing on both recovery and prevention; applying hands-on assessment and treatment to repair structural, mechanical and physiologic dysfunction (Singleton et al., 2005).

Osteopathic intervention for human conditions

Osteoarthritis

OA is the musculoskeletal disease that most affects dogs and humans. At present, no curative treatments for OA exist. Existing management methods aim at decreasing pain and increasing function, with as little side effects as possible (Altinbilek et al., 2018). The literature on OM and OA is growing, with positive effects apparent and very minimal adverse effects. OMT has been demonstrated in a number of studies to be effective in relieving OA pain in humans. Osteopathic principles remain the same whether the patient is human or animal. Most studies for humans are focussed on knee OA as this is the most common type (Wieland et al., 2005). OM aims to take a global and individualised approach to patient care, as highlighted when reviewing the osteopathic principles in practice. This practice is challenged in clinical trials where techniques must only be applied to a certain joint or structure, such as the knee, to test specificity. It seems tougher to measure effects of a holistic approach like OM than a precise intervention like one technique or one medication. This likely influences numerous clinical trials to attempt to put OMT into a box for the purpose of research, and certain components of the whole osteopathic umbrella are discounted.

One of the most widely used aphorisms by AT Still was that the rule of the artery is absolute (Sprafka, 1981). Jardine et al. (2012) examined the effects of OMT on knee OA in people, focussing on this rule of the artery and attempting to bring the philosophy of OM into a clinical trial. The aim was to determine whether select osteopathic techniques focussed on vascular supply, such as fascial release along the superficial femoral artery pathway, would positively influence vascular supply, range of movement, function and self report measures. There were significant improvements in the OMT group compared with the control group for the resistance index of the superficial femoral artery, active range of knee flexion and symptom rating of the participants (Jardine et al., 2012). This study used both objective (ultrasound recordings) and subjective (VAS) measures which strengthened its validity. Another study on OMT for knee OA split participants into two groups – one that performed particular exercise, and the other that received OMT in addition to exercise (Altinbilek et al., 2018). The OMT was specific and involved three minutes of joint mobilisation, three minutes of compression each for both patellofemoral and tibiofemoral joints followed by two minutes of pumping techniques to the lower extremities bilaterally. The participants in the exercise plus OMT group had significant functional improvement and pain relief following completion of the intervention (Altinbilek et al., 2018). One limitation of this study could be the lack of objective measures. Results were obtained through a series of questionnaires plus a 50 metre walk time. As argued above, the lack of an individualised approach, though necessary in a clinical trial setting, is uncharacteristic of OMT.

A systematic review on manual therapy for relieving symptoms of knee OA was undertaken by Xu et al. (2017). OMT was included under the umbrella of manual therapy. Their results showed significant positive effects on pain, stiffness and physical function. They highlighted the need however, for long term follow up within studies as there is little research on long term benefits of manual therapy (Xu et al., 2017). One longer study was carried out on the effects of preoperative OMT on early post operative pain and subsequent opioid intake following total knee arthroplasty (Barral et al., 2020). This study involved 70 participants split into two groups. One group received traditional preoperative management and the other had additional preoperative OMT. Data collected one month post surgery showed significantly reduced pain at rest and during walking, and significantly lower opioid consumption. Despite this, there was no significant difference statistically between the two groups at either six months or one year post total knee replacement (Barral et al., 2020). In a clinical setting, OMT pre and post knee arthroplasty would additionally focus on reducing compensation and compression on other body structures independent of the knee and maintenance of overall function (Kuchera, 2007).

The placebo response should perhaps be given mention. Subjective measures such as pain and self-reported function obviously improve in response to placebo intervention, as found in a systematic review by Abhishek and Doherty (2013) involving OA studies. These improvements are not true for more objective measures such as strength tests and radiographic disease progression. These placebo trial findings again highlight the subjectivity of OA pain. Further, the majority of brain zones involved in pain processing are activated during a placebo intervention. Other factors such as patient-practitioner interface, patient expectations and the knowledge of receiving treatment, and patient character will influence placebo trial results (Abhishek & Doherty 2013). These psychosomatic factors may be more present in humans than canines, though evidence to support this could be difficult to discover.

Osteopathy for other chronic pain conditions

The exact mechanism for pain in OA remains unclear but we know there is often an element of sensitization seen in many chronic pain conditions. The effect of osteopathic intervention for multiple chronic pain conditions in humans has been examined and may help in the development of individualised and holistic treatment approaches for individuals with OA. The mechanism of chronic pain is multifaceted in its physiology and psychology. Chronic pain is not as simple as being acute pain that has persisted, though it is defined by pain lasting longer than three months (Treede et al., 2015). Brain imaging in people with chronic pain illustrates a transference from the sensory cortex regarding acute pain activity to brain regions associated with motivation and emotion (Hsieh et al., 1995). Different pain generators may manifest as similar symptoms and so individualised, dissimilar treatment plans must be developed by the osteopathic practitioner (Kuchera, 2007). The principles of osteopathy and their application to treatment, highlight the fact that hands-on treatment is just one part of OMT, which should also encompass patient education, environmental and behavioural intervention.

OMT for chronic low back pain (LBP) has often been tested in human trials. One study, using the principle of the interrelationship between structure and function, examined the use of OMT for 183 people with chronic LBP lasting an average of 31 months (Greenman, 1996). Participants were examined for five somatic dysfunctions often existent in chronic LBP during each treatment consult throughout the trial. 75% of the study group were able to return to their normal work and daily activities following OMT intervention aimed at removing the identified somatic dysfunctions (Greenman, 1996). In another study of people with LBP ranging from three weeks to six months acute, the effects of OMT were comparable to that of non-steroidal, anti-inflammatories and more efficacious than physical therapy or home exercises (Andersson et al., 1999). The group receiving OMT used significantly less pain medication than the group receiving standard allopathic care (involving medication, physical therapy, hold and cold therapy, among others). These results were measured using pain questionnaires, VAS and range of motion testing (Andersson et al., 1999).

Removal of myofascial trigger points has been demonstrated to be very successful in the treatment of chronic LBP (Travell & Simons, 1992). Myofascial trigger points, in dysfunctional musculature, are recognized to refer pain in familiar patterns. These trigger points are involved in a number of chronic pain conditions, not specifically LBP. Osteopathically employed techniques such as counter-strain, myofascial release methods, and muscle energy technique have been documented to be effective in the treatment of participants with myofascial trigger points (Travell & Simons, 1992). Osteopaths utilised these techniques, as well as high-velocity, low-amplitude (HVLA) thrusts and soft tissue techniques, in a study examining clinical response to OMT in a group of 186 participants with chronic LBP of at least three months (Licciardone & Aryal, 2014). There was an OMT group and a sham control group, receiving six treatments over a period of 12 weeks. The results found that with reasonably few, three treatments over four weeks, OMT sessions were enough to produce at least a 50% reduction in participants' LBP (Licciardone & Aryal, 2014). This was double the improvement in LBP that the sham control group experienced. Most studies on OMT for chronic pain seem to focus on the short term outcomes which limits knowledge on continuing effectiveness.

OMT is the hands-on component of treatment that applies distinctive osteopathic principles and practice as part of an overall focus on whole patient care (Kuchera 2007). It is only one facet of osteopathic care, but is often the focus of clinical trials due to its easier quantifiability. OM encompasses patient-practitioner interaction, expectation and education, as well as hands-on treatment. The total patient care significance of osteopathy seems much tougher to examine in clinical trials. In addition to studies examining pain reduction, a trial by Edwards and Toutt (2018) examined mental health effects from OMT on participants with chronic pain. It is well known that chronic pain is frequently accompanied by mental health conditions like depression, anxiety and fear avoidance behaviours (Nanke & Abbey, 2017). This trial involved OMT over a two week period, surveying 74 participants with pain lasting at least three months. The authors found a significant reduction in anxiety and quality of life, in addition to pain reduction. They also noted an increase in self-care (Edwards & Toutt, 2018). These notable psychosocial improvements may contribute more to the lasting success of an intervention than simply the hands-on treatment, solely applied in most trials. If these measures are difficult to assess in human trials, they will be even harder in canine trials where communication is already a limitation.

Osteopathic intervention in the canine population

There is a need for research on osteopathic intervention for dogs with OA specifically. However, we can endeavour to apply what we know about the effectiveness of manual therapy and some documented OMT techniques on dogs and begin to draw some of our own hypotheses. OA is named as the primary cause of chronic canine pain. Early intervention is key, ideally at the first signs of altered behaviour of the dog (Packer, 2020). The pathological OA process leads to functional change, movement restriction, altered joint loading and subsequently the compensatory effects on the rest of the body from that joint. This progression highlights the osteopathic tenet of the reciprocal relationship between structure and function. OMT is applied striving to restore mobility, fluid flow, and structural balance hopefully restoring body homeostasis and reducing pain (Pham, 2000). Treatment goals for OA, in both humans and dogs, are aimed at managing pain and subsequently decreasing disability and functional limitation. Currently, the management of OA pain in both species is largely pharmaceutical. Despite their recognisable effectiveness, medications have limitations and side effects. OMT for dogs with OA may be a viable alternative or adjunct to the current management approach but the lack of literature makes this difficult to support.

Canine trials using osteopathic intervention

In specific literature for osteopathic intervention and the canine population most studies identified focussed on lymphatic flow in the thoracic duct using osteopathic lymphatic drainage techniques. Lymphatic pump techniques (LPT) were developed in 1926 and referred to as an “exaggeration of the movements of respiration” (Knott et al., 2005). They have been integrated into OMT since and speak to AT Still’s osteopathic principle of the body’s self-regulatory mechanisms, using OMT techniques to aid homeostasis (Kuchera, 2007). LPT is used for conditions such as oedema, which can be part of the OA process (Brown, 2017). A study by Knott et al. (2005) showed an increase in lymph flow in conscious canines using abdominal and thoracic LPT. Each intervention lasted 30 seconds and was repeated at least two times. Despite the affirmative increase in lymphatic flow, these levels reduced quickly at the cessation of intervention. Other studies have built on this, exploring increased time and frequency of LBP to examine further clinical benefits. All studies demonstrate a definite increase in lymphatic flow in conscious canines when LPT is applied, though the lasting effects of this intervention remains unclear (Downey et al., 2008) (Prajapati et al., 2010).

Manual therapy comprises a number of therapeutic modalities involving hands-on treatment techniques. It encompasses manipulation and mobilisation of soft tissue and joints, including stretching and massage (Lane & Hill, 2016). These therapies aim to improve tissue quality, range of motion, reduce inflammation and modulate pain. Manipulations and mobilisations can refer both to the joint, in the context of a high velocity, low amplitude thrust directed at a joint to restore joint quality, and to soft tissue structures through stretch and massage techniques (Lane & Hill, 2016). OMT falls under the umbrella of manual therapy and so, while the principles of each modality may be different, there is a significant overlap in the types of techniques used amongst different professions. The subsequent articles discuss a number of techniques also used by osteopaths. A study of 47 pet dogs with naturally appearing lameness was undertaken by Lane & Hill (2016) testing the effectiveness of a combination of acupuncture and manual therapy, compared with an exercise restriction program. The acupuncture and manual therapy group received two treatment sessions total, and data was reported six days after the first session (immediately before the second) and eight days after the second session. At the first post intervention data collection, significant improvement was noted in the dogs' gait, ability to rise from a lying position and stiffness post rest or exercise. These positive findings were amplified again at the second data collection, when compared with the restricted exercise control group (Lane & Hill, 2016). Additional data collection at a later date could have enhanced the quality of this study. Another limitation was the lack of isolation between acupuncture and manual therapy, so it was not possible to determine each modality's specific benefits. Another study using 47 dogs already diagnosed with OA and receiving conventional medication was carried out to compare solely conventional medication effects against a combined approach with massage (Fuentes Beneytez, 2021). Tui-na massage, which is a type of Chinese manual therapy using hands to stimulate acupuncture points, stretch and manipulate tissues, was applied weekly over five weeks. Following five weeks of a combination of existent conventional medication and massage there was a significant improvement identified in joint mobility, strength and activity levels, and a reduction in pain (Fuentes Beneytez, 2021). These findings were recorded using a mixture of objective measures and owner-reported subjective measures. Again, this study could have benefited from subsequent measurements post trial.

There are clear indications in the literature that manual therapy can help with OA pain, and other musculoskeletal conditions, in dogs. Despite this, a number of the studies available have similar limitations. More follow up is widely needed at later dates post treatment intervention. It continues to be a challenge to effectively quantify the effects of manual therapy on the canine population, and the literature attempts to draw on a multitude of subjective and objective measures to increase this. Even with this effort, it challenges inter-study reliability when there are frequently different measurement tools. In human studies, where ease of communication aids measurement tools, tissue texture features palpated by the practitioner are still the biggest influence in the osteopath's treatment focus and technique choice. The tissue characteristics comprising tenderness to palpation, asymmetry, restricted motion and texture change are still seen to provide osteopathic practitioners with the greatest information about the patient's current condition (Kuchera, 2007). Considering this major palpatory influence even in human studies where communication is straightforward, verbal communication may be less crucial than we think.

It is important to note that while hands-on therapy is the most recognisable part of manual therapy, including OM, it is not absolute. Lasting treatment effects can be achieved through applying osteopathic principles and practice to factors such as exercise routines, lifestyle changes and owner-facilitated involvement. A multimodal approach to canine OA is recognised as best practice, including medication/supplements, weight management and rehabilitative exercise (Packer, 2020). Before the initiation of hands-on intervention it is important to gain as much information as possible, in order to develop the best treatment plan. Information is gained through a thorough case history followed by a gait analysis and physical examination. The treatment plan formulated through these findings will not be limited to hands-on OMT but will consider total patient care. Realistic goals are important and should be decided on between owner and practitioner (Packer, 2020).

Conclusion

This paper has attempted to draw on the literature that currently exists to answer the question of whether osteopathic intervention is effective in the management of canine OA. The lack of research specific to this topic is obviously limiting when considering current knowledge. As it stands, there is more research on OMT in the management of human OA, and this has largely heeded positive results. Studies have identified OMT as being effective in reducing chronic pain, improving mobility of OA affected joints and improving quality of life of the affected person. Specific OMT techniques performed in canine studies, outside of OA, have shown statistical significance in their effectiveness. The techniques applied in both human and canine OMT are similar, and both draw on fundamental osteopathic principles in practice to address body unity, improve the reciprocal structure and function relationship and aim to restore body homeostasis. Canine OA is currently treated using medication, lifestyle change and exercise. Studies have demonstrated that OMT can reduce the need for as much medication, thus limiting potential adverse side effects. OMT is a form of hands-on manual therapy however practitioners also offer lifestyle advice, exercise plans and owner education. In attempting to answer the research question, other questions have arisen. One question is does the canine population experience the same psychosomatic relationships to chronic pain that humans do? It was difficult to find evidence for central nervous system plasticity involved in chronic pain sensitization in canines. This may be a consideration significant in the future management and treatment of canine OA. Or, they may just be more simple beings than we humans are. In conclusion, there is a definite need for more research to confidently answer the thesis question. This research needs to consider the holistic care involved in OM, the pain mechanism and experience of canine OA, and the best way to both subjectively and objectively measure osteopathic intervention. The available literature and research so far shows signs of OMT having a well-founded place in the overall management of canine OA.

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