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Physiotherapy and rehabilitation in geriatric dogs and cats

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ABSTRACT

This review aims to give current approach about physical therapy and rehabilitation of the geriatric dogs and cats. The word "geriatric" refers to the medicine of the elderly and it is used in veterinary medicine for animals that have completed 75% of their lifespan. As the size of an animal increases, the age at which they become geriatric decreases, therefore; geriatric age varies amongst different species and breeds. Homeostatic changes occur with increasing age and some diseases such as obesity, tumor formation, orthopedic, cardiovascular and neurological disorders are frequently seen. Some breeds are genetically predisposed to such diseases. Thus, regular screening tests and clinical examinations are important for early diagnosis. Geriatric physiotherapy is a developing field that is noninvasive and, in some cases, can be used as a form of primary treatment or supportive treatment. Physiotherapy prevents muscle atrophy and reduces pain caused by inflammation all the while improving the patient's quality of life. There are many different methods used in physiotherapy; TENS and NMES devices, passive and active range of motion exercises, hydrotherapy, acupuncture, massage, laser therapy, ECSWT and cryotherapy. However, treatment protocols are tailored by physicians to fit each patient's needs depending on the disease and severity of the disease to be treated.

Keywords: *Physical therapy modalities, Geriatrics, Musculoskeletal diseases, Obesity, Cardiovascular diseases, Nervous system diseases*

INTRODUCTION

Terms such as elderly or aged are commonly used in human medicine, however; there were no such classifications available for animals before the 21st century. In the 21st century, as a result of the advancements in veterinary science, the term "geriatric" was also applied to animals (Davies, 1996). The American Animal Hospital Association used the term "geriatric" for dogs who have exceeded 75% of their expected lifespan in the 2019 Canine Life Stage Guidelines (Creevy et al., 2019). In 2021, The American Animal Hospital Association (AAHA) Feline Senior Life Stage Guidelines, it was mentioned that cats over 10 years of age are defined as geriatric (Quimby et al., 2021). The age for being considered a geriatric differs in different animal species, and even in the same species depending on the breed. Large breed dogs weighing >45 kg can be defined as geriatric at approximately 7 years of age, although small breed dogs weighing lower than 10 kg are geriatric in 12 years of age (Altınkaya, 2022; Quimby et al., 2021; Vogt et al., 2010). However, it is important to recognize that both the environment and genetics play a role in the aging process demonstrated in the tables (Davies, 1996).

1. Diseases Observed in Geriatric Animals

Geriatric animals are at an increased risk of acquiring diseases due to decreased strength, diminished body homeostasis, and declined

energy reserve (Ward et al., 2016). Therefore, veterinarians should examine geriatric animals more often and perform additional tests such as blood analyses, radiography and ultrasonography to detect possible disorders and delay the onset of disease. Although two different animals may have the same disorder, they might not show the same symptoms clinically (Mosier, 1989).

Veterinarians commonly fail to acquire a proper history from owners since owners believe that some signs are normal and related to aging. Thus, it is vital to apply a clinical examination along with the suitable laboratory tests in order to detect the disease (Pati et al., 2015). For this purpose, screening tests are desirable and widely recommended (performed annually for middle-aged patients and semi-annually for healthy geriatric patients) (Davies, 2012; Dhaliwal et al., 2023).

Diseases associated with the aging process include degenerative joint diseases, periodontal disorders, heart-related diseases, obesity, disorders related to the endocrine system, kidney disorders, and neoplasia. In addition, externally visible changes such as graying of the hair, alopecia, thickening of the foot pads/callus formation, and loss of elasticity of the skin would be observed (Pati et al., 2015).

Physical therapy is a treatment choice in most geriatric patients for pain reduction, improving functional movement, and quality of life (Frye et al., 2022). Therapists can also provide the optimal exercises necessary to renew neural pathways and improve joint mobility and muscle function (Carmeli, 2017; Fransen, 2004).

2. Physiotherapy in Orthopedic Diseases

With advanced age, muscle atrophy can be observed alongside structural changes in cartilage tissue. Naturally, their physiological reserves are depleted, thus; recovery after injuries will slow down or will be completely absent (Pecina et al., 2013). Due to these changes, many orthopedic diseases are observed in geriatric animals but the most remarkable observation is osteoarthritis (Beale, 2005). Dogs commonly present with osteoarthritis caused by natural aging which in some cases leads to crepitus, this phenomenon is less seen amongst cats (Dhaliwal et al., 2023). However, more than 60% of cats older than 6 years have osteoarthritis which is not easily diagnosed during a physical examination since the cats use behavioral change strategies to disguise pain instead of developing lameness (Slingerland et al., 2011). Other disorders such as cranial cruciate ligament diseases or hip dysplasia occur secondary to osteoarthritis (Mille et al., 2022).

1.1 Osteoarthritis

Osteoarthritis is a chronic progressive degenerative joint disease (Bland, 2015; Kurt et al., 2023). It is the most common and most painful disease that is seen in geriatric dogs (Anderson et al., 2018; Capon and Dycus, 2018). 20% of dogs suffer from osteoarthritis and this number increases up to 80% in dogs over 8 years of age (Capon and Dycus, 2018). Obesity and advanced age increase the severity of the disease (Altınkaya, 2022). Clinical signs observed in dogs include lameness, difficulties in jumping or climbing stairs, crepitus, joint pain, and swelling. If the condition becomes chronic, a further decrease in the range of motion is seen. Cats show similar clinical signs to dogs, but try to hide their pain due to instincts (Slingerland et al., 2011). The most common clinical sign of osteoarthritis in cats is decreased activity (Yamazaki et al., 2020). Treatment should consist of a combination of non-steroid anti-inflammatory drugs, painkillers, weight control, physiotherapy and rehabilitation, joint supplements, and/or pharmaceutical injections to the joints. In some certain cases, surgical treatment such as total joint replacement, excision arthroplasty or arthroscopy may be needed (Bland, 2015).

The goals of physical therapy in osteoarthritis are to reduce pain, enhance muscular function, and maintain the function of the joints (Mille et al., 2022). Environmental modifications depend on the individual needs of the patient. For bedridden patients, since they spend most of their time in bed, soft bedding is highly recommended to avoid ulcerations. Owners can use support slings as well to raise and ambulate the patients safely. Also, carpets or rubber mats should be placed in order to avoid injuries (Jhonson et al., 2020).

Suitable exercises should be chosen for each patient to avoid worsening of osteoarthritis. For obese animals, the first step should be weight loss since the joint load must be decreased (Capon and Dycus, 2018).

Home exercise programs can include strengthening, proprioceptive exercises, and balancing exercises. Strengthening exercises can include sit-to-stand exercises, exercises with elastic bands or carpal weights, and regular walking on

different types and inclines of terrain. Passive range of motion techniques can be used in a home environment to improve joint health (Goldberg, 2022). Massage is commonly used by physiotherapists at the beginning of therapy sessions due to its pain-relieving effect. Physiotherapists should teach owners about basic massage techniques so that they can apply these techniques at home on geriatric osteoarthritic dogs (Mille et al., 2022). Lastly, especially overweight patients, may benefit from aquatic therapy since it provides high-intensity low-impact exercise (Song and Oh, 2022).

When starting physiotherapy, muscles, and joints that are about to be treated must be warmed up in preparation, which will increase the blood flow to the area and support flexibility. Heat bags or a warm bath up to 42 °C can be used which will warm tissue 1-2 cm under the skin (Altınkaya, 2022). Another method of warming up tissue is the use of therapeutic ultrasound on a continuous mode of 1 and 3 MHz. This affects deeper tissues (5cm under the skin). Since the heating effects of therapeutic ultrasound have a short duration, they are applied right before or during the stretching process (Mille et al., 2022; Nakano et al., 2012). After warming up the tissue, stretching exercises should be performed since they will prevent stiffness after rehabilitation (Park et al., 2018). In addition, electrical stimulation methods such as NMES and TENS can be applied. NMES is mainly used in cases where patients are in too much pain or are significantly weak to the degree that they cannot perform given exercises (Mille et al., 2022). TENS is used due to its analgesic effect (Pedersen et al., 2024). After TENS application, certain exercises are suggested such as walking on a treadmill or underwater treadmill, climbing stairs, or controlled walking with a leash (Altınkaya, 2022). Underwater treadmills are valuable for physiotherapists since with the help of water, friction forces that move through the joints will decrease and the patient will move more freely (Tomlinson, 2012). However, hydrotherapy can tire out the cardiovascular system of the geriatric dogs, thus; physiotherapists should be cautious to avoid putting too much pressure on the patient. Also, obese geriatric dogs may have an increased respiratory rate during therapy, thus; respiration should be monitored (Goldberg, 2022). After each session, the patient should be allowed to cool down for 5 to 10 minutes with low-tempo walking for 3-5 minutes followed by stretching exercises (Mille et al., 2022).

1.2 Cranial Cruciate Ligament Deficiency

Cranial cruciate ligament disease is commonly seen among dogs and it is almost always degenerative (Frye et al., 2022). Common causes in geriatric dogs include mild trauma caused by daily mechanical wear and degenerative changes in the fibers. Contributing factors are obesity, sterilization, and being from a certain breed such as Rottweilers, Terriers, Mastiffs, Saint Bernards, Mastiffs, and Retrievers (Spinella et al., 2021). Canine cranial cruciate ligament disease disrupts the normal range of motion and hindlimb properties leading to lameness. Moreover, it increases the tendency and rate of progression of osteoarthritis (Comerford et al., 2011). The ideal solution for cranial cruciate ligament disease is tibial plateau leveling osteotomy surgery since direct ligament replacement is not very successful in dogs (Frye et al., 2022). During the post-operative management (up to 2 weeks), rehabilitation should be provided with icing of the incision and its surroundings, massage, gentle stretching, passive range of motion, and controlled leash walks for 5 minutes twice a day (Monk et al., 2006). Backward walking, high stepping, wobble/rocker board, and neuromuscular electrical stimulation of the quadriceps and semitendinosus muscles are performed between the 2nd and the 4th week. For 4-6 weeks post-operatively, an underwater treadmill twice a week is recommended. In weeks 6-8, an inclined land treadmill can be added to the program. Also, figure 8 walking 2 to 3 times a week can be added to the schedule since it would help the dog regain balance and the ability to use surgical legs (Frye et al., 2022).

1.3 Tendinopathies

Tendinopathies are conditions that cause pain near the tendons which occur as a result of aging or chronic trauma (Andres and Murrell, 2008; Canapp et al., 2016). They are commonly observed in retired canine athletes and geriatric dogs. Clinical symptoms include stiffness of gait, lameness, missing jumps/obstacles, and decreased extension of the stifles. Many cases do not require surgical interventions because of the availability of physiotherapy and rehabilitation (Baltzer, 2012).

When diagnosed early, rest and ice therapy are applied alongside anti-inflammatory drugs. The patient may also benefit from therapeutic

ultrasound (pulsed mode, 3.3 MHz, 2.0W/cm^2, five minutes twice weekly), laser (12 joule/cm^2 daily), and pulsed electromagnetic field therapy (Prydie and Hewitt, 2015). In order to reduce inflammation and swelling, cryotherapy should be applied to decrease the blood flow and tendon metabolic rate (Edge-Hughes, 2016). In chronic cases, shockwave therapy is applied since it leads to neovascularisation which promotes the healing process (Canapp et al., 2016; Millis and Ciuperca, 2015). In addition to these therapies, aquatic therapy is added to the schedule to help develop proprioceptive skills (Barnicoat and Wills, 2016).

1.4 Canine Hip Dysplasia

Canine hip dysplasia is a developmental anomaly that causes joint inflammation and is likely to cause excessive cartilage wear and osteoarthritis (Mikkola et al., 2019; Schachner and Lopez, 2015). It is commonly seen in large breed dogs such as Mastiffs, Boxers, Saint Bernards, Labrador Retrievers, and German Shepherds (Hou et al., 2013). In comparison to dogs, hip dysplasia is rarely seen in cats (Perry, 2016). Diagnosis is confirmed when pain and laxity occur during the external rotation and abduction of the hip joint. In geriatric patients, laxity is not easily recognized because of fibrous tissue proliferation (Güzel and Altunatmaz, 2006). Bunny hopping is a typical sign, alongside lameness, decreased physical activity, reluctance to jump, pelvic muscle atrophy, and swaying gait. In addition to the clinical signs and physical examination, radiography is also used, and common techniques are Nornberg angle examination, distraction index calculation, hip-extended radiography, and dorsal acetabular rim view examination (Butler and Gambino, 2017; Fry and Clark, 1992).

Surgery and conservative therapies are among the methods of treatment. The main goal of the treatment is to minimize the progression of osteoarthritis (Schachner and Lopez, 2015). Surgical treatment methods include triple pelvic osteotomy, juvenile symphysiodesis, femoral head and neck excision, intertrochanteric osteotomy, Shelf arthroplasty and total hip replacement (Bergh and Budsberg, 2014).

Physiotherapy for pain management includes cold therapy, massage, low and high-level heating. Icing therapy should be applied after range of motion exercising and prior to bedtime for 10 to 15 minutes (Dycus et al., 2017). Massage therapy helps reduce muscle tension, thus; relieving myofascial pain (Riley et al., 2021). While low-level heat (elevation of tissue temperature by 1–2°C) provides vasodilation and normalizes blood flow, high heat (elevation of tissue temperature by 3–4°C) helps increase the effectiveness of stretching (Corral, 2018).

Active and passive range of motion along with stretching exercises should be applied as a part of the patient's daily exercises since they provide increased flexibility, adhesion prevention, improved extensibility, increased blood and lymph flow, improved synovial production and maintained mobility (Dycus et al., 2017). Moreover, Cavaletti rail walks and sit-to-stand exercises can help improve range of motion and they can be performed during clinical therapy or as home exercises (Corral, 2018; Charalambous et al., 2022).

Figure 1. Physio-ball exercise in a geriatric dog

Geriatric patients with hip dysplasia also suffer from decreased proprioception; thus, balance exercises should be integrated into the rehabilitation program (Dycus et al., 2017).

Following these exercises, when the patient is physically stronger, perturbation exercises are performed (Saunders, 2007). In addition to balance and perturbation exercises, there are other tools with similar therapeutic effects, such as balance boards, wobble boards, exercise balls, and rolls (Figure 1). Another option is for the patient to walk on foam rubber, mattresses, or trampolines, since the surface texture is different, the patient will regain its proprioceptive abilities (Weigel and Millis, 2014). Aquatic therapy will also help with the rehabilitation process and relieving of the symptoms (Millis and Ciuperca, 2015).

Physical modalities such as therapeutic ultrasound, electrical stimulation, laser therapy, and extracorporeal shockwave therapy are performed by physicians as part of hip dysplasia therapy (Corral, 2018). Treatment protocols vary but therapy starts with 6 sessions done over 3 weeks (Dycus et al., 2017).

1.5 Patellar Luxation

Patellar luxation is common amongst dogs, especially in smaller breeds such as Terriers, Malteses, Chihuahuas, and Poodles (Harasen, 2006). In cats, it is not as common as in dogs, but some breeds such as Abyssinians, Devon Rexs, and Siameses have a higher tendency to present with a dislocation in the patella (Cerna et al., 2021). Medial luxations are more commonly observed than lateral dislocations in small breeds, while lateral luxation is more common in larger or giant breed dogs (Harasen, 2006).

The clinical signs mostly include lameness, skipping gait, and backward stretching of the leg (Harasen, 2006). There are 4 grades of luxation: grade I, grade II, grade III, and grade IV (Lara et al., 2018). In grade I, the patella is displaced but returns to its normal position with certain maneuvers. With limited exercising, the dog can tolerate luxation but is more likely to develop osteoarthritis as they age. In grade II, the patella is displaced and remains luxated until stifle extension or manual replacement takes place (Perry and Dejardin, 2021; Roush 1993). In grade III, the patella keeps luxating and even after manual replacement to its anatomical position, it spontaneously dislocates when manual pressure is removed. In grade IV, there is continuous luxation and the patella cannot be replaced manually. Thus, in grades III and IV, the patient displays persistent lameness and an abnormal gait (Roush, 1993). Depending on the case, soft tissue techniques (medial desmotomy, lateral imbrication, antirotational sutures, and release of medial musculature) and/or osteotomy procedures (tibial tuberosity transposition, trochleoplasty) can be performed for treatment (Harasen, 2006).

Cold packs (as a form of cryotherapy) can be used since they have analgesic effects and can reduce inflammation (Wiputhanuphongs et al., 2015). Due to the decreased temperature, vasoconstriction of the vessels will occur. Moreover, nerve conduction decreases, thus; muscle spasms reduce (Kwiecien and McHugh, 2021). TENS, acupuncture, laser therapy, or therapeutic ultrasound can be used as professional approaches. After the pain is under control, it is important to focus on strengthening hindlimb muscles, especially the ones opposing the dislocated side (Akaraphutiporn et al., 2024). For lateral luxation, the treatment should be focused on the sartorius and adductor muscles, while for medial luxation, the main focus is on the gluteal area and biceps femoris. For hindlimb muscle strength, 3-legged stands, 2-legged stands, inclined stands, sit-to-stand, uphill walking, side stepping, and underwater treadmills exercises are recommended (Maddox, 2017).

In some cases, when physiotherapy is not sufficient, surgery is required. Also, during the early postoperative stages, several methods of physical rehabilitation are used, such as passive range of motion, massage, and cryotherapy. While in the late recovery period, warm therapy and active exercises are applied (Perry and Dejardin, 2021).

2. Obesity and Physiotherapy

Obesity is defined as an excessive amount of fat that accumulates within white adipose tissue which results in impairment of normal body function (Moraitou et al., 2014). Currently, 65% of dogs and 63% of cats are diagnosed with being overweight and obese (Purina Institute, 2024). Some breeds of dogs (Pugs, Beagles, Retrievers, and Dachshunds) have a higher tendency to become obese (Pegram et al., 2021). Breeds of cats that are at greater risk include mixed breeds, Manxes, British Shorthairs, Norwegian Forest Cats, and Persians (Öhlund et al., 2018; Purina Institute, 2024). While age varies amongst species, most obese dogs are between 5 and 11 years old (Lund et al., 2006). While obesity causes osteoarthritis, renal diseases, skin diseases, neoplasia, oral cavity diseases, and insulin resistance in dogs, in cats it leads to dermatological problems, diabetes

mellitus, neoplasia and urolithiasis (German 2016; Loftus and Wakshlag, 2015). The most common obesity-related disease in dogs is osteoarthritis (Purina Institute, 2024).

In veterinary clinics, evaluation of obesity is achieved by body condition score (BCS). Body condition scoring is an indirect way to evaluate the body fat accumulation. BCS can be determine by visual observation and palpation of the animal's body. For dogs, the optimal BCS is between 4/9 or 5/9 and over 7/9 is obese, while for cats, the ideal score is 5/9, and over 7/9 is obese (Chun et al., 2019; Santarossa et al., 2017).

For the management of obesity in senior pets, owners should maximize activity and choose a correct diet (German, 2016). Before the arrangement of an activity program, a detailed interview about the patients' medical history is conducted with the owner since physiotherapy methods can change in case of some disorders. Activity levels are to be safely increased depending on the patients' current physical ability. Owners can also provide an activity-promoting environment. For example, owners can take their dogs out for a walk at least twice a day regardless of their age. In the case of dogs that are more lenient to water exposure, controlled low-impact swimming can be helpful as an alternative to walking (Brooks et al., 2014). In clinics; land-based exercises, joint manipulation, treadmills, underwater treadmills, and acupuncture can be applied (Chauvet et al., 2011; Fernandes et al., 2022). If an obese animal has osteoarthritis; laser therapy, massage therapy, and acupuncture can be incorporated into their physiotherapeutic program for pain management (Mille et al., 2022).

Activities for cats should be provided through playing, puzzle feeders, and challenging them to find hidden food. Since cats have short bursts of energy, owners need to provide toys that will stimulate their predatory instincts (German, 2011; Zoran, 2009). Physical rehabilitation for feline species is challenging, especially when water is involved. Thus, sessions should be brief and the environment should be quiet in order not to promote stress. Although activity through playing is the most effective way of losing weight, in case of need of physical therapy, land-based and water-based exercises are performed (Goldberg, 2016).

3. Cardiovascular Diseases and Physiotherapy

Dogs are 1,5 times more likely to develop cardiovascular disorders as they age by one year (Inoue et al., 2016). Thus, cardiovascular diseases are frequently encountered in geriatric populations and they are the 2nd most common cause of death in dogs (Kosic et al., 2017).

Geriatric patients usually have a sedentary lifestyle which increases the prevalence of obesity, and promotes cardiac diseases (Lee et al., 2022). Heart failure is one of the most common cardiovascular diseases in senior dogs and is frequently caused by dilated cardiomyopathy, valvular diseases, hypertrophic cardiomyopathy, atherosclerosis, and diabetic cardiomyopathy (Çolakoğlu et al., 2022; Turgut et al., 2017). The incidence of mitral valve disease increases as the animal ages, with a much higher prevalence in small breeds and males, while large breeds are mainly affected by dilated cardiomyopathy (Gaar-Humphreys et al., 2022; Parker and Kilroy-Glynn, 2012).

Physiotherapeutic exercising has a positive impact on cardiovascular health (Dibben et al., 2021; Taylor et al., 2022). In a study conducted on rodents, it has been proven that exercise training protects the heart from cardiac injuries such as heart failure or diabetic cardiomyopathy (Bei et al., 2021).

In humans, low-energy extracorporeal shockwave therapy was found useful for improving angiogenesis and myocardial perfusion significantly in patients with refractory angina. Although exact mechanism under the angiogenesis effect of the shockwave is still unknown, it is thought to be mediated through vascular endothelial growth factor (VEGF) and endothelial nitric oxide synthase (Prasad et al., 2015). Another safe option for physiotherapy of cardiac patients is low-level laser therapy. It is noninvasive and it enhances cardiac function, myocardial contractility, myocardial reserves, coronary reserves, and aerobic reserves (Sayed et al., 2023). In addition, it helps with the treatment of ischemic regions of the heart and enhances anastomosis (Karvandi, 2021).

Since TENS affects the heart rate through the vagal nerve, it is believed that it should not be used on cardiac patients (Hsieh et al., 2021). Ganguie et al. (2017) conducted research on humans regarding the effects of TENS on congestive heart failure patients who are not able to perform aerobic exercises. However, the results have shown that the patients to which TENS was applied walked significantly more than the others without any major difference in systolic and diastolic blood

pressures (Ganguie et al., 2017). But up to now, despite the promising results of some studies, electrotherapy applications to animals with cardiac diseases are controversial (Ağırman and Aydın, 2018; Badger et al., 2017). In practice, physical therapists hesitate to use TENS on cardiac patients due to the lack of sufficient research on the effect of TENS application on cardiac patients. If these methods will be used, patients should be monitored carefully by therapists and physicians for the potential side effects during Treatment. Pacemakers are a definite contraindication for the use of electrical stimulus (Hoshiai et al., 2021; Lago et al., 2018).

Precautions must be taken during the use of cryotherapy in patients with impaired circulation and cardiac insufficiency. Also, in geriatric animals, thermal regulation or pain reception may be impaired, therefore; patients with diminished cardiovascular reserves may have a lower heat tolerance (Dragone et al., 2014). Moreover, therapeutic ultrasound directed at the heart should be avoided, as well as on patients with cardiac pacemakers since electrocardiographic changes can occur (Rennie, 2010).

4. Neurological Diseases and Physiotherapy

In geriatric animals, many neurological diseases can be observed, namely degeneration of intervertebral disks, cervical spondilomyopathies, degenerative myelopathies, spinal neoplasias, cognitive dysfunctions, and instability of lumbosacral vertebras (Bagley, 1997). The most common type of spinal disease in dogs is intervertebral disk disease (Hermansen et al., 2022). It is more commonly seen in dogs compared to cats (Amey et al., 2024; Sharp, 2012). During the neurological evaluation, the Modified Frankel Score is commonly used (Hermansen et al., 2022). Conservative management of intervertebral disk disease for grades 1 to 3 in dogs is highly successful (90%), for grade 4, the success rate is only 50%, and for grade 5, the response to conservative management is poor (Olby et al., 2022). The severity and type of disorder guide physicians to the method of treatment, some cases might require surgery and the use of anti-inflammatory drugs, while others may not, but regardless, physical therapy is recommended (Jeong et al., 2019; Nicholson, 2016; Olby et al., 2020).

In the acute phase of treatment of non-ambulatory patients, rehabilitation aims to improve the musculoskeletal system (Moore et al., 2020). Physical therapy exercises include standing exercises, range of motion exercises, pain control, toe pinch exercises, and the use of underwater treadmills (Olby et al., 2020). The goal of standing exercises is to strengthen the hip joints, strengthen the stifle joints, regain balance, and regain proprioception (Figure 2) (Brantberg et al., 2023). For this purpose, slings or Hoyer lifts can be used. Toe pinch exercises aim to stimulate flexor reflex and they can be combined with passive range of motion exercises (Drum, 2010).

During the acute phase of treatment, ambulatory patients can benefit from the exercises that are normally applied for non-ambulatory patients, however; they also require additional exercises such as sling-assisted walking, Cavaletti rails, and physio roll balancing (Drum, 2010). Attention must be paid to the placement of the foot since some patients might not be able to place their feet in the proper position. In this case, specially designed boots or white medical tape can be used to provide correct foot positioning (Sims et al., 2015). Cavalatti rails not only strengthen the hip and stifle flexors but also enhance neuromuscular coordination (Weigel and Millis, 2014). Physioroll and physioball balancing help regain coordination and proprioception (Millis et al., 2014).

Figure 2. Proprioceptive, standing and shifted weight-bearing exercise on a balance disc in a dog with intervertebral disc disease.

After the acute phase of rehabilitation, the animals' neurologic condition improves, and advanced exercises such as stair climbing, carrying/pulling weights, walking on different surfaces, hill climbing, and swimming against resistance are added to the therapy schedule (Drum, 2010). In

addition to active exercising, electrical stimulation, cryotherapy, and ultrasound have a role in neurologic rehabilitation (Spinella et al., 2022). However, they should not replace active exercising (Packer et al., 2016). During the acute phase of treatment for both ambulatory and non-ambulatory patients, TENS can be used post-operatively on incision lines and NMES can be combined with exercising to maximize muscle contraction (Drum, 2010). If there is muscle or joint contracture that delays recovery, patients can benefit from continuous ultrasound (Morishita et al., 2014). Cryotherapy is commonly used immediately in the postoperative period in order to reduce inflammation and pain (Olby et al., 2020). Lastly, acupuncture has an analgesic effect and it increases brain-derived neurotrophic factor, provides neuroprotection, reduces cell death of neurons, and reduces expression of proinflammatory mediators (Miao et al., 2023). It is recommended to start acupuncture therapy during the acute phase of a neurological disorder or early after injury/surgery (<72 hours), however; the most prominent recoveries are observed when applied within 24 hours after injury (Frank and Roynard, 2018).

Satisfactory results of physiotherapy are obtained approximately within 40 sessions. For instance, in traumatic spinal diseases, results are obtained after 20-30 sessions, and in the case of degenerative spinal diseases, it takes around 80 sessions (Henea et al.,2020).

Degenerative myelopathy is a central nervous system disease that severely affects the thoracic spinal cord segments (Bouche et al., 2023; Coates and Wininger, 2010). It is caused by a genetic mutation in the superoxide dismutase 1 gene and mainly affects geriatric dogs (Awano et al., 2009). Unfortunately, no specific medication is available for these cases. However, affected dogs can benefit from physiotherapy which improves their quality of life and survival rates (Kobatake et al., 2021). A nonrandomized study showed that extensive physical therapy largely enhances mobility and helps patients maintain mobility for a longer period which results in significantly increased survival periods (a mean of 255 days). The same results were not obtained with moderate or absent physical therapy (130 days and 55 days respectively) (Thomas et al., 2014).

CONCLUSION

There is an increasing trend to treat orthopedic and neurologic diseases as possible as conservatively. In this concept physical therapy has a pivotal role since it is non-invasive, relatively low costed, and also its promising results were shown. In geriatric small animals improved muscle strength, mobility and all in all quality of life may be achieved by physical therapy interventions. Joint flexibility and reduced pain can specifically be attained through exercise, therapeutic modalities, aquatic therapy, massage therapy, and cryotherapy. Overall, physiotherapy is a promising field due to its valuable therapeutic potential for managing age-related diseases. Physiotherapy should be recommended as a part of the standard care protocol for geriatric animals. Specific tailored programs for each individual patient can be developed considering their limitations and specific needs. Further exploration and research are ongoing to deeply understand the long-term effects and optimal frequency of physical therapy sessions.

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