

## **810 nm Low-intensity laser in the treatment of degenerative articular disease associated with kinesiotherapy and chondroprotectors – Case report**

**Laser de baixa intensidade 810 nm, no tratamento de doença articular degenerativa associada à cinesioterapia e condroprotetores – Relato de caso**

**Láser de baja intensidad de 810 nm, em el tratamiento de enfermedades articulares degenerativas asociadas a cinesioterapia y condroprotectores – Reporte de caso**

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### **Abstract**

Degenerative Joint Disease (DJD), also known as Osteoarthritis (OA), is a chronic disease of progressive degeneration for which there is no cure, which can occur in one or more joints in the body, usually caused by overweight of the animal, longevity, instability, incongruence or by injury to the articular cartilage itself. Adult and senile dogs may be affected by this disease as a result of obesity, hormonal disease, natural wear of the joints. In this case, the most affected joint processes are in the pelvic limbs, in the knees and in the hip joint, in the thoracic limbs and in the elbow joints. This work aims to describe the Low Intensity Laser (LIL) efficacy of treatments associated with kinesiotherapy and chondroprotective drugs, performed on a female canine dog affected by this disease in her hip joint and to evaluate this methodology as one of the therapeutic choices more appropriate and less aggressive for the treatment of this disease.

**Keywords:** Degenerative joint disease; Osteoarthritis; LIL; Joint cartilage; Kinesiotherapy.

### **Resumo**

A Doença Articular Degenerativa (DAD), também conhecida como Osteoartrite (OA), é uma doença crônica de degeneração progressiva para a qual não há cura, que pode ocorrer em uma ou mais articulações do corpo, geralmente causada pelo excesso de peso do animal, longevidade, instabilidade, incongruência ou por lesão da própria cartilagem articular. Cães adultos e senis podem ser afetados por esta doença como resultado de obesidade, doenças hormonais, desgaste natural das articulações. Nesse caso, os processos articulares mais afetados estão nos membros pélvicos, nos joelhos e na articulação do quadril, nos membros torácicos nas articulações do cotovelo. Este trabalho tem como objetivo descrever a eficácia do Laser de Baixa Intensidade (LBI) como tratamento associados à cinesioterapia e condroprotetores, realizados em uma fêmea canina acometida por esta doença na articulação do quadril e avaliar esta metodologia como uma das opções terapêuticas mais adequadas e menos agressivo para o tratamento desta doença.

**Palavras-chave:** Doença articular degenerativa; Osteoartrose; LLLT; Cartilagem articular; Cinesioterapia.

### **Resumen**

La enfermedad degenerativa de las articulaciones (EDA), también conocida como osteoartritis (OA), es una enfermedad crónica de degeneración progresiva para la que no existe cura, que puede ocurrir en una o más articulaciones del cuerpo, generalmente causada por el sobrepeso del animal, la longevidad, inestabilidad, incongruencia o por lesión del propio cartilago articular. Los perros adultos y seniles pueden verse afectados por esta enfermedad como consecuencia de la obesidad, enfermedad hormonal, desgaste natural de las articulaciones. En este caso, los procesos articulares más afectados se encuentran en las extremidades pélvicas, en las rodillas y en la articulación de la cadera, en las extremidades torácicas y en las articulaciones del codo. Este trabajo tiene como objetivo describir la eficacia del Láser de Baja Intensidad (LBI) de los tratamientos asociados a la kinesioterapia y los

condroprotectores, realizados en una canina afectada por esta enfermedad en la articulación de la cadera y evaluar esta metodología como una de las opciones terapéuticas más adecuadas y adecuadas menos agresivo para el tratamiento de esta enfermedad.

**Palabras clave:** Enfermedad articular degenerativa; Osteoartritis; LLLT; Cartilago articular; Kinesioterapia.

## 1. Introduction

Degenerative joint disease is common in companion animals such as dogs and cats, being a slow development chronic degenerative disease, for which there is no cure. It affects mainly the cartilage of synovial joints and can be divided into two classes: primary (or gene), derived from the cartilage aging and atavistic disorders such as dysplasias, or other providing joint instability, and the secondary, proceeding circumstances that stimulate destabilization or overloading of joints (Gomes, Colpani, Almeida & Queiroz, 2020).

Diagnosis of this condition is usually obtained by anamnesis, analysis of patient's history and physical examination when the presence of animal joint pain can be observed. Restriction in animal's mobility, crackling to flex and extend the members, and possibly an increase in volume in the affected site are frequent symptoms. Additional tests, such as X-ray, computed tomography, ultrasound, magnetic resonance, synovial fluid analysis, among others, help in the diagnosis of disease (Gomes *et al.*, 2020; Silva, 2012).

When affected by this disease, joint cartilage undergoes lysis of proteoglycans and interlaced collagens, thus increasing the amount of water in the joint capsule (lymphoplasmacytic infiltration), causing necrosis of chondrocytes and reduction of its consistency, resulting in an abnormality of joint face, potentially exposing the subchondral bone occur if the progression of this factor (Melo *et al.*, 2008).

As a consequence, the cartilage components of the joint try to prevent the matrix degradation process, caused by proteolytic enzymes that mediate inflammation, thus delaying its degeneration. To assist in this process against cartilaginous degeneration, some drugs have been shown to prevent and reduce the pathological expansion of osteoarthritis, and may complement the treatment of DJD, stimulating the synthesis of proteoglycans and collagen capable of increasing chondrocytes proliferation and matrix biosynthesis (Vieira *et al.*, 2010). In addition, due to the fact that there is no cure, physical rehabilitation, supported by physiotherapy resources, becomes almost the remaining indication for these cases, as it helps in attenuating clinical signs, promotes relief of the pain process, controls the progression of the degenerative condition and strengthens the adjacent musculature in order to effectively restore normal activities (Klos, Coldebella & Jandrey, 2020).

A case report related to a dog diagnosed with degenerative joint disease (DJD) in bilateral hip joint, treated with low intensity laser therapy (LIL) associated with therapeutic exercise (kinesiotherapy) and chondroprotective drugs is shown here.

## 2. Methodology

This report is a qualitative, longitudinal, observational, and uncontrolled clinical study (Hocman, Nahas, Oliveira Filho & Ferreira, 2005). The purpose of this case report is to demonstrate that physical agent (LIL) is a unique biomedical tool in the treatment of the degenerative process. It is a non-invasive and non-pharmacological therapy with rapid results and accessible costs for joint disorders treatments in animals (Calin & Coman, 2011).

All the procedures for diagnosing the degenerative condition, as well as the physiotherapy protocol that was recommended and performed on the patient, were previously clarified to the animal's guardian. Consent and authorization for disclosure of data (patient photos, images, and exam reports) were obtained freely and consciously from the patient's tutor, also, all rights are protected.

### 3. Case Report

In November 2020, a castrated female canine, 07 years old, mixed breed, 29.5 kg, white and black coat, considered obese for your size was cared for at the Veterinary Clinic Urbavet - São José dos Campos, SP, Brazil. During physical therapy interview, the owner reported that the animal showed lameness in right pelvic member (RPD) that did not support him when she tried to walk. Also she did not perform the steps correctly, jumping like a rabbit with both hindlimbs during her routine strolls, which took place twice a day.

In the radiographic examination of the pelvic region (Figure 1), a moderate incongruity was found in the bilateral hip joint, more evident in ventral margins of the acetabulum, accompanied by shallower regions, with the presence of bone sclerosis at the edges associated with thickening of the femoral neck and flattening with loss of anatomical conformation of the femur head. However, the pelvis bones were preserved and the patellae were in their respective trochlear grooves. In the computed tomography image of the lumbosacral spine in the L3 and S1 segment region, there were small dorsal bulging of the intervertebral discs between L6-L7 and L7-S1, presenting normal morphology and texture in the region of vertebral bodies, pedicles, laminae, spinous processes, articular and transverse, and the column axis was preserved. Presence of periarticular osteophytes in both hip joints his also been observed. The blood count showed no significant changes, considered within normal limits. In view of the physical and complementary exams, the diagnosis was of degenerative joint disease in the hip joints.

Figure 1. Radiographic image of the hip joint, with evidence of articular incongruity, razing the acetabulum and the presence of bone sclerosis.



Source: author

This patient was taken for rehabilitation treatment and maintenance of body weight, with the use of physiotherapy. In the physical therapy evaluation, a painful condition was found in the pelvic region, shortening of the muscles and muscle atrophy in the right posterior limb. Considering the findings during the physical examination and supplemented by imaging tests, the treatment protocol for the patient has been then defined.

The physiotherapy protocol consisted of Low Intensity Laser (LIL) therapy, associated with kinesiotherapy exercises and prescription of oral chondroprotective medication. Other anti-inflammatory medications for pain control were suspended during treatment with physiotherapy. The animal's diet correction was performed at initiation of treatment, indicating the intake of 300 g of commercial light feed, divided into two portions a day. Natural snacks, vegetables and cooked chicken, in

moderate amounts completed the daily meals. With this diet correction, the goal was to reduce about 5 kg / body weight of the initial weight, which was 29.5 kg, thus reaching ideal weight.

The aim of this physiotherapy protocol in which the LIL associated with dynamic exercises and oral medication was to delay the progression of the degenerative condition, promoting longevity and quality of life, as well as the well-being of the animal. The treatment was performed three times a week, according to the availability of owner and the veterinary team, making a total of 12 physiotherapy sessions.

LIL therapy was used to control the pain and inflammation of the affected joint. The equipment used was an AsGaAl Laser Diode (Eccofibras®), a cluster composed of 3 laser beams, in the spectral range of 810 nm wavelengths, with the parameters shown in Table 1. All the laser parameters adopted in this protocol were based on the recommendations of the WALT (*World Association for Photobiomodulation Therapy*). The application points were chosen so as to surround the entire region of the hip joint - an irradiated area comprised the gluteus medius, tensor fascia lata and the biceps femoris. The cluster was kept in direct contact with the animal's skin. Seven (07) LIL application sessions have been conducted during treatment.

Tabela 1. Parameters used in low-level laser therapy

Parameters	Laser
$\lambda$ (nm)	810 nm
A (cm <sup>2</sup> )	6
$\varnothing$ (cm)	0.1
P (W)	0.15
t (s)	67
E (J)	30
ED (J/cm <sup>2</sup> )	5.025

Caption:  $\lambda$  = Wavelength, A = Area;  $\varnothing$  = Diameter; P = Power; t = time; E = Energy; ED = Energy Density

Source: author

The kinesiotherapeutic exercises, described in Table 2, aimed the recovery of muscle stretching and strengthening support structures and the combined aerobic exercise to maintain body weight (Griffiths, 2014) (Figure 2). The oral medication prescribed understood chondroprotective drugs (Condroplex LB®), Omega 3 and Diacerein 50mg, with cartilage preservation purpose. Kinesiotherapy consists of performing therapeutic physical exercises, with the aid of equipment such as Swiss balls, bean balls, elastic bands, obstacles of various heights, ramps, cones, bars, among others; it can be performed in an assisted and guided manner by the physiatrist. They are fundamental in the recovery and strengthening of the muscles lost due to immobility caused by pain, it improves the amplitude of movements, allowing adequate walking, without causing damage to any other joints. Kinesiotherapeutic exercises should always be adapted for each animal according to their pathology and convenience, in a playful way and respecting their limits (Johnston, McLaughlin & Budsberg, 2008; Coutinho, 2009; Luz, 2018).

Table 2. Protocol of Kinetic exercises

Physiotherapy Technique	Objective	Exercises
Passive therapy	Increased blood and lymph flow Stretching of atrophied musculature	1. Mobilization of all joints of the hind limbs, right and left, followed by stretching.
Proprioceptive exercises and isometrics	Increase in muscle tone Uniform body weight distribution Proprioception of the affected limb	1. Isometric exercises with balance disc and proprioception with peanut ball to improve muscle tone, flexibility and stretching.
Active exercise	Recruitment of the pelvic musculature Correction of load distribution Recovery of synchronous and correct gear ambulation Strengthening of the flexor and extensor muscles	1. Activities with obstacles, using cables between cones and slalom for recruiting pelvic muscles, correcting the distribution of loads between the posterior members and correcting ambulation. 2. "sit and stand" exercises; on a flat surface and on an inclined plane; for strengthening the muscles recruited in flexion and extension of the hind limbs and abdominal muscles as well as the range of motion.
Aerobic exercises	Generalized muscle recruitment Tissue oxygenation Caloric expenditure Body weight reduction	1. Walked for 5 minutes with an elastic band, with light tension, attached to one limb at a time, through moorings between the medial and hip digits for correction and amplitude of movement. 2. Walking, trot and canter, alternately for 2.5 minutes for 05 minutes. 3. Daily tours with pet owners twice a day for 30 minutes.

Source: author

Figure 2. Sequence of active exercises



Source: author

As the pain process had been then kept under control, improvements in joint movements and muscle gain in the pelvic limbs were observed and it was decided to interrupt LLLT applications, maintaining only the kinesiotherapy exercises in the final five sessions. As most of the clinical signs have disappeared and, based on the tutor's report of significant improvement in the animal, discharge from the physiotherapy treatment was granted.

#### 4. Discussion

Degenerative joint disease (DJD) or osteoarthritis is a chronic multifactorial disease joint which can compromise numerous joint synovial by cartilage degradation, and especially knee, elbow and hip joints most affected. It is characterized by restriction of joint mobility accompanied by cracking, inflammation and thickening of the joint capsule, osteophyte

formation, lameness and loss of function (Osorio-Carmona & Faria Rezende, 2014; Silva, 2012). It is divided into two classes: primary and secondary. The primary is originating from hereditary disorders that result in important joint incongruity, compromising the functionality and adequate development of the animal that evolves, secondarily, to DJD. Hip dysplasia condition is an example of this primary class. The DJD classified as secondary comes from circumstances that cause joint inconstancy and overload such as overweight, age, trauma, etc. Among the most common clinical signs of this condition, there is claudication - which can start after exercising, staying for long periods in decubitus, poor performance in activities, reluctance and changes in walking and climbing stairs, these are manifestations that indicate the need for immediate treatment (Schmidt, 2009).

According to de Souza, de Oliveira Saladino and Matera (2010), this pathological condition has treatments aimed at reducing pain and discomfort to the patient as well as the delay of cartilage degenerative process, with no treatments to prevent or reverse changes inherent in the case. When the condition does not require surgical intervention, it is possible to treat and to delay the degenerative process with other techniques and therapeutic approaches, such as LIL.

The treatment of the joint with LIL aimed at controlling the signs and symptoms of pain and improving joint function, promoting cartilage healing. The biomodulatory effects that laser therapy provides to the articular tissue, within suitable parameters, previously selected, promote the increase of electron transport in the mitochondrial membrane favoring the production of ATP, the stimulation of collagen production and the proliferation of chondrocytes, the improvement of morphology cellular tissue, modulating the interaction of the components of the extracellular matrix; the electrical excitation of molecules oxygen-carrying respiratory chain, cell proliferation, tissue regeneration, increased extracellular matrix, inducing the restoration of cellular homeostasis (de Freitas & Hamblin, 2016; Bjordal, Lopes-Martins, Joensen & Iversen, 2010).

During the treatment applied to the patient reported in this case, it was observed that since from the first to the seventh laser application, the improvement of the patient's pain state was noticeable. The laser parameters adopted in this protocol were based on the recommendations of the WALT.

According to de Freitas and Hamblin (2016), organic chromophores, such as cytochrome C oxidase present in the chain IV of the mitochondrial process responsible for cellular respiration, are sensitive to the electromagnetic spectrum in the red and near infrared region. This first interaction of laser light with cytochrome promotes an increase in electron number that reduce molecular oxygen, leading to a consequent increase in the potential of mitochondrial membrane (MMP), production of ATP, cAMP and reactive oxygen species (ROS). When there is any inflammation in the living organism, there is an oxidative stress in cells marked by the increase of ROS and decrease in inflammatory mediators. Thus, when the inflammatory process is treated with LIL, the increase in the potential of the mitochondrial membrane reduces ROS resulting in the protective modulating effect of inflammation (Freitas & Hamblin, 2016; Huang, Sharma, Carroll & Hamblin, 2011). The study by Bjordal *et al.* (2010) demonstrates that anti-inflammatory effect of LIL in wavelengths between 632 and 904 nm wavelengths with doses ranging from 0.6 J/cm<sup>2</sup> and 15 J/cm<sup>2</sup>, act by modulating proinflammatory substances and anti-inflammatory cells consequently assisting tissue remodeling.

The control of pain promoted by LIL inhibits the production of prostaglandins (PGE<sub>2</sub>) and the expression of cyclooxygenase 1 and 2 (COX-1 and COX-2) (Huang *et al.*, 2011) corroborating the results obtained initially in the treatment of this case reported and with the findings in the study by Barale, Monticelli, Raviola & Adami (2020) that used the low intensity laser in 17 dogs with different articular pictures of osteoarthritis accompanied by severe pain, treating with a 808 nm wavelength laser, for a variable duration of 50 seconds to 4 minutes, with a power of 1 W and energy densities that varied between 5 and 4.2 J/cm<sup>2</sup>, and its results show that all treated animals had their pharmacological treatments with anti-inflammatory drugs interrupted or drastically reduced, in addition to point out that the most relevant finding of his study was the improvement in the quality of life of the animals, treated only with low intensity laser, perceived and reported by the tutors

of the animals included in the study. In the present case report, the animal did not receive any anti-inflammatory medication from the group of glucocorticoids or NSAIDs, corroborating the results of Barale *et al.* (2020) and Alfredo *et al.* (2018) who used LIL and exercises to treat knee osteoarthritis in human patients.

The improvement of the animal in the present report treated with LIL was accomplished by the preservation of the articular cartilage by stimulating the proliferation and metabolic activity of the chondrocytes, thus reducing the cellular alterations of the cartilaginous cells and preserving the content of glycosaminoglycans (Felizatti *et al.*, 2019). Corroborating the findings of Forzanfar, Ramezani, Rahpeyma, Khajehahmadi & Arbab (2013) who used a wavelength of 810 nm, a power of 50 mW and an energy density of 4 J/cm<sup>2</sup> in fibroblast cells; and their results showed that there was an expression of proteins and proteoglycans found in cartilage cells and connective tissues. Alves *et al.* (2013), also in his *in vivo* study, where he promoted inflammation of the knees of Wistar rats with papain and treated with 808 nm, 50 and 100 mW, in the dosages of 4 J per irradiated point, had results in the histological findings: increased type I collagen and decreased type II collagen expression and reduced metalloproteases.

The pharmacological therapy instituted for the patient, in this case, had the purpose of assisting in the regression of the cartilage degenerative process, thus reducing the loss of proteoglycans and collagen, stimulating its synthesis, vetoing degrading enzymes, and acting on the inflammation generated by even considered complementary to the treatment of this disease (Johnston *et al.*, 2008; Melo *et al.*, 2008; Vieira *et al.*, 2010).

Due to pain, lameness and consequent disuse of the affected limb, there is atrophy of the musculature that surrounds and supports the joint and the respective limb as a whole. After that, automatically, there is a change in the discharge and distribution of body weight among the other members as an adaptive mechanism. This damages the other lateral and contralateral joints due to overload. In this question, kinesiotherapy is included, which through movement promotes complementary treatment, contributing to the rupture of a vicious cycle, improving the clinical and functional condition, bone density, decreasing pain, improving biomechanics and the reduction of the patient's weight (Marques & Kondo, 1998; Coutinho, 2009). Kinesiotherapy can be active, when performed by the animal, passive, when performed by the physiotherapist, or active assisted, when performed by the patient, however, with the help of the physiatrist. Inherently to kinesiotherapy, there is stretching, which maintains muscle flexibility by providing extension of muscle extension, helps in the preparation of physical exercises, being an important factor for the rehabilitation of injuries, attenuating muscle tensions and improving motor coordination. Before dynamic exercises, the application of LIL helped to promote oxygenation of the worked muscles. This is due to the increase in ATP production and the promotion of tissue neovascularization. A result similar to that found in the work of de Matos Brunelli Braghin *et al.* (2019) in which he treated patients with knee osteoarthritis with laser and exercises, and this combined therapy improved gait, which is a relevant improvement because it is associated with quality of life and independence rehabilitation patients.

Thus, in addition to making the musculature more malleable, the removal of tension and the balance between the extensors and flexors determines a good range of motion and mobility of the soft tissues that surround them, reducing the risk of injury.

## 5. Conclusion

Early diagnosis, supported by clinical examination and complementary imaging tests, helps to speed up the treatment for degenerative joint disease (DJD), which although there is no cure and its origin is multifactorial, when recognized early, has treatments that provide well-being and quality of life for the affected animals.

The use of physical agents such as LIL, associated with kinesiotherapy exercises, allows a non-invasive and effective treatment for animal's rehabilitation with this joint pathology, allowing the animal to perform its usual movements, free of

inconvenience. LIL, associated with kinesiotherapy exercises, treats osteoarticular disorders, as does DJD, because they increase the blood and lymphatic supply of the affected tissues, modulate the painful process, interrupt inflammation, promote cartilage health and prevent muscle atrophy adjacent to the affected joint. Although, studies that elucidate the parameter of such physical agent when applied alone - that is, without being associated with other biomedical equipment - are still needed. Also, new studies must inspire the use of laser therapy in the veterinary medicine field.

In the present case, it was clearly demonstrated that the association of LIL with kinesiotherapy and chondroprotectors was positive for the improvement of this patient with DJD, significantly impacting the quality and longevity of the animal's life.

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