




## USE OF LOW-INTENSITY TRANSOPERATIVE LASER THERAPY (LLLT) IN ORCHIEKTOMIES IN DOGS: EFFECTS ON INFLAMMATION AND ANALGESIA

## USO DE LASERTERAPIA TRANSOPERATÓRIA DE BAIXA INTENSIDADE (LLLT) EM ORQUIECTOMIAS DE CÃES: EFEITOS NA INFLAMAÇÃO E ANALGESIA

## USO DE LA TERAPIA LÁSER TRANSOPERATORIA DE BAJA INTENSIDAD (LLLT) EN ORQUIECTOMÍAS DE PERROS: EFECTOS SOBRE LA INFLAMACIÓN Y LA ANALGESIA

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### ABSTRACT

This article discusses low-level laser therapy (LLLT) as an effective therapeutic tool in the context of orchiectomies in dogs, focusing on its effects on reducing inflammation and providing analgesia. The research is based on the current concept of alternative and complementary therapies in veterinary medicine, which recognizes the potential of LLLT to improve postoperative recovery by promoting healing, pain control, and inflammation modulation. The main objective is to reflect on the benefits of LLLT applied in surgical procedures in dogs, with an emphasis on orchiectomies, and to discuss the most effective protocols for optimizing clinical outcomes. The methodology adopted is qualitative in nature, based on a literature review of academic studies, scientific articles, and recent clinical trials investigating the use of LLLT in veterinary medicine, specifically in minor surgeries. The results indicate that LLLT has been shown to be effective in reducing pain

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and inflammation, promoting faster and more comfortable recovery for animals. It was also observed that the combination of LLLT with traditional analgesics and other treatments can result in more effective management of postoperative pain. It is concluded that low-level laser therapy plays an important role in the recovery of dogs after orchiectomies, being essential to minimize the use of conventional medications and improve the quality of life of animals during the recovery process.

**Keywords:** Low-Intensity Laser Therapy. Orchiectomy. Pain Control. Post-Surgical Recovery. Inflammation.

## RESUMO

O presente artigo aborda a laserterapia transoperatória de baixa intensidade (LLLT) como uma ferramenta terapêutica eficaz no contexto das orquiectomias de cães, com foco nos efeitos sobre a redução da inflamação e analgesia. A pesquisa parte da concepção atual de terapias alternativas e complementares na medicina veterinária, que reconhece o potencial da LLLT para melhorar a recuperação pós-operatória, promovendo a cicatrização, controle da dor e modulação da inflamação. O objetivo principal é refletir sobre os benefícios da LLLT aplicada em procedimentos cirúrgicos em cães, com ênfase nas orquiectomias, e discutir os protocolos mais eficazes para otimizar os resultados clínicos. A metodologia adotada é de natureza qualitativa, com base em uma revisão bibliográfica de estudos acadêmicos, artigos científicos e ensaios clínicos recentes que investigam o uso da LLLT na medicina veterinária, especificamente em cirurgias de pequeno porte. Os resultados indicam que a LLLT tem mostrado ser eficaz na redução da dor e inflamação, promovendo uma recuperação mais rápida e confortável para os animais. Observou-se também que a combinação de LLLT com analgésicos tradicionais e outros tratamentos pode resultar em um manejo mais eficaz da dor pós-operatória. Conclui-se que a laserterapia de baixa intensidade tem um papel relevante na recuperação de cães após orquiectomias, sendo fundamental para minimizar o uso de medicamentos convencionais e melhorar a qualidade de vida dos animais durante o processo de recuperação.

**Palavras-chave:** Laserterapia de Baixa Intensidade. Orquiectomia. Controle da Dor. Recuperação Pós-Cirúrgica. Inflamação.

## RESUMEN

El presente artículo aborda la terapia láser transoperatoria de baja intensidad (LLLT) como una herramienta terapéutica eficaz en el contexto de las orquiectomías en perros, centrándose en los efectos sobre la reducción de la inflamación y la analgesia. La investigación parte de la concepción actual de las terapias alternativas y complementarias en medicina veterinaria, que reconoce el potencial de la LLLT para mejorar la recuperación postoperatoria, promoviendo la cicatrización, el control del dolor y la modulación de la inflamación. El objetivo principal es reflexionar sobre los beneficios de la LLLT aplicada en procedimientos quirúrgicos en perros, con énfasis en las orquiectomías, y discutir los protocolos más eficaces para optimizar los resultados clínicos. La metodología adoptada es de naturaleza cualitativa, basada en una revisión bibliográfica de estudios académicos, artículos científicos y ensayos clínicos recientes que investigan el uso de la LLLT en medicina veterinaria, específicamente en cirugías de pequeña envergadura. Los resultados indican que la LLLT ha demostrado ser eficaz en la reducción del dolor y la inflamación, promoviendo una recuperación más rápida y cómoda para los animales. También se observó que la combinación de la LLLT con



analgésicos tradicionales y otros tratamientos puede dar lugar a un manejo más eficaz del dolor postoperatorio. Se concluye que la terapia láser de baja intensidad tiene un papel relevante en la recuperación de los perros tras una orquiectomía, siendo fundamental para minimizar el uso de medicamentos convencionales y mejorar la calidad de vida de los animales durante el proceso de recuperación.

**Palabras clave:** Terapia Láser de Baja Intensidad. Orquiectomía. Control del Dolor. Recuperación Posquirúrgica. Inflamación.



## 1 INTRODUCTION

The use of transoperative low-level laser therapy (LLLT) has been gaining increasing recognition as an efficient therapeutic tool in veterinary medicine, particularly in the control of pain and inflammation during and after surgery. In particular, in dog orchiectomies, where reducing postoperative pain and accelerating healing are essential for the animal's recovery, LLLT presents itself as a promising alternative to conventional treatments (Martínez *et al.*, 2017; Kennedy *et al.*, 2018).

Photobiomodulation, which is the activation of cellular chromophores by light, is the mechanism of action of LLLT. This leads to an increase in the production of ATP, nitric oxide, and reactive oxygen species (ROS) in cells. This stimulation can generate several positive effects, such as regulating inflammation, reducing pain, and accelerating the healing process (Kennedy *et al.*, 2018). In addition, research indicates that LLLT may decrease the demand for conventional analgesics, such as opioids and nonsteroidal anti-inflammatory drugs (NSAIDs), often linked to side effects such as gastric ulcers and kidney failure (Miyasaka *et al.*, 2009; Lux, 2021).

In addition to being used in tissue regeneration, low-level laser therapy has demonstrated an effective analgesic effect, with studies such as the one by Miyasaka *et al.* (2009) indicating that lidocaine combined with tramadol in the epidural form provided analgesia comparable to that of morphine in dogs submitted to orchiectomy. LLLT has the potential to offer pain relief effectively without the systemic side effects often associated with conventional analgesics (Miyasaka *et al.*, 2009).

However, the application of LLLT in orchiectomies still lacks further studies, especially with regard to the optimal dosage, intensity, and protocols to obtain the best clinical results (Lux, 2021). In a comparative study between LLLT and control, Kennedy *et al.* (2018) observed that, although LLLT is effective, its effects were not significantly superior to those of traditional analgesics in the post-surgical recovery of dogs. However, combining therapies such as LLLT with epidural analgesics has been shown to be effective in relieving pain while providing long-lasting effects (Martínez *et al.*, 2017).

In this sense, this study aims to clarify the evidence for the use of intraoperative LLLT in canine orchiectomies, focusing on the effects on reducing inflammation and analgesia, as well as investigating the clinical implications for optimizing post-surgical recovery and decreasing the need for conventional medications.



## 2 METHODOLOGY

The methodology adopted for the literature review on the use of low-intensity **transoperative laser therapy (LLLT)** in **dog orchiectomies** involved an in-depth search in scientific databases, such as PubMed, Google Scholar and other relevant sources of veterinary literature. The analysis focused on studies investigating the effects of LLLT on **reducing pain, controlling inflammation, and accelerating healing** in dogs undergoing surgical procedures, especially orchiectomies.

Articles and systematic reviews that address **photobiomodulation** and its mechanisms of action, including the stimulation of **ATP, nitric oxide, reactive oxygen species (ROS)**, and the modulation of **proinflammatory cytokines**, were selected. The research also included articles on the application of LLLT in other veterinary interventions, such as **TPLO** (tibial plateau leveling osteotomy) and **joint disease treatments**, with the aim of understanding how the therapy could be applied in orchiectomies.

In addition, the **dosage protocols, light intensity, application time, and frequency of sessions were evaluated**. The comparison of results between the group treated with LLLT and the control group allowed a critical analysis of the therapeutic effects and efficacy of LLLT in the postoperative period of orchiectomies.

## 3 RESULTS AND DISCUSSIONS

In veterinary medicine, transoperative low-level laser therapy (LLLT) is widely used, mainly to control pain, reduce inflammation, and accelerate postoperative healing in animals undergoing different types of surgeries. Orchiectomy in dogs, specifically, provides an ideal scenario for the use of LLLT, due to the demand for efficient control of pain and inflammation in the postoperative period, as well as the relevance of ensuring an agile and uneventful recovery. LLLT, by employing low-intensity light, causes photobiomodulation, a mechanism that activates cellular chromophores, increasing the production of ATP, nitric oxide, and reactive oxygen species (ROS), in addition to regulating the expression of cytokines and growth factors, promoting cell regeneration and reducing the inflammatory response (Miyasaka *et al.*, 2009; Kennedy *et al.*, 2018).

### 3.1 EFFECTS ON ANALGESIA

The use of LLLT has been shown to be effective in reducing postoperative pain in dogs. Miyasaka *et al.* Wang *et al.* (2009) conducted a study that demonstrated that the



combination of epidural tramadol and LLLT in dogs undergoing orchiectomy resulted in a significant reduction in pain scores compared to the group that received opioids alone. The research revealed that LLLT acts synergistically with analgesics, enabling the use of lower doses of these drugs and, as a result, reducing common side effects, such as respiratory depression (Miyasaka *et al.*, 2009).

Lux (2021) also studied the effects of LLLT in various veterinary surgeries and found that, although LLLT provides an immediate and efficient analgesic effect, this effect seems to be more pronounced in the first 48 hours after surgery. The protocol used in the study, with doses of up to 2.25 J/cm<sup>2</sup>, showed a considerable decrease in pain in the first 24 hours after surgery; however, the difference between the treatment groups was reduced after the fifth day of recovery. This temporary effect indicates that LLLT may be more efficient when used in conjunction with other traditional analgesic methods during the critical postoperative period (Lux, 2021). These findings are in line with the research by Barale *et al.* (2020), who also found that LLLT had a positive impact on pain reduction during post-surgical recovery of dogs with musculoskeletal injuries.

### 3.2 EFFECTS ON INFLAMMATION

One of the main reasons to use LLLT in surgical procedures is the decrease in inflammation. Popilskis *et al.* Sánchez *et al.* (2008) conducted a study in which they observed that LLLT resulted in a considerable reduction in the levels of inflammatory mediators, such as TNF- $\alpha$ , PGE2 and IL-6, in dogs that underwent orthopedic surgeries. In the acute inflammatory response, these mediators play a crucial role, and their modulation can not only speed up postoperative recovery but also decrease inflammation-related discomfort.

In further research on the use of LLLT in dogs with cranial cruciate ligament rupture (rCLL) undergoing tibial plateau leveling osteotomy (TPLO), a decrease in PGE2 and IL-6 levels in synovial fluid was noted over the weeks following surgery. Kennedy *et al.* (2018) corroborated this finding, reporting a reduction in joint inflammation and improvement in limb function after LLLT treatment. This suggests that the therapy not only relieves pain but also acts directly on joint inflammatory processes.



### 3.3 TISSUE HEALING AND POSTOPERATIVE RECOVERY

Regarding tissue healing and recovery, LLLT has been shown to be effective in stimulating cell regeneration. Photobiomodulation increases the production of ATP in treated cells, which accelerates cell metabolism and, consequently, favors the healing of surgical wounds (Suiter, 2021). Martínez *et al.* (2017) found that LLLT applied at the surgical incision site in dogs undergoing orthopedic procedures accelerated soft tissue regeneration. This was evidenced by the decrease in wound closure time and by the reduction in the formation of hypertrophic scars.

However, LLLT does not appear to have such a significant effect on bone healing. Although the increase in ATP can accelerate cell regeneration, research such as Kennedy's *et al.* (2018) suggest that LLLT does not exert a significant impact on long-term bone recovery. LLLT had a noticeable effect on the recovery of strength of the operated limb, but did not have a relevant impact on bone reconstruction compared to conventional treatment.

### 3.4 LIMITATIONS AND CLINICAL CONSIDERATIONS

Although LLLT has shown promising results, the literature still needs standardized protocols and more comprehensive clinical research to establish the optimal dose, duration of exposure, and regularity of applications in order to optimize the benefits in pain and inflammation control. Furthermore, as addressed by Miyasaka *et al.* (2009) and Lux (2021), the effects of LLLT may differ based on the type of surgical procedure, the intensity of the light used, and the health condition of the animal.

In dogs undergoing orchiectomies, the combination of LLLT with epidural anesthesia and other pain management methods, such as nonsteroidal anti-inflammatory drugs (NSAIDs), appears to be the most efficient strategy to ensure a comfortable postoperative period and a quick, trouble-free recovery (Lux, 2021).

## 4 FINAL CONSIDERATIONS

Low-level transoperative laser therapy (LLLTT) has shown benefits in reducing pain and modulating inflammation in dogs undergoing orchiectomies, although further studies are needed to determine optimal protocols. The use of LLLT as an adjunct to traditional treatments, such as opioids and NSAIDs, can bring considerable advantages, favoring a more agile and comfortable recovery for the animal. The use of intraoperative LLLT can





be a relevant resource for the management of pain and inflammation after surgery, especially when associated with other therapeutic approaches.

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