**Republic of Iraq**
**Ministry of Higher Education**
**& Scientific Research**
**University of Al-Qadissiya**
**College of Veterinary Medicine**

# Low Level Laser Therapy As an Analgesic Method

A Graduation Project Submitted to
the Department Council of the Internal and Preventive Medicine-
College of Veterinary Medicine/ University of Al-Qadisiyah
in a partial fulfillment of the requirements for
the Degree of Bachelor of Science in Veterinary Medicine and Surgery.

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بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

فَتَعَٰلَى ٱللَّهُ ٱلْمَلِكُ ٱلْحَقُّ ۗ وَلَا تَعْجَلْ بِٱلْقُرْءَانِ مِن قَبْلِ أَن يُقْضَىٰٓ إِلَيْكَ وَحْيُهُۥ ۖ وَقُل رَّبِّ زِدْنِى عِلْمًا ﴿١١٤﴾

صَدَقَ ٱللَّهُ ٱلْعَظِيمُ

# Certificate of Supervisor

I certify that the project entitled (**low level laser as an analgesic method**)was prepared by **Hameed Wasfi Abbas** under my supervision at the College of Veterinary Medicine / University of Al-Qadissiya.

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/ 3 / 2018

# Certificate of Department

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## Abbreviations

| | |
|---|---|
| Light Emitting Diodes | LED |
| Low Level Laser Therapy | LLLT |
| Photobiomodulation | PBM |
| Nitric Oxide | NO |
| Adenosine Triphosphate | ATP |
| Reactive Oxygen Species | ROS |
| Membrane Potential | MMP |

## Abstract

Pain is a common cause of disability and is extremely costly to society at large. The excessive reliance on opioid analgesics for treating both acute and chronic pain has contributed to the current global opioid epidemic.

Prolonged use of opioid analgesics is associated with an increased risk of more serious complications, including opioid use disorder,overdose, and death.

The low-level laser therapy (LLLT) seems to offer many benefits in the stimulation of the healing process and control of the inflammatory process by reducing the swelling and pain, with no reports of adverse effects.

Pain relief endorsed by therapeutic laser application outcomes from inhibition of peripheral nerve action potential, affecting the transmission of the nerve stimuli, dropping or disturbing the communication of impulses aroused from the nociceptors to the spinal cord.

A simple, safe, and effective noninvasive pain therapy without side effects could significantly reduce the dependence on oral opioid-containing medications in the post-discharge period after surgery

## Introduction

Pain classically defined as an unpleasant sensory and emotional experience which is usually associated with tissue damage (Hermanussen et al,2004) . Two clinical types of pain including acute and chronic are reported, the former one is a protective mechanism which alerts the individual to certain condition that is immediately harmful to the body; whereas, the chronic pain is persistent or intermittent. Acute pain rarely needs medical attention; when it does,nonsteroidal anti-inflammatory drugs (NSAIDs), powerful opioid analgesics, or local anesthetics can adequately control the pain. Chronic pain differs from acute pain not only due to its onset and duration, but more importantly in its mechanisms. Chronic pain may not have identifiable ongoing injury or inflammation, and often responds poorly to NSAIDs and opioids (Wang et al., 2010).

low level laser (light) therapy (LLLT) and LED (light emitting diode) therapy (also known as photobiomodulation) has been shown to redauce inflammation and edema, induce analgesia, and promote healing in a range of musculoskeletal pathologies(Kothari et al.,2002). The purpose of this study aimed to evaluate the analgesic effects of application of low-level laser therapy to control pain.

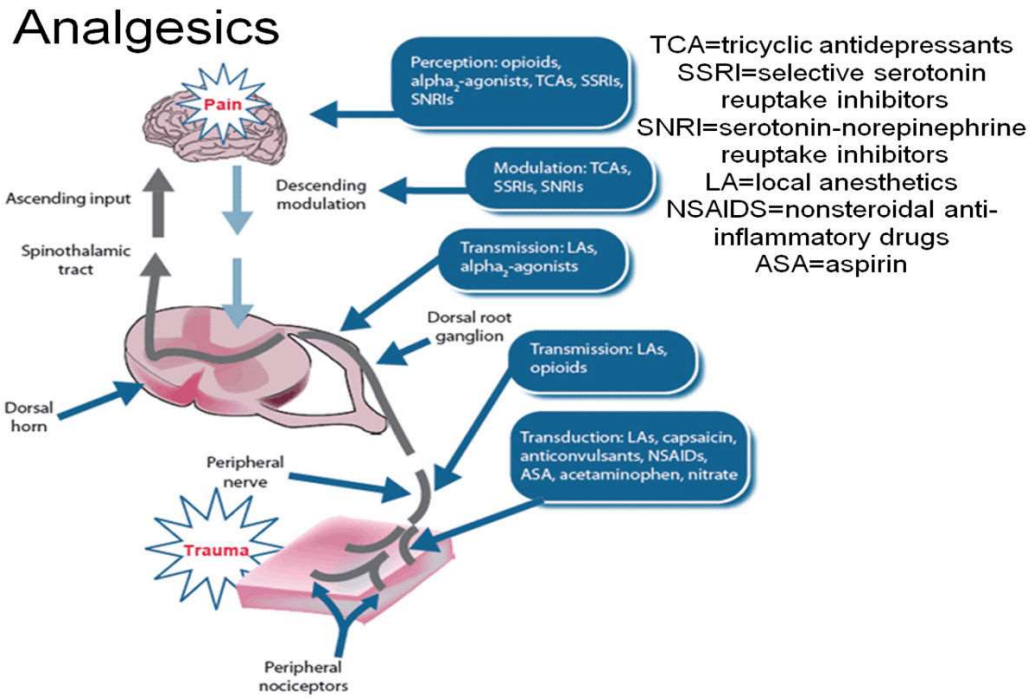
# Chapter one

## Pain

Pain may be defined as an unpleasant sensory and emotional practice which is usually related with tissue damage (Merskey & Bogduk ,1994). Two clinical types of pain containing acute and chronic are stated, the earlier one is a protective mechanism which alerts the individual to certain condition that is directly harmful to the body; while, the chronic pain is insistent or recurrent. Acute pain seldom needs medical care; when it does, nonsteroidal anti-inflammatory drugs (NSAIDs), powerful opioid analgesics, or local anesthetics can sufficiently control the pain. Chronic pain varies from acute pain not only due to its beginning and length, but more importantly in its mechanisms. Chronic pain may not have recognizable ongoing injury or inflammation, and often responds poorly to NSAIDs and opioids (Wang & Wang,2003). Neuropathic pain (NP) recognized as a form of chronic pain results from any type of damage to the central or peripheral nervous system (Woolf & Mannion ,1999; Zimmermann,2001). Patients with NP often have spontaneous pain, allodynia, and hyperalgesia. NP may have postponed onset after early nerve injury; consequently, pain may be present in the absence of obvious lesion or injury, making proper diagnosis and early treatment hard (Dubner,1991; Woolf,1996).

Occasionally however, pain continues in spite of exclusion of the stimulus and even after healing of the body. Pain can also ascend in the absence of any stimulus, disease or injury. Acute pain is regardedas last less than 30 days, though chronic pain is of more than 6 months length or as “pain that extends

beyond the expected period of healing". There are 3 different types of pain; nociceptive, neuropathic and central(Altunkaya et al,2004).




Site of analgesic action on the pain pathway.

A number of methods are available to control and decrease postoperative pain such as administering opioids or nonsteroidal anti-inflammatory drugs (NSAIDs) and patient-controlled analgesia (PCA). It is well-known that the use of systemic opioids alone is not adequate to relieve postoperative pain. In most circumstances, inadequate dosage is recommended to decrease the side effects of these drugs similar to respiratory depression and so, the drug cannot control pain totally (Sieber ,2011). Analgesic nephropathy, skin reactions, and peptic ulcers are common side effects of nonsteroidal anti-inflammatory drugs

( Altunkaya,2004). Modern advances current new techniques for inhibition and decrease of postoperative pain. One of the most important technologies of this

century is the usage of low-level laser (LLL) at the site of surgery (Asnaashari & Safavi ,2011)

Pain, in turn, is known to be efficientlymeasured bynumerous endogenous mechanisms. Recent studies haverevealed that these mechanisms are not limited to thecentral nervous system (CNS). Somewhat, intrinsic paincontrol can happen also in the peripheral nervous system (PNS), mediated by an communication between immune cellsand the terminals of sensory neurons (Stein et al.,1990). The endogenousopioid peptide, beta-endorphin, appears to be chieflyin chargeof this intrinsic analgesia. In peripheraltissue, opioid-containing immune cells migrate preferentiallyto inflamed situates, where they release beta-endorphinsthat trigger pain-inhibiting opioid receptors (Hermanussen et al,2004).

The communication between immune cell-derived opioidsand opioid receptors, limited on sensory nerve terminals,can terminate in clinically measurable peripheral analgesia. Moreover, beta-endorphins and other opioidswere established to cause peripheral analgesia with the secretionof the precursor molecules proopiomelanocortin (POMC)and corticotrophin discharging factor (CRF) (Cabot et al.,1996) .

Though opioid-relatedside effects (for example, nausea, vomiting, constipation, ileus,bladder dysfunction, pruritus, sedation, visual hallucinations, andventilatory depression) are well known, there are rising

concernsconcerning long-term physical dependency and addictionobligation with continued opioid use after surgical procedures.Prolonged use of opioid analgesics is related with an amplifiedrisk of more severe complications, counting opioid use disorder,overdose, and death(Olsen .,2016).

Chronic pain is well-defined as pain that continues for greater than twelve weeks (Task- Force, 1994) and presently affects roughly thirty % of the population in the United States (Johannes et al., 2010). The most common way for handling chronic pain has conventionally been pharma- cological (Nalamachu, 2013). These managementsfrequently include non-steroidal anti-inflammatory drugs (NSAIDS), opioids, acetaminophen, and anticonvulsants (Nalamachu, 2013). Alternate medicine is currently also being used more frequently to treat chronic pain and may contain of acupuncture (McKee et al., 2013), Tai Chi (Wang et al., 2010; Wang, 2012), and low- level laser therapy (LLLT) (Enwemeka et al., 2004; Ay et al., 2010).

## Chapter Two

## Laser therapy

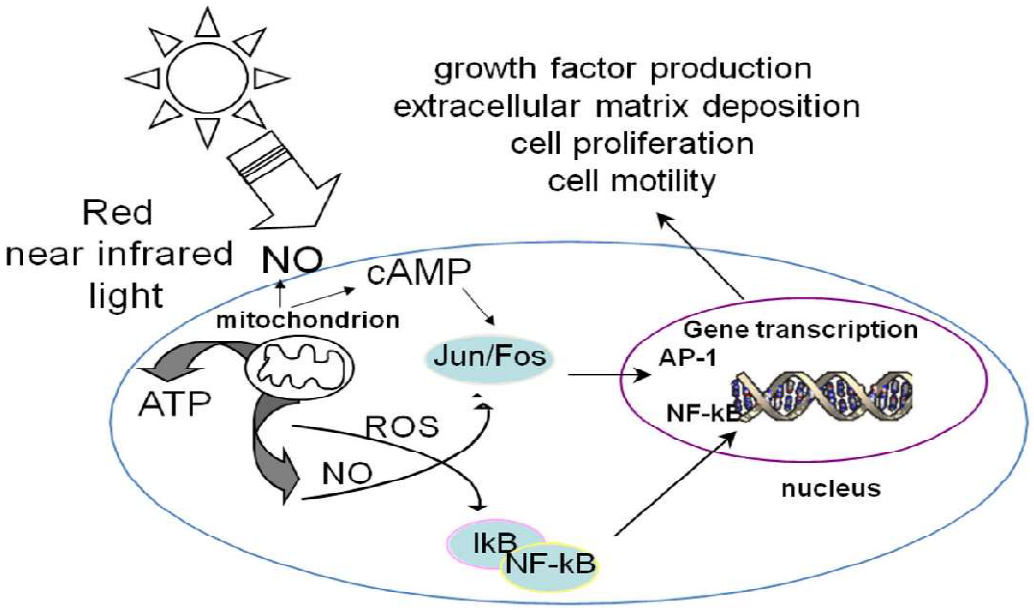
laser therapy is a fairly recent progress in medicine. The first cold laser was US Food and Drug Administration (FDA)-permitted for treating pain in 2001, and low-level laser therapy (LLLT), also recognized as cold laser therapy, has been applied in the USA since only 2002. High-intensity laser therapy (HILT), also identified as laser heat therapy, is an even more new development; initial periodicals appeared in 2011. Laser therapy includes a simple, non-invasive, “point-and-shoot” procedure which can be achieved by technicians. Cellular chromophores are assumed to be the receptor sites in chargeof the useful effects

of the laser light beam, together with both cytochrome c oxidase (with absorption peaks in the near-infrared range) and photoactive porphyrins(Hamblin & Demidova .,2006).

A laser is a device that creates light through a process of optical amplification built on the stimulated emission of electromagnetic radiation(Cruz et al.,2003).

Since the 1970s, Laser (Light Amplification by Stimulated Emission of Radiation) has been extensively used in medical practice helping several purposes. Among their numerous applications in the medical practice, lasers have been used in several surgical operations. Moreover, nonsurgical or therapeutic lasers, which do not cause tissue injury, have been broadly used to excite tissue repair, as well as for analgesic commitments interrupting the transmission of impulses induced from the nociceptors to the spinal cord(Krespi & Ling,1994). Overall, the average power of these lasers ranges between 10- to 20W. Lasers used for analgesic, anti-inflammatory and healing drives are recognized as low-level lasers or therapeutic lasers, with abundant lower power (around 30mW)( Kothari et al.,2002).

Mitochondria are also supposed to be a location for the therapeutic effects of infrared light, leading to amplified ATP production,variation of reactive oxygen species, and initiation of transcription factors. These effects lead to augmented cell proliferation and migration by fibroblasts; decrease in the heights of cytokines,growth factors, and inflammatory mediators; and enlarged tissue oxygenation, leading to boosted control of the inflammatory process, condensed pain, and enhanced wound healing(Ojea et al.2016). Studies with laser therapy have established enhanced wound healing in together diabetic(Sousa & Batista,2016) and non-diabeticpatients. Applying LLLT within the first five days of herpes zoster eruption also meaningfully reduced the occurrence of post-herpetic neuralgia(Chen et al,2016).




Low Level Laser Therapy (LLLT) occasionally known as Low Level Light Therapy or Photobiomodulation (PBM) is a short intensity light therapy. The result is photochemical not thermal. The light triggers biochemical variations within cells and can be associatedwith the process of photosynthesis in plants, where the photons are absorbed by cellular photoreceptors and triggers chemical deviations(Howard et al,2015).

LLLT is the usage of light (usually a low powered laser or LED typically power range of (10mW–500mW). Light with a wavelength in the red to close infrared region of the spectrum (660nm–905nm), is commonly employed as these wavelengths have the capability to enter skin, and soft/hard tissues (Figure 2) and are confirmed in clinical experiments to have a good result on pain, inflammation and tissue healing.

The power density (irradiance) is frequently between 5W/cm2 and is useful to an injury or to a painful location for 30–60 seconds a few periods a week for numerous weeks. The consequence is a discount of inflammation, pain relief and augmented tissue regeneration. In greatest cases the lasers/LEDs used for LLLT emit a deviating beam (not focused or

collimated) because collimation is missing in tissue, but as a result ocular dangers are also reduced over distance(Howard et al,2015).

Since the 1970s, LLLT has been used in numerous clinical and experimental research studies on peripheral nerve injuries. Irradiation parameters and possessions of LLLT, such as dose,intensity, time, and application methods are particularlydifferent among dissimilar clinical reports.

The clinical effects of LLLT counting cell apoptosis; enhanced cell proliferation, migration, and cell bond, improving the cells' mitotic activity; enlarged blood flow; and local microcirculation were stated in many studies (Khullar et al 1999).

The resulting effects of low-intensity lasers on tissues: 1) Growth of the activity of certain cells, as leukocytes and phagocytes, and amplified content of calcium ions in the cytoplasm of these cells. 2) Enhancement of cell division and cell growth. 3) Stimulation of the synthesis of proteins and cytokines. 4) Improvement of blood circulation due to the relaxation wallsof the vessels(Vladimirov et al,2004).

Low-level laser therapy (LLLT) is a exceptional type of lasertherapy in which the irradiation used is red or near-infraredbeams with a wavelength of 600–1100 nm and an outputpower of 1–500 mW. This kind of radiation is a constantwave or pulsed light that involves of a constant beam offairly low energy density (0.04–50 J/cm2)( Huang et al,2009).

The physiological mechanisms of LLLT are not well-known and the mechanisms like to be very broad (Yamamoto et al., 1988; Kudoh et al., 1989; Campana et al., 1993; Sakurai et al., 2000; Chow et al., 2007; Moriyama et al., 2009; Cidral- Filho et al., 2014). One theory is that there may be an rise in nociceptive threshold after LLLT causing neural

blockade, precisely an inhibition of A and C neural fibers (Kudoh et al., 1989; Chow et al., 2007).

This inhibition may be mediated by changing the axonal current (Chow et al., 2007) or by hindering neural enzymes (Kudoh et al., 1989). Moreover, data proposes an increase in

endorphin production (Yamamoto et al., 1988) and opioid- receptor binding through opioid-containing leukocytes with LLLT (Cidral-Filho et al., 2014). LLLT may similarly mimic the effects of anti-inflammatory drugs by weakening levels of prostaglandin-2 (PGE2) (Campana et al., 1993) and inhibiting cyclooxygenase-2 (COX-2) (Sakurai et al., 2000). Furthermore, data have recommended that LLLT may enhance levels of nitric oxide, a powerful vasodilator, which would in turn the performance to increase blood flow and promot with healing (Samoilova et al., 2008; Moriyama et al., 2009; Cidral-Filho et al., 2014; Mitchell and Mack, 2013).

# Chapter Three

## LLLT in the treatment of pain

At present,obtainable analgesic agents contain aspirin and other non-steroidal anti-inflammatory drugs (NSAIDs). The effectiveness and care of NSAIDs have been revisedwidely, Shapiro and Cohen (1992).Potential contrary effects of NSAIDs involved peptic ulcer disease, gastrointestinal (GI) bleeding, GI perforation, compromised renal function and inhibition of platelet function. Thus, there is a necessity to depend on additional analgesic implement with nominal side effects, Fisher et al., (1988). The application of low energy lasers in the field of dentistry and oral surgery has been defined since the 1970s. Low energy laser light was theoretically reduce pain, to hasten wound healing and ought to a positive effect on inflammatory courses, Neckel et al.,(2001).

Analgesic drugs with peripheral activity could act by two diverse mechanisms. One produces analgesia by avoiding the sensitization of 2,3 through the use of drugs that hinder the chemical mediators of the inflammation, ascyclo-oxygenase inhibitors (COX) (Ferreira, 1990).

The further mechanism is by the straight blocking of the hyperalgesia. Opioids and drugs that endorse an surge in nitric oxide act by this mechanism, done via L-arginine /nitric oxide/cyclic GMP. All drugs effect undesirable side effects. Aspirin-like drugs commonly induce gastric or intestinal ulceration, and para-aminophenol may cause skin

rash, and in a few insulatedcases neutropenia. Because of that, other treatments are beingexplored for treatment of the inflammatory pain. Amongthose novel treatments, the low level laser therapy (LLLT)appears to be very promising (Cunha,et al.,1999).

Pain control with opioids is related with somedoubts for clinicians due to its finalpermanentcomplications such as depressing respiratory system.Local infiltration of bupivacaine and dexamethasoneare instances of treatment presented as part of theproper replacement therapies for opioids indropping post tonsillectomy pain. Lately, use of lowlevel laser has also been mentioned in children tonsillectomy(Neiva et al.,2010). Jackson et al. (2009) have described that laser therapy considerably decrease post mastectomy pain. Kreisler et al(2004) with a study on odontologic surgeries exhibitedthe effect of low level laser therapy in dropping pain.

Likewise laser therapy on mucositis caused by radiotherapy caused reduction of pain episodes from 8/23 to1/9 5(Giannoni et al.,2002).

The precise mechanisms by which phototherapy releases pain continue to progress. It has been exposed that phototherapy rises local and systemic microcirculation thereby dropping swelling and pain. The augmented blood flow is related with nitric oxide synthesis. Others have displayed that phototherapy dismisses pain by modulating key mediators of inflammation—for example, falling the level of prostaglandin E2 and inhibiting cyclo-oxygenase (Sakurai et al.,2000) alike to the effects of non steroidal anti-inflammatory drugs and steroids. Besides, it has been assumed that photostimulation induces athermal photochemical reactions that control nerve transmission, in that way changing the pain threshold of nociceptors(Mendez et al.2004). Moreover, there is proof that phototherapy enhances the release of endorphins—the bodies endogenous pain relievers(Gibson & Kernohant1993). It is likely that a combination of these and other mechanisms are complicated in the effect of phototherapy on pain relief. Therefore, additional studies are wanted to explain the mechanisms involved. As our study was restricted to articles published in English, we recommend that future meta-analysis contain articles printed in other languages. Such work could harvest a significantly greater pool of articles even still the comparatively few foreign language articles we observed had such

limited data that it was not possible tocalculate effect sizes from them(Ohshiro T, Calderhead 1991) .

Numerous studies have found that laser is an effective short-term method to relieve chronic muscle pain as the anti-inflammatory effect of the reduction of prostaglandin synthesis, inhibition of prostacyclin, and increase in blood flow, peripheral nerve action andanalgesic effects(Gur et al.,2002).

The rise of blood flow after laser therapy is a significant factor in pain relief because it rises oxygenation, lymphatic drainage, the activity of neutrophils, macrophages, fibroblasts, and the metabolism of injuredor defective cells (Núñez et al.,2004).Wavelength and dose are significant factors in laser therapy,and their difference may inhibit or stimulate definite effects, such as ATP synthesis (Hawkins & Abrahamse.,2005).

The present medical treatment of pain or analgesics is focused to various steps of the pain pathways. Clinically, low level laser therapy (LLLT) can treat nociceptive(. Nesioonpour et al.,2014) and neuropathic pain, whereas central pain has not yet been confirmed to be receptive to LLLT(Falaki et al.,2014).

This biphasic dose response curvature may have significant implications for LLLT for pain relief for the following explanations. Low-intensity LLLT excites mitochondria and elevations mitochondrial membrane potential (Huang et al.,2014) and may be supposed to be more likely to increase metabolism and transport of action potentials in neurons rather than reduce it. Nevertheless, abundant higher intensity LLLT created by a focused laser spot acting on a nerve has the reverse effect, inhibiting mitochondrial metabolism in c-fibers and a-delta fibers and dropping mitochondrial membrane potential, in that way inducing a nerve obstruction (Sharma et al.,2011) .

Acute orthopedic circumstances such as sprains, strains, post-surgical pain, a whiplash damage , muscular back pain, cervical or lumbar radiculopathy, tendinitis ] and chronic circumstances such as osteoarthritis , rheumatoid arthritis, frozen shoulder , neck and back pain , epicondylitis , carpal tunnel syndrome, tendinopathy , fibromyalgia , plantar fasciitis , post tibial fracture surgery and chronic regional pain syndrome are agreeable to LLLT.

Dental circumstancesgenerating pain such as orthodontic procedures, dentine hypersensitivity , and third molar surgery respond well to treatment with LLLT. Neuropathic pain circumstances can likewise be treated such as post herpetic neuralgia, trigeminal neuralgia, and diabetic neuropathy . Due to the wide spectrum of circumstances one would surmise that multiple mechanisms can work to attain pain relief(Knapp, 2013).

The peripheral nerve terminations of nociceptors, containing of the finely myelinated A∂ and unmyelinated, slow-conducting C fibers, lie inside the epidermis. This compound network transduces noxious stimuli into achievement potentials. Furthermore these nerve terminations are very superficial in nature and therefore are simply within the penetration depths of the wavelengths used in LLLT. The cell bodies of neurons lie inside the dorsal nerve root ganglion, but the extended cytoplasm (axons) of the neurons extends from the cell body to the bare nerve terminations in the exterior of the skin. The straight effect of LLLT are originally at the level of the epidermal neural network, but the special effectstransfer to nerves in subcutaneous tissues, sympathetic ganglia, and the neuromuscular connections within muscles and nerve trunks(Nesioonpour et al.,2014).

LLLT applied with a adequate level of intensity causes an inhibition of action potentials where there is an about 30% neural obstruction within 10 to 20 minutes of application, and which is reversed within about 24 hours (Bashiri .,2013).

LLLT can have short, medium and long duration effects. Fast acting pain relief arises within minutes of submission, which is a consequence of a neural obstruction of the peripheral and sympathetic nerves and the release of neuromuscular contractions leading to in a decrease of muscle spasms(Carrasco et al.,2009).

In the medium term there is a reduction of local edema and a decrease of inflammation within hours to days(Carati et al.,2003). The act of LLLT in dropping swelling and inflammation has been well recognized in animal models in addition to in clinical trials. The numbers of inflammatory cells has been revealed to be reduced in joints inoculated with protease(Pillar & Thelander.,1995), in collagen-induced rheumatoid arthritis (Guo et al.,2011), and in acute pulmonary inflammation(Alves et al.,2013). The expression levels of pro-inflammatory cytokines have been exposed to be abridged by LLLT in burn wounds (Mafra et al.,2010), in muscle cryoinjuriesand in late type hypersensitivity(Gupta

et al.,2014). The long term effects of LLLT occur within a week or two and can last for months and occasionally years as a result of enhanced tissue healing(Assis et al.,2012).

A 2007 editorial on the potentiallyvaluable role of “alternative” treatments as fragment of a multimodalapproach for reducing anxiety, pain, and emetic symptoms in theperioperative period(White,2007).

Pain relief endorsed by therapeutic laser application outcomes from inhibition of peripheral nerve action potential, affecting the transmission of the nerve stimuli, dropping or disturbing the communication of impulses aroused from the nociceptors to the spinal cord(Cruz et al.,2003).

The mechanism whereby LLLT relieves pain is unidentified. It has been supposed that any biologic effects are subordinate to the direct effects of photonic radiation and are not the consequence of thermal processes(Walker,2006). In the case of neuropathic pain, LLLT has been projected to mediate analgesia by liberating local neurotransmitters such as serotonin (Ohshiro & Calderhead,1991), stimulating the release of endorphins (Yamamoto et al.,1988),growing mitochondrial ATP production(Passarella,1989), or through anti-inflammatory effects(Ailioaie & Lupusoru-Ailioaie,1999).

The effectiveness of low-level laser application in falling postoperative pain after endodontic surgery in grown-ups was verified in the Department of Oral Surgery and Dentistry at University Mainz, in Germany, in 2004. The consequences revealed that the pain level was lesser in the laser group than in the placebo group on the first seven postoperative days(Cruz et al.,2003).

Reis et al. stated on the efficiency of laser at 660 nm forrescue of the sciatic nerve in rat model following neurotmesis . Belchior et al. also stated on the clinical and practical recovery of an damaged sciatic nerve by using gallium-aluminum-arsenide (GaAlAs) laser at a wave length of 660 nm and density of 4 J/cm2 for 21 days repeatedly.

Concerning these studies, the use of low-level laser (660 nm)meaningfully promotes neural renewal(Reis et al.,2009). Barbosa et al.used laser at 660 and 830 nm for the recovery of sciatic nerve regeneration following severe injuries, and they informed that 660 nm providing early functional nerve recovery as compared with 830 nm(Belchior et

al.,2009). Hsieh et al. proved that660-nm GaAlAs laser at a dose of 9 J/cm2 ominously reduced neuropathic allodynia in rats with CCI and considerably stimulated functional recovery(Hsieh et al.,2012) ; their outcome is like to the results of Bertolini et al. in 2011.

Low-energy laser therapy (LLLT) has lately been spreadin the management of numerous rheumatologic, neurologic, and musculoskeletal disorders such as osteoarthritis, rheumatoid arthritis, fibromyalgia, carpal tunnel syndrome, rotator cuff tendinitis, and chronic back pain syndromes(Gibson & Kernohant, 1993). LLLT is thought to modulate neuronal activity in the tissue and have a pain relieving effect; nevertheless, the indication for LLLT in painfulmusculoskeletal system disorders is still discussed(Basford et al.,1998).

The low-level laser therapy (LLLT) appears to offer many assistances in the stimulation of the healing process and control of the inflammatory process by falling the swelling and pain, with no reports of contrary effects(López-Ramírez et al.,2012). LLLT diminishes pain intensity without varying the healing process(Paschoal & Santos-Pinto.,2012). On the other hand, LLLT displayed better results in controlling swelling and trismus when associated with ozone therapy(Kazancioglu et al.,2014). Nevertheless, Lopez-Ramirez et al.(2012) found that LLLT exhibited no positive effectsin falling pain, swelling and trismus after the elimination ofthird molars.

FDA has ongoing different inquiries on LLLT for 15 years and has permitted the use of LLLT for pain relief in carpal tunnel syndrome since 2002 (Bjordal et al.,2006; Hopkins et al.,2004). It is also used to treat injuries in sport damages and musculoskeletal illnesses.

Additionally, it is applicable to decrease neck pain and the size of keloid scarring after surgery (Hegedus et al.,2009). Many studies discussed that LLL stimulates respiratory cycle in mitochondria and rises adenosine triphosphate molecules that diminish swelling and pain (Carvalho et al.,2010). In another study, applying LLL directly over painful points was beneficial in treatment of stress fracture of tibia (Ribeiro et al.,2010). The LLL is active in relieving pain of knee osteoarthritis, breast augmentation surgery, and cryosurgical treatment of oral leukoplakia (Chauhan et al.,2006).

## Conclusion

1- The previous argument has revealed that LLLT is valuable for pain relief and can hasten the body's capability to heal itself.

2- LLLT does not have side effects like respiratory depression, skin reaction, and analgesic nephropathy that are seen with other methods.

3- the combination of laser therapy and analgesic medications had better effect during the 24 hours of recovery after the surgery.

4- A simple, safe, and effective noninvasive pain therapy without side effects could significantly reduce the dependence on oral opioid-containing medications in the post-discharge period after surgery.

5- laser therapy are safer and more cost-effective for managing chronic pain than the long-term use of opioid analgesics.

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