

# Application of Low level Lasers in Dentistry (Endodontic)

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## Abstract:

Low level lasers, cold or soft lasers:

These lasers do not produce thermal effects on tissues and induce photoreactions in cells through light stimulation which is called photobiostimulation. Power of these lasers is usually under 250mW.

The main point differentiating low level lasers and high power ones is the activation of photochemical reactions without heat formation. The most important factor to achieve this light characteristic in lasers is not their power, but their power density for each surface unit (i.e cm<sup>2</sup>). Density lower than 670mW/cm<sup>2</sup>, can induce the stimulatory effects of low level lasers without thermal effects.

Low level lasers (therapeutic) used today as treatment adjunctive devices in medicine and dentistry. Numerous studies have been performed on the applications of low level lasers in patient pain reduction. Mechanisms of pain reduction with therapeutic lasers and their application are expressed, and the studies realized in this field are presented.

**Keywords:** LLLT; endodontic; laser

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## Laser Definition

Laser is a kind of electromagnetic irradiation source, having particular and exclusive properties. The word LASER is an abbreviation formed by joining the first letter of the words: Light Amplification by Emission of Radiation.

**L** refers to Light.

**A** refers to Amplification.

**S** refers to Stimulation.

**E** refers to Emission.

**R** refers to Radiation.

## Lasers Classification

Different parameters influence lasers classification and the most important of them are power, wavelength

and laser source material.

## Classification of lasers based on Power

Power is one of the important parameters in treatments with lasers. Any physician using lasers should be able to recognize them and to know their characteristics. Based on the power, lasers are classified in three groups, as bellow<sup>1</sup>:

### A-High power, warm or hard lasers:

These lasers instill their therapeutic effects by causing heat and enhancing the moving energy in tissues. These effects includes necrosis, carbonization, evaporation, coagulation and protein denaturation. As it's been mentioned in table 1, it is possible to benefit from one or more of these effects, based on

**Table 1.** Tissue reactions under heat

Type of Reaction	Temperature (C°)
Hyperthermia	37-43
Decline of Enzyme Activity	43-50
Protein Coagulation- Protein Damage	50-60
Collagen Damage and effect on Cell Membrane	70-80
Molecular Destruction	80-100
Carbonization	100-140
Evaporation and Desquamation	140-400
Cutting	500-800

controlling the resulted temperature. Power of these lasers is usually more than 0/5W. These types of lasers have applications in surgery.

**B-Lasers with Moderate Powers:**

These lasers have their therapeutic effect without inducing a lot of heat. Their light has a stimulating effect in tissues. Powers of these lasers are between 250 to 500mW.

**C-Low Level or Cold Lasers:**

These lasers have no thermal effect on tissues. Inducing a light stimulation, they result in light and gradual reactions in tissues which are called Photobiostimulation. Power of these lasers is usually less than 250mW.

The principal point in differentiating low level lasers from high power ones is induction of photochemical reactions without heat. The most important factor to achieve this light feature in these lasers is not their power, but their power density per each surface unit (i.e. cm<sup>2</sup>). A density less than 670mW/ cm<sup>2</sup> without heat can induce the stimulating effect of low level lasers.

**Classification of lasers based on wavelength**

Lasers are classified in 4 categories based on their wavelengths, as follows<sup>2</sup>:

- Ultraviolet range 300-400 nm
- Visible light range 400-700 nm
- Near Infrared (NIR) range 700-1200nm
- Far Infrared (FIR) range more than 1200nm

**Classification of lasers based on source material<sup>2</sup>**

- Gas lasers such as CO<sub>2</sub>, Ne and He
- Liquid lasers such as Dye lasers

- Solid lasers such as Ruby lasers
- Semi-conductor lasers such as GaAlInP, GaALAs and GaAs

**History of Laser Therapy**

The first studies on the application of lasers in medical treatments were focused on its use in the surgical field with the high power lasers. But gradually, in late sixties laser therapy and use of low level lasers in medicine started. At that time, scientists used laser irradiation on cell to exert an effect on disease.

Professor Andrew Mester, is known as the pioneer in the science of laser biologic stimulation. He reached the conclusion that lasers with low powers can have biologic effects in their beam trajectory. And have non thermal effects when irradiated on skin<sup>3</sup>.

In 1968, Mester performed studies on cells using Ruby, Argon and He-Ne with low output powers<sup>3</sup>. He also studied the histologic, immunologic and electromicroscopic effects of laser on open wounds under irradiation. Results of these experiments indicated that improvement of collagen synthesis, induction of neovascularization and increased enzyme synthesis occurred in areas under laser irradiation.

At the end of 1969, Mester released an article in the field of the effects of low level laser on the improvement of unhealed or delayed healing wounds, and published his results with the title of application of low level lasers<sup>3</sup>. One of the most important applications of lasers in medicine is the usage of Low Level Laser Therapy (LLLT) or laser biostimulation in order to treat patients. This treatment modality has attracted a lot of attention from clinicians and specialists in recent years.

In this treatment technique of using low level lasers, because of the low output power of the laser, wavelength between 630-1300nm and the deep penetration ability, it easily penetrates up to several centimeters in tissues and reaches the cell chromophores such as mitochondria and effects on them.

In laser therapy, energy absorbed by tissues does not provoke heat or damage to the vital tissues. In laser therapy method, the energy of laser photons is absorbed by the cell and leads to stimulation which is referred as Photobiostimulation<sup>4</sup>.

The beauty of laser therapy lies in the fact that how much of the amount of photons are directed towards which cells.

Considering the wide spectrum of applications of

photon medicine, many clinicians haven't realized the real grandeur and power of photons, so they don't believe in this treatment modality. But results of numerous studies show that this treatment method is somehow considered as an evolution in the treatment of the patients. Photo biotherapy is not a new and emerging method. It has been many years since sun light radiations are being used for treatment; however, normal light because of its natural properties, which is released and distributed in all directions, does not have the ability to penetrate enough in living tissues. Thus it is only used for biologic stimulation in limited dermal treatments. While laser therapy, easily and without consumption of any drug, can heal most wounds or accelerate tissue growth and development via cellular stimulation.

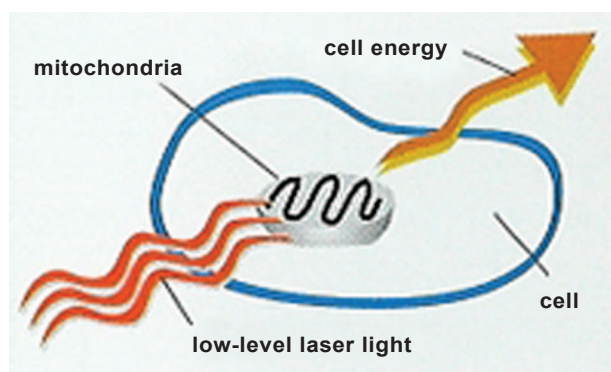
It is also suggested that it can stimulate and activate the body immune system with LLLT, as well as considerably reducing harmful inflammatory responses.

It is mentioned that laser treatment maintains the process of the body tissue growth in a normal state via enzymatic activation. Since enzymes accelerate chemical reactions, laser photon action is seen in its potential to decouple enzymatic chain process capability<sup>5</sup>.

In human body, photons are absorbed via the eye, skin and mucosa. Absorptive molecules are categorized in photo acceptors and photo receptors.

Photo acceptors are part of key cell structures and do not react directly to light. But they play a role in the turning on or off of a reaction after its activation by light. The main location of these substances is the cell respiratory chain and mitochondria. Examples of these photo acceptors are cytochrome C oxidase, flavoproteins, riboflavins and porphyrin rings. Photo acceptors have a light regulatory role when cells are in redox state. The site of action of Red and Infrared ranges' wavelengths is the mitochondria, and these wavelengths affect molecules responsible for oxidation or reduction of the respiratory chain such as cytochromes. The cell membrane and matrix are other sites of action for Red and Infrared wavelengths. Flavoproteins, riboproteins are the photo acceptors of the ultraviolet range<sup>6</sup>.

Electrons are transferred to oxygen by cytochrome. Change and transfer of the electron charge in the mitochondrial membrane results in electrochemical potential which activates the ATP synthesis pathway potential up to 300%. Increase of ATP leads to RNA



**Figure 1.** Photons' energy is absorbed by mitochondria and lead to activation of primary reactions and increase in ATP synthesis. Then reactions of the dark region or secondary reactions start.

and DNA synthesis and finally protein synthesis<sup>7,8</sup> (Figure 1).

The effect of laser on a cell does not only depend on its wavelength, but also on the chromophores concerned oxidation state. In a way that in a normal or close to normal state, response to laser is weak but it is stronger in the reduction state, which is the reason for various responses in cell biology<sup>9</sup>.

Irradiation of certain wavelengths results in activation of photo acceptors of other wavelengths. It means that change in the oxidation and reduction of the target photo acceptors influences the absorption of other wavelengths. cytochrome oxidase C are the Photo acceptors of the Red and Infrared spectrums and the Photo acceptors of Ultra violet spectrum are flavoprotein molecules. The absorption of oxidases in activated state is partial, which is the basis for combination treatments with different wavelengths for certain diseases<sup>10</sup>.

### Mechanism of Low Level Laser effect on Cell

The effect of laser irradiation on cell is divided in two stages of: primary reactions or reactions of the bright region and secondary reactions of dark region.

#### Primary Reactions

Reactions occurred in the cell during laser irradiation, resulting in the change of cell Redox state leading to oxidation or reduction.

In general, all cell metabolic reactions are controlled by the Redox state. Cells' response to laser is different based on the quality of Redox. In a normal or close to normal stat, the response is weak and cases of transfer

or tendency toward reduction have better response. Healthy cells show less reactions under laser light which is an advantage of laser<sup>1,4</sup>.

### **Delayed Reactions**

They are referred to the mechanisms that continue after laser irradiation. After mitochondrial stimulation a chain of biochemical reactions starts. And finally the amount of cell ATP increases, which subsequently leads to mRNA activation and DNA replication and in the end protein synthesis.

The amount of effect of laser with various wavelengths is assessed by measuring cell DNA and the quantity of the proteins. The synthesized protein is in many cases a neurotransmitter, a coenzyme, an enzyme or another substance regulating critical processes.

Following this process, laser effects spread from cell level to tissues and organ or macro vascular levels<sup>1,4</sup>.

### **Physiologic effects of laser at tissue level**

Tissue response to laser can be divided in two categories:

#### **Primary responses, comprising:**

Vasodilation, blood circulation and lymphatic drainage enhancement, increased activity of neutrophil and fibroblast, improvement of cellular metabolism and increased stimulus threshold of pain receptors.

#### **Secondary responses, comprising:**

- Increased concentration of certain prostaglandins such as PGL<sub>2</sub> which has an anti-inflammatory effect.
- Increased immunoglobulins, lymphokins and their effect on the immune system.
- Increased beta endorphins and encephalins which are effective in analgesia.

Responses mentioned above result in physiologic responses which includes<sup>1</sup>:

- Stimulation of biologic system
- Effect on immune system
- Anti inflammatory and anti edema effect
- Effect on vessels and circulation
- Effect on wound healing
- Effect on nerves
- Analgesic effect

### **Anti inflammatory and anti edema effect of LLLT**

Treatment by low level laser is effective in every 3 phases of inflammation (Exudation, alteration and proliferation). Laser decreases swelling, redness, heat, pain and inflammation by the following mechanisms<sup>11</sup>:

- Change in prostaglandins synthesis (PGE and PGF<sub>2</sub>α)  
Increased synthesis of PCL<sub>2</sub>
- Inhibition of bradykinins synthesis  
Increase of phagocytosis  
Vasodilatation and more circulation  
Increased lymphatic drainage  
Increased secretion of MIF (Migration Inhibitory Factor)
- Reduction of histamine release

### **Biologic stimulation of LLLT**

By moving the cell Redox system, laser orients the anaerobic metabolism toward aerobic. Anaerobic metabolism plays a major role in creation of pain and inflammation as well as slowing down healing process by formation of waste products and reduction of PH. Therefore, moving the metabolism toward aerobic and normal, laser has a positive impact<sup>12</sup>.

### **Effect on immune system**

Red and Infrared wavelengths of laser activate the immune system by the following pathway<sup>13</sup>:

- Activation of T cells (T helper-T suppressor)
- Immune Modulation
- Increased macrophages and lymphocytes activity
- Increased phagocytosis
- Increased immunoglobulins and lymphokins
- Enhancement of complement system

### **Effect on wound healing**

#### **Are low level lasers carcinogenic?**

One of the most thoroughly studied areas in laser therapy is wound healing. In fact, this was one of the first indications reported, with studies by Mester and by Carney<sup>14</sup> as early as 1967. Electromagnetic radiation can injure living organisms if it has enough intensity to burn (many Watts) and/or contains highly energy photons (short wavelengths). Photons with

the wavelength shorter than 320 nm are capable of ionizing molecules and atoms in tissue and can cause cancer. The risk factor depends on both, the dose (input energy, measured in joules per cm<sup>2</sup> of skin) and the power density (intensity) of the radiation.

No effects have been observed resulting from light with wavelengths in the red or infrared range in doses used within laser therapy, but does it stimulate the cancer growth in someone who has cancer and is unaware of it?

There are many in vitro studies on this subject; however, with respect to the cancer in vivo, the situation is rather different.

Experiments on rats have shown that, small tumours treated with laser therapy may completely disappear, although it has no effect on tumours over a certain size<sup>15</sup>.

The electromagnetic spectrum comprises radiations with various wavelengths. Wavelengths of some of these radiations like Gamma rays are very short i.e. 10<sup>-6</sup>nm, when radio wavelengths reach 10<sup>5</sup> nm. Wavelength has an inverse proportion with frequency. Considering that energy of each atom is equal to its frequency multiplied by plank constant so the shorter the wavelength the more energy photons will have. High energy photons result in ionization of target cells. Photons with wavelengths shorter than 320nm like Gamma, X and ultraviolet rays cause atom and molecules' chemical liaisons to fracture, and finally mutation happens, so they are carcinogenic. Ultra violet radiations with wavelengths between 320-400nm provokes skin burns in prolonged irradiation, and are rarely carcinogenic. While radiations with long wavelengths such as radio frequency, microwave, infrared and visible light do not cause ionization, but only cause excitation and heat.

Wavelengths used in laser are comprised between visible light and infrared i.e. 600-1200nm. Photons of the visible and infrared range when they collide to tissues are either reflected, pass through them or are absorbed. So the energy they lose is transformed to other forms of energy. Till now no scientific report claiming mutation effect in these wavelengths range has been presented<sup>4,16</sup>. On the other hand doses used in laser therapy between 0.01 up to a maximum of 50 joules/cm<sup>2</sup> are sometimes in inhibitory doses, while small changes in DNA result from 250 joules/cm<sup>2</sup> irradiation, which has a very large distance to therapeutic doses<sup>5</sup>.

Nevertheless, till the time when our science

**Table 2.** Most important therapeutic lasers with their wavelengths

HeNe laser	633nm	Gas laser
InGaAlP lasers	633-700nm	Semiconductor laser
GaAlAs lasers	780-890nm	Semiconductor laser
GaAs laser	904nm	Semiconductor laser
Defocused CO <sub>2</sub> laser	10600nm	Gas laser
Defocused Ruby laser	694nm	Solid state laser
Defocused Nd:YAG laser	1064	Solid state laser

and knowledge hasn't be turned to certitudes, it is reasonable in special cases where there is possibility of cancer or procreative organs concerned to avoid the use of low level lasers.

Lasers used in laser therapy from the beginning up to now include He-Ne, Ruby, Argon, CO<sub>2</sub>, Nd:YAG lasers and types of semi solid lasers (like GaAs, GaAlAs, GaAlInP). But today semi solid lasers constitute the base and foundation of more laser therapy devices. These lasers, in addition to positive biologic effects, are considered the lighter, smaller, cheaper and in the same time more durable lasers (Tuner)<sup>4</sup>.(Table 2)

### Application of Low Level Lasers in Dentistry

The oral cavity is one of the best regions for laser therapy, because of convenient accessibility, comfortability for patients and particular biologic conditions. Low level lasers are used in the oral cavity and surrounding tissues including soft tissues, hard tissues and temporomandibular joint (TMJ). Soft tissues comprise mucosa, muscles and skin; hard tissues comprise bones, teeth and TMJ. Existence of such complex biologic structures in a small and limited space is seen nowhere else in the body.

Laser is used to treat various conditions in dentistry. Use of laser needs minimum anesthesia and is time saving for patients. Sometimes it is used as an adjunctive beside other treatments (drugs, surgery and physiotherapy) and sometimes as the principal treatment. It is the anti-inflammatory, analgesic and biostimulative regeneration effects of laser which causes the reestablishment of tissue normal physiologic state.

Low level lasers are used in different fields of dentistry. Treatment method, convenient wavelength and efficient doses are items to be determined by the clinician. Also response to different treatments and drugs varies from an individual to another. Response to laser therapy also depends on patient tissues and immune system condition.

Taking into account the mechanisms for biologic effect of lasers, it is possible to modify laser physical parameters in order to obtain treatment effect concordant with the targeted lesions. As well, time between treatment sessions which can be daily or every two days are determined depending on the type of disease in an acute or chronic point of view with consideration of the body resistance.

Since laser therapy is a young science, methods and conditions of treatment are continuously under evaluation and improvement by researchers. Treatment failure is mostly due to choice of incorrect method or insufficient dosage and is not a reason for inefficiency of laser. In general it is necessary that the treatment course and the amount of effect of laser on the person, to be regularly under control<sup>5</sup>.

## Application of Low Level Laser in Endodontic Treatments

### 1- Laser therapy in decreasing dentin hypersensitivity

Dentin hypersensitivity happens as a short and sharp pain from naked dentin in response to various stimuli. To treat dentin hypersensitivity, different anti sensitivity substances are used. In more complicated cases like reversible pulpitis, it is possible to use laser energy to help. Low level laser irradiation of cervix and apex region of sensitive teeth can be an appropriate treatment to eliminate sensitivity (Figure 2).

Effect of this laser is more based on changes created on pulp nerve transmission<sup>17</sup>. It is possible to relate laser effect at the cell level to the prevention of the



**Figure 2.** Laser therapy can be use for decreasing dentin hypersensitivity

signal transmission of pain from peripheral to central parts as well as blocking of the depolarization of sensory C fibers<sup>18,19</sup>. In a study Gerschman et al<sup>20</sup> used low level laser with 830nm to decrease sensitivity in the dentinal region of teeth and repeated treatment in three time intervals. The most reduction of sensitivity was observed after the first treatment session. Also evidence has been presented on decrease of dental hypersensitivity immediately after beginning of treatment with He-Ne laser and lasted till 3 months after treatment and all teeth remained vital as well. GaAs and GaAlAs have more penetration. Irradiation is done in the apex region but by the use of Ne-He laser, irradiation would be only possible in the teeth anterior cervical region. Sometimes irradiation on cervix, pulp and apex is recommended. A tooth that would not respond to 4 to 6 joules of irradiation on its root for 2 to 3 sessions probably needs root canal therapy<sup>21,22</sup>.

### 2- Laser therapy in treatment of wounds and periapical lesions

In a study, low level laser was used to wound healing and the result showed that:

Less inflammation was observed on days 3 and 7 in the treatment group ( $p < 0.01$ ). The inflammation rate on both sides was the same on day 14 ( $p > 0.05$ ).

LLLT using optimal parameters can accelerate full thickness wound healing<sup>23</sup>.

Laser therapy result in better wound healing by the following mechanisms on the 3 phases of primary inflammation, proliferative and remodeling phases.

- Increased synthesis of RNA, DNA and proteins
- Angiogenesis and neovascularization
- Accelerated epithelialization

Anti inflammatory effect by affecting leukocytes and macrophages

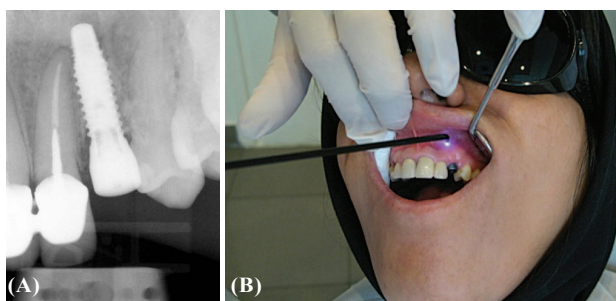
Moving metabolism toward aerobic

Reduction of pain and decreased secretion of pain mediators

Activation of the immune system via effect on immunoglobulins IgM-IgG and complements (Figure 3)

Also daily use of low level laser in a treatment course resulted in stimulation of synthesis of type I collagen fibers and strengthens the scar tissue.

The anti-oedematous effect of laser energy is based on a dilation of lymphatic vessels and a reduction in the permeability of blood vessels. Laser energy has



**Figure 3.** Laser therapy result in better wound healing. (A) Patient X-ray (B) Patient treatment by LLLT

a regenerative effect on lymphatic vessels, as it has on veins<sup>4,24</sup>.

### Pain reduction

Patient may sometimes experience pain the day after endodontic treatment. This is particularly common after the treatment of chronic complaints. It occurs because an injury is made acute when the process of healing starts<sup>4</sup>.

In a study, low level laser was used to decrease the pain after one session treatment and the result showed that:

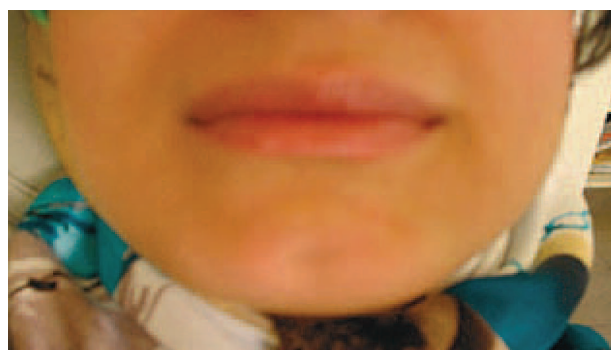
Regarding the significant pain reduction in LLLT group at 4, 8, 12, and 48 hours after endodontic treatment, LLLT seems to be an effective and nonpharmacological approach for the reduction of post-endodontic treatment pain<sup>25</sup>.

One of the most thoroughly studied areas in laser therapy is the wound healing. In fact, this was

one of the first indications which has been studied by Mester<sup>13</sup>. In the case study using 810nm diode laser and low Level Laser and sixteen months follow-up to improve healing of the edema<sup>26</sup> (Figure 4,5).



**Figure 4.** Chief complain: A fistula on the chin skin with a large swelling around it.



**Figure 5.** Follow up after 16 month low level laser therapy

### 3- Laser therapy in repairing damaged nerves

Generally, damages on nerve repair slowly. Surgeries in dentistry and endodontics can result in nerve damages. Also, Extrusion of sealers containing formaldehyde from the end of the canals can affect the adjacent nerve tissue. Use of low level laser can be a good idea for the regeneration of damaged nerve tissue in animal models use of low level laser resulted in stimulation of damaged fibers' axon growth. Protocol of laser therapy includes the use of 4/5J irradiation for 10 days.

In a double blind clinical study by Khullar et al, effects of LLLT on 13 patients with antecedent of injury of inferior alveolar nerves were evaluated. In the experimental group, after treatment with low level laser, significant improvement in touch sense was observed compared to control group. For sense of heat there was no difference between the two groups<sup>27</sup>.

### 4- Effects of laser on analgesia

One of the most important effects of low level lasers is its analgesic effect. Laser act on acute and chronic pains via the following mechanisms:

- Decrease of histamine, acetylcholine, serotonin, bradykinin and prostaglandin E<sub>2</sub>
- Augmentation of acetylcholine esterase
- Increase of lymphatic drainage
- Increase ATP and aerobic metabolism
- Augmentation of pain threshold
- Increase of beta adrenaline and encephalins
- Equilibrium in adrenalin and noradrenalin activity
- Reducing the production of P substance in spinal posterior horn

In vivo studies of analgesic effect of low level lasers on nerves of the oral cavity showed that these lasers reduced the frequency of stimuli of pain in nerve fibers

and also increased the nerve stimulation threshold. In controlling pain by laser, it is possible to irradiate the points introduced by acupuncture medicine instead of stimulation by needles and obtain similar results<sup>28</sup>.

### 5- Laser therapy in accelerated anesthesia

In patients experiencing problems during anesthesia, with irradiation of 2 to 3 J of laser on apex of teeth, blood circulation of the area improves and anesthesia with lidocaine is obtained sooner. In addition, the start time of anesthesia is reduced because of improvement of local blood circulation. Irradiation of 2J of laser on injection area is effective in reducing patient's pain and increasing stimulation threshold. Injection in periodontal ligament is very painful, and irradiation of 3 to 4J under papilla, well decreases pain during injection<sup>4</sup> (Figure 6).



Figure 6. Laser therapy can accelerated anesthesia

### 6- Laser therapy to reduce nausea during stages of root canal therapy and radiography

Nausea is one of the most common problems during dental treatments. Some clinicians use acupuncture to reduce nausea. It is possible to use laser instead of special needles. For this purpose at least 2J of energy is used in the hand wrist area and P6 Meridian point. Application of this method was accompanied with success in more patients<sup>4</sup> (Figure 7).

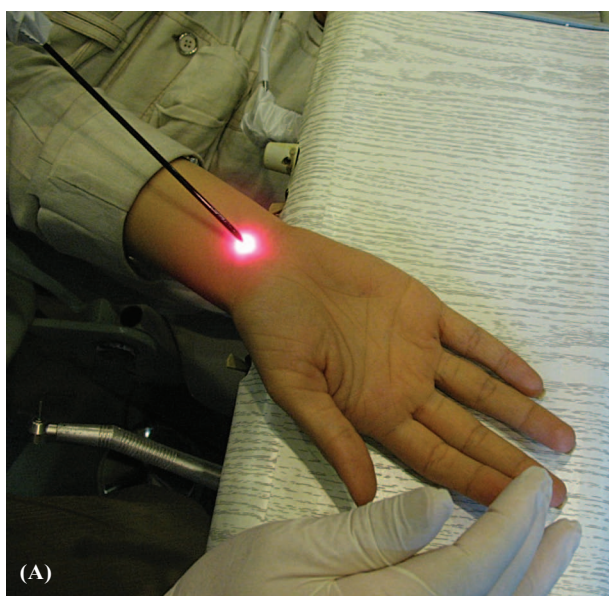


Figure 7. Use laser therapy to reduce nausea during stages of root canal therapy. (A) Finding the point. (B) Using low level laser

### Risks and side effect related to laser irradiation on the body

Laser light depending on wavelength, power or output energy can be dangerous for body tissues, particularly eyes and skin. Laser light is not only dangerous when directly encountering tissues but also after reflection from reflective materials. Also, when using low level laser, its complications have to be kept in mind. The most important complications are:

- 1- Pain sensation in first sessions because of a chronic process becoming acute
- 2- False impression of improvement because of the analgesic effect of laser before apparition of repair effect
- 3- Sensation of fatigue is common after treatment with laser
- 4- Drop of blood pressure and vertigo if laser irradiation site is close to vessels or if laser is used intravenously and causes vessel dilation which results in drop of



blood pressure, vertigo and darkening of the visual fields<sup>4</sup>.

### Contraindication of laser therapy use

- 1- It is not prescribed in patients with pacemakers, or used with precaution
- 2- Laser should not be used in the uterus region in pregnant women
- 3- Shouldn't be used in epileptic patients or with frequency less than 800Hz
- 4- Shouldn't be used in patients with antecedent of arrhythmia or chest pain
- 5- Shouldn't be used on glands, e.g. thyroid gland
- 6- Laser therapy should be avoid on tumorous tissues or benign tumors with malignant tendency
- 7- Prescription of laser therapy is forbidden in patients with lupus or patients treated with substances sensible to light
- 8- Low level lasers, under the title of cold-soft lasers, are used for years in different countries all over the world. The favorable effects of these lasers such as: decreasing inflammation and pain, increasing the quality and rapidity of repair, increasing the immunologic system, etc., are presented in different books and articles.
- 9- The aim of this article is to present a part of favorable effects of these lasers in dental, especially in endodontic treatments.

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