Original Article

# Effect of low-level laser on controlling pain after clinical lengthening of tooth crown surgery

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## ABSTRACT

Background and objective: the effect of low-level laser on reducing pain after oral surgeries such as clinical tooth crown lengthening surgery has not yet been confirmed, and it is a controversial issue discussed in the studies. The aim of this study was to investigate the effect of low-level laser on reducing pain after clinical tooth crown lengthening surgery. Materials and Methods: The study is a clinical trial and the size of the samples consists of 30 patients undergone clinical tooth crown lengthening surgery. 15 patients were treated with laser radiation immediately after surgery, and the rest were treated with placebo laser irradiation. After that, the pain was assessed on the same day of laser radiation, the third day, and the seventh day following the surgery. After collecting data, they were analyzed by SPSS statistical software using t- test. P-values less than 0.05 were considered as statistically significant. Findings: The mean pain score in samples treated with laser therapy after surgery was less than those who were treated with placebo laser radiation, and this difference was statistically significant. ($p < 0.05$). Conclusion: The results of this study indicate that low-level laser can reduce the severity of pain in clinical tooth crown lengthening surgery.

**Keywords:** Low-level laser, pain, surgery, clinical tooth crown lengthening surgery.

## Introduction

In the past, the teeth losing their clinical crown due to an impact, decay, or any other lesions at 1/3 cervical of their root including perforation, reseption, etc. in a manner which seemed unrepairable, were subject to extraction. Today, with the help of endodontics, periodontist, and prosthesis, such teeth can be cured and kept in the patient's mouth.

Clinical tooth crown lengthening is one of these techniques. Using this method leads to exposure of more healthy parts of the tooth structure to achieve more beauty or for restorative purposes inside the oral cavity. This purpose can be achieved using periodontal surgery or orthodontic procedures [1].

The pain after periodontal surgeries (e.g. crown lengthening surgery) is a common and normal phenomenon. Several factors including the nature of the person, length, type and extent of surgery, as well as psychological aspects including stress and euphoria may affect the severity of pain. Post-surgery pain is one of the complications that bring an unpleasant experience for the patients. After the surgery, inflammation will occur in dental protective tissues due to trauma and healing process. Tissue damage process results in damage to the cell walls. Phospholipase enzyme facilitates the rupture of membrane, releasing the phospholipids of the membrane, which will turn into prostaglandins, thromboxane, and other metabolites by COX-1 and COX-2 enzymes, which eventually produces the sense of pain. [2] One of the primary objectives in dentistry interventions is providing a painless treatment for the patients [3].

Today, laser technology is widely used in medicine, and there has been a significant increase in using it for dentistry treatments [4].

The term laser stands for Light Amplification by Stimulated Emission of Radiation.

"Ruby Laser" was first introduced by "Theodor Maiman" in 1960. [5] The pain suppressing effects of laser therapy include reduced neural signals speed, reduced potential for complex

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activities, selective prohibition of A and C fibers, and reduced brain stimulation . The first phase of reducing chronic pains is to reduce the level of prostaglandin and other markers of inflammation. Direct inhibition of peripheral afferent terminals suppress peripheral sensitization and reduces the further release of neurokinins. Dose will be depended on patient's feedback [6].

Low Level Laser Therapy is described by using the light for improving tissue healing, reducing tissue inflammation, and controlling the pain [7].

The benefits of using LLLT include its positive effect on oral post-operative conditions including surgeries of impacted wisdom teeth, periodontal, implant, and endo [8].

Javier D et al. (2013) compared tissue response and post-operative pain after using 810 nm diode laser as a supplement for modified Widman flap surgery. They performed the surgery on 13 patients with severe chronic periodontitis. Examining edema and pain one week after surgery showed that the laser is effective in reducing pain and edema after MWF surgery [9].

Seda sevic ozbec et al. (2018) studied the effect of low-level laser on treatment of necrotizing ulcerative gingivitis. During the study, they first removed pseudo membranes with cotton roll in the patient. Then, the patient was administered with amoxicillin and metronidazole three times a day for five days. During the second session, scaling and root planning was performed on patient, and then on the area subjected to laser radiation in the third, fifth and ninth days for 60 seconds. The utilized laser was a 980 nm diode with a power of 0.4 watts and 9 Jules of energy per square centimeter. After performing the laser therapy, the patient's pain was decreased [10].

Merigot et al. (2015) examined the effect of low-level laser on post-operative pain and inflammation [11]. They studied 59 patients who they operated for impacted wisdom teeth. During their study, they radiated the patients with 240 Jules in the area and a total of 480 Jules per square cm on each side of the face immediately after the surgery and about 12 hours later, using GaAs diode laser with 910 nm pulse and continuous 650 nm pulse. Studying the variables before the surgery, after the first radiation, and 24 hours after the second radiation indicated the effectiveness of the laser in reducing pain.

The purpose of the present study was to study the effect of low-level laser in reducing post-operative pain of clinical tooth crown lengthening surgery.

## Method

This clinical trial study was performed on 30 patients referred to Ardabil dentistry faculty from November 15, 2017 to May 5, 2018 who had the indication of clinical tooth crown lengthening surgery. The patients were entered the study after completing the informed consent form. The Ethics Committee of Ardabil University of Medical Sciences has approved the study. The criteria for entering the study were all patients who needed tooth crown lengthening surgery and aged between 20 and 60 years. The exclusion criteria included 1- smokers; 2- patients taking medications that effect the healing process; 3- Patients with underlying systemic diseases including diabetes, immune system deficiency, etc.; 4- Patients with a clear nutrition disorder; 5- Patients who did not accept laser treatment; 6- Patients who were having crown lengthening surgery for molar teeth; and 7- Patients aged under 20 years over 60 years.

The qualified patients were entered the study after a dentist's permission and full explanation of the treatment process. 30 patients were selected for surgery and they were divided into two groups of 15. The patients in these two groups needed clinical tooth crown lengthening surgery on the upper or lower anterior teeth. In order to perform crown lengthening surgery, patients were first treated with local anesthesia. Then the gums were flapped and the bone was removed (to make a 3 mm distance between the edge of the fracture of the tooth and the margin of the bone). After the osteotomy, the flap was positioned in its place and sutured. Patients of the first group were radiated immediately after the surgery for 10 seconds with a diode laser device with a wavelength of 810 nm, a dose of 15 J, and an output of 0.5 W by contact method. The area around the surgery tissue was divided into points with a maximum diameter of 8 mm (tip of the device size), and after preparing the patient and the laser, the tip was contacted with the tissue and the laser was radiated. The second group consisted of 15 patients who were treated with placebo laser immediately after the surgery. After surgery, both groups received usual treatments including antibiotics, analgesics and anti-inflammatory drugs (if needed). Then they were dismissed. Patients were operated by a surgeon and then they were randomly treated with laser therapy or placebo by the second researcher based on the code.

Then, the pain was evaluated in both groups in 3 turns after the surgery. The first turn was the same day of surgery in which patients were asked to respond to the third researcher for pain control. The second turn was done after 3 days, and the third turn was run seven days after the surgery when removing the sutures. Therefore, the surgery was performed by one person, the laser was radiated by the second person, and monitoring was done by the third person. In this way, the study was double-blinded. VAS method was used to assess the pain. In this method, the intensity of pain is divided into 10 degrees and the patients are asked to score their pain in a scale from zero to ten. The results were evaluated by SPSS software version 20 using t-test and chi-square tests.

## Results

32 surgeries were performed totally, of which, 1 patient was excluded from the study due to uncooperation of the patient in filling the questionnaire of pain, and another patient was excluded because he needed antibiotics and analgesics. Table 1 indicates the results of pain comparisons in both intervention and control groups. According to the table, t-test shows that the pain score in the intervention group was significantly lower than the control group.

**Table 1. Comparison of pain between the intervention group and the control**

| Variable | Pain intensity score | | Time | p-value |
|---|---|---|---|---|
| | Intervention group Mean (standard deviation) | Control group Mean (standard deviation) | | |
| Pain | 4.6 (1.40) | 6.00 (2.03) | Day 1 | 0.037 |
| | 2.40 (1.50) | 3.00 (1.81) | Day 3 | 0.332 |
| | 0.933 (0.883) | 1.40 (1.68) | Day 7 | 0.352 |

The results of t-test showed that there is a significant difference between the intervention group and control in pain severity in day 1. The pain severity was lower in the intervention group compared to the control (0.037). No significant difference was observed in the other days.

## Discussion

Like any other treatment method, the occurrence of undesirable complications and consequences is an inseparable part of surgical treatments [12]. During most surgeries, tissue becomes traumatized, resulting in various degrees of inflammatory response. By controlling the extent of inflammation, we can reduce the edema, trismus, pain, and infection which are common phenomenon after surgery [13]. Post-surgery guidelines and care are important factors which lead to success of treatment [14]. A relatively new method to control these complications is low-level laser [15].

Using low-level laser is a conservative method which is introduced in recent years [14]. Laser therapy leads to normalization of tissue physiologic state due to specific biological status of the oral cavity. This effect was used from the very beginning of invention of low-level lasers, which is now used for their pain suppressing, anti-inflammatory, and anti-edema effects, as well as their effect in wound healing by stimulating the immune system, etc. these reasons have led to the widespread and increasing use of laser therapy in several dentistry fields [16]. The use of this therapeutic method is desirable due to lack of side effects, acceptable equipment, and low cost of treatment [15].

As stated in the introduction section, in the present study, we intended to investigate the effect of low-level laser on pain reduction after CL surgery. The aim of this study was to determine the effect of laser therapy on pain intensity compared to placebo group. Considering the effect of analgesics on pain suppression and the focus of the study on measuring the amount of pain, no analgesic drug was administered during the study and the patients who needed to receive an analgesic drug were excluded from the study. Therefore, the obtained results on the effect of laser therapy on pain in patients are comparable between the two groups. This study was based on the information obtained from the VAS grading, which is proven to be a precise evaluation of this type of grading.

In this regard, the results of our study indicate a decrease in the severity of pain after surgery in the laser group compared with placebo group, which is statistically significant.

Effects of low-level laser in reducing pain include reduced neural signals speed, reduced action potential, selective prohibition of A and C fibers, and inhibited painful stimulus. Direct inhibition of peripheral efferent neural terminals limits the environmental sensing and releasing of neurokinins [17]. These concepts are in line with the results of this study.

We can refer to the study of Javier D et al. (2013) [9] and Seda sevic ozbec et al. (2018) [10] concluding that LLLT has a significant positive effect on pain reduction after surgery, which consistent with the results of the present study.

The result of the study is interpreted as follows:

In addition to inhibitory effects on inflammatory markers, laser therapy leads to reduction of pain by effecting the central and peripheral nervous system, reducing the action potential, inhibition of painful stimuli, increasing pain threshold, and balancing the activity of adrenaline-noradrenaline. Therefore, mediatory inflammation reduction is part of the laser's function in controlling pain.

## Conclusion

It is concluded in the extent of this study that, regarding the biological effects of pain control in CL surgeries, supplementary treatments with laser significantly reduce the severity of pain.

Thorough researches are needed to obtain a definitive conclusion about the low-level laser-therapy method. The following conditions are suggested for better management of future studies:

1. Increasing patients knowledge about laser therapy
2. Selection of patients who need bilateral CL surgery, and considering one side as the control in two different sessions and comparing the results.
3. Reviewing different laser parameters and different radiation designs in achieving results.
4. Performing similar studies with more samples.

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