

## The Effect of Low Level Laser Ga-Al-As on the Treatment of Dentinal Sensitivity after Amalgam Restorations

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### ABSTRACT

**BACKGROUND AND OBJECTIVE:** Pain and sensitivity to thermal irritation after amalgam restoration is one of the most common problems, causes frequent recurrence of these patients to dental clinics. Since low-level laser has several benefits in reducing inflammation, pain and sensitivity, the aim of this study was to evaluate the effect of low-level Ga-Al-As laser on the treatment of dentinal sensitivity after amalgam restoration.

**METHODS:** In this double-blind clinical trial study, 21 patients with short-term sensitivity to thermal irritation after amalgam restoration (from the time of repair to two months) were evaluated. The case group was treated with Ga-Al-As laser in 4 sessions with intervals of three days. For the control group, the similar condition was applied except that the device was off. The sensitivity was assessed based on VAS criteria prior to treatment, immediately after treatment, and 3 and 6 months after treatment.

**FINDINGS:** Pre and post-treatment pain in case group was  $7.3 \pm 1.16$ ,  $4.5 \pm 3.03$  and in control group was  $6.45 \pm 1.75$ ,  $4.27 \pm 3.04$  respectively. The reduction in pain immediately after treatment was significant only in the case group ( $p = 0.004$ ). In the follow-up period of 3 and 6 months, the mean VAS in the case group was significantly higher than that in the control group ( $p = 0.026$  and  $p = 0.020$ , respectively).

**CONCLUSION:** Based on the results this study, the Ga-Al-As low-level laser has a decreasing effect on the sensitivity of post-amalgam restorations in a short term.

**KEY WORDS:** Low-Level laser, Dental Amalgam, Hypersensitivity.

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## Introduction

One of the most common causes of patient discomfort and re-referral to dental clinics is post restoration pain and discomfort. As the pain intensifies after restoration, many patients are unable to use hot and cold and acidic foods and drinks, and sometimes feel uncomfortable even while brushing and breathing (1). The increased dentinal sensitivity is caused by the exposure of open dentinal tubules to the oral environment. The most common theory for justifying pain is the increased dentinal hypersensitivity of hydrodynamic theory (2,3). Causes of pain and tenderness after amalgam restoration include trauma and heat during the preparation of the cavity, as well as the invasion of bacteria that cause inflammatory reactions and subsequently increase the pressure inside the pulp. On the other hand, the process of crosslinking products in current low-copper amalgams is long, so these amalgams need more time to seal the edges, and at this time, due to the openness of dentinal tubules and hydrodynamic theory, it may be develop allergies in some patients. Therefore, in cases where the depth of the cavity is high, we need to protect the pulp against external stimuli with other dental materials such as liners and bases. In cases where even after observing all the principles of cavity preparation and restoration and pulp protection, there is still sensitivity after restoration, various treatments such as laser therapy are used to reduce and eliminate the sensitivity (2-6). In recent years, the use of lasers as a complementary treatment to reduce pain has expanded, especially in the field of dentistry. Low-level lasers stimulate blood flow and cellular activity, resulting in various effects such as anti-inflammatory, anti-pain and tissue healing. Also, the ability of these lasers to prevent the depolarization of nerve fibers and suppress neuro-transmission plays an important role in reducing dentinal sensitivity. In addition to its immediate analgesic effect, the use of lasers in the right parameters stimulates the function of normal physiological cells, and in subsequent radiation, stimulates the production of sclerotic dentin and the internal blockage of dentinal tubules. Therefore, the use of low-level laser as an effective treatment method to eliminate inflammation and repair dental pulp tissue and thus reduce pain and tenderness is recommended (4,7,8). There have been no studies on the use of low-level lasers in the treatment of sensitivity after amalgam restoration. Numerous studies have been conducted to investigate the effect of low-level lasers, especially Ga-Al-As, in the treatment of increased dentinal

sensitivities. Praveen et al. concluded that the GaAlAs laser at one-week, two-week, and 30-day intervals are more effective in reducing dentinal sensitivity than glutaraldehyde. (9). Umberto et al. also showed that the Ga-Al-As laser, if used alone, is a useful tool for treating increased dentinal hypersensitivity, and if used in combination with sodium fluoride gel, its effects on reducing dentinal sensitivities increases (10). Vieira et al., In a comparative evaluation of the clinical effect of 3% potassium oxalate gel and Ga-Al-As laser in the treatment of dentinal sensitivity, concluded that in both groups statistically a significant decrease in dentinal sensitivity happens immediately after treatment and three months after treatment (11). Another study by Marsilio et al. found that there was a significant difference between the values of increased dentinal sensitivity before treatment and 60 days after treatment (12). According to the results of a study by Gerschman et al., the Ga-Al-As laser is an effective method for treating increased sensory and thermal dentinal sensitivities (13). Given the many benefits of low-level lasers in reducing inflammation, pain and tenderness, as well as the numerous complaints of patients about increased sensitivity after amalgam restoration and the fact that so far no studies have been performed to investigate the effect of low-level lasers on sensitivity after amalgam restoration, this study was performed to determine the effect of Ga-Al-As low-level laser on dentinal sensitivities after amalgam restoration as a two-way blind clinical trial study.

## Methods

This study is a two-way blind clinical trial that was performed after approval in ethics committee of Mashhad University of Medical Sciences with ethics code of IR.MUMS.sd.REC.1394.85 and the registration of Iranian clinical trial number: IRCT20180416039318N4. In this study, 21 patients who were treated by a number of rehabilitation specialists in Mashhad were examined. People with short-term sensitivity to various stimuli, including cold, heat after amalgam restoration (from the time of restoration to two months later), visual scale of pain, Visual Analogue Scale (VAS)  $\geq 5$  (14) and having conscious satisfaction were studied. Patients during pregnancy and lactation, with spontaneous and nocturnal toothache and a history of swelling, radiographic view with symptoms of periapical involvement (dilation of periodontal ligaments, loss

lamina dura and the presence of radiolucent lesion or radiopaque), defective restoration (fractures, overhang, over contour, recurrence of decay, long restoration in occlusion), inability to attend laser therapy sessions for any reason, VAS > 9, tooth sensitivity for other reasons (such as gingival resorption, decay or cracking in another part of the restored tooth), pain in other teeth except restored teeth (after examination of teeth) and teeth with irreversible or necrotic pulpitis were removed after vitality tests. Before each patient was started, a periapical radiograph was prepared with a parallel technique to ensure that there is no periapical lesion and pathological conditions that could not be diagnosed at the clinic. If individuals had the conditions to enter the study, signed the consent form after learning how to conduct the research. Also, patient characteristics including age, sex, education, marital status, position of teeth in two jaws, type of posterior teeth (molar, premolar), type of restoration (class 1, class 2 and complete crown reconstruction), extent of decay in dentin (one-third external dentin, one-third of middle dentin, and one-third of the internal dentin), the presence of base and liner and base alone, the onset time of sensitivity, the sensitivity to chewing before treatment, were recorded in specific checklists. If necessary, information was extracted from patients' files. For each patient, sensitivity to percussion, heat and cold tests and an Electrical Pulp Tester were performed along with the control tooth. To test the cold, ethyl chloride cooling spray (German DC Company) was used, and to evaluate the tooth's response to heat stimulus, a dry rubber cup was applied to the middle third of the facial surface to generate frictional heat. Prior to laser irradiation, patients' sensitivity time and amount of sensitivity to stimuli (cold, heat) were measured and recorded on a VAS scale. Patients were then divided into study groups (10 people) and control (11 people) based on a table of random numbers obtained from [www.randomizer.org](http://www.randomizer.org). In the study group, real laser therapy was performed for patients. The control group was in the same condition as the study group, and the beep sound was simulated, but the laser device was off. Laser therapy was performed for 4 sessions twice a week. In each session, the sensitivity of each patient was recorded according to the VAS evaluation criterion. Also, immediately after treatment, 3 and 6 months after treatment, sensitivity was assessed according to VAS criteria. Special protective goggles were used for both the patient and the therapist. In this study, a low-level Ga-Al-As laser with a wavelength of 810 nm, an approximate penetration depth of 3 cm and

a power of 200 mW was used, and the radiation method was spotted. The location of the laser irradiation on the root surface was beyond the bone of the buccal and lingual surfaces of the sensitive teeth. The apex of posterior teeth was laser irradiated for 3 minutes (90 seconds from the buccal and 90 seconds from the lingual) (Figure 1).



**Figure 1. How to place the laser probe in the buccal apex area (right), how to place the laser probe in the lingual apex area (left)**

The radiation dose in this study was determined J/CM<sup>2</sup> 80. In this study, Fishers exact test was used to compare qualitative variables, Friedman test was used to compare between different times, independent t-test was used to compare between two independent groups and t-test was used between dependent groups and  $p < 0.05$  considered as significant.

## Results

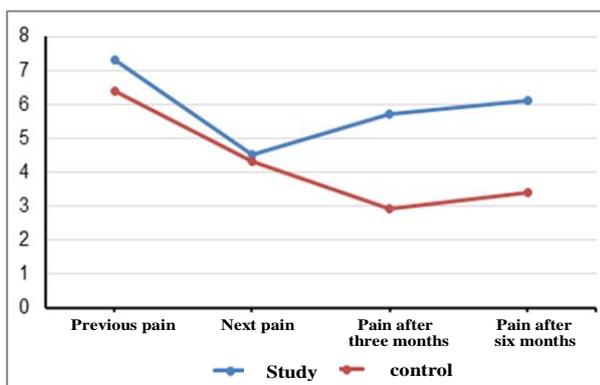
The study involved 21 people, including 20 women and 1 man, with an average age of  $31 \pm 7$  years and an age range of 20 to 47 years. Frequency distribution of education, marital status, position of teeth in two jaws, type of posterior teeth (molar, premolar), type of restoration (class 1, class 2 and complete crown reconstruction), extent of decay spread in dentin (one third of dentin external, one third of the middle dentin and one-third of dentin internal), the presence of base and liner and base alone, sensitivity to thermal stimuli based on VAS criteria, sensitivity onset time, sensitivity to chewing before treatment, dental vitality and return of pain after treatment, between two groups had no significant statistical differences. Sensitivity to percussion in the study group was significantly higher than the control group ( $p = 0.03$ ). Also, in the study group, the pain continued for more than 5 seconds, significantly less than the control group ( $p = 0.009$ ). According to the findings, the amount of pain before and after treatment in the study group was  $7.3 \pm 1.15$ ,  $4.5 \pm 3.02$ , respectively, and in the control group, was  $6.4 \pm 1.75$ ,  $4.27 \pm 3.03$  respectively. The reduction in pain

was significant only in the study group ( $p= 0.004$ ). Also, the amount of pain three months after treatment was reported in the study group about  $5.97\pm 2.26$  and in the control group it was  $2.93\pm 2.45$ . The amount of pain in the study group was significantly higher than the control group ( $p= 0.03$ ). The amount of pain six months after the end of treatment in the study group was  $6.17\pm 2.54$  and in the control group was  $3.43\pm 2.87$ , and at this time, as well as three months after treatment, the amount of pain in the study group was significantly higher than the control group ( $p= 0.02$ ), (Table 1). Friedman's test showed a statistically significant difference in pain rates between different evaluation times in the study group ( $p= 0.001$ ) (Figure 2).

**Table 1. Comparisons of mean pain, before treatment with pain immediately, three months and six months after intervention in both study and control groups**

	Study group* Mean±SD	Control group** Mean±SD	P-value***
Pain before treatment	7.3±1.15	6.45±1.75	0.21
Pain immediately after treatment	4.5±3.02	4.27±3.03	0.86
Pain three months after treatment	5.9±2.26	2.93±2.45	0.02
Pain six months after treatment	6.17±2.54	3.43±2.87	0.02

\*n= 10, \*\* n= 11, \*\*\* Independent T-test



**Figure 2. Comparison of mean sensitivity at four evaluation times, pre-treatment, immediately, three months and six months after treatment in two study and control groups**

**Discussion**

Based on the findings of the present study in both study and control groups, the amount of pain after treatment decreased compared to before treatment, but the decrease was only significant in the study group. There was also no significant difference in sensitivity after restoration immediately after treatment between the study and control groups, but in the 3 and 6 month follow-up, the mean VAS in the laser irradiation group was significantly higher than the control group. Most previous studies have examined the effect of laser radiation on the increase in dentin sensitivities, and no similar study has examined the effect of lasers on dentin sensitivities after amalgam restoration. Different types of lasers with different power and wavelengths have been used to reduce dentin sensitivities. In this study Ga-Al-As laser with power of 200 mW, wavelength of 810 nm and energy of 80 joules per square centimeter was used, and the irradiation time was 3 minutes, with a contact time of 1.5 minutes from the buccal and 1.5 minute from lingual. Yilmaz et al., who studied the effects of Er, Cr: YSGG and Ga-Al-As lasers on reducing dentin sensitivity found that the Ga-Al-As laser wavelength was 810 nanometers similar to the present study, but the radiation time was 1 minute and non-contact (15).

The increase in laser power and usage time in the present study was due to laser irradiation of the bone and considering the thickness of the bone in the dental apex area, while in most studies of dentin sensitivity, the device is placed vertically and with gentle contact on the exposed dentin area (16). According to the results of this study, a significant reduction in pain immediately after treatment and an increase in pain in the follow-up of three and six months in the study group, it can be concluded that the role of Ga-Al-As laser in pain healing and post-restoration sensitivity is temporary and short-lived. In a study by Raichur et al. in the study of the effect of low-level laser Ga-Al-As, potassium nitrate gel and stannous fluoride on dentin sensitivities, showed that low-level lasers are more effective in relieving and reducing pain in the short term than potassium nitrate and stannous fluoride gels. (17).

Also in a 2018 study by Tabatabaei et al., which looked at the effects of Nd: YAG laser, laser diode, and dentin binding agents on dentin sensitivity, it was found that in all three groups, post-treatment dentin sensitivity decreased before treatment and this reduction was significant in all three groups, but there was no statistically significant difference in the sensitivity

immediately after treatment between three groups. Also, in the diode laser group and the dentin binding agents, the reduction in sensitivity was not statistically significant 3 or 6 months after treatment (18). In the present study, the effect of the laser on the improvement of the first phase of inflammation was seen, and perhaps the abrupt discontinuation of the laser caused the uncompleted restoration. In future studies, it is recommended that laser sessions be increased and that reminder sessions be continued at longer distances and for longer periods of time. One of the limitations of this study is the low volume of the sample due to the length of one year of study, which requires continued study over a longer period of time. It is also recommended that restoration be performed by a restorative specialist,

which is one of the limitations of the above study. Based on the results of this study on reducing the amount of pain in patients immediately after treatment and increasing the amount of pain in patients in 3 and 6 months follow-up, it can be concluded that Ga-Al-As low level laser has a temporary and short-term effect on reducing post restoration sensitivity with amalgam. Of course, a definite statement of this result requires further study.

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