

A Clinical Investigation of Low Level Laser Irradiation on Hypersensitive Dentine

Hassas Dentinde Düşük Güçlü Lazer Uygulamasının Klinik Değerlendirilmesi

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ABSTRACT

Purpose: The study was conducted to evaluate the efficacy of low power diode laser for the treatment of dentin hypersensitivity, to assess the reliability of two pain measurement methods.

Materials and Methods: Twenty seven patients with a history of dentin hypersensitivity were selected and 54 exposed sensitive teeth were divided into test and control groups. In the test group 1, a low power laser (685 nm, 25mW, 2j/cm²) was used in hypersensitive teeth for one minute and forty seconds. The dentin hypersensitivity of all teeth was measured with VAS (Visual Analogue Scale).

Results: After desensitizing procedures, most of the patients reported distinct reductions in dentin sensitivity at the baseline. The statistical analysis of patient's data revealed statistically significant differences between the baseline measurement and examination periods. Furthermore, the statistical analysis indicated that an air-blast stimulus is a more reliable method than tactile stimuli in dentin hypersensitivity.

Conclusion: The results of the present study demonstrated that the laser irradiation is efficient in the treatment of hypersensitivity.

KEYWORDS

Dentin hypersensitivity, Laser irradiation, Diode laser, Low power laser

ÖZET

Giriş ve Amaç: Bu çalışma, düşük güçlü diod lazerin dentin hassasiyeti üzerindeki etkisini incelemek ve iki ağrı ölçüm metodunun güvenilirliğini değerlendirmek için gerçekleştirilmiştir.

Gereç ve Yöntem: Dentin hassasiyeti olan yirmi yedi hasta seçilmiş ve 54 hassas diş test ve kontrol grubu olarak ikiye ayrılmıştır. Test grubunda, düşük güçte bir lazer (685 nm, 25mW, 2j/cm²) hassas dişler üzerinde bir dakika kırk saniye boyunca uygulanmıştır. Bütün dişlerin dentin hassasiyeti VAS (Visual Analogue Scale) ile ölçülmüştür.

Bulgular: Hassasiyeti kaldırmak için uygulanan işlemten sonra, hastaların büyük bir kısmı başlangıca göre dentin hassasiyetinde belirgin bir azalmayı belirtmişlerdir. Hastaların verilerinin istatistiksel değerlendirmesi, başlangıç ölçümü ile muayene dönemleri arasında istatistiksel olarak anlamlı farklılıkları göstermiştir. Buna ek olarak, istatistiksel analiz, dentin hassasiyeti değerlendirilmesinde hava sıkma uyarımının dokunma ile gerçekleştirilen uyarıma göre daha güvenilir bir yöntem olduğunu göstermiştir.

Sonuç: Bu çalışmanın bulguları lazer uygulamasının dentin hassasiyetinin tedavisinde etkili olduğunu göstermiştir.

ANAHTAR KELİMELER

Dentin hassasiyeti, Lazer uygulaması, Diod lazer, Düşük güç lazer

INTRODUCTION

Dental hypersensitivity is one of the most common causes of dental pain. It is claimed that 14,3% of all patients have some degree of sensitivity¹. A range of therapies have been devised to alleviate this condition^{1,2}. Most of the desensitizing methods in use to date attempt to inhibit the pain by either sealing the dentinal tubules with coating mechanisms or by altering the tubules' contents through coagulation, protein precipitation, or creation insoluble calcium complexes². However, the long-term results of the agents that were used in these mechanisms were found not effective or the previous studies³⁻⁷ have revealed contradictory results. Recently, laser has been used as a new treatment method⁸⁻¹⁰ and the results indicate that it may have beneficial effects under certain conditions. Experiments with laser on hypersensitive teeth have suggested that it probably results in a melted dentine surface with occlusion of open dentinal tubules¹¹. Several types of laser have been utilized to treat hypersensitive dentine. Recently low level laser therapy was suggested as a new method in hypersensitivity. The new method differs from other laser treatment modalities since it was suggested that low level laser changed the neural transmission networks within dental pulp rather than alterations to the exposed dentine surfaces¹². However, the mechanism involved is still unknown.

The aim of this study is to investigate the clinical effect of a low level laser on hypersensitive dentine.

MATERIAL and METHOD

The research protocol was approved by the research committee at the Gulhane Military Medical Academy. The subjects were selected out of the patients referred to the Dental Sciences Center at the Department of Periodontology. To participate in the study, the subjects had to have two teeth with cervical abrasion or gingival recession that were hypersensitive to tactile and evaporative stimulation. All patients were asked

to sign the informed consent form.

The patients were excluded from the study if they;

- Were under analgesic, anti-inflammatory or anti-depressive treatment regimens,
- Had eating disorders,
- Were pregnant,
- Were undergoing orthodontic therapy, or
- Had cognitive disfunctions or general communication difficulties.

The patients' teeth were excluded if they;

- Had been subjected to periodontal surgery within the past three months,
- Had congenital tooth crown defects,
- Had carious lesions
- Had restored or fractured teeth,
- Had non-vital or had symptoms of pulp damage, or
- Had undergone anti-hypersensitive therapy within the last 30 days.

Twenty seven male and female patients between 23-47 years of age who fulfilled all criteria were selected for the study. The patients were instructed to brush their teeth three times a day and monitored for two weeks prior to the study. Fifty four teeth were randomly divided into two groups: test group and control group.

Pain assessment:

Two methods were applied on the subjected teeth to provoke a hypersensitivity reaction:

Tactile Stimulation: The stimulation was provoked by a Williams Periodontal probe. The probe was dragged laterally and vertically on the exposed root surface.

Air blast Stimulation: This method was performed two minutes after the tactile scoring procedure by means of a standard air syringe from the dental unit.

All stimuli were performed after all subjec-

ted teeth had been cleaned with a cotton pellet soaked in warm distilled water, and dried. The stimulus was delivered until a reaction was observed, or up to a maximum duration of 5 seconds. All stimuli were given by one operator, in the same dental chair with the same equipment and the pain was assessed with the VAS (Visual Analogue Scale) by another periodontologist.

The patients' reactions to the stimuli were recorded before and after the treatment, and then at one-week intervals for four weeks.

Treatment Procedure:

After the baseline pain assessment, a low level laser irradiation (685 nm, 25mW, 2j/cm²) with continuous wave mode was used according to the manufacturer's recommendation in hypersensitive teeth for one minute and forty seconds with a GaAlAs laser (BTL 2000, UK). In the control group teeth, the laser irradiation was not used, unknown to the patient.

Statistical Methods

The scores of VAS of test and control groups were analyzed with the Friedman test for tactile and air blast stimulation methods. If a statistical significance was found, the Wilcoxon signed rank test was used to determine the statistically significant period of examination. In the control group, there was no significant difference between the periods, although there was in laser

group. Therefore, it was decided that the differences in the VAS scores between the baseline measurement and each recall of the test group would be analyzed and the Mann-Whitney U test would be used.

RESULTS

Clinical Results: Statistical analysis between the examination periods of control group showed no difference. However, we observed statically significant results between the baseline measurement and the examination periods of test group. The statistical analysis of data revealed that laser irradiation on hypersensitive teeth is a very effective method (Table-I,II).

The analysis of the difference between air blast stimulation and tactile stimulation in laser irradiation presented statistical differences in baseline measurement and second, third and fourth weeks (Table III).

DISCUSSION

Essentially, cervical dentine hypersensitivity results when a stimulus is applied to the dentine causing a movement of the fluid within dentinal tubules, which then stimulates nervous processes in the pulp areas of the dentine and/or the nerves in the pulp itself producing a pain impulse transmission¹³. Theoretically, occluding the dentinal tubules may decrease the hydraulic conductance

TABLE I

Dentin sensitivity scores using air-blast stimulation

Examination periods Groups	LASER Mean± (S.D)	CONTROL Mean± (S.D)
Baseline pain score	64,8±32	65,8±9,9
Baseline treatment	24±21,6*	65±11,6
1 week pain score	27,9±36,4*	64,1±9,9
2 week pain score	18,1±29,3*	65,8±9,9
3 week pain score	18,1±30,1*	67,5±9,6
4 week pain score	18,5±30,8*	68,3±8,3

*Sign indicates statistically significant differences between the baseline pain score and the related examination period

TABLE II

Dentin sensitivity scores using tactile stimulation

Examination periods Groups	LASER Mean±(S.D)	CONTROL Mean± (S.D)
Baseline pain score	42,5±41,4	70±15,3
Baseline treatment	9,25±18,3*	72,5±16
1 week pain score	16,2±28,7*	70,8±13,7
2 week pain score	11,4±26,9*	68,3±15,8
3 week pain score	11,4±27,8*	71,6±13,3
4 week pain score	11,8±28,5*	72,5±14,8

* Sign indicates statistically significant differences between the baseline pain score and the related examination period.

TABLE III

Statistical analysis results of the comparison of airblast and tactile stimulation of each group.

Measurements	(p=) scores
Baseline pain score- Baseline treatment	N.S
Baseline pain score 1 week pain score	N.S
Baseline pain score 2 week pain score	0,043*
Baseline pain score 3 week pain score	0,039*
Baseline pain score 4 week pain score	0,03*

* indicates statistically significant differences. N.S: non significant

and thus lead to treat hypersensitivity. Several materials and methods have been used to reach this endeavor. However, chemical methods have been found unresistant against the saliva and the mechanical forces.

Therefore, laser treatment has become a new approach in dentine hypersensitivity. The lasers used for the treatment of dentine hypersensitivity are divided into two groups; low output power lasers (He-Ne and GaAlAs) and middle output lasers¹⁴. The main effect of middle output lasers on hypersensitive teeth are based on melting the dentine surface and occluding dentine tubules. However, the mechanism of low output lasers is mostly unknown. According to physiological

experiments He-Ne laser irradiation does not affect peripheral or C-fiber nociceptors,¹⁵ but does affect electric activity (action potential), which in the healthy nerve increased by 33% following a single transcutaneous irradiation^{16,17}. This was found to be a long lasting effect, inducing an increase in the size of nerve action potential for more than eight months after cessation of irradiation¹⁶. He-Ne laser irradiation at 6 mw does not affect the enamel or dentine surface morphologically, but a small fraction of the laser energy transmitted through enamel or dentine to reach the pulp tissue leads to cessation in dentine hypersensitivity¹⁸. In GaAlAs lasers three wavelengths (780, 830, 900 nm) have been used for the treatment of dentine sensitivity. Several authors

have used this type of laser in different outputs and duration¹⁹⁻²². The results revealed differences in the effectiveness of GaAlAs lasers. It was postulated that low output power lasers mediates an analgesic effect related to depressed nerve transmission. According to physiological experiments using the GaAlAs laser at 830 nm, it was found that the analgesic effect was caused by the blocking of the depolarization of C-fiber afferents^{21,22}. GaAlAs laser irradiation at a maximum power of 60mW does not affect the enamel or dentine surface morphologically, but the laser energy was also transmitted through enamel or dentine to reach the pulp tissue.

Several stimulation methods were suggested to measure dentine hypersensitivity. The VAS method is widely used in clinical research to assess the intensity of acute pain²³. However, it is very difficult to interpret the subjective data of patients and convert them into objective findings. Therefore, the results from the VAS are questionable. Under these circumstances, it is very important to form a well-designed control group to prevent the indefiniteness of the scores. The control group may help to compare the subjective data of patients and to interpret them in an objective manner. Statistical insignificance in our control group was evaluated as we had obtained objective results in the test groups.

The thermal and tactile stimuli are the most common methods used in VAS questionnaire. An air blast from water syringe has been used in the majority of studies as means of combining thermal and evaporative stimulation of sensitive dentine. The stimulus is the operator controlled for duration and is poorly reproducible. It is generally accepted that a thermal stimulus should be supplemented by the use of a tactile stimulus²⁴. This is frequently a hand held probe, which is dragged over the dentine surface. However, misalignment of the probe tip may alter the load applied to the tooth surface²⁵. and the area of hypersensitivity may not involve all of an exposed dentine surface on a single tooth and may even change location between assessments²⁶.

Therefore, tactile stimuli were accepted poorly reproducible. In our study, the results revealed that air blast stimulation is more effective than tactile stimulus in the assessment of pain measurement. Although, a previous study³ indicated good validity for the tactile stimulus; our data implied that the tactile stimulus was not a valid method of assessing pain measurement.

In conclusion, the goal in hypersensitivity studies is to relieve patient discomfort and to provide long lasting effect. Although the action mechanism of low output lasers are unclear, the results of our study indicated that they were very effective in dentine hypersensitivity and resistant to mechanical forces and chemical irritation. In addition, we could not determine any side effect that could be evaluated as a special feature. However, well-designed control and test groups with a great deal of patients and physiological tests are needed to understand the effects of low level lasers.

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