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Application of Diode Laser in the Treatment of Dentine Hypersensitivity

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ABSTRACT

Introduction: Dentine hypersensitivity is characterized by acute, sharp pain arising from the exposed dentine, most commonly in response to thermal, tactile, or chemical stimuli, and which cannot be linked to any other pathological changes in the tooth or the environment. Therapy uses various impregnating agents in the form of solutions or gels and, in more recent times, laser. **Aim:** The aim of this research was to examine the effects of treatment of hypersensitive dental cervix with diode laser. **Materials and Methods:** The study included 18 patients with 82 sensitive teeth. The degree of dentine hypersensitivity was evaluated by visual analogue scale (VAS), and the treatment was carried out by application of low-power diode laser over the span of three visits, which depended on the initial sensitivity. **Results:** There is a significant difference in VAS values measured at the onset of treatment (baseline) and immediately after the first laser treatment (t=9.275; p=0.000), after 7 days, after the second laser treatment (14 days) (t=7.085, p=0.000), as well as after 14 days and the third laser treatment (t=5.517, p=0.000), which confirms the effectiveness of this therapeutic procedure. The results showed a reduction of hypersensitivity in response to tactile stimulus with a probe after the third treatment, even with teeth whose value on the VAS was very high at the beginning of treatment (baseline). **Conclusion**: Within the scope of the conducted study, laser therapy has provided extremely safe and effective results in the treatment of cervical dentine hypersensitivity.

Keywords: dentine hypersensitivity, desensitizing agent, diode laser, laser therapy.

1. INTRODUCTION

Thanks to good preventive dental programs and developed knowledge about the importance of oral hygiene, the vitality of teeth within the oral cavity has been extended in the recent times, which led to an increase in non-carious cervical lesions, or dental erosions, abrasions, etc. (1, 2).

Dentine hypersensitivity (DH) is characterized by acute, sharp pain in the area of exposed dentine, in response to thermal, chemical, osmotic, and tactile stimuli (3). Although sensitivity can occur on any part of the tooth, it is most commonly felt in the vestibular area of dental cervical region (for canines and first premolars) and on the root surface. The frequency at which it occurs ranges between 3 and 57%, and it is much more frequent (72-98%) in patients suffering from periodontal disease. It most often occurs between 20 and 50 years of age, and is more common among women (4, 5).

Difficulties in treating cervical DH gave rise to a large number of techniques and therapeutic procedures which are currently used for pain alleviation in DH (6).

Therapy uses various impregnating agents in the form of solutions or gels and, in more recent times, laser. Based on hydrodynamic theory, several methods, such as the application of fluoride, dentine adhesives, corti-

Number of treatments	Number of teeth N	Percentage %	X VAS baseline	SD
1	27	32.92	2.90	±2.09
2	29	35.36	4.36	±2.49
3	26	31.70	4.59	±2.73
Total	82	100	3.95	±2.53

Table 1. Number of treatments compared to average VAS value at baseline (at the beginning of treatment)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	45.54	2	22.77	3.77	0.027
Within groups	476.13	79	6.02		
Total	521.68	81			

Table 2. Baseline assessment of tooth sensitivity and number of treatments

costeroids, and silver nitrate solution, work by blocking the open dentine tubules.

In recent decades, classic treatments with desensitizing agents have been supplemented by the use of laser. Using lasers to treat DH dates back to the 80s with the advent of erbium lasers. Even though the initial results were quite disappointing, the improvement of technology and scientific knowledge over time has led to the development of new lasers with wavelengths suitable for therapeutic treatment (7).

Recent studies report satisfactory results of treatment with laser irradiation. Most studies conducted with different types of lasers, with different wavelengths and duration of application, reveal the effectiveness of this treatment, both immediately upon the completion of therapy, and after circa 6 months from the first treatment. As a result, the pain is reduced and, in many cases, eradicated (8, 9, 10). Among the published works, there are those which confirm the exceptional efficacy of the use of diode lasers in the treatment of DH. Thus, the aim of our study was to investigate the effects of diode laser therapy on hypersensitive dental cervix.

2. MATERIALS AND METHODS

The study included 18 patients with 82 sensitive teeth. The degree of dentine hypersensitivity was evaluated by visual analogue scale (VAS). Dentine hypersensitivity was stimulated by touching the dental cervix with the tip of the probe, with mesial-distal directionality. All patients were asked to assess their level of dentine hypersensitivity using the VAS scale of 0 to 10, where 0 represents "no pain" and 10 represents "greatest pain." After initial sensitivity was assessed and recorded, laser therapy was initiated.

Laser treatment protocol: Low-power diode laser (SmilePro980, Biolitec) was used in this study. The laser was operated in a continual regime, and 2 W of power was applied to the tooth surface. During the 60 seconds of exposure, tooth tissue was around 2mm away from the laser.

Exposure time (60s) was repeated after sensitivity control (using the VAS scale), seven and fourteen days after initial exposure, only on those teeth that were still sensitive. While working with the laser, both the therapist and the patient wore protective goggles, and work space was appropriately designated and marked.

3. RESULTS

The study included 18 patients, with average age of 27 years, who had 82 sensitive teeth.

It can be seen that initially less sensitive teeth required fewer treatments!

ANOVA test was carried out in order to assess whether this difference is significant.

There is a significant difference in tooth sensitivity values measured at baseline, in teeth that had a different number of laser treatments. ANOVA F=3.77, p=0.027.

Based on the obtained results, we can say (with 95% confidence) that teeth which had lower dentine sensitivity at the very beginning will require fewer laser treatments.

In order to determine between which teeth this difference is observed, given the number of treatments, a post-hoc analysis was carried out using Turkey's Honest Significant Difference (HSD) test.

Differences occur only between the mean sensitivity values at baseline between teeth that had only one treatment and teeth that had three laser treatments (p=0.037), but there is no difference between VAS value at baseline between teeth that had one laser treatment and those that were treated twice (p=0.073), nor between the teeth that had two and those that had three laser treatments (p=0.934).

There is a significant difference in VAS values measured at baseline and after the first laser treatment: t=9.275, p=0.000. There is a significant difference in VAS values measured at baseline and after the second laser treatment: t= 1.268, p=0.000. There is a significant difference in VAS values measured at baseline and after the third laser treatment: t=8.749, p=0.000.

	Paired differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. error mean	95% Confidence Interval of the difference				
				Lower	Upper			
Baseline tooth sensitivity assessment – Immediate tooth sensitivity following the first treatment	1.97	1.92	0.21	1.55	2.39	9.27	81	0.000
Baseline tooth sensitivity assessment – Tooth sensitivity following the second treatment (7 days)	3.19	2.53	0.28	2.62	3.75	11.26	79	0.000
Baseline tooth sensitivity assessment – Tooth sensitivity following the second treatment (14 days)	3.70	2.71	0.42	2.85	4.56	8.74	40	0.000

Table 3. VAS values of all teeth before treatment and following the first, second, and third laser application

	Paired differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. error mean	95% Confidence Interval of the difference				
				Lower	Upper			
Baseline tooth sensitivity assessment – Immediate tooth sensitivity following the first treatment	1.97	1.92	0.21	1.55	2.39	9.27	81	0.000
Immediate tooth sensitivity following the first treatment - Baseline assessment (7 days)	0.09	2.12	0.23	-0.38	0.56	0.37	79	0.706
Baseline assessment – Tooth sensitivity following the second treatment (7 days)	1.13	1.43	0.16	0.81	1.45	7.08	79	0.000
Tooth sensitivity following the second treatment - Baseline assessment (14 days)	-0.08	1.59	0.24	-0.58	0.41	-0.34	40	0.733
Baseline assessment – Tooth sensitivity following the second treatment (14 days)	0.74	0.86	0.13	0.46	1.01	5.51	40	0.000
Baseline tooth sensitivity assessment – Tooth sensitivity following the second treatment (7 days)	3.19	2.53	0.28	2.62	3.75	11.26	79	0.000
Baseline tooth sensitivity assessment – Tooth sensitivity following the second treatment (14 days)	3.70	2.71	0.42	2.85	4.56	8.74	40	0.000

Table 4. VAS values for all teeth after the first, second, and third application of laser, and baseline measurement prior to the application of laser

There is a significant difference in VAS values measured at baseline and after the first laser treatment (t=9.275; p=0.000), as well as after 7 days and after the second laser treatment (14 days) (t=7.085, p=0.000), and after 14 days and the third laser treatment (t=.517, p=0.000), which supports the effectiveness of this therapeutic procedure.

4. DISCUSSION

Dentine hypersensitivity (DH) is common, and individual needs for treatment depend on aetiology, as well as on the subjective experience of painful sensations and the degree of tolerance to this type of pain.

In this study, some of the patients reported pain so severe that it has become a physical and emotional problem that affects their quality of life. Many of them were not able to consume hot or cold foods or liquids, acidic foods or liquids, and even had difficulty with brushing teeth. As the data from previous studies suggest, several methods should be applied during treatment in order to obtain satisfactory results, since the aetiology of DH may be multifactorial (11, 12, 13).

Conventional methods of treating DH include topical application of desensitizing agents, either professionally or at home, such as protein precipitates, agents for occlusion of dentinal tubules (14) and, more recently, lasers (15, 16, 17). It is believed that the occlusion of dentinal tubules leads to a decrease in permeability of dentine and, proportionally, also reduces DH (18). According to hydrodynamic theory, efficacy of dentine desensitization agents is directly related to their ability to efficiently close dentinal tubules (19, 20).

In their study, Yilmaz et al. compared the effectiveness of application of sodium fluoride and diode laser in the treatment of DH. They concluded that, within the scope of their study, GaAlAs laser therapy is effective in the treatment of DH, and is a more comfortable and faster treatment than traditional treatments for DH (21). These results support the results of our study.

Several studies (22, 23) describe the synergistic effect of lasers in conjunction with desensitization agents. For this reason, our study included laser irradiation of the cervical portion of the tooth only, and we obtained exceptionally good results in terms of lowered dentine hypersensitivity (F = 3.77, p = 0.027). Therefore, we can state (with 95% confidence) that teeth which had lower dentine sensitivity at the very beginning will require fewer laser treatments.

Previous published data indicate that only the Nd: YAG laser has an additional analgesic effect, compared with other lasers. These findings are the result of the effect of radiation which can temporarily alter the endings of sensory axons and block both C and AB fibres, thereby reducing the pain (24).

Parameter of the power used in our study was 2 W, which is in accordance with the study by Liu et al. (25). Their study (25) demonstrated that 2 W (166 J/cm^2) is a suitable parameter for the 980nm diode laser, which sealed dentinal tubules without excessive melting of the dentine, thus achieving a good level of analgesia, which is comparable to our results. Good results arise from the closure of dentinal tubules, which prevents internal communication of dental pulp with oral cavity fluids (15, 26).

Based on the results of our study in which only a diode laser was used, we believe that modern low-power lasers can also provide good results in the treatment of DH; this finding is also supported by the results of research by Umberto et al. (27).

Our research, as well as research by other authors (28, 29), demonstrates that low-energy lasers, including GaAlAs diode laser with wavelengths between 780 and

980 nm, have an effect on nerve endings, thus eliminating sensitivity.

In a study conducted on 27 patients with 55 hypersensitive teeth, Lopes et al. assessed the efficacy of various protocols for treating dentine hypersensitivity. They concluded that all desensitising protocols are effective in reducing dentine hypersensitivity, but have different effects. Therefore, they believe that a combination of protocols is an interesting alternative for the treatment of cervical dentine hypersensitivity (30). This conclusion follows from the need to achieve satisfactory results in as few treatments as possible. The results of our study indicate that, applied through multiple treatments, this modern therapeutic procedure independently achieves good results, even in teeth with greater level of hypersensitivity.

We believe that further research is needed to assess long-term effects of these therapeutic procedures on a larger sample in order to provide recommendations for use in routine clinical practice.

5. CONCLUSION

Within the scope of the conducted study, laser therapy has provided extremely safe and effective results in the treatment of cervical dentine hypersensitivity.

- Authors' contributions: Conception and design: MGV, EP and VP; Acquisition, analysis and interpretation of data: SH, EP and AZ; Drafting the article: MGV and AZ; Revising it critically for important intellectual content: MGV, VP, SH.

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