

ORIGINAL PAPER

Comparative Evaluation of the Effects of Diode Laser and Desensitizing Agents on the Treatment of Dentin Hypersensitivity: a Clinical Study

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ABSTRACT

Background: Dentine hypersensitivity (DH) is a frequent clinical problem that represents a long-term painful discomfort for the patients, and for the dentists, it represents a diagnostic and therapeutic challenge. **Objective:** The aim of the research is to verify the effect of the treatment with diode laser SiroLaser Blue (660nm) of DH alone or in combination with different impregnating agents. **Methods:** Fifty patients were included in this research, separated into five groups. All the patients have been asked to define the level of dentine hypersensitivity using VAS (0-10). The first group was treated with Fluor Protector, the second group after the application of Fluor Protector has undergone irradiation with SiroLaser Blue (660nm), the third group was treated with impregnating agent Vivasens, the fourth group, after the application of impregnating agent Vivasens, has had SiroLaser Blue (660nm) irradiation. The fifth group has just been treated with SiroLaser Blue (660nm). The efficiency of the treatment was checked using VAS for every group immediately after the conducted treatment, after 7 days and 1 month. **Results:** Our results showed that all of the desensitizing agents used in the research alone or in combination with a diode laser (660nm) have shown a reduction of DH. The difference has been proven statistically significant in mean values by groups and examinations. Vivasens and diode laser irradiation have provided the best results in the review of mean values after the first examination and one month after the treatment of DH ($p < 0,05$). In our research, the application of diode laser alone has not proven superior to other treatment methods that have been used in the research. **Conclusion:** Vivasens plus diode laser irradiation has provided the best results even after one month since the treatment of DH. **Keywords:** Dentin hypersensitivity; Desensitizing; Diode Laser; Non-carious cervical lesion

1. BACKGROUND

Dentine hypersensitivity (DH) is a frequent clinical problem with an increasingly higher rate of prevalence. This represents a long-term painful discomfort for the patients, and for the dentists, it represents a diagnostic and therapeutic challenge (1, 2).

It is defined as a short and sharp pain that occurs in the exposed dentine as a response to thermal, chemical, tactile, or osmotic stimuli, that cannot be attributed to any other tooth defect or pathology (2,3).

Although hypersensitivity can occur in any part of the tooth, the most common is in the cervical part on the vestibular side and the surface of the root. The frequency of this occurrence

is from 3 – 57%, and in patients suffering from periodontal disease, it is more common, 72 – 98% (4, 5).

Many theories have been trying to explain the mechanism of DH. The theory that was most widely accepted originated as a hypothesis, and was amended in 1972 (Brannstrom and Astrom) under the title “hydrodynamic theory” which tried to explain the occurrence of pain by moving fluid within the dentine tubules (6, 7). The ability to block dentine tubules and reduce the movement of fluid in the dentin tubules and/or block the painful sensation in the pulp is considered necessary for the ideal treatment of DH (8, 9). Based on hydrodynamic theory, several methods are

based on blocking open dentine tubules, such as the application of fluorides, dentine adhesives, corticosteroids, and silver nitrate (10,11).

In the last few decades, classic treatments with desensitizing agents are supported by lasers (12). Most of the studies conducted with different types of laser, with different wavelengths and application time, reveal the effectiveness of this treatment, immediately after the conducted treatment as well as after several months from the first treatment. As a result, the pain is reduced, and in many cases, it disappears (8, 13, 14).

2. OBJECTIVE

The aim of the research is to verify the effect of the treatment with diode laser SiroLaser Blue (Dentsply Sirona) of DH alone or in combination with different impregnating agents.

3. MATERIAL AND METHODS

Fifty patients have been included in this research and they were randomly separated into five groups. Every patient has undergone anamnestic diagnostic protocol: general anamnesis (information about patient's general health and habits – smoking) and clinical evaluation of periodontal status (verification of Plaque index, Papilla bleeding index and Gingival index).

DH has been determined in all the patients using a visual analog scale (VAS), in a way that DH was stimulated using an air syringe of the dental unit from the distance of circa 1 cm from the tooth neck. All the patients have been asked to define the level of pain using VAS with a score of 0 to 10, where 0 represents "not in pain" and 10 "most painful".

All the subjects gave their written informed consent for the treatment of DH.

After verifying DH, Fluor Protector (Ivoclar Vivadent) was applied to one group (group 1) of patients in the treatment in a way that the tooth was isolated from the saliva, dried with a cotton ball, and Fluor Protector was applied according to the manufacturer's instructions.

After the application of Fluor Protector, the second group (group 2), has undergone irradiation with SiroLaser Blue laser (660nm) using the program pre-specified by the manufacturer.

The third group (group 3), after the already-described tooth preparation, has had impregnating agent Vivasens (Ivoclar Vivadent) applied, and the fourth group (group 4), after the application of impregnating agent Vivasens, has had diode laser irradiation conducted using SiroLaser Blue (660nm) using the same program, already specified by the manufacturer.

After verifying DH, the fifth group (group 5) has had their tooth isolated in an above-mentioned manner and irradiation was conducted using SiroLaser Blue laser (660nm), using the same program, already specified by the manufacturer.

Immediately after the conducted treatment and at the control examination after 7 days and 1 month, the efficiency of the treatment was checked using VAS for every group. All the obtained data has been noted into the work chart specifically designed for this research.

4. RESULTS

For the statistical analysis of the received data, a program package SPSS for Windows (version 21.0, SPSS Inc., Chicago, Illinois, the USA) and Microsoft Excell (Version 11, Microsoft Corporation, Redmond, WA, the USA) were used. Nominal and ordinal variables in the research were analyzed with the χ^2 test and T-test. For the limit of statistical significance, a value of $\alpha=0,05$ was used.

A total of 50 patients participated, both male and female, within the age range of 18 to 69. The most dominant age group are patients between 18 and 29 years of age, 25 (50%). Even though there was a significantly larger dominance of females concerning male sex in the research, the difference hasn't proven to be statistically significant when observing the sex structure of the subjects concerning age groups ($p>0,05$).

Table 2 shows the comparison between the applications of Fluor protector and Vivasens desensitizing agents in the

Sex and age structure of the subjects	Sex				Total	
	Male		Female		N %	
age 18-29	3	6	22	44	25	50
age 30-39	4	8	12	24	16	32
age 40-49	2	4	5	10	7	14
age 60-69	1	2	1	2	2	4
Total	10	20	40	80	50	100

Table 1. Sex and age structure of the subjects, $\chi^2=2,696$ ($p=0,441$)

Comparison in the treatment of dentine hypersensitivity	Fluor protector	Vivasens
Before treatment	1,3	1,1
Immediately after the treatment	0,8	0,8
Seven days after the treatment	0,7	0,6
One month after the treatment	0,6	0,6

Table 2. Comparison of Fluor protector and Vivasens method of dentine hypersensitivity treatment, $T=0,384$ ($p=0,195$)

Comparison in the treatment of dentine hypersensitivity	Fluor protector	Fluor protector plus SiroLaser Blue irradiation
Before the treatment	1,3	1,3
Immediately after the treatment	0,8	0,8
Seven days after the treatment	0,7	0,6
One month after the treatment	0,6	0,4

Table 3. Comparison of Fluor protector and Fluor protector plus diode laser irradiation. $T=0,302$ ($p=0,77$)

Comparison in the treatment of dentine hypersensitivity	Vivasens	Vivasens plus SiroLaser blue irradiation
Before the treatment	1,1	2,4
Immediately after the treatment	0,8	1,3
Seven days after the treatment	0,6	0,9
One month after the treatment	0,6	0,3

Table 4. Comparison of Vivasens and Vivasens plus diode laser irradiation. $T=0,98$ ($p=0,36$)

Comparison in the treatment of dentine hypersensitivity	Fluor protector plus diode laser Sirolaser Blue irradiation	Vivasens plus diode laser Sirolaser Blue irradiation	Diode laser Sirolaser Blue irradiation
Before the treatment	1,3	2,4	1,3
Immediately after the treatment	0,8	1,3	0,7
Seven days after the treatment	0,6	0,9	0,5
One month after the treatment	0,4	0,3	0,5

Table 5. Comparison of different means for the treatment of dentine hypersensitivity plus diode laser irradiation, T=0,09 (p=0,929)

	Dentine hypersensitivity before the treatment	Dentine hypersensitivity immediately after the treatment	Dentine hypersensitivity seven days after the treatment	Dentine hypersensitivity one month after the treatment
	Mean	Mean	Mean	Mean
Fluor protector	1,3	0,8	0,7	0,6
Fluor protector plus diode laser Sirolaser Blue irradiation	1,3	0,8	0,6	0,4
Vivasens	1,1	0,8	0,6	0,6
Vivasens plus diode laser Sirolaser Blue irradiation	2,4	1,3	0,9	0,3
Diode laser Sirolaser Blue irradiation	1,3	0,7	0,5	0,5

Table 6. Comparison of different methods for the treatment of dentine hypersensitivity T=9,181 (p=0,0001)

treatment of DH. Comparative analysis has proven that there is no statistically significant difference in the treatment of DH between Fluor protector and Vivasens methods of treatment (p>0,05).

Table 3 shows the comparison of the application of Fluor protector and Fluor protector with additional irradiation using a diode laser in the treatment of DH. By observing the treatment method using two different techniques – namely, Fluor protector and Fluor protector plus SirLaser Blue irradiation, it can be seen that the second method provided a better result after only seven days, and after one month it had an even more significant effect. The difference has proven to be statistically significant (p>0,05).

Table 4 shows that Vivasens plus diode laser irradiation is far more effective concerning the Vivasens method of treatment alone. The treatment where the additional diode laser was applied provided results twice as better after one month of treatment. However, statistical significance has not been proven due to the small sample and high degree of freedom (p>0,05).

Table 5 shows that the difference has not proven to be



Figure 2. Fluor protector (p=0,05).

5. DISCUSSION

Due to the pain present with DH different methods of treatment are applied, as well as different therapy protocols. In our research on the treatment of DH, we used desensitizing agents that are available on our market, and that are different by their chemical characteristics, as well as diode laser with the program intended for the treatment of DH with the 660 nm wavelength.

Our results showed that all of the desensitizing agents used in the research have shown a reduction of DH immediately after the application, as well as after seven days and

after one month, but there was no statistically significant difference between these two groups (table 2.), which corresponds to the conclusion made by Samuel et al. (15). They compared three agents and the results have shown a significant immediate reduction of DH.

Similarly, results obtained by Ravishankar et al. have shown significant pain reduction indicated using a vi-

sual analog scale (VAS) from the initial value in all three groups in all time intervals, and it also revealed that Admira Protector is better with pain reduction in DH than PRG protective coating and polyfluoride varnish after one month of application (16).

Results by Torres et al. (17) have shown that there has been a significant reduction of DH immediately after the application of Admira Protector, Bifluoride 12, and Colgate Pro-Relief, whereas Yu et al. (18) concluded that Gluma desensitizer and Bifluoride 12 can cause immediate reduction of DH directly after the treatment.

Based on the above-presented data we find that most of the agents for the reduction of sensitivity lead to immediate pain reduction and momentary and significant reduction of DH immediately after application, but there are no long-term sustainable treatment results.

The aim of the clinical research by Ozlem et al. was to determine and compare the effectiveness of the glutaraldehyde agent (GCA), Nd: YAG, Er, Cr: YSGG laser, and their combination in the treatment of dentine hypersensitivity (DH). Even though the research was conducted on only 17 subjects, the researchers have concluded that laser Er, Cr: YSGG has a promising potential in the treatment of DH (19). The conclusion of this research corresponds with our results that the use of diode laser provides better long-term treatment results.

The results of a meta-analysis that included 13 accept-



Figure 1. Laser equipment in dental practice.jpg

able studies which compared desensitizing agents and Nd:YAG or diode laser showed that the clinical effectiveness of the laser for hypersensitivity on the dentine was not significantly different from topical agents for desensitization according to Kaiyan Zhou et al. (20), which does not correspond to our results. In our research, Fluor protector plus diode laser irradiation immediately after treatment did not show significantly better results. This combined treatment gave better treatment results after seven days, and after one month it had an even more significant effect (table 3.). Also, the application of Vivasens desensitizing agent plus diode laser irradiation has proven more effective concerning the application of Vivasens alone. The treatment during which diode laser was also additionally applied has given twice as better treatment results after one month (table 4.).

The results of our research have shown that the combination of desensitizing agent Vivasens with diode laser irradiation has proven the most effective (table 5.).

Within the limitations of their study, Zeol LF et al. (21) find that today's discoveries indicate that, regardless of the clinical experience, dentists in Brazil still find dentine hypersensitivity a challenge for an everyday dental practice, with which we agree.

Our results partially correspond to the results by Lopes et al., whose treatments proved effective in the reduction of dentine hypersensitivity, and the results did not statistically differ from the results after 12 months, and there were no noticeable statistical differences in the levels of sensitivities for all treatments even up to 18 months (22).

In our research, the application of diode laser alone has not proven superior concerning other treatment methods that have been used in the research. Vivasens plus diode laser irradiation has provided the best results even after one month since the treatment of DH (table 6.), which corresponds to the results by Thamyres Maria Silva Simões et al. (23), as well as Poli et al. (24).

Pourshahidi S et al. concluded that Er, Cr: YSGG laser is a better option than the diode laser for short-term treatment of DH (25), which does not correspond to the results of our research.

Based on the obtained data we find that the combined treatment provides better treatment results concerning the use of laser alone or conventional topical desensitizing agents in the treatment of DH. Still, we find that new, better-designed, studies are needed on this topic for conclusions to be reached.

The results also indicate that existing knowledge on DH should be expanded to facilitate diagnosing and planning the most effective treatment for each patient individually. Regarding the rising prevalence of DH in clinical practice, an effort should be made to educate undergraduate students on the latest findings in this area.

6. CONCLUSION

Based on obtained results, we can conclude that desensitizing agents (Vivasens, Fluor Protector, Ivoclar Vivadent) and the use of diode laser SiroLaser Blue (Dentsply, Sirona) alone have provided good treatment results in DH immediately after the treatment.

The treatment with diode laser SiroLaser Blue (660nm)

in combination with a desensitizing agent (Vivasens) has proven to be more effective in the treatment of dentin hypersensitivity, and its effect was longer lasting.


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