Treatment of dentin hypersensitivity using diode laser: A six-moth follow-up study

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Treatment of dentin hypersensitivity using diode laser: A six-moth follow-up study

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ABSTRACT

Objective. To investigate the characteristics of cervical dentin hypersensitivity (CDH) in worn teeth and evaluate the effectiveness of diode laser treatment for CDH in worn teeth.

Methods. The study of characteristics of worn teeth was conducted on 67 patients selected by a convenience sampling method. The characteristics of worn teeth and dentin hypersensitivity were recorded. The depth of dentin wear was assessed using the Tooth Wear Index (TWI) index of Smith and Knight (1984). Dentin hypersensitivity was assessed by air blast stimulation using the VAS scale. The effectiveness of dentin hypersensitivity treatment was conducted on 180 teeth from 57 patients selected from the above sample and treated with a diode laser: power

0.5W, continuous irradiation, dose 10 seconds – rest 10 seconds, distance from the laser tip to the tooth surface was 1mm. Results were recorded using the VAS scale.

Results. The prevalence of sensitivity was 86.6%. The prevalence of dentin hypersensitivity in males was 47.8%, which was lower than that of females at 52.2%. Cold stimuli accounted for the majority with 74.6%, and air blast accounted for 62.7%. The effectiveness of dentin hypersensitivity treatment at different time points with air blast stimulation was: immediate 39.5%, 1 month 45.4%, 3 months 69.0%, and 6 months 63.5%.

Conclusion. Diode laser treatment showed good effectiveness and should be widely applied in the clinical treatment of dentin hypersensitivity.

Key words: Dentin hypersensitivity, laser diode, TWI, VAS

INTRODUCTION

Dentinal hypersensitivity is a common dental condition characterized by sharp, transient pain arising from exposed dentin in response to various stimuli, such as thermal, tactile, osmotic, or chemical changes [1-4]. This condition significantly impacts patients' quality of life, leading to discomfort and avoidance of certain foods or beverages [3]. While the etiology of dentinal hypersensitivity is multifactorial, it is primarily attributed to the exposure of dentinal tubules due to enamel loss or gingival recession [5, 6].

Traditional treatments, including desensitizing toothpaste, fluoride varnishes, and sealants, aim to occlude the exposed tubules or reduce nerve excitability [6-9]. However, these approaches often provide only temporary relief and may require prolonged use to achieve noticeable effects.

Recent advancements in dental technology have introduced diode lasers as a promising alternative for the effective management of dentinal hypersensitivity [10].

Diode lasers, operating at wavelengths between 800 nm and 980 nm, offer unique advantages in dental applications due to their ability to penetrate soft tissues and selectively target affected areas [11,12]. Their photothermal effects can seal exposed dentinal tubules, thereby reducing sensitivity. Furthermore, diode laser treatment is minimally invasive, relatively quick, and has shown to provide immediate and long-lasting results, making it an attractive option for both clinicians and patients [13,14].

Numerous studies worldwide have explored various treatment methods for dentin hypersensitivity, with diode laser therapy showing promising results [5,15,16]; however, there have been limited studies on laser application for treating dentin hypersensitivity in Vietnam. Therefore, this article explores the efficacy and clinical applications of diode laser treatment in managing dentinal hypersensitivity, highlighting its advantages over conventional therapies and its role in improving patient outcomes.

MATERIALS AND METHODS

Study design

This study employed a prospective clinical design to evaluate the effectiveness of diode laser treatment in managing dentinal hypersensitivity at the Odonto-Stomatology Center of Hue Central Hospital. Participants were selected based on specific inclusion criteria, including experiencing cervical dentin wear with a depth of ≤1mm, and had no pulp disease, periapical disease, or periodontal disease [1]. Inclusion criteria for laser treatment of hypersensitivity

included cervical dentin wear of grades 1-2 [4], dentin hypersensitivity with no indication for restorative treatment, and no hypersensitivity in other areas [1].

Participants

The study of characteristics of worn teeth was conducted on 67 patients selected by a convenience sampling method. The effectiveness of dentin hypersensitivity treatment was analyzed on 180 teeth from 57 patients selected from the above sample. Patients with acute medical conditions, pregnancy, using analgesics, anti-inflammatories, or sedatives within 72 hours, who had teeth whitening within the past 6 months, and endodontically treated or restored teeth were excluded from the study.

Intervention

The treatment protocol involved using a diode laser (power 0.5W, continuous irradiation, dose 10 seconds – rest 10 seconds, distance from the laser tip to the tooth surface was 1mm). The affected teeth were isolated and cleaned with pumice before laser application. The laser was applied in a sweeping motion over the exposed dentin, ensuring uniform coverage without direct contact.

Outcome measures

The primary outcome measure was the reduction in pain sensitivity, assessed using a visual analog scale (VAS) ranging from 0 (no pain) to 10 (severe pain). Secondary outcomes included patient-reported satisfaction and any adverse effects observed during or after treatment.

Data collection and analysis

Pain sensitivity was recorded baseline (T0), immediately after treatment (T1), and at follow-up intervals of one month (T2), three months (T3), and six months (T4). Statistical analysis

was performed using paired t-tests to compare baseline and post-treatment VAS scores, with significance set at $p < 0.05$.

RESULTS

Baseline characteristics of patients

The study included 67 patients for cervical dentin wear and dentin hypersensitivity study. The effectiveness of dentin hypersensitivity treatment was analyzed on 180 teeth from 57 patients selected from the above sample. Patients with cervical dentin wear experienced sensitivity in 86.6% of cases, while 13.4% reported no sensitivity. According Smith and Knight classification, the highest of tooth wear was at score 2 (42.1%), while score 4 had the lowest (2.3%) (Table 1). Before treatment, patients with mild sensitivity accounted for 25.4%, moderate sensitivity for 50.4% (Table 2). Cold stimuli accounted for 74.6%, air flow accounted for 62.7%, and hard food accounted for 10.4% (Figure 1).

Table 1. Frequency of cervical dentin wear classified Smith and Knight (n = 340 teeth)

Smith and Knight Score								Total	
Score 1		Score 2		Score 3		Score 4			
n	%	n	%	n	%	n	%	n	%
93	27.4	143	42.1	96	28.2	8	2.3	340	100

Table 2. Distribution of VAS sensitivity levels by age (n = 256 teeth)

Age	Mild		Moderate		Severe		Total	
	n	%	N	%	n	%	n	%

30 – 39	0	0	10	3.9	0	0	10	3.9
40 – 49	2	0.8	10	3.9	3	1.2	15	5.9
≥ 50	63	24.6	109	42.6	59	23	231	90.2
Total	65	25.4	129	50.4	62	24.2	256	100
p-value	p <0.015							

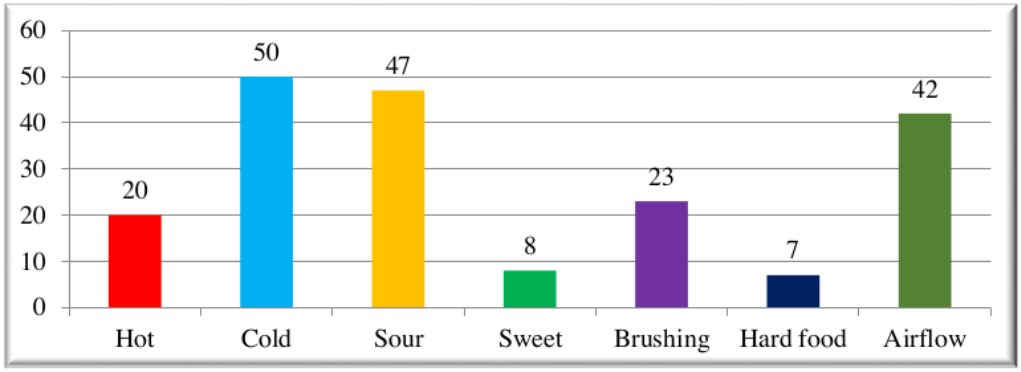

Figure 1. Frequency of triggering stimuli for dentin hypersensitivity

Reduction in pain sensitivity

Change after treatment for mild sensitivity was 0.46, for moderate sensitivity was 1.67, and for severe sensitivity was 3.28 (Table 3). Change after treatment for mild sensitivity was 0.95; for moderate sensitivity was 1.79; and for severe sensitivity was 3.72 (Table 4). The treatment effect for mild sensitivity was 1.26; for moderate sensitivity was 2.93; and for severe sensitivity was 5.38 (Table 5). The treatment effect for mild sensitivity was 0.97; for moderate sensitivity was

2.71; and for severe sensitivity was 5.06 (Table 6). The results above show that the level of dentin hypersensitivity decreased over time, with a slight increase in dentin hypersensitivity at 6 months compared to 3 months (69% vs. 63.5%) (Figure 2).

Table 3. Treatment results immediately after treatment according to VAS score

Time Level of pain	Pre-Treatment	Post-Treatment	Change after treatment
Mild	1.56 ± 0.60	1.10 ± 0.38	0.46 ± 0.60
Moderate	4.52 ± 0.58	2.85 ± 0.61	1.67 ± 0.76
Severe	7.52 ± 0.54	4.24 ± 0.77	3.28 ± 1.01
p-value	$p < 0.001$		

Table 4. Treatment results one month post-treatment according to VAS score

Time Level of pain	Pre-Treatment	Post-Treatment	Change after treatment
Mild	1.56 ± 0.60	0.62 ± 0.54	0.95 ± 0.69
Moderate	4.52 ± 0.58	2.73 ± 0.58	1.79 ± 0.80
Severe	7.52 ± 0.54	3.8 ± 0.76	3.72 ± 0.83
p-value	$p < 0.001$		

Table 5. Treatment results at 3 months according to VAS score

Time Level of pain	Pre-Treatment	Post-Treatment	Change after treatment

Mild	1.56 ± 0.60	0.31 ± 0.47	1.26 ± 0.60
Moderate	4.52 ± 0.58	1.58 ± 0.92	2.93 ± 1.07
Severe	7.52 ± 0.54	2.14 ± 0.90	5.38 ± 1.11
p-value	p < 0.001		

Table 6. Treatment results at 6 months according to VAS score

Time Level of pain	Pre-Treatment	Post-Treatment	Change after treatment
Mild	1.56 ± 0.60	0.59 ± 0.50	0.97 ± 0.67
Moderate	4.52 ± 0.58	1.80 ± 0.97	2.71 ± 1.12
Severe	7.52 ± 0.54	2.46 ± 0.93	5.06 ± 1.15
p-value	p < 0.001		

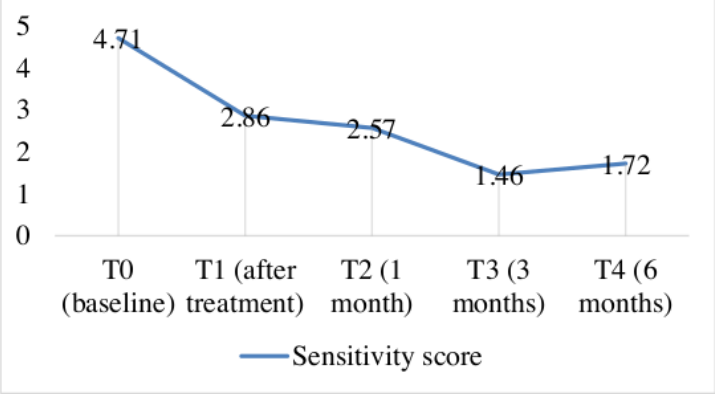

Figure 1. Average dentin hypersensitivity levels over the study period according to VAS score

Patient satisfaction

Over 90% of participants reported high levels of satisfaction with the treatment, citing immediate relief and sustained reduction in sensitivity as key benefits. No significant discomfort or adverse effects were reported during or after the procedure.

Adverse effects

No adverse effects, such as burns or tissue damage, were observed throughout the study period, underscoring the safety of the diode laser treatment protocol.

DISCUSSION

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The findings of this study underscore the efficacy of diode laser treatment as a reliable and innovative approach to managing dentinal hypersensitivity. The significant and sustained reduction in pain sensitivity observed among participants supports the hypothesis that diode laser application effectively seals exposed dentinal tubules through photothermal effects [17]. Compared to traditional therapies, such as desensitizing agents and fluoride varnishes, diode lasers offer a faster onset of relief and longer-lasting results [18,19].

The majority of study participants experienced tooth sensitivity (86.6%), which was the primary reason for seeking treatment. Sensitivity could be triggered by hot or cold foods, toothbrush abrasion, or acidic beverages.

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The cervical wear classification used in our study was the Tooth Wear Index (TWI) classification by Smith and Knight (1984) [20] to assess the depth of cervical lesions on the external surface of the tooth. We focused on the external surface as it is the most common site of cervical wear. The results showed that teeth with cervical wear predominantly had the degree of wear grades 1 and 2, indicating mild cervical wear. This result is similar to studies by Borcic (2004) [21] and Orchardson (2006) [22], which found that the degree of wear grade 1 was the

most prevalent. Correctly classifying the lesion level aids in accurate diagnosis and treatment decisions.

In this study, when examining the stimuli that triggered pain in dentin hypersensitivity, 74.6% of patients were sensitive to cold stimuli. This is also the most common trigger reported in most studies by Dhaliwal (2012) [23], Naidu (2014) [24], Umana (2013) [25], and Zang (2014) [26]. When analyzing the effectiveness of diode laser treatment for dentin hypersensitivity, the results showed a significant improvement immediately after treatment, and this improvement continued throughout the study period. This can be attributed to the laser's interaction with dental pulp, which creates a photobiological effect, stimulating the metabolism of odontoblasts and sealing dentinal tubules with increased production of tertiary dentin [19,27]. Additionally, the energy of the diode laser increases the pain threshold of nerve endings or interrupts the conduction pathway of nerve impulses in sensory nerves, thus reducing pain. Recent studies have also demonstrated the effects of lasers on the nervous system, showing that laser energy inhibits Na+ pumping, alters cell membrane permeability, and causes changes in the nerve endings of sensory neurons, thereby reducing pain. The treatment effect was more significant in teeth with severe sensitivity compared to those with moderate or mild sensitivity ($p < 0.001$). The laser treatment method continued to be effective, maintaining the reduction in sensitivity at 1 and 3 months. Studies by Jomaa (2023) [28], Mobadder (2019) [29], and Naghsh (2024) [30] also reported immediate and sustained effects after 6 months. In our study, there was a slight decrease in efficacy between 6 months and 3 months, which may be due to the accumulation of wear-inducing agents (mechanical, chemical) over time, leading to the recurrence of sensitivity. Overall, the improvement was significant at each time point and statistically significant ($p < 0.001$).

Patient-reported satisfaction further highlights the clinical value of diode laser treatment. Over 90% of participants expressed satisfaction, emphasizing the practicality and comfort of this minimally invasive technique. The absence of adverse effects throughout the study period reinforces the safety profile of diode lasers, making them an ideal choice for patients seeking a non-invasive and effective solution.

This study's findings align with previous research, which also demonstrated the effectiveness of diode lasers in reducing dentinal hypersensitivity. However, variations in laser parameters, such as wavelength and power settings, among studies suggest the need for standardized protocols to optimize outcomes further.

Limitations of this study include its relatively small sample size and short follow-up period. Future research should focus on larger, randomized controlled trials with extended follow-up durations to validate these results and explore the long-term benefits of diode laser treatment.

CONCLUSION

Diode laser treatment represents a promising advancement in the management of dentinal hypersensitivity. This minimally invasive approach provides immediate and sustained pain relief, high patient satisfaction, and an excellent safety profile. While further research is needed to standardize treatment protocols and evaluate long-term outcomes, diode lasers have the potential to become a cornerstone in the therapeutic arsenal for dentinal hypersensitivity, significantly improving patients' quality of life.

Conflict of interest: none declared

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