DOI: 10.7860/JCDR/2023/59983.18073

Original Article

Dentistry Section

Treatment of Dentinal Hypersensitivity with Diode Laser of Two Different Wavelengths- A Randomised Clinical Trial

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ABSTRACT

Introduction: Dentinal Hypersensitivity (DH) is one of the most prevalent dental issues that is treated by both periodontists and endodontists. Hypersensitive dentin is a sensitive or painful response that is one of the most prevalent and poorly treated chronic dental disorders. Due to the difficulty in treating cervical DH, a great range of approaches and therapeutic procedures for pain relief in have developed. Treatments with desensitising drugs have been combined with laser treatment in recent decades. The most often utilised lasers in the treatment of DH are Diode Lasers (DL). DL act on DH provoking a melting effect with crystallisation of dentine inorganic component and the coagulation of fluids contained into the dentinal tubules.

Aim: To compare the effectiveness of DL of two different wavelengths in managing DH.

Materials and Methods: This split-mouth randomised clinical trial conducted in the Department of Periodontology at Vishnu Dental College, Bhimavaram, Andhra Pradesh, India. The duration of the study was, from October 2021 to December 2021. A total of 12 patients with DH were selected and assigned to two groups. All the patients were subjected to desensitisation using DL of two different wavelengths 475 nm Bluelase system and 810 nm. Denlase system and parameters were evaluated 15 minutes after treatment, 7 days, 15 days and 30 days after treatment. Data were entered in Microsoft Excel and analysed using Statitical Package for Social Sciences (SPSS) version 10.5 software.

Results: The mean age of the study participants was 45±3 years. There was a significant difference (p-value <0.001) in tooth sensitivity values measured at baseline, and at different time intervals in both groups. Among the two groups, Denlase group showed the greatest reduction in Visual Analogue Scale (VAS) scores from baseline to one month recall compared to Bluelase laser group. Highly significant difference was found when mean VAS scores were compared between baseline and all the other time points (p-value <0.001).

Conclusion: The present study concluded that, based on the results obtained, DL of 810 nm Denlase system was effective than DL of 475 nm Bluelase system in reducing the DH. Desensitisation treatment with laser irradiation has shown to be effective in the present study.

Keywords: Denlase, Desensitisation, Laser therapy

INTRODUCTION

The DH is characterised by sharp, short pain arising from exposed dentin in response to stimuli typically tactile, evaporative, thermal, chemical, osmotic, that cannot be attributed to any other pathology. It is one of the common problems encountered in dental practice [1]. Although, sensitivity can occur on any part of the tooth, it is most commonly felt in the cervical region and on the tooth root surface. Frequency ranges between 3%-57%, and is much more frequent in patients suffering from periodontal disease [2]. Denudation of dentin mainly occurs due to two reasons: i) removal of enamel for any reason; ii) denudation of root surface following the loss of cementum and recession of the supporting periodontal tissues [3]. With the advancements in dentistry and oral hygiene promotion, greater proportion of the older population is retaining their teeth, and thus, the prevalence of denuded root surfaces following gingival recession and periodontal surgery is raising [4]. DH occurs according to the hydrodynamic theory, where external stimuli cause the movement of fluid inside the dentinal tubules inwards or outwards, promoting mechanical deformation of nerve ending at the pulp dentine interface, which is transmitted as pain sensation [5].

The effectiveness of the various treatment options for DH is directly associated with the sealing of dentinal tubules to prevent dentinal fluid flow or blocking nerve activity. Difficulty in treating cervical DH gave rise to a large number of techniques and therapeutic procedures which are currently used for pain alleviation. In recent decades, treatments with desensitising agents have been supplemented using a laser [4]. The development of laser technology over last few decades, as well as, its widespread use in dentistry, has provided a new therapeutic alternative for the treatment of DH. Most often used lasers in the treatment of DH are DLs [6]. Treatment with laser irradiation has shown to be effective in recent research. Studies have addressed the safety of using a laser for treating DH, analysing the possibility of laser-induced pulp damage. One such study found that, if the temperature increase within the pulp remains below 5°C, then no pulp damage is evident. This thermal threshold is generally not exceeded when the energy and power settings of the laser remain within reported ranges [7]. The mechanisms of laser therapy for DH remain unknown. Depending on the active medium, wavelength, power density of the laser, and the optical properties of the target tissue, the laser produces various tissue reactions by interacting with it. A laser must melt and resolidify the dentin surface to change it. Dentinal tubules are effectively closed. Laser therapy is thought to lessens sensitivity by coagulation and protein precipitation of plasma in the dentinal fluid, or by changes in nerve fiber activity, according to Pashley DH [8].

The majority of research using various types of lasers, different wavelengths, and varying durations of application suggest that, this treatment is successful, immediately after treatment and later on. DH has traditionally been treated with lasers of various wavelengths (810, 940, and 980 nm) [9]. As a new horizon in the field of dentistry, a DL device emitting blue light was introduced.

This Bluelase system has several benefits, including high working effectiveness at low power levels and low depth of absorption of light at 475 nm, indicating minimal harm to the pulpal tissues [10]. There is very little literature on comparing different wavelengths of the lasers. Thus, the primary aim of the study was to compare effectiveness of DL of two different wavelengths (475 nm with 810 nm) in managing DH.

MATERIALS AND METHODS

This split-mouth randomised clinical trial conducted in the Department of Periodontology at Vishnu Dental College, Bhimavaram, Andhra Pradesh, India. The duration of the study was, from October 2021 to December 2021. The study was approved by the Institutional research committee and ethical clearance was obtained from the Institutional Ethics Committee (IECVDC/2021/PG01/PI/IVV/48) CTRI/2021/08/035329. Written informed consent was obtained from patients who were willing to participate voluntarily. [Table/Fig-1] shows the Consolidated Standards of Reporting Trials (CONSORT) flow diagram of study participants.

Sample size calculation: Calculations to determine the sample size was performed using G-Power 3.1 software. The calculations were based on an effect size of 0.38 [4] and an α-value of 0.5 with a desired power of 80%. The estimated sample size was 10 patients. Considering 10% loss of follow-up, 12 patients were included in the study.

Inclusion criteria: A total of 12 systemically healthy patients, previously untreated for DH, aged between 18 to 60 years with a chief complaint of DH, contributing 68 teeth were enrolled for the study. Patients in good systemic health with clinically elicitable dentin hypersensitivity who were reliable in their response to test measurements and those, who were not treated earlier for DH were included in the study.

Exclusion criteria: Patients with any systemic diseases or conditions and those, who were on any analgesics/anti-inflammatory drugs at the time of the study. Patients who had used any desensitising paste or mouthwash during the last six months and patients with cracked teeth, large carious lesions or restored teeth and wasting diseases were excluded in the study.

Study Procedure

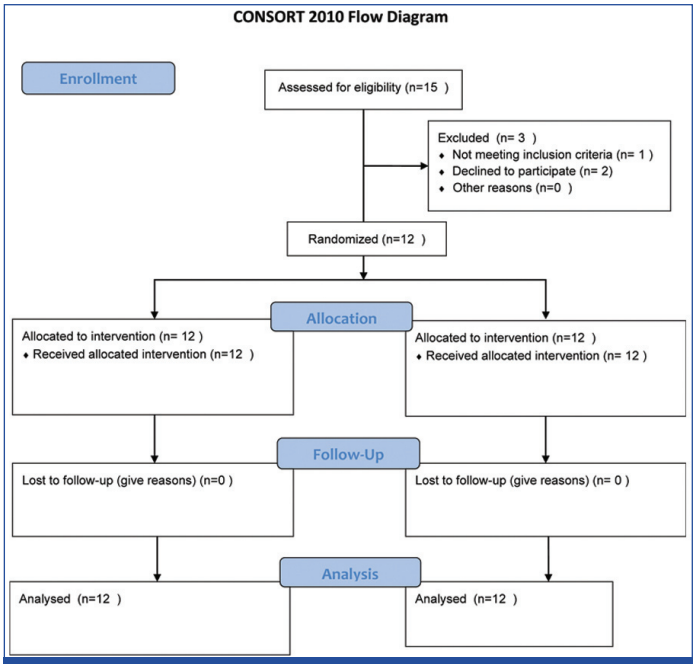
A total of 12 systemically healthy patients, previously untreated for DH, aged between 32 to 60 years with a chief complaint of DH, 12 patients contributing 68 teeth were enrolled for the study. A 2-4 teeth were treated in each side. The patients who satisfied all the inclusion and exclusion criteria were enrolled in the study. DH was assessed using evaporative stimuli. The evaporative stimulus was performed using an air syringe of the dental unit that was directed to the exposed tooth area for three seconds at a distance of 1 cm and a right angle to the buccal site of the assigned teeth. The patient then was asked to record their comfort by marking a point on a 10 cm VAS. A 0-10 numerical pain rating scales was given to the patient and they were asked to rate their pain. 0: no pain, 1-3: mild pain, 4-6: moderate pain, 7-10: severe pain.

In each patient, hypersensitivity teeth in two different quadrants were randomly assigned to one of the two treatment groups by the coin toss method.

Group 1: diode laser 810 nm-Denlase system

Group 2: diode laser 475 nm-Bluelase system

After the oral prophylaxis, baseline hypersensitivity scores were noted. The DL of wavelength 810 nm and 475 nm of frequency 15 Hz and power of 0.5 W in a continuous mode for one minute [4] was directed onto the hypersensitivity tooth surfaces and parameters were evaluated for 15 minutes, 1 week, 14 days, and 1 month after treatment [Table/Fig-1-4].



[Table/Fig-1]: CONSORT flowchart.

[Table/Fig-2]: Pre-op image.

[Table/Fig-3]: Desensitisation using Denlase.

[Table/Fig-4]: Pre-op image.

STATISTICAL ANALYSIS

Repeated measures of Analysis of Variance (ANOVA) and Bonferroni test was used for statistical analysis. Data were entered in Microsoft Excel and analysed using SPSS version 10.5. Bonferronni test was used for pair-wise comparison between the group/visit. The results were averaged (mean±standard deviation) for continuous data. p-value <0.05 was considered statistically significant.

RESULTS

The mean age of the participated subjects was 45±3 years. A total of 12 subjects were included in the present study. Patients who presented with cervical hypersensitivity when the air was delivered against the tooth surface were enrolled in the study. No adverse effects had been observed in any of the cases during the study. The mean VAS score for the Denlase group at baseline was 8.38±1.01 and after the treatment mean value reduced to 0.64±1.27 after 15 minutes, 0.29±1.03 at one week, 0.26±0.96 at 15 days and one month with a p-value <0.001 at all time intervals which was highly statistically significant [Table/Fig-6]. Data for pair-wise comparison has been given in [Table/Fig-7]. Highly significant difference was found, when mean VAS scores were compared between baseline and all the other time points (p<0.001).

[Table/Fig-5]: Desensitisation using Blulase.

Denlase	Mean	Standard deviation	p-value
Baseline	8.3824	1.01548	<0.001*
15 minute	0.6471	1.27641	
1 week	0.2941	1.03072	
14 days	0.2647	0.96323	
1 month	0.2647	0.96323	

[Table/Fig-6]: Mean VAS scores at difference time points in Denlase group.
*statistically significant, Repeated measures of ANOVA

Group 1	Group 2	Mean difference	Std. error	Significance	95% CI	
					Lower bound	Upper bound
Baseline	15 minute	7.735*	0.217	<0.001	7.084	8.387
Baseline	1 week	8.088*	0.195	<0.001	7.501	8.675
Baseline	14 days	8.118*	0.188	<0.001	7.553	8.682
Baseline	1 month	8.118*	0.188	<0.001	7.553	8.682
15 minute	1 week	0.353*	0.111	0.031	0.020	0.686
15 minute	14 days	0.382*	0.112	0.017	0.046	0.719
15 minute	1 month	0.382*	0.112	0.017	0.046	0.719
1 week	14 days	0.029	0.029	1.000	-0.059	0.118
1 week	1 month	0.029	0.029	1.000	-0.059	0.118
14 days	1 month	0	0	0	0	0

[Table/Fig-7]: Pair-wise comparison in of mean VAS scores in Denlase group.
CI: Confidence interval

The mean VAS score for the Blulase group at baseline was 7.73±2.67 and after the treatment mean value reduced to 2.23±1.67 after 15 minutes, 1.94±1.55 at one week and 14 days, 1.85±1.50 at one month with a p-value <0.001 at all time intervals which was highly statistically significant [Table/Fig-8]. On pairwise comparison significant difference was found when mean VAS scores were compared between baseline and all the other time points [Table/Fig-9]. On intergroup analysis, there was significant reduction in mean VAS scores in Denlase group when compared to Bluelase group at all time periods except baseline (p<0.001). Hence, Denlase laser performed better in reduction of sensitivity when compared to Bluelase group [Table/Fig-10].

Bluelase	Mean	Standard deviation	p-value
Baseline	7.7353	2.67173	<0.001
15 minute	2.2353	1.68880	
1 week	1.9412	1.55585	
14 days	1.9412	1.55585	
1 month	1.8529	1.50015	

[Table/Fig-8]: Mean VAS scores at difference time points in bluelase group.
*statistically significant, Repeated measures of ANOVA

Group 1	Group 2	Mean difference	Std. error	Significance	95% CI	
					Lower bound	Upper bound
Baseline	15 minute	5.500*	0.609	<0.001	3.667	7.333
Baseline	1 week	5.794*	0.569	<0.001	4.082	7.507
Baseline	14 days	5.794*	0.569	<0.001	4.082	7.507
Baseline	1 month	5.882*	0.569	<0.001	4.170	7.595
15 minute	1 week	0.294*	0.090	0.025	0.024	0.564
15 minute	14 days	0.294*	0.090	0.025	0.024	0.564
15 minute	1 month	0.382*	0.104	0.008	0.071	0.694
1 week	14 days	0	0	0	0	0
1 week	1 month	0.088	0.049	0.831	-0.060	0.237
14 days	1 month	0.088	0.049	0.831	-0.060	0.237

[Table/Fig-9]: Pair-wise comparison in of mean VAS scores in Denlase group.

Time period	Group	Mean	p-value
Baseline	Denlase	8.3824±1.01	0.192
	Bluelase	7.7353±2.67	
15 minute	Denlase	0.6471±1.27	<0.001
	Bluelase	2.2353±1.67	
1 week	Denlase	0.2941±1.03	<0.001
	Bluelase	1.9412±1.55	
14 days	Denlase	0.2647±0.963	<0.001
	Bluelase	1.9412±1.55	
1 month	Denlase	0.2647±0.963	<0.001
	Bluelase	1.8529±1.50	

[Table/Fig-10]: Intergroup comparison of mean VAS scores between Denlase and Bluelase groups at different time points.
*statistically significant, Independent sample t-test

DISCUSSION

The main hypothesis evaluated in the present study was, whether applying an 810 nm DL and a 470 nm DL to a tooth with DH for 60 seconds would result in a significantly larger immediate reduction of DH. Denlase group was better when compared to Bluelase group in reducing the DH. The dentinal hypersensitivity is a quite common issue found in a dental practice that is characterised by a sharp, transitory unpleasant response to a stimulus such as eating, drinking, brushing one's teeth, or breathing, thus, impacting the quality of life [11]. Individual treatment needs for DH vary depending on the aetiology, as well as, the subjective perception of painful sensations and the degree of tolerance to this type of pain [12] because the aetiology of DH may be complex, evidence from past

studies suggest that, many techniques have been used during treatment to achieve excellent results.

Traditional DH treatment involves using desensitising agents to obliterate the dentinal tubules that are exposed to the oral environment. Since, the use of tubule occlusive agents have several drawbacks, such as, the necessity for multiple administrations, a longer treatment time, and poor patient compliance, the demand for alternate treatment techniques has arisen. In the last decade, laser technology has given rise to a new therapeutic option for DH. The majority of experimental and clinical research on the effectiveness of Low-Level Laser Treatment (LLLT) on DH used DLs with wavelengths ranging from 635 to 910 nm [13]. Low-power lasers have been used to treat DH using a variety of irradiation techniques. Their interaction with dental pulp creates a photo-bio modulating effect, increasing the metabolic activity of odontoblastic cells and, as a result, obliteration of the dentinal tubules and intensification of tertiary dentin formation. Furthermore, the low-power laser is thought to enhance cell circulation and activity, resulting in anti-inflammatory effects, analgesia, and tissue normalcy [14]. Until now, DLs of various wavelengths, such as 660, 810, 940, and 980 nm, have been used in the treatment of DH [4,14]. Recently, a blue DL device was developed, a new laser that is now available in the field of medicine and dentistry. This Bluelase system has several benefits, including high working effectiveness at low power levels and a low depth of absorption of light at 475 nm, which indicates minimal harm to the pulpal tissues [8].

In the present study, there was a decrease in sensitivity ratings on the VAS scale in both groups from baseline to 15 minutes after treatment, with a significant difference. The results were similar to those achieved in a study by Dilsiz A et al., in which Nd: YAG and a 685 nm DL were utilised to treat DH and provide immediate relief. Their findings revealed a considerable reduction in DH, as well as, rapid and long term therapeutic effects on teeth with gingival recession [15]. In a clinical study, conducted by García-Godoy F, 660 nm was used in the treatment of DH after non surgical periodontal therapy. He reported a statistically significant reduction in hypersensitivity immediately after therapy (after two minutes), two weeks, one month, and two months after treatment. The findings were similar to those of the current investigation [16]. The results obtained were comparable to the results obtained in the study by Bilichodmath R et al., where they compared Stannous Fluoride (SnF_2) and DL in the treatment of DH for providing instant relief [4]. In clinical investigations by Tabatabaei MH et al., Garcia-Delaney C et al., and Hashim NT et al., found that, DL was successful in delivering instant alleviation of hypersensitivity. The findings of the current investigation were comparable to the above mentioned studies [3,17,18].

Limitation(s)

In the present study, the authors have used single energy level and single application of laser for desensitisation, which could be a limitation to the present study.

CONCLUSION(S)

Desensitisation treatment with laser irradiation has shown to be effective in the present study, 810 nm DL has shown to be more effective in treating hypersensitivity when compared to 475 nm DL at different time intervals. Further long term research is required to evaluate the predictability and the effectiveness of lasers in the treatment of DH.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Sep 20, 2022
- Manual Googling: Dec 27, 2022
- iThenticate Software: Jan 07, 2023 (21%)

ETYMOLOGY: Author Origin

EMENDATIONS: 9

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Sep 01, 2022**
Date of Peer Review: **Nov 03, 2022**
Date of Acceptance: **Jan 12, 2023**
Date of Publishing: **Jun 01, 2023**