International Journal Dental and Medical Sciences Research
Volume 7, Issue 5, Sept – Oct 2025 pp 212-216 www.ijdmsrjournal.com ISSN: 2582-6018

Effectiveness of Diode Laser, Nano-Hydroxyapatite Paste and Their Combination in Treatment of Dentinal Hypersensitivity: A Comparative Clinical Study

Dr. Himalay Rathod[(1)], Dr. Shilpa Duseja[(2)], Dr. Hiral Parikh[(3)], Dr. Jalpa Patel[(4)], Dr. Priya Patel[(5)]

[1]*PhD Scholar, Department of Periodontology, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar*

[2]*Professor, Department of Periodontology, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar*

[3]*Professor and Head Department of Periodontology,Narsinhbhai Patel Dental College and Hospital, Sankalch and Patel University, Visnagar*

[4]*Reader, Department of Periodontology, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar*

[5]*Sr. Lecturer, Department of Periodontology, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar*

Corresponding Author: Dr. Himalay Rathod

Date of Submission: 15-09-2025 Date of Acceptance: 25-09-2025

ABSTRACT: Dentin hypersensitivity is a common clinical problem encountered in dentistry. Sensory stimuli do not yield any response in healthy teeth but lead to exaggerated response in hypersensitive teeth. Dentin hypersensitivity is characterized by sharp pain arising from exposed dentin in response to stimuli. Enamel can be worn off by attrition, abrasive toothbrushing, and erosion from acidic diet and parafunctional habits. The root surfaces of teeth can be exposed by gingival recession and periodontal disease. Dentin abrades 25 times, whereas cementum abrades 35 times more easily than enamel. The most accepted theory for hypersensitivity is the hydrodynamic theory. This theory attributes the movement of dentinal fluid in either direction within the dentinal tubules on application of an external stimulus. This excites the pulp's mechanoreceptors in turn and results in hypersensitivity, perceived as pain by the patient.

KEYWORDS: Dentin hypersensitivity, Diode Laser, Nano-Hydroxyapatite Paste.

I. INTRODUCTION

Dentin hypersensitivity is a common clinical problem encountered in dentistry. Sensory stimuli do not yield any response in healthy teeth but lead to exaggerated response in hyper sensitive teeth. An international workshop denies this condition as: "Dentin hypersensitivity is characterized by short, sharp pain arising from exposed dentin in response to stimuli, typically thermal, evaporative, tactile, osmotic or chemical and which cannot be ascribed to any other dental defect or pathology." Dentin hypersensitivity can range from slight discomfort to extreme pain depending on the individual's pain perception and tolerance. A variety of desensitizing agents have been recommended to reduce dentin hypersensitivity.[1]

In 1985, Lasers were introduced as a potential desensitizing tool. The working parameters such as wavelength and the power density of the laser and the optical properties of the target tissue can lead to different tissue reactions. Kimura et al. reported an effectiveness varying from 5.2% to 100% depending on the laser parameters being used. The combination of lasers with chemical substances such as nano-hydroxyapatite paste presents as an additional therapeutic option. In various clinical studies, the effectiveness of more than 20% has been found over the laser treatment alone.[2]

Dentin hypersensitivity has been the topic of research since the past decade. Many treatment modalities that obliterate the dentinal tubules are available; however, till date, no consensus regarding the most efficient method for treating dentin hypersensitivity has been published. Effective therapeutic options that provide long-lasting relief with a predictable prognosis are being explored even today. Thus, this study aimed to evaluate the effectiveness of the 810-nm diode laser alone nano hydroxy apatite paste alone and in combination of both in the treatment of dentin hypersensitivity.[3]

International Journal Dental and Medical Sciences Research
Volume 7, Issue 5, Sept – Oct 2025 pp 212-216 www.ijdmsrjournal.com ISSN: 2582-6018

II. MATERIALS AND METHODS

In this split-mouth, double-blind, randomized control trial, twenty systemically healthy controls aged 20–60 years visiting the outpatient department of periodontics and fulfilling the inclusion criteria were selected for the study. Inclusion criteria:

1. The presence of a minimum of two teeth, hypersensitive to tactile, cold, or air stimulation corresponding to 4 cm and above on the Visual Analog Scale (VAS) in three quadrants
2. Willingness to provide written informed consent for being included in the study.

Patients who had received any professional treatment with desensitizing agents during the past 6 months; patients with a history of antibiotics, anti-inflammatory drug, or immunosuppressive drug therapy in the past 6 months; patients who underwent periodontal treatment in the past 6 months; patients with history of any systemic disease or allergy to fluorides; pregnant or lactating women; smokers; and chronic alcoholics were excluded from the study. The teeth having carious lesions, extensive restorations, endodontic treatment on the selected teeth, teeth diagnosis to have cracked tooth syndrome, vertical fracture, and pulpitis were also excluded from the study.

In each patient, hypersensitive teeth in three different quadrants were randomly assigned to one of the three treatment groups by a lottery method. In Group 1, Nano hydroxyapatite paste application was done, in Group 2, Diode laser application was done, and in Group 3, Nano hydroxyapatite paste followed by diode laser application, and in Group 4 Placebo gel application was done.

VAS score for each stimulus was recorded before each treatment session (at baseline, 1 week, and 2 weeks), followed by VAS score recording at 1 month, 3 months, and 6 months. Thefollowing stimuli were used for the assessment of dentin hypersensitivity with a 5-min gap between each stimulus.

Air-blast stimulus: Three-way syringe attached to the dental chair was used, kept at a distance of 0.5 cm, and perpendicular to the tooth surface for 1 s per tooth at room temperature.

Cold stimulus:A precooled 2-ml disposable syringe was filled with freshly melted ice-cold water. After isolating the specific tooth, 0.5 ml of the water was slowly expelled from the syringe on the tooth surface.

Tactile stimulus: The University of North Carolina-15 probe tip was moved back and forth in contact on the buccal tooth surface.

Adjacent teeth were covered with the operator's fingers and or cotton rolls while dentin stimulation. A single operator evaluated all teeth for hypersensitivity while other operators per formed all the treatments assigned.

In each patient, periodontal therapy consisting of full-mouth scaling and root planing using hand instruments and ultrasonic scaler, followed by oral hygiene instructions, was given. Dentin hypersensitivity was assessed and recorded for the three stimuli (air blast, cold, and tactile) before initiating any hypersensitivity treatment. After recording the baseline dentin hypersensitivity scores, hypersensitive teeth in different quadrants were assigned to one of the three treatment groups.

In Group 1: Nano-hydroxyapatite paste was applied only on the buccal surfaces at one site with the help of a disposable applicator tip / plastic syringe for 3 mins while rubbing using a micro-brush then removed gently using slightly moist cotton for each sample.

In Group 2: Hypersensitive teeth in the selected sites were irradiated using diode laser: 940 nm (Biolase®), power 0.5 W continuous emission form. Each tooth was irradiated for 2 min in noncontact mode with the laser beam directed perpendicular to the buccal surface of the tooth as close as possible but without touching the tooth surface.

In Group 3: Hypersensitive teeth in the selected sites were treated by application of nano-hydroxyapatite paste for 3 min, followed by irradiation treatment using 940-nm diode laser (Biolase®), power 0.5 W continuous emission form. Each tooth was irradiated for 2 min in noncontact mode with the laser beam directed perpendicular to the buccal surface of the tooth as close as possible but without touching the tooth surface.

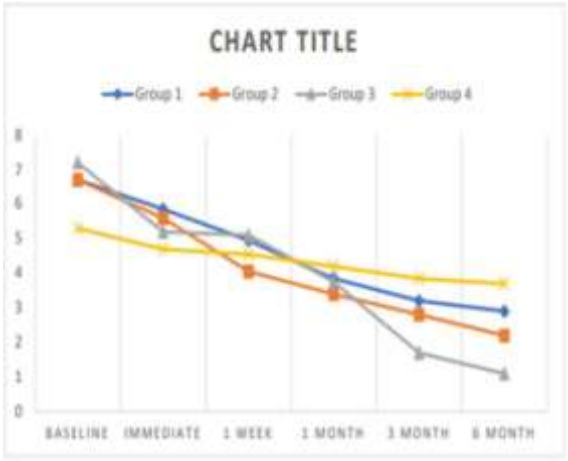
In Group 4: Placebo gel was applied only on the buccal surfaces at one site with the help of a disposable applicator tip and adjacent teeth will be isolated with a cotton roll, cotton pellet etc.

Visual Analogue Scale again recorded immediate post operatively. The parameters were recorded again after 1 week, after 1 months and after 3 months with same treatment as well. Again parameters were recorded after 6 months without treatment. All patients were instructed not to eat for 1 hour and to resume toothbrushing after 12 hours.

International Journal Dental and Medical Sciences Research
Volume 7, Issue 5, Sept – Oct 2025 pp 212-216 www.ijdmsrjournal.com ISSN: 2582-6018

III. RESULT

Total 80 sites were taken in this study among 20 peoples aged between 20 to 60 years. There was reduction in dentin hypersensitivity in all the groups. Group 3 showing highest hypersensitivity reductions when compared to Group 1, Group 2 and Group 4 respectively.



IV. DISCUSSION

Dentin hypersensitivity (DH) is a rising concern in clinical dentistry that causes pain and discomfort and negatively affects the quality of life of patients. The prevalence of dentin hypersensitivity varies between 3% and 57% in the general population. Root instrumentation during periodontal therapy may lead to cementum removal which explains the higher frequency of dentin hypersensitivity in periodontitis patients. It is one of the most common and painful, and least successfully treated chronic tooth problems. The goal in treatment of dentin hypersensitivity is the immediate and permanent relief of discomfort and/or pain.[4]

In 1884, Calvo wrote that 'there is a great need of a medicament, which while lessening the sensitivity, will not impair the vitality of the pulp'. In 1884, Calvo wrote that 'there is a great need of a medicament, which while lessening the sensitivity, will not impair the vitality of the pulp'. Research has been going for this so long but till now no completely reliable treatment has been found; an agent can be of benefit in one case but fail in another, so, the search for an ideal agent still continues.[5]

Toothpastes are the most widely used dentifrices for delivering over-the counter desensitizing agents because of their low cost and ease for the use for home application. New technologies, such as the Pro-Argin technology, BioMin bioactive glass, and hydroxyapatite crystals are believed to bind to the exposed dentin surface and within the openings of the dentin tubules to mediate the formation of biological mineral, thereby reducing dentinal hypersensitivity.[6]

The present study aimed to evaluate efficacy of Diode laser, nano hydroxyapatite paste and its combination and a placebo toothpaste on dentinal hypersensitivity over a period of 6 months. The duration for most studies that examined the effects of reducing dentinal hypersensitivity ranged from 4 to 12 weeks. The duration of present study was 6 months with sensitivity scores measured at baseline, 1-week, 1-month, 3-months and 6-months. In the current study, tactile stimulus, evaporative air stimulus and cold-water stimulus were used because these are physiologic and controllable. 4 groups were there in this present study.[7]

Group 1: Nano-hydroxyapatite Paste application
Group 2: Diode Laser (940mm) application
Group 3: Nano-hydroxyapatite Paste application followed by Diode Laser
Group 4: Placebo gel application
Among all 4 groups, group 3 has shown maximum reduction in dentinal hypersensitivity.

Meng-Long Hu (2018) did a study where authors concluded that desensitizing agents relievethe symptoms of Dentinal Hypersensitivity. Visual Analog Scale (VAS) was used for assessing painful sensations in this study. In the present study, Group 3 reported a higher reduction in dentin hypersensitivity using airblast, cold, and tactile stimuli when compared to Group 2;however, no significant difference was observed between the two groups at any follow-up interval.[8]

In study by Tailor et al., the efficacy 808 ± 10 nm diode laser with topical fluoride (6% NaF and 6% CaF) in the reduction of dentin hypersensitivity was found to be similar. A similar study done by Tasance Tengrungsun, Worawan Sangkla (2008) compared the clinical efficacy of the GaAlAs laser and dentin bonding agent in treating dentin hypersensitivity. Statistically significant differences between the studied time intervals ($p \leq 0.05$) were detected. They concluded that the GaAlAs laser had less desensitizing efficacy compared with dentin bonding agent. However, the desensitizing effect of the GaAlAs laser still could be considered an effective therapy for treating dentin hypersensitivity.[9]

Masumeh Hasani Tabatabaei, Nasim Chiniforush (2018) stated that reduction of dentin hypersensitivity was observed at 3 and 6 months following the use of laser ($p < 0.001$). A similar

study done by RK Yadav, UP Verma (2019) concluded that VRS values showed maximum reduction in SRP + nanocrystalline hydroxyapatite dentifrices + laser group with mean of 0.3 ±0.5 and minimum reduction in CG with mean of 3.0 ± 0.5 (P < 0.001). Amongst all the groups, SRP + Nanocrystalline hydroxyapatite + Laser can be an effective treatment modality for DH.[10,11]

According to Mohammed Abbood Al-maliky (2014) aimed to evaluate a new treatment modality for the occlusion of dentinal tubules (DTs) via the combination of 10.6 µm carbon dioxide (CO2) laser and nanoparticle hydroxyapatite paste (n-HAp) which concluded that CO2 laser in moderate power density combined with n-HAp seems to be a good treatment modality for reducing the permeability of dentin. A similar study done by Sgolastra et al. concluded that greater degree in dentinal occlusion was found in combination of Nano hydroxyapatite paste and Diode Laser while comparing with Nano hydroxyapatite paste and Laser alone.[12]

It has been well documented in dentin hypersensitivity trials that the placebo effect is profound, and can be as high as 40% limiting the available range for the test agent to show significance. Placebo effect consists of a complex mixture of physiologic and psychological interactions, depending considerably on the doctor patient relationship with both parties believing that the treatment is of value and the desire to obtain relief from symptoms. A Similar study done by Yu et al (2010) investigated the desensitizing efficacy of two one-bottle self-etching adhesives, two dentine desensitizers, and a placebo (water) at 1-month follow-up. All dental materials significantly reduced the dentin hypersensitivity immediately ($p<0.05$) and one month after treatment ($p<0.05$). The placebo (water) only caused a short-term effect on the thermal dentin hypersensitivity ($p<0.05$).[13]

V. CONCLUSION

It can be concluded that both Nano-hydroxyapatite Paste and Diode Laser are effective in treating dentin hypersensitivity. However, diode laser used alone and in combination with Nano-hydroxyapatite Paste is significantly more effective than Nano-hydroxyapatite Paste alone in the treatment of dentin hypersensitivity.

REFERENCES

[1]. Canadian Advisory Board on Dentin Hypersensitivity. (2003). Consensus-based recommendations for the diagnosis and management of dentin hypersensitivity. Journal of the Canadian Dental Association, 69(4), 221-226.

[2]. Kimura Y, Wilder-Smith P, Yonaga K, Matsumoto K. Treatment of dentine hypersensitivity by lasers: a review. J Clin Periodontol. 2000;27(10):715-721.

[3]. Effect of the Clinical Application of the Diode Laser (810 nm) in the Treatment of Dentine Hypersensitivity — Hashim et al., BMC Research Notes, 2014.

[4]. Addy M. Dentine hypersensitivity: definition, prevalence, distribution and aetiology. In: Addy M, Embery G, Edgar WM, Orchardson R, eds. Tooth wear and sensitivity: Clinical advances in restorative dentistry. London: Martin Dunitz; 2000. p. 239–248.

[5]. Orchardson R, Gillam DG. Managing dentin hypersensitivity. J Am Dent Assoc. 2006;137(7):990–998

[6]. Narayanan S, Varughese JM, Narayanan A, Salian S, Rajesh S. Effect of bioactive glass-containing toothpaste on dentin hypersensitivity: a randomized, controlled clinical trial. J Conserv Dent. 2020;23(4):340–344.

[7]. Treatment of Dentin Hypersensitivity Using Nano-Hydroxyapatite Pastes: A Randomized Three-Month Clinical Trial — Comparing nano-HAP treatments vs. other agents, using evaporative stimulus, follow-ups at 1 and 3 months.

[8]. Hu ML, Zheng G, Zhang YD, Yan X, Li XC, Lin H. Effect of desensitizing toothpastes on dentine hypersensitivity: A systematic review and meta-analysis. Journal of dentistry. 2018 Aug 1;75:12-21.

[9]. Tengrungsun T, Sangkla W. Comparative study in desensitizing efficacy using the GaAlAs laser and dentin bonding agent. Journal of dentistry. 2008 Jun 1;36(6):392-5.

[10]. Tabatabaei MH, Chiniforush N, Hashemi G, Valizadeh S. Efficacy Comparison of Nd: YAG laser, diode laser and dentine bonding agent in dentine hypersensitivity reduction: a clinical trial. Laser therapy. 2018 Dec 28;27(4):265-70.

[11]. Yadav RK, Verma UP, Sajjanhar I, Tiwari R. Frenectomy with conventional scalpel and Nd: YAG laser technique: A comparative evaluation. Journal of Indian Society of Periodontology. 2019 Jan 1;23(1):48-52.

[12]. Sgolastra F, Petrucci A, Gatto R, Monaco A. Effectiveness of laser in dentinal

hypersensitivity treatment: a systematic review. Journal of Endodontics. 2011 Mar 1;37(3):297-303.

[13]. Yu X, Liang B, Jin X, Fu B, Hannig M. Comparative in vivo study on the desensitizing efficacy of dentin desensitizers and one-bottle self-etching adhesives. Operative Dentistry. 2010;35(3):279-286.