



Treatment of Dentine Hypersensitivity with Diode Laser

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Abstract

Patient discomfort due to dentin hypersensitivity DH is one of the major challenges faced by dentists in daily practice. Difficulties in DH treatment have resulted in the many regimens currently used. This clinical study aimed to evaluate the effectiveness of a new protocol in reducing dentin hypersensitivity using a 980 nm diode laser.

50 cases of DH were enrolled in the study, and the pain level was assessed using the Visual Analog Scale (VAS) Apply a 980 nm diode laser with continuous mode, backward motion, tangential incidence of the beam in non-contact mode and 0.7 W delivered output with a total exposure time of 60 s per tooth. Postoperative pain was significantly reduced immediately after treatment. Means remained stable until the 2-week follow-up.

Introduction:

Dentine hypersensitivity DH: This is one of the most common complaints of dental clinic patients. DH is defined as transient, severe pain due to exposed dentin in

response to non- noxious stimuli and that cannot be attributed to any other form of dental defect or disease (1).

The efficacy of using diode laser therapy in the part of dentin hypersensitivity. The study will evaluate the reduction of pain and sensitivity among patients who receive diode laser treatment, utilizing a comparative analysis of pre-and post-treatment scores. The goal is to provide a reliable and effective method for managing symptoms and improving the quality of life in individuals suffering from dentin hypersensitivity. Overall, the study aims to support the use of diode laser therapy as a viable treatment option for individuals struggling with the discomfort associated with dentin hypersensitivity.

Cold drinks, thermal hot and foods (2), cold air, triple syringe in dental office, electrical pulp testers (3), mechanical dental examination with dental probe , periodontal ordinary (3), tooth brushing (2),osmotic-hypertonic solutions (3), evaporation dental -air blast from a dental instrument (3) , and chemical - acids (3),e.g. gastric, dietary, acid etch during composite filling .Variable frequency and severity of the DH pain (4). Different studies reported the prevalence distribution and appearance of DH. The differences could be attributed to differences in diet, and population habits (5). The DH is common in patients aged 20-50, and common in women, which may be related to their dental hygiene and dietary (6-8). Additionally, the incidence of *DH* is higher in the cusp and bicuspid than in other teeth (8). There is a high prevalence of *DH* on the teeth's check (*oral surface*) compared to other areas of the tooth.

Mechanisms of dentine hypersensitivity are proposed:

Direct Innervation (DI) Theory.

Odontoblast Receptor (OR) Theory.

Fluid Movement/Hydrodynamic Theory.

Hydrodynamic Concept: This concept is the most widely agreeable concept for DH. The concept is based on the motion of fluid within the dentinal tubules. This concept claims that the dentinal tubules are open between the dentin surface exposed to the environment and the pulp (9,10). DH is believed to arise due to fluid motion within the dentinal tubules, which

is further due to thermal and physical changes, or due to osmotic stimuli that form near exposed dentine. The motion of the fluid stimulates the baroreceptors and leads to nervous discharge (11).

Possible Causes of dentine hypersensitivity:

Periodontal disease, receding gums, cracked teeth, erosion, wear, and broken teeth can lead to hypersensitivity. All these conditions lead to exposure of the dentine, thereby creating an environment in which stimulation causes the movement of the dentine tubular fluid, which activates nerve fibers that can cause pain. Exposed dentin may be due to cementum removal during scaling and root planning, trimming, and polishing of restorations, or excessive brushing, especially after ingestion of acidic foods or beverages, which can lead to structural damage to the teeth. Pain can be local or general and may affect various tooth surfaces simultaneously or individually (12). In addition to these sources, tooth whitening often leads to DH. The use of hydrogen peroxide or carbamide peroxide may penetrate the pulp through enamel and dentin.

Clinical diagnosis of dentine hypersensitivity and treatment:

An accurate diagnosis of DH is critical for successful treatment. The diagnosis of the DH starts with investigating the patient's medical history and clinical examination. Patient complaints about durability the time of the start of DH, the intensity of the pain, the stability of the pain and the factors that increase or decrease the pain of the DH. Some techniques such as pure air, pure water, and percussion are used to determine the degree of pain of the patient (12). Treatment of DH: Clinicians can recommend a variety of treatments for use at home or in the office. The treatment depended on the severity of sensitivity and etiology, usually neural desensitization, protein precipitation, occlusion of dentinal tubules, dentine sealing, or laser ablation of dentine. The most prevalent treatment employed substances that decrease inflammation, those that cause protein precipitation that blocks tubules and

compounds that seal tubules (13). At home: As a first line of defense against sensitivity, clinicians may wish to recommend a toothpaste that contains potassium salts (such as potassium nitrate, potassium chloride, or potassium citrate) or fluoride. Potassium ions diffuse along the dentinal tubules, block nerve activity, and relieve pain associated with hypersensitivity. Potassium toothpastes are effective, but patients may need to continue using them for two weeks to feel the effects. Calcium phosphate technologies are another option for treating hypersensitivity (make calcium and phosphate ions on hand in saliva to accelerate remineralization, and may also assist in decreasing whitening-induced sensitivity (8). In-office application: Clinicians can follow a desensitizing prophylaxis paste; to apply the desensitizing agents, cotton pellets were used to clean the teeth and air was used to dry the teeth. The area that was treated was isolated by cotton rolls and suction. formulated with 8% arginine and calcium carbonate to occlude tubules. The addition of potassium oxalate is utilized to minimize dentinal hypersensitivity. Oxalates have been shown to cut down dentinal permeability and block tubules (14). Chlorhexidine varnish types have a mechanical barrier after drying, which lessens sensitivity, while supplying an antiplaque and action of antibacterial (15).

Invasive treatment options: Restoration of hard tissue defects in addition to surgical correction for gingival recession may be considered as substitute treatment to DH according to needs (16). Hydroxycarbonate apatite layer could be precipitated over the dentinal tubule openings by using Glass ionomer cement (17). Both high power and low-level lasers have been reported to give success in treatment of DH. laser treatment action of DH is not totally clear at this time and still needs to be elucidated. Some experiments recommend that low level lasers may suppress pulpal nerves excitability. High power laser may minimize signs and symptoms of DH by the occlusion of dentine tubules (18).

Laser

“Light Amplification by Stimulated Emission of Radiation”. In the following, the difference between laser and ordinary light source (19).

Monochromaticity: Each laser has a single color or wavelength unlike ordinary lights, which has a band of colors at different wavelengths.

Directionality: Every ray in the laser beam will travel in the same direction. Whereas ordinary light travels in different directions.

Coherence: The rays in a laser are accurately synchronized with each other unlike ordinary lights.

Laser in dentistry:

When it comes to laser dentistry, some lasers are used in the treatment of hard tissue (teeth), while others are used to treat gums and soft tissue. The wavelength and type are different in the Lasers of tissue they target. For example, soft tissue lasers use light wavelengths that are easily absorbed by water and hemoglobin, making them ideal for gum and tissue treatments. Traditional treatments for mild to severe gum disease include microorganism inhibition, scaling, root planning to remove calculus and plaque (20,21), and bone or soft tissue grafting. Laser gum surgery eliminates these procedures because the laser removes inflamed or dead tissue while killing bacteria, lengthens crowns to remove oral soft tissue folds commonly caused by dentures in addition to relief facial pain(22).In contrast, hard tissue lasers use wavelengths that work with calcium phosphate salts in teeth and bones, making them ideal for specific dental procedures ex: Preparing and shaping teeth composite bonding, repairing worn or damaged fillings, removing small amounts of tooth structure, treating tooth sensitivity - sensitivity to heat and cold is the result of open tubules and laser whitening is often used to help brighten and improve the smile in addition to in increase the caries resistance of dental tissue (23- 25).

Typically, the lasers used in dentistry are diode lasers, argon lasers, *Nd – YAG*

lasers, *carbon dioxide lasers*, *Erbium lasers* and more (26,27).

1-Diode Lasers: The active medium of diode lasers is a solid-state semiconductor made of aluminum, gallium, arsenide, and occasionally indium. It produces laser light in the wavelength range of 810 nm to 980 nm. All diode wavelengths are mainly absorbed by hemoglobin and melanin. Instead, they are poorly absorbed by hydroxyapatite and water in tooth enamel. Specific procedures include cosmetic gum restoration Soft Tissue - Crown lengthening, exposure of soft tissue-blocked teeth, removal of inflamed and hypertrophic tissue, frenectomy, and photo stimulation of oral ulcers and herpes lesions (27,28).

2-Advantages of diode laser (29):

- 1) **Simple design.**
- 2) **Better modulation capability.**
- 3) **Using laser treatment can provide the operator with better management over the laser and minimize the possibility of heat damage.**
- 4) **It gives high optical power.**
- 5) **It has a smaller size.**

Material and Method:

50 cases of DH were selected. The degree of DH was evaluated by visual analogue scale (VAS), by air Figure1 and by tactile Figure 2. DH was stimulated by touching the tooth neck with the tip of the probe, with mesial-distal directionality. Patients were asked to assess their level of DH pain using the VAS scale of 0 to 5, where 0 represents "no pain" and 5 represents "greatest pain." The laser therapy commenced after the assessment and documentation of initial sensitivity. In this study, a low-power diode laser (Epic bio laser-USA) (980nm) was employed with continuous mode protocol. During this procedure, 0.7watts of power was directed at the tooth surface which was positioned 2mm away from laser and exposed for 60 seconds. The safety protocol included the use of protective eyewear worn by both the dentist and patient and proper labelling and designation of the workspace. DH pain was measured after the laser

irradiation immediately 2 weeks after treatment, the DH was measured again using (VAS). Statistical analysis was applied using (Minitab var.17).

Result:

In this study, single irradiation of diode laser caused decrease in the mean of (PAS)records after irradiation immediately. The recorded pain seemed to continue to decrease after 2 weeks Figure 3. Tables (1) and (2) show that there is a significant decrease in the (PAS) between the records before, immediately after, and 2 weeks after the diode laser irradiation. The findings of this study suggest that a single session of diode laser therapy can significantly reduce the intensity of pain experienced by individuals with DH. The study observed a decrease in the mean of visual analogue scale (VAS) pain scores immediately after laser irradiation, with a mean reduction from 4.160 before irradiation to 1.540 after irradiation. Furthermore, the reduction in pain appeared to continue even after two weeks, with a mean pain score of 1.080. These results suggest that diode laser therapy may have a sustained effect on reducing pain associated with DH.

Discussion:

The literature has presented numerous treatments for DH, but none of the treatments removes the pain completely level. To remove the pain, the stimuli transmission to the odontoblast nerve ending needs to be interrupted which can be achieved by decreasing the fluid flow in the dentinal tubules or blocking the tubule opening (30). Additionally, laser therapy has been proposed as a treatment that has shown a noticeable decrease in sensitivity to hot and tactile stimuli. Thus, in this study, laser therapy promoted a significant reduction in sensitivity seconds after the first application. The diode laser induces changes in the neurotransmission network

(*inhibition of neurotransmission*) in the dental *pulp*. Furthermore, laser therapy can restore the normal functioning of physiological cellular activities (31).

Several studies have shown that diode laser treatment can be an effective method for treating dentine hypersensitivity.

For instance, a study investigated the efficacy of diode laser treatment compared to a placebo control group.

In this study, the diode laser treatment significantly reduced *DH* in comparison to placebo treatment. In addition, the study reported that laser treatment was well-tolerated by patients with no side effects (32). The diode laser treatment was also evaluated for its effectiveness in reducing *DH* in patients with periodontal disease. The treatment reduced sensitivity and lasted up to six months.

According to the research can be effectively treated with diode laser treatment by Dentine hypersensitivity This treatment modality needs further research to determine optimal treatment protocols, long-term effectiveness, and potential side effects.

Yilmaz et al. reported the effectiveness of sodium fluoride and diode lasers in treating *DH*. Based on their study, *GaAlAs* laser therapy was an effective treatment for *DH* and offered greater convenience and efficiency than traditional treatments (34).

These results confirm our study's results. Many reasons may disagree with treating *DH* with a diode laser. One of the reasons may be the lack of substantial evidence to support its effectiveness as a treatment option for *DH*. The study may highlight no significant difference between diode laser-treated groups and control groups in terms of pain relief or sensitivity reduction (35). Another reason why the study may disagree with diode laser treatment is that it carries a risk of thermal damage to the underlying pulp and root of the tooth. Prolonged or excessive exposure to laser light can heat the tooth structures, leading to irreversible damage and long-term dental problems.

Conclusion:

This study showed that Diode laser may reduce pain in dentine hypersensitivity immediately after irradiation. The pain reduction continues after 2 weeks from the irradiation.



Figure 1: Air Stimulation Application



Figure 2: Tactile Stimulation

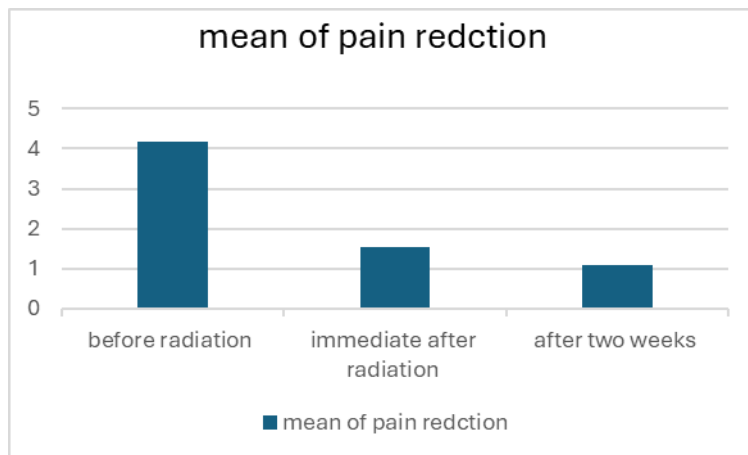


Figure 3: Shows the value of pain reduction.

Table (1): Descriptive Statistics: Bef., Immediate after, and after 2weeks

Variable	Mean	SE Mean	St Dev	Minimum	Q1	Median	Q3	Maximum
Bef.	4.160	0.1080	0.7660	3.000	4.000	4.000	5.000	5.000
immediate	1.540	0.0712	0.5035	1.000	1.000	2.000	2.000	2.000
Af.2weeks	1.080	0.1890	1.3380	0.000	0.000	1.000	1.000	5.000

Table (2): One-way ANOVA: Bef., Immediate, Af.2Week

Source	DF	Adj SS	Adj MS	f-value	p-value
Factor	2	276.0	138.020	157.50	0.01
Error	147	128.8	0.876		
total	149	404.9			

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