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Evaluation of effectiveness of diode laser in treating dentinal hypersensitivity following scaling and root planing- A clinical study

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Abstract

Background: Dental treatments, such as removal of dental deposits and debridement of root surfaces during scaling and root planing, may facilitate elimination of necrotic cementum and cause subsequent exposure of large number of dentinal tubules. This may lead to Dentinal Hypersensitivity (DH). Elimination of pain and discomfort due to dentinal hypersensitivity is our main concern, regardless of the origin of this discomfort. According to the proven literatures, there are several options for treating dentinal hypersensitivity and diode laser therapy is one of them. This study is conducted to evaluate the effectiveness of diode laser for treatment of the same.

Methods: Participants having dentinal hypersensitivity after scaling and root planing with pain measured more than 4 on VAS (Visual Analog Scale) were selected. Study was conducted on 25 patients having 102 sensitive teeth with DH assessed by cold water, air blast and tactile stimuli. Diode laser was applied on the cervical areas of each sensitive tooth in non-contact mode with 1W power for 30 seconds. Sensitivity was checked again on VAS scale after 2 weeks.

Result: The VAS reduction percentages were calculated, and there was a significant reduction in pain on tactile, air blast and cold water stimuli.

Conclusion: Diode laser application provides a significant decrease in dentinal hypersensitivity after single dose treatment within a 2 week follow up period.

Keywords: Dentinal hypersensitivity, Scaling, Root planing, Dentinal tubules, VAS scale, Diode laser.

Introduction

Dentinal hypersensitivity (DH) is one of several challenges that dentists face day-to-day in response to external stimuli, which cannot be ascribed to the other kind of dental pain. The sensory stimuli usually considered are thermal by applying a burst of air to the tooth and tactile by running a metal instrument across the hypersensitized region of the tooth.[1] Dentinal hypersensitivity is completely different from dentinal and pulpal pain, in this the patient's ability to locate the site of pain is accurate. The majority of cases (89.3%), cold is the major stimulation for pain, other usually reportable causes are tooth brushing (38.6%), hot (37.9%) and sweet (25%) stimuli [2].The frequency of hypersensitized dentine within the overall population is higher among patients with dentin surfaces exposed by cervical abrasion, erosion, animal tissue recession, hypoplasia or post periodontal procedures; where loss of normal protecting soft tissue is evident. These teeth are usually subjected to hypersensitized responses which can limit effective plaque control.[3] Loss of enamel, cementum, and/or gingival tissue recession usually leads to exposed dentin, that will cause sensitivity characterised by sharp pain right after mechanical, chemical, or osmotic stimulation [4,5]. Some dental treatments, like removing of dental deposits and debridement of root surfaces in scaling and root planing will facilitate elimination of necrotic cementum and result in exposure of huge number of dental tubules to the stimuli of oral environment. Elimination of pain and discomfort caused by dental hypersensitivity is our main concern, no matter the origin of this discomfort.[6,7] Many product are assessed relating to their effects on DH, together with traditional home remedies containing sodium fluorides or chlorides, and recently within the last fifteen years, the introduction of lasers gave additional potentialities to DH treatment.

Diode laser is semiconductor device in which the laser beam is created at the diode's junction similar to a light-emitting diode[8] by converting electric energy into light. The immediate impact of diode laser depends mainly upon induced changes in the neural transmission networks within the dental pulp.[9] Diode laser act by provoking a melting effect with crystallization of inorganic component and coagulation of fluids contained within the dentinal tubules. Even in high-grade DH cases due to high power, diode lasers are able to show good results in many clinical protocols.[10]

Materials And Methods

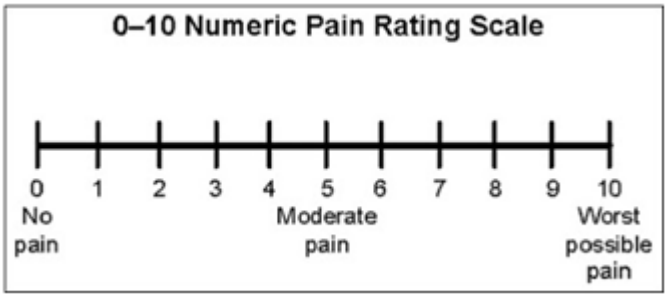
A total of 24 participants (67% males and 33% females) were included within the study. Informed consents were taken from the participants before the study.

Individuals who were systemically healthy within 20 – 70 years old, with at least 30% of natural teeth, who experienced ≥4 rated dentinal hypersensitivity on VAS scale after scaling and root planing procedure were included.

Individuals with any systemic diseases or cardiac pace makers, habit of smoking and tobacco chewing, pregnant and lactating women, fractured, restored or carious teeth, those undergoing orthodontic treatment and other people unwilling to participate were excluded.

VAS (Visual Analogue Score)[11] was recorded using tactile, air blast and cold water test

Figure number 1: VAS (visual Analogue Score)



1. Tactile test: Dental explorer was passed lightly across the affected area at a 90% angle to the long axis of the tooth. The test was repeated 2-3 times before scoring.

2. Air blast test: using a dental syringe blast of air at 60 pound/inch pressure was directed on the affected area of the tooth for 1 second from a distance of 10 mm (measured by taping a scale to the three-way syringe); the adjacent teeth were protected by covering with cotton rolls.

3. Cold water test: using pre-cooled 1 cc disposable syringe filled with melted ice-cold water. Cotton rolls were used to isolate the teeth and after that the stimuli was applied.

Patient's response on visual analogue scale (VAS) out of 10 was recorded. After the tests were performed, the teeth rated 4 or more on VAS scale for any of the two tests were selected.

Following the measurement of VAS score at baseline, Patients were subjected for diode laser (810nm) at each of hypersensitive site. The sensitive teeth were isolated by using cotton rolls and with 1W output power irradiation was done in non-contact mode. To obtain complete irradiation, laser beam was directed right angle to tooth surface on the cervical area for 30s. Laser application was done by the co-investigator.

The participants were instructed to follow oral hygiene measures by brushing their teeth with standard toothpaste and toothbrush. Participants were recalled after 2 weeks for follow-up and the response on VAS was recorded again.

Result

The study included 24 patients with average age of 28 years who had 102 sensitive teeth.

The study revealed that for VAS Tactile, VAS Air Blast and VAS Cold (the mean baseline) was 5.333, 6.04 and 6.58 respectively. After 2 weeks it decreased to 2.71(VAS_T), 2.83(VAS_AB) and 3.38(VAS_CW) respectively with a mean difference of 2.625(VAS_T), 3.208(VAS_AB) and 3.208(VAS_CW) respectively, which was statistically significant with the p-value for the difference between VAS at baseline and 2 weeks which was <0.001. (Table number 1)

Table 1: Changes and comparison in clinical parameters from baseline to follow-up period

Clinical parameters	Baseline Mean ± SD	2 week follow-up Mean ± SD	Difference from baseline to follow up Mean ± SD	95% Confidence Interval of the Difference		P-value
				Lower	Upper	
VAS_T*	5.33±1.6	2.71±1.9	2.625±1.5	1.980	3.270	<0.001
VAS_AB†	6.04±1.3	2.83±2.09	3.208±2.1	2.302	4.115	<0.001
VAS_CW‡	6.58±1.7	3.38±1.9	3.208±1.7	2.461	3.955	<0.001

*VAS_T = VAS of Tactile,

†VAS_AB = VAS of Air Blast,

‡VAS_CW = VAS of Cold Water

DISCUSSION

Dentine hypersensitivity (DH) is common, and individual needs for treatment depend on etiology, as well as on the subjective experience of painful sensations and the degree of tolerance to this type of pain.[12]

Many factors are involved in increased number of Dentinal hypersensitivity incidence, due to which no standard treatment has been available for the same. Elimination of painful symptoms resulting from the DH is directly related to reducing the fluid movement inside the dentinal canalicules[13] through the narrowing or occlusion of tubules openings.

In Conventional treatment, desensitizing agents were applied on the dentinal surface but these agents do not last for longer duration; therefore, the effectiveness is just temporary.[14,15]

Several studies describe a synergistic action of lasers in association with desensitizing agents.[16] The obliteration of dentinal tubules by laser beam-generated heat inhibits the transmission of the stimulus; which blocks the inward or outward movement of the dentinal fluid and hence reducing the sensitivity.[17]

Several authors have investigated the effectiveness of the sole diode laser for treatment of DH. In their study, Yilmaz et al. compared the effectiveness of application of diode laser and sodium fluoride in the treatment of DH. They concluded that, within the scope of their study, GaAlAs laser therapy is effective in the treatment of DH, and is a more comfortable and faster treatment than traditional treatments for DH.[18]

A meta-analysis on the type of lasers found to be effective for treating DH was summarized. The analysis indicated that erbium: yttrium-aluminum-garnet (Er:YAG), neodymium: yttrium-aluminum-garnet (Nd:YAG), and gallium-aluminum-arsenide (GaAlAs) garnet were effective in reducing DH. However, the high degree of heterogeneity required more clinical trials. In our study, GaAlA laser was used, which confirms the effectiveness of GaAlAs laser analysis done by Bader *et al.*[19]

Diode lasers can be used either by direct or indirect method in the treatment of DH. Direct method involves only laser irradiation over the area affected and indirect method involves the application of certain chemical agents followed by laser irradiation of the affected area.[20] In this study we chose the direct method of treating DH.

Diode lasers mainly work by interacting with the dental pulp thus resulting in photobiomodulating (PBM) effect, which causes an increased cellular metabolic activity of odontoblasts and intensifying tertiary dentine production, thus obliterating the dentinal tubules[21]. PBM is the application of light (usually delivered via a low power laser of light-emitting diode; LED) to promote tissue repair, reduce inflammation or induce analgesia. PBM uses the action of light and light alone to directly stimulate host cells.[22] The laser or LED devices applied in PBM typically emit in the 600-1000 nm spectrum range (red to near infrared). Other wave-lengths outside the 650-850 nm spectrum can have similar effects they do not penetrate the tissues as well as those in the red and near-infrared range. [23]When sufficient level of intensity is applied, there is inhibition of action potentials by forming reversible varicosities (bending of axons) causing approximately 30% neural blockade within 10–20 min of application.[24]Based on the results obtained in our present study, there was gradual reduction of dentinal hypersensitivity by diode laser at baseline and after 2 weeks. Considering the short sample analyzed the laser-induced superficial melting permits the tubular occlusion, thus resulting in reduction of DH-related pain. Looking at the positive results of this study a long term randomized control trial can be conducted for the conclusive remarks on the use of laser for DH.

Conclusion

Within the limitations of this study, we can say that diode laser 810 nm applications provides a significant decrease dentinal hypersensitivity following scaling and root planning after one treatment and within a 2 week follow up period.

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