Effect of Diode Laser on Sealing Ability of Dentinal Tubules – An In Vitro SEM Study

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Abstract: Background and objective: The purpose of this study was to evaluate the effect of diode laser on sealing ability of dentinal tubules in human extracted teeth with the help of Scanning Electron Microscope Method: Sixty extracted premolars were divided into two groups of 30 each. Coronal portion of all the teeth were sectioned transversely so as to expose the dentin surface and treated with ethylenediaminetetraacetic acid, to remove the smear layer. Group A served as the control group whereas Group B specimens were lased with Diode Laser and were observed under Scanning Electron Microscope. Results & Statistical Analysis: Results were obtained from SEM observations & were analysed statistically with the help of ANOVA test. Interpretation, Conclusion & Clinical Relevance: Diode laser is effective in sealing dentinal tubules and may be used in the treatment of dentinal hypersentivity. [A Oak, Natl J Integr Res Med, 2018; 9(3):48-51]

Key Words: Diode Laser, Dentinal hypersentivity, Scanning electron microscope

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Introduction: Dentinal hypersensitivity is one of the most commonly encountered clinical problems. It can be described as an exaggerated response to application of a stimulus to exposed dentine, regardless of its location[1]. Dentin hypersensitivity has been defined as a “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 form of dental defect or pathology[2]. Several theories have been proposed to explain the mechanism of dentin hypersensitivity. Currently, the hydrodynamic theory has been widely accepted, and it states that external stimuli cause movement of fluid inside dentinal tubules inwardly or outwardly, promoting mechanical deformation of nerve endings at the pulp/ dentin interface, which is transmitted as a painful sensation[3,4]. The prevalence of Dentinal Hypersensitivity has been reported ranging from 4 to 57% depending on the population samples studied. Dentinal hypersensitivity is basically due to the exposure of dentinal tubules which are normally covered by enamel and dentin hence blocking such exposed tubules is a necessary part of treatment[5,6]. Conventional therapies for Dentinal Hypersensitivity are based on the local application of desensitizing agents, either professionally or at home. The results from research regarding the effect of lasers on the treatment of dentin hypersensitivity vary. Also irradiation parameters, wavelengths, and application techniques differ for different types of laser[7]. In some studies, the dentin is irradiated at low energy densities (*4 J/cm)[8,9],with the aim of stimulating the production of tertiary dentin by the odontoblasts. On the contrary, several studies use higher energy densities in order to provoke a dentinal melting and occlude dentinal tubules, but this practice can induce significant thermal effects, if laser parameters are inadequately controlled. Studies reported that Nd:YAG, Er:YAG, CO2 and diode lasers produce an efficient desensitizing effect[10,11]; however, subsequent further research seems necessary to define the optimal irradiation conditions for harmlessness to pulp and tubule occlusion. The aim of this study was to evaluate the effect of diode laser (810 nm) on sealing ability of dentinal tubules on human extracted teeth.

Method: Sixty extracted human premolars were used in this study. Teeth were cleaned with scaler and Discs of 2-3mm thickness were cut perpendicular to long axis of teeth with the help of plaincut tungsten carbide fissure burs (Densply; Maillefer Instruments Holding Co., Ballaigues, Switzerland) at high speed under a continuous water spray. All of the discs were stored in 4 degree centigrade distilled water containing 0.2% thymol to inhibit microbial growth until use. Each specimen was dipped in 17% EDTA (Canalarge, Amdent, India) for 1 min to expose the dentinal tubules and then was rinsed with normal saline and copious distilled water. Teeth were divided into two groups of 30 each. Group A was the control group where in teeth were not subjected to laser irradiation whereas in Group B teeth were exposed to 810nm (Denlase-810, china daheng group Inc.) laser in continuous, tangential, noncontact mode at 2w power for 5 seconds. At room temperature, the specimens were dehydrated in blue silicon and attached to aluminium stubs and metallized with a layer of gold (25nm thick), using vacuum evaporation in a metallizer (model SCD 005, Bautec, Berlin, Germany). The samples were analyzed by SEM (Jeol JSM 840-A, Japan) and were observed under 500x and 1000x magnification.

Statistical analysis: Carried out using student t test with the help of SPSS software (Table 1)

Results: Scanning electron microscope analysis at 500x and 1000x of Group A samples, the control group, showed opening of dentinal tubules which was treated with EDTA and non irradiated by diode laser (Figure 1 and 2) where as those of Group B which were laser treated, showed occlusion of dentinal tubules (Figure 3 and 4)

Table 1: Effect of diode laser on dentinal Tubules

Width of Dentinal Tubules (um)		
	Mean	**Standard Deviation**
Group A	2.373	0.225
Group B	0.061	0.466
P-Value	0.001	

Figure 1: Non-irradiated group (500x)

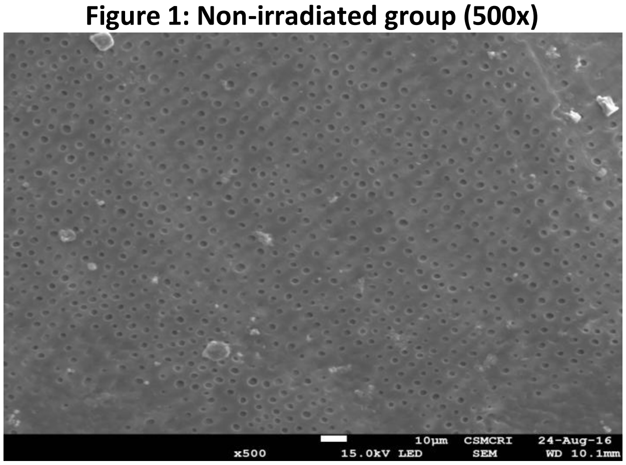


Figure 2: Non-irradiated group (1000x)

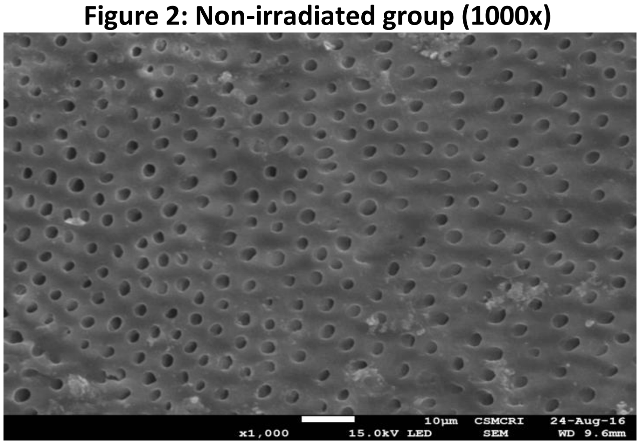


Figure 3: Laser treated group (500x)

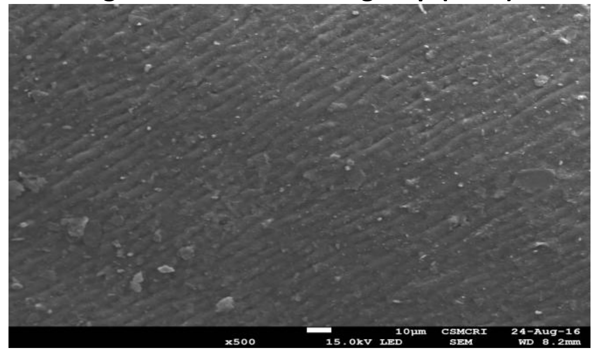
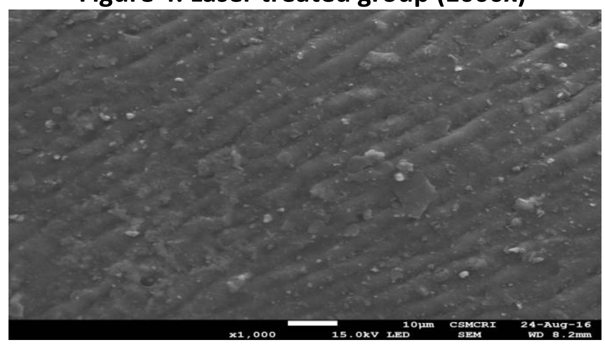


Figure 4: Laser treated group (1000x)



Discussion: Various therapies for the treatment of dentinal hypersensitivity range from topical use of desensitizing agents, either professionally or at home such as protein precipitants[12], tubule-occluding agents[13], tubule sealants[14], and, recently, lasers[15]. Diode lasers provide an abundance of available wavelengths in the visible and infrared spectrum. For this study, we selected the 810 nm wavelengths, the most commonly used wavelengths in dentistry, especially in endodontics and periodontics[7,16]. Low level output lasers are shown to have biostimulatory effect rather than causing morphological changes. It is assumed that the laser energy is transmitted to the dentine–pulp complex, interacts with the pulp tissue and causes a photo-biomodulating effect, increasing the cellular metabolic activity of the odontoblasts and obliterating the dentinal tubules by means of tertiary dentine production (Ladalardo et al. 2004; Walsh 1997)[9,17]. According to Pashley[18], there are two types of dentinal permeability: intratubular, which occurs inside the dentinal tubules, and intertubular, which is found between the tubules in the dentinal matrix. The sensitive dentine is permeable across its thickness. Hence, any treatment that reduces dentinal permeability must reduce dentinal sensitivity. Occlusion of dentinal tubules does limit dentinal hypersensitivity but it may not in some cases where hypersensitivity may be due to other causes like release of neuropeptides from activated nervous terminals hence causing neurogenic inflammation which could be self sustainable[19]. According to studies conducted by Landry and Voyer[20], there is no ideal desensitizing agent but any treatment method for dentine hypersensitivity should be effective from the first application. Also it should not irritate the pulp, soft tissue, periodontal ligament or cause pain, should be easy to apply and effective on a permanent basis. Additionally it should not discolour or stain the teeth and should have low cost. Present study which shows occlusion of dentinal tubules using low output diode laser in human extracted teeth can be a baseline for further research to establish its effect in treating dentinal hypersensitivity.

Conclusion: Results of the present study indicate that diode laser (810 nm, CW, 2w) for 5 seconds is effective in sealing dentinal tubules in human extracted teeth. Application of the same clinically warrants further research.

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