Short Communication

Tubule-Occluding Effect of Desensitizing Laser Treatment on Prepared Dentin Surfaces: An Environmental SEM Study

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Purpose: The purpose of this in vitro study was to demonstrate the dentinal tubule-occluding effect of desensitizing laser treatment on dentin surfaces using environmental scanning electron microscopy (E-SEM). ***Materials and Methods:*** Ground dentin surfaces were divided into 5 areas. Each area received a different mode of laser irradiation (low potency [LP] versus high potency [HP] and short time [ST] versus long time [LT]). Lased dentin surfaces were viewed and graded under E-SEM at ×5,000 magnification. ***Results:*** The tubule closure rates of 4 different irradiation modes were as follows: LP/LT (74%) > HP/ST (70%) > LP/ST (51%) > HP/LT (46%) > control (6%). ***Conclusion:*** It was demonstrated that desensitizing laser application was an efficient treatment option for the occlusion of dentinal tubule apertures. *Int J Prosthodont 2006;19:37–39.*

Dentinal hypersensitivity is characterized by sharp pain arising from exposed dentin in response to thermal, tactile, or chemical stimuli. The protective enamel layer can be removed by attrition from occlusal wear, abfractions, parafunctional habits, abrasive tooth brushing, erosion from acidic diet, gingival recession, or tooth preparation for conservative or restorative treatment.[1] It has been reported that any substance or technique that reduces dentinal fluid movement or dentin permeability should decrease sensitivity.[2] Considering the mechanism of action and treatment modalities, desensitizing agents may be assigned to 1 of 3 main groups[1]: *(1)* anti-inflammatories, *(2)* tubule-occlusive agents, or *(3)* those with effect on the depolarization of nerve endings. Products that promote partial or total closure of dentinal tubules, such as oxalates, resin-bonding agents, and formulations containing sodium fluoride or potassium ions, are the most commonly used desensitizing agents. These agents interfere with the hydrodynamic mechanism by acting on the exposed sensitive area so as to reduce the number of open dentinal tubules or decrease their diameter, thereby minimizing the movement of dentinal fluid.

The advent of dental lasers has introduced another option for the treatment of dentin hypersensitivity. The clinical success of laser treatment on dentin hypersensitivity is well documented.[3–5] However, there is sparse data about the tubule-occluding effect of desensitizing laser treatment on dentin surfaces in vitro. The purpose of this in vitro study was to demonstrate the dentinal tubule-occluding effect of desensitizing laser treatment on dentin surfaces by use of environmental scanning electron microscopy (E-SEM).

Materials and Methods

Ten freshly extracted intact maxillary incisors were selected and stored in neutral buffered formalin solution (Globe Scientific). The labial enamel layers of the teeth were frontally cut and removed with a parallel-sided di-

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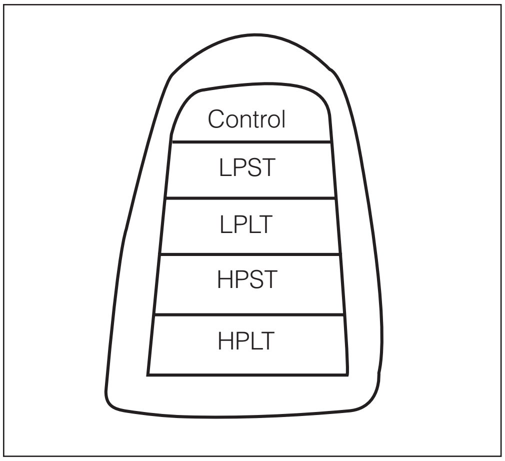

Fig 1 Application areas of different laser treatment modes on a specimen surface.

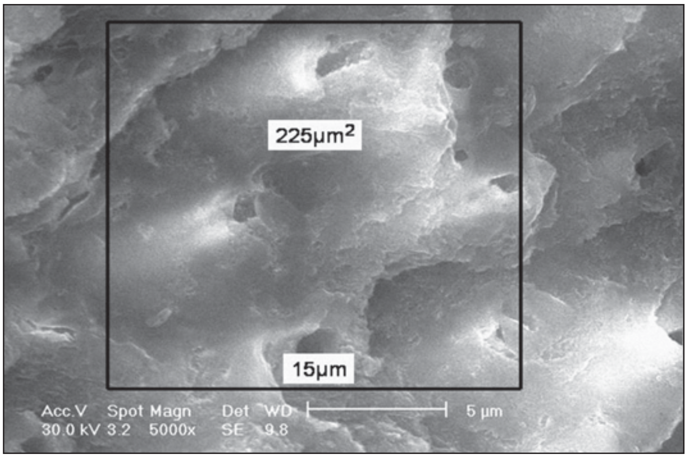

Fig 2 Open or closed dentinal tubule apertures within a selected area of 225 μm².

Table 1 Minimum, Maximum, and Mean Tubule Closure Rates and Standard Deviations of the Applied Laser Modes

Laser Mode	N	Min	Max	Mean	SD
Control	10	0	2	0.6	0.699
LP/ST	10	3	6	5.1	1.197
LP/LT	10	6	9	7.4	0.966
HP/ST	10	6	8	7.0	0.816
HP/LT	10	3	6	4.6	0.966

amond bur (Diatech Diamant) to expose the underlying dentin surface. A second parallel frontal cut was made 1 mm below the formerly obtained dentin surfaces, and 1-mm-thick dentinal sections were obtained. The dentin surfaces were manually ground with 20-μm aluminum oxide (AlO2) grit papers under flowing water for 30 s to obtain standardized smooth dentin surfaces. The ground surfaces were then rinsed with a hot water-spraying apparatus (Triton SL, BEGO) for 30 s and the specimens were ultrasonically cleaned (Eurosonic E4D, Euronda) for 1 h. The specimen surfaces were divided into 5 equally sized test areas (Fig 1). Control areas were left unlased. The low-potency/short-time irradiation areas (LP/ST) were lased at 0.5 W potency for 15 s. The low-potency/long-time irradiation areas (LP/LT) were lased at 0.5 W potency for 30 s. The high-potency/short-time irradiation areas (HP/ST) were lased at 0.75 W potency for 15 s. The high-potency/long-time irradiation areas (HP/LT) were lased at 0.75 W potency for 30 s.

An ErCr:Waterlase yttrium-scandium-gallium-garnet laser (Biolase) was used for irradiation of the specimens. The laser probe was positioned at 1 cm away from and at a 90-degree angle to the ground dentin surfaces. The laser was applied at 10 Hz frequency, with 50 mJ/pulse energy, without air or water spray, in accordance with the instructions of the manufacturer.

The lased dentin surfaces were then viewed under an E-SEM (×L30 ESEM-FEG, FEI Company/Philips) at ×5,000 magnification. Images obtained from each divided area of the dentin specimen surfaces were obtained. Open or closed dentinal tubule apertures of each test area were counted using a specially designed micrometric chart (Fig 2) drawn on the recorded images, within an area of 225 μm².

The recorded data were analyzed with a statistical software program (SPSSFW, 9.0; SPSS). The Friedman test and Wilcoxon signed rank test (with Bonferroni correction) were used to demonstrate differences between the 4 different laser application modes. All statistical tests were performed at the 0.95 confidence level ($\alpha = .05$).

Results

Minimum, maximum, and mean tubule closure rates of 4 different laser modes, along with standard deviations, are presented in Table 1. All lased areas were significantly different from the unlased control areas (chi-squared = 37.563; $P < .001$). The tubule closure rates of the 4 different laser modes were as follows: LP/LT (74%) > HP/ST (70%) > LP/ST (51%) > HP/LT (46%) > control (6%). Differences between the test groups were significant, except for LP/LT and HP/ST ($P < .157$).

Conclusion

Within the limitations of this study, it can be deduced that application of a desensitizing laser may be an efficient treatment option for the occlusion of dentinal tubule apertures. LP/LT irradiation (74%) and HP/ST irradiation (70%) were found to be the most effective treatment modalities for dentinal tubule occlusion.

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Literature Abstract

Does platelet-rich plasma promote remodeling of autologous bone grafts used for augmentation of the maxillary sinus floor?

The aim of this study was to evaluate the effect of platelet-rich plasma (PRP) on remodeling of autologous bone grafts used for augmentation of the floor of the maxillary sinus. Five edentulous patients suffering from insufficient retention of their upper denture related to a severely resorbed maxilla were included in this study. The inclusion criteria besides a severely resorbed maxilla (Classes v-VI, Cawood & Howell 1991) were: *(1)* comparable bone height between maxillary sinus and top of the maxilla on both sides, *(2)* Class IV bone quality (Lekholm & Zarb 1985), *(3)* edentulous for at least 1 year, *(4)* no history of radiotherapy, and *(5)* no history of reconstructive or preprosthetic surgery. The floor of both maxillary sinuses was augmented with an autologous bone graft from the iliac crest. Randomly, PRP was added to the bone graft used to augment the floor of the left or right sinus (split-mouth design). Blood test was taken before application of PRP, immediately after application and 24 hours later to rule out the possibility of a systemic elevation of TGF-ß. Three months after the reconstruction, bone biopsies were taken with a trephine from the planned implant sites (n = 30). Subsequently, 3 implants were placed in the left and right posterior maxilla. Microradiograms were made of all biopsies (n = 30), whereafter the biopsies were processed for light microscopic examination. In addition, clinical parameters were scored. Wound healing was uneventful, clinically no difference was observed between the side treated with PRP or not. Also microradiographical and histomorphological examination of the biopsies revealed no statistical difference between the PRP- and non-PRP side. One implant placed in the PRP side of the graft was lost during the healing phase. Implant-retained overdentures were fabricated 6 months after implantation. All patients functioned well (follow-up 20.2 ± 4.3 months). In this study, no beneficial effect of PRP on wound healing and bone remodeling was observed. It is posed that PRP has no additional value in promoting healing of grafted non-critical size defects.

Raghoebar GM, Schortinghuis J, Liem RSB, Ruben JL, van der Wal JE, Vissink A. *Clin Oral Implants Res* 2005;16:349–356. **References**: 26. **Reprints**: Dr GM Raghoebar, Dept of Oral and Maxillofacial Prosthetics, University Hospital Groningen, PO Box 30.001, 9700 RB Groningen, The Netherlands. Fax: +31 50 3611161. E-mail: g.m.raghoebar@kchir.azg.nl—*Tee-Khin Neo, Singapore*