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Research Article

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Comparing the effect of a desensitizing material and a self-etch adhesive on dentin sensitivity after periodontal surgery: a randomized clinical trial

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Conflict of Interest
No potential conflict of interest relevant to this article was reported.

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ABSTRACT

Objectives: This double-blind randomized placebo-controlled clinical trial evaluated the ability of a desensitizing agent and a self-etch adhesive on cervical dentin sensitivity (CDS) after periodontal surgery.
Materials and Methods: Ninety hypersensitive teeth of 13 subjects were included in the study. After periodontal surgery, the teeth of each posterior sextant treated with one of the following materials: G1: Clearfil S^3 Bond (Kuraray Dental), G2: Gluma Desensitizer (Heraeus Kulzer), and G3: placebo (water). The sensitivity was assessed using evaporative stimuli before treatment (baseline, T0), 1 day after treatment (T1), after 1 week (T2), and 1 month (T3) according to visual analog scale (VAS).
Results: Following the treatment, all the 3 groups showed significant reduction of CDS in T1 compared to T0. Reduction of CDS between T1 and T2 was observed only in G1 but there was no significant difference between T2 and T3 in this group. Although we observed a significant difference in T3 compared to T1 and T2 in G2 and G3, comparison of treatment groups in each assessment time showed a significant difference only in T3. According to paired comparison, this was due to the difference between G2 and G3.
Conclusions: Dentin sensitivity following periodontal surgery will decrease spontaneously over time, but treating the sensitive teeth with Gluma Desensitizer and Clearfil S^3 Bond can have some benefits.

Keywords: Cervical dentin sensitivity; Desensitizing agent; Gluma desensitizer; Periodontal surgery; Self-etch adhesive; Visual analogue scale

INTRODUCTION

Cervical dentin sensitivity (CDS) is one of the most common painful conditions affecting oral comfort and function and can be defined as a painful symptom of the exposed dentin in response to chemical, thermal, tactile or osmotic stimuli which cannot be explained by any other dental defect or pathology [1,2]. The occurrence of CDS ranges from 3 up to 98%. This vast range can be explained by the differences in the selection criteria for the study sample

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and also the variety in diagnostic approaches or time frames. Women are slightly more affected than men with an age peak of 30 to 40 years [3]. Exposure of root surface by loss of the overlying cementum and periodontal tissues is one of the most common etiological factors related to CDS [4].

The most widely accepted explanation for tooth sensitivity is Brännström and Åström's hydrodynamic theory [5]. According to this theory, the exogenous stimuli applied to the exposed dentinal tubules result in the flow of dentinal tubular fluid, activate the intratubular nerve endings, and create pain. The number, size, and diameter of the open dentinal tubules are important factors that determine the degree of hypersensitivity in the subjects [6]. Recently, two strategies are used for the treatment of CDS. One is occluding the dentine tubules and the other is interfering with the sensitivity of the mechanoreceptors [7]. A variety of products have been developed with the aim of alleviating the discomfort arising from the CDS [8].

Some researchers believe that self-etch adhesives can reduce dentin sensitivity by decreasing dentin permeability [9,10] due to production of an acid-resistant hybrid layer [11]. This acid-base resistance zone may result in longer lasting clinical effectiveness. Yu *et al.* [12] showed that the one-bottle self-etching adhesives and dentin desensitizers could significantly relieve CDS (which was not due to periodontal surgery) immediately and over the course of a month after treatment.

The aim of the current clinical study was to compare the clinical effectiveness of a dentin desensitizer, a one-bottle self-etching adhesive, and a placebo for CDS treatment after periodontal surgery and the null hypotheses of the present study was that all three methods have the same clinical effectiveness at different interval times.

MATERIALS AND METHODS

According to the study of Yu *et al.* [12], 14 patients who were planned to undergo surgical periodontal treatment in at least three posterior sextants were recruited into this randomized, double-blinded, placebo-controlled, split-mouth study.

These patients were referred to the Department of Restorative and Cosmetic Dentistry of Mashhad University of Medical Sciences for desensitizing treatment if they had complained about CDS after removing the periodontal pack of the first sextant. Participants were given a brief explanation about the investigation and all consented to participate and signed a consent form approved by the Committee on Ethics in Research, Mashhad University of Medical Sciences. This trial was registered at: http://www.IRCT.ir and its identification number is IRCT201408176267N2.

The inclusion and exclusion criteria are stated in **Figure 1**.

All the patients had moderate to severe chronic periodontitis. This means that all of them had more than 4 mm attachment loss and more than 5 mm periodontal pockets, so all of them needed periodontal surgery which was contained flap debridement, scaling and root planning and respective osseous surgery as needed, suturing, and covering the area with dressing. Generally, patients with periodontal diseases suffer from some degrees of dental

Inclusion criteria	Exclusion criteria
• Patients with cervical tooth sensitivity after periodontal surgery • Patients aged between 20–65 years • Patients agreed to participate in the study	• Patients receiving professional desensitizing therapy during the previous 3 months • Using desensitizing toothpaste in the last 6 weeks • Pregnant or lactating women • Teeth with ICDAS score ≥ 4 • Root-filled teeth • Crowned teeth • Teeth with cervical restorations interfering with the evaluation

Figure 1. Inclusion and exclusion criteria.
ICDAS, International Caries Detection and Assessment System.

hypersensitivity which usually increases after scaling and root planning or periodontal surgery. Because the periodontal pack was removed between 1 to 2 weeks after the surgery, the first treatment session was scheduled 10–20 days after the surgery of the first sextant.

A total of 96 teeth with CDS after periodontal surgery were considered suitable for the study and the rate of sensitivity to the cold air stimulation was recorded at baseline (T0) for each tooth according to visual analog scale (VAS). To produce the stimuli, 2-second air blast (45 psi, 19°C–24°C) was applied using an air syringe held 2 mm away, and perpendicular to the tooth surface whilst shielding adjacent teeth with the operator's fingers. In this step only teeth with VAS score of 4 and more (teeth with moderate to severe sensitivity) were selected for study. In order to avoid bias, each sextant was randomly allocated to one of 3 treatment groups by choosing an envelope containing the order of treatment options which were placebo (distilled water), Gluma Desensitizer (Heraeus Kulzer, Hanau, Germany), and Clearfil S^3 Bond (Kuraray Dental, Okayama, Japan). The teeth of the different sextants received different treatment and the adjacent teeth received the same material. By using a split mouth study design, three study groups, had the advantages of similar pain perception, oral hygiene habits, dietary habits, and psychosomatic factors in the same patient. Allocating the samples in each group is showed in **Figure 2**.

Clinical procedure

After anesthetizing each sextant, the teeth were cleaned very gently using cotton swap, microbrush, and supper floss. The area was isolated with cotton rolls and the selected

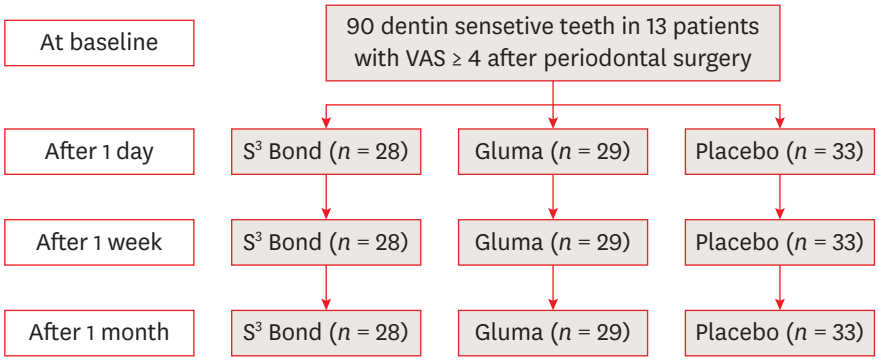

Figure 2. Flowchart of allocating the samples in each group.
VAS, visual analog scale.

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material was applied basically according to the manufacture's instruction. In the first group (G1, $n = 28$), the self-etch adhesive, Clearfil S^3 Bond was applied for 20 seconds, dried with high-pressure air flow for 5 seconds and light cured for 10 seconds according to manufacture. Then in order to assimilate with the Gluma material, the area was rinsed with water. In the second group (G2, $n = 29$), Gluma Desensitizer was applied for 30–60 seconds on the sensitive area, the solvent evaporated gently, then, the tip of an off light cure unit was positioned on the area for 10 seconds in order to assimilate with adhesive group, so, the patient remained blind about the treatment procedure. Finally, the area was rinsed with water. In the third group (G3, $n = 33$), the placebo (distilled water) was applied the same as Gluma Desensitizer. All subjects were instructed not to brush their teeth, eat, drink or rinse their mouth for at least 2 hours after each treatment.

Clinical evaluation

A clinical evaluation of each tooth was assessed by another investigator who was not involved with the treatment procedure. Air stimulation response measurement was done via VAS as the baseline evaluation (T0) and data were collected on each tooth, 1 day (T1), 1 week (T2), and 1 month after treatment (T3). The same examiner calculated the total VAS score of each study group at each follow-up time from the mean of the VAS scores of all the treated teeth of every subject in the same group.

Statistical analysis

All the data were analyzed using the SPSS software package (version 16.0, SPSS Inc., Chicago, IL, USA). The normality of the data was checked using Kolmogorov-Smirnov test. Repeated measurement analysis assessed the interaction of follow-up time and treatment group. Hotelling's Trace test was used to analyze the efficacy of all the materials in each of the follow-up times. Analysis of variance (ANOVA) test followed by Tukey test as its *post hoc* was used to assess each material in different investigation times (baseline, 1 day, 1 week, and 1 month after treatment). The level of significance was set at $\alpha = 0.05$.

RESULTS

At the beginning of the survey, 6 males and 8 females between the ages of 20 and 65 years recruited in the study but one of the patients excluded, because all his teeth in the last sextant undergone surgery showed VAS scores less than 4, so we had not 3 sensitive sextants to treat. Therefore, a total of 52 premolars and 38 molars remained in the three study groups.

First, the normality of the data was confirmed with Kolmogorov-Smirnov test. There was no significant difference between all groups in base line sensitivity ($p = 0.83$).

Repeated measurement analysis considering follow-up time and treatment group showed the interaction of this 2 variables. So, Hotelling's Trace test showed a significant difference between all assessment times in all 3 groups. Therefore, paired comparison of groups according to the assessment times was done. The results have been shown in **Table 1**.

ANOVA test was used to assess each treatment group in different investigation times (baseline, 1 day, 1 week, and 1 month after treatment). The results of this test showed a significant difference only in the last follow-up time (T3, $p = 0.029$). Accordingly, Tukey test was used for paired comparison of treatment groups in the last follow-up time and showed a

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Table 1. Mean visual analog scale (VAS) scores for each treatment group within each assessment time

Material	Baseline (T0)	One day (T1)	One week (T2)	One month (T3)
S³ Bond (G1)	5.38 ± 1.62^{Aa}	3.70 ± 1.97^{Ab}	3.10 ± 1.67^{Ac}	2.46 ± 1.10^{ABc}
Gluma Desensitizer (G2)	5.15 ± 1.39^{Aa}	2.92 ± 1.37^{Ab}	2.42 ± 1.46^{Ab}	1.57 ± 0.84^{Ac}
Placebo (G3)	5.06 ± 1.19^{Aa}	4.24 ± 1.63^{Ab}	3.65 ± 1.74^{Ab}	2.78 ± 1.40^{Bc}

The data were presented as mean ± standard deviation.
Same superscript letter indicates no significant differences between groups as per the results of pairwise multiple comparisons ($p < 0.05$). Lowercase superscripts denote differences in each row (horizontal). Uppercase superscripts denote differences in each column (vertical).

significant difference between G2 and G3 ($p < 0.05$).

DISCUSSION

The current clinical study tried to compare the clinical effectiveness of Gluma Desensitizer, Clearfil S³ Bond (one-bottle self-etching adhesive), and placebo (distilled water) for CDS treatment after periodontal surgery in different evaluation times by using VAS. Several studies noted that the patient may encounter abrupt and severe dentin sensitivity after periodontal therapies [13,14]. Also, the occurrence and severity of CDS directly depend on the type of periodontal treatment and are greater after surgical procedures [15]. The main reason for sensitivity is exposing dentinal tubules to the oral environment [16]. Thus, the basis of most desensitizing treatments is to block these tubules.

To date, only few studies have evaluated the effect of dentin bonding agents in reducing CDS [17-21]. Even these studies rarely assessed all-in-one adhesives and CDS following periodontal surgery [12,22]. The results of this study showed that in the group treated with Clearfil S³ Bond, CDS values reduced 1 day after treatment and the reduction continued for 1 week after treatment. This may be due to the concurrent effect of natural tubule blocking factors over time and blocking effect of adhesive material. According to microscopic findings, topical application of these adhesives on the sensitive dentinal areas resulted in occlusion of the patent tubules and produced an acid-base resistant hybrid layer on the dentin surface [23]. This acid-base resistant zone is a combination of dentin and the adjacent hybrid layer. Since this layer is mechanically, chemically, and biologically more resistant than normal dentin, it is also called 'Super Dentin' [23]. One of the functional monomers with the ability to create Super Dentin is 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) [24]. Clearfil S³ Bond contains 10-MDP.

On the other hand, Yu *et al.* [12] showed that some occluded dentinal tubules partly reopened 1 month after treatment and so some sensitivity returned after 1 month. The reason might be the fact that all-in-one adhesives contain mixtures of more hydrophilic monomers, and thus, are permeable to water after application to the dentinal surface [9]. However, our study showed reduction of CDS over time after applying Clearfil S³ Bond. It seems that time factor could add some positive effect during 1 month.

According to this study, as there were significant difference between T1 and T2 with T3, Gluma can reduce CDS 1 day after treatment. Moreover, gradual reduction of CDS happened in this treatment group over the investigation period. These results are consistent with the results of other studies, which have shown the same reduction [12,22,25,26]. It has been noted that the effect of Gluma (5% glutaraldehyde and 35% hydroxyethyl methacrylate [HEMA] marketed as Gluma Desitizer) as a desensitizer to block

dentinal tubules occurs through 2 mechanisms: first, through denaturation of dentinal fluid proteins by glutaraldehyde and second, through polymerization of HEMA. Both of them result in decrease in dentin permeability [27].

The present study showed that placebo can significantly reduce CDS one day after treatment. Patient's supposition of receiving a treatment can be effective on decreasing CDS, because pain is a subjective phenomenon. This mechanism is undeniable and is shown by many investigations. Therefore, the efficacy of placebo in one day after treatment can be explained by its psychological effects [12,18,22]. Additionally, the mean of VAS in placebo group decreased gradually over time. This is not in line with the results of the study by Yu *et al.* [12], which showed that some of the CDS will return during one month. This difference may be explained by the various conditions of studies. The present study was implemented on CDS following periodontal surgery, but in the study by Yu *et al.* [12], it was performed on sensitive teeth which did not passed any surgical procedure. Therefore, in this study, cervical dentin had been suddenly exposed to oral environment and the natural factors such as saliva protein precipitation, smear layer formation, and remineralization, did not have enough time to block tubules and decrease CDS. While, in the study by Yu *et al.* [12], cervical dentin have been exposed to oral environment for long a time and those natural processes would not meet any additional effect even if they had more time. Studies have shown that some natural factors, can decrease dentin permeability and therefore decrease CDS over time [28-30].

This study noted that Gluma was the most effective and placebo the least effective treatment of CDS among three groups in the last follow up time. The effectiveness of Gluma may be due to its dual effect of HEMA and glutaraldehyde. Since Gluma has low viscosity and does not need light curing, it is more user-friendly and less technique sensitive than Clearfil S^3 Bond, especially in interproximal areas. Also, our investigation showed that the effectiveness of Clearfil S^3 Bond is the same as Gluma and placebo in 1 day and 1 week follow-up times and have significant difference with Gluma after 1 month. Since this adhesive affects CDS reduction only by polymerization into the dentinal tubules, it seems that it can merely meet just one of the action mechanisms of Gluma Desensitizer. The problem of not being sure of the successful light curing of resin in more difficult accessible areas might also reduce its effectiveness in CDS treatment. Although, the all-in-one adhesive tested in the current study did not perform better than the dentin desensitizer, but it could reduce the CDS to some degree.

CONCLUSIONS

According to the limitations of this study, it was shown that also dentin sensitivity following periodontal surgery will decrease spontaneously over time, but treating the sensitive teeth with Gluma Desensitizer and Clearfil S^3 Bond can have some benefits.

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