Results of White Spot Lesion Treatment after Orthodontic Treatments

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Abstract

Purpose: The aim of this study was to evaluate the quantity of enamel loss after microabrasion treatment in different severity of white spot lesions resulting from orthodontic treatment.

Materials and Methods: Forty-five recently extracted caries-free human upper premolar were collected. White spot lesions (WSLs) were formed, considering the severity of the decalcification using an artificial caries solution. According to this, lesions were scored and 3 groups were established, Group 1: mild lesion, Group 2: severe lesion, and Group 3: cavitation lesion. Microabrasion was applied only distobuccal side of the teeth. The other side were used as control. Each specimen picture was captured with a stereo microscope and its’ camera. The axiovision software was used to measure the depth of the demineralization in micrometer. Scanning electron microscope (SEM) images were taken after the microabrasion application.

Results: The highest enamel wear was 304.44 µm ± 72.61 µm found in cavitation group after microabrasion. In the microabrasion side there was no differences between mild and severe groups. Whereas cavitation group was found statistical significance due to increased enamel wear depth after microabrasion (p<0.001).

Conclusion: This study quantitatively prove that microabrasion technique is a conservative treatment with a satisfactory outcome for mild and severe WSLs.

Keywords: White spot lesion; Microabrasion; Enamel loss

Introduction

White spot lesions affect many orthodontic patients who don’t care oral hygiene and preventive advices during orthodontic treatment. The presence of fixed orthodontic appliances for a long period further affects oral hygiene and makes the cleaning of teeth more difficult. Hence, accumulation of plaque around brackets and bands increases, which causes enamel demineralization [1].

Different methods for treatment of WSLs were stated in the literature. Restorative treatments are the conventional approach for treating white spot lesions; however, this technique has the disadvantage of being invasive [1]. One of WSLs treatment is microabrasion which was advocated as a conservative technique in recent years. This technique is performed utilizing an association of an erosive and abrasive agent, applied mechanically using a low rotation hand piece [2,3]. It was first used by composed of 18% hydrochloric acid (HCL) and pumice [4]. Since its introduction there have been various approaches [5-7].

A sub layer of enamel with normal characteristics is exposed due to erosive and abrasive effects by this method. That is to say, microabrasion could cause to enamel loss due to purpose is to remove staining and produce a glasslike luster, an exceptionally smooth texture [8].

It has been reported that different factors as the number of applications, pressure and time has an increasing effect on enamel wear during microabrasion [9]. A few studies have evaluated the amount of enamel loss after microabrasion treatment [10,11]. However teeth without caries or WSL were used in those studies.

The aim of this study was to evaluate the results which is enamel loss quantity after microabrasion in different severity of white spot lesions.

Materials and Methods

Specimen preparation

Recently 45 extracted caries-free human upper premolar were collected. Teeth that had
restoration, white spots, demineralization areas, fractures, abrasions, or microcracks were eliminated from the sample. The teeth were cleaned and disinfected, stored in 0.1% aqueous thymol solution and used within a month. All sample were embedded in a resin block with wax to expose the labial surface. After cleaning with water, the exposed tooth surface was polished with nonfluoride pumice with a rubber cup for 10 s, rinsed with water, and dried with compressed air. All teeth surfaces, except the experimental mesiobuccal surfaces, were covered with wax (Figure 1). The teeth were stored in artificial saliva solution consisting of 20 mmol/L of NaHCO₃, 3 mmol/L of NaH₂PO₄, and 1 mmol/L of CaCl₂ at room temperature, neutral pH, and constant circulation. This solution was changed every other day during the experiment, and each group was cycled in a separate beaker of solution throughout the experiment. All teeth were kept in artificial saliva solution for 12 h before initial exposure to the artificial caries solution to simulate clinical condition. The following day, cycling between artificial saliva and artificial caries challenge solutions began. Teeth were cycled between artificial saliva and artificial caries challenge for 37 days.

All teeth were subjected to an artificial caries solution consisting of 2.2 mmol/L of Ca²⁺, 2.2 mmol/L of PO₄⁻, 50 mmol/L of acetic acid at pH 4.4, room temperature, and constant circulation for 1 h, two times daily. After cycling between artificial saliva and artificial caries, the teeth were dried thoroughly and evaluated for erosion with naked eye. This procedure continued until the desired lesions were established in each tooth. The lesions were scored according to Gorelick et al. [12] and grouped as mild, severe and cavitation levels (Figure 2) [13].

**Microabrasion mixture**

Abrasive gel was prepared with 18% hydrochloric acid (Ak-Kim, Izmit, Turkey), fine powdered pumice and glycerin. The ingredients were mixed in a glass container, using a 2:1 ratio of powder to acid by weight, then small amounts of glycerin were added until the mixture became a fluid gel consistency.

**Application**

Microabrasion was applied only distobuccal side of the teeth. The other side were used as control. Groups was conducted as 3 main groups (each 15 teeth) with 3 sub-groups depend on severity of lesion; microabrasion groups (M1: mild lesion, M2: severe lesion, M3: cavitation), control groups (C1: mild lesion, C2: severe lesion, C3: cavitation).

All procedure was applied by one investigator to avoid pressure differences during microabrasion (IEG). The mixture was applied by an electric toothbrush that modified by cutting peripheral bristles to create a smaller brush tip for a better fit on the tooth surfaces (Braun Oral-B Plak Control 3D; Braun, Kronberg, Germany). The toothbrush were used at a low speed and procedure was done for 3 times and three-minutes to each teeth. The teeth were rinsed for 1 min. After 37 days, each crown was cut on a mesiodistal line from
occlusal to cervical with the same disk (Batch No. 0976, S.S. White Limited, Harrow, England), and the buccal surfaces were retained for the study.

**Enamel loss evaluation**

The wax was removed from the surfaces with a plastic excavator gently. Teeth were sectioned into two halves buccopalatinally through the middle of the lesion with a low speed diamond saw (Isomet 1000, Buehler, Lake Bluff, IL, USA) under continuous water coolant. Each specimen picture was captured with a stereo microscope and its’camera (Axio Imager. A2 and Axiocam 105 color, Carl Zeiss Microscopy LLC, NY, US). Microphotographs were taken from the mesiobuccal and distobuccal parts of both lesion and intact enamel on same regions of the crown. The cervical and middle third of the distal crown was the area where the lesion was treated with microabrasion technique, and the cervical and middle third of the mesial crown was the area where lesion was not treated. The axiovison 4.8.2 software (Carl Zeiss Microscopy LLC, NY, US) was used to measure the depth of the demineralization in micrometer (Figures 3-5). SEM (MK III, Cambridge Stereoscan) images were taken after the microabration application in all groups (Figures 6-8).

**Statistical analysis**

Data were analyzed with statistical analysis computer software (Statistical Package for the Social Sciences (SPSS) 15.0 for Windows, SPSS Inc, Chicago, IL, USA). Ten randomly selected teeth were used for method error (ME) analysis calculated by Dahlberg’s formula, $ME = \sqrt{\frac{\sum d^2}{2n}}$, where $d$ was the difference between the two measurements of a pair and $n$ was the number of double measurements. ME was 0.283. Kolmogorov-Smirnov test showed normal distribution of the data. One-way ANOVA used with Post-Hoc Tukey test for comparison of the groups. T-test was performed to analyze the differences between microabrasion and control group measurements for each subgroup.

**Results**

The mean values for enamel wear depth (µm) in all groups are shown in Table 1. The highest enamel wear was 304.44 µm ± 72.61 µm found in M3. There was no differences between M1 and M2 whereas M3 was found statistical significance due to increased enamel wear depth after microabrasion. C1 and C3 groups has similar enamel wear depth whereas C2 has some lower degree. One-way ANOVA indicate significant difference among groups after microabrasion, according to Post-Hoc Tukey test, M3 was significantly different. There was a difference between C2 and C3 but it was border of the significance (p=0.49). Microabrasion was applied to only one side of the teeth in this study. It was seen that enamel prism free region and a smoother surface was obtain. SEM images demonstrate that the tooth surfaces were significantly smoother when compared to their initial situations in all WSLs groups (Figure 6 and 7). However in the cavitation group still microcavity was observed (Figure 8).

**Discussion**

Several studies have evaluated the possible effects of mechanical and chemical agents on enamel. Microabrasion is one of the treatment alternative for WSL that cause enamel wear due to erosive and abrasive effects [14]. Amount of enamel wear during microabrasion has to be taken into consideration and investigated in the literature [15]. Nevertheless recent studies show that the technique is a conservative treatment alternative when the enamel wear is minimal and clinically imperceptible. Barely to our knowledge, non-caries teeth were used in all studies that reported enamel wear results after microabrasion. Enamel wear amounts could be different after microabrasion in the teeth with WSLs due to slightly softer areas in surrounding enamel surfaces. In this *in vitro* study, enamel wear were measured in the teeth with different severity of WSLs after microabrasion.

Microabrasion demonstrated successfull results in the mild and severe WSLs. Also enamel wear were within acceptable amount as 106.66 µm in mild and 124.44 µm in severe microabrasion groups. Microabrasion procedure were recommended for treating superficial enamel discoloration to a maximum depth of 100 µm [16]. Premolar
buccal surface enamel thickness were measured as approximately 1 mm in different populations [17]. According to this study results, it was considered as safe and conservative method that 10% of the enamel thickness reduces after microabrasive treatment for mild and severe WSLs. Amount of enamel wear were showed significantly higher results in all groups of microabrasion groups comparison with control groups. However enamel wear was low enough to ignore the difference in the mild and severe groups. Enamel was demineralized but still enamel surface was intact in the mild and severe after microabrasion treatment. This could be the reason to obtain similar results between microabrasion and control for non cavitated groups. Similar results were reported about enamel wear after microabrasion with HCL and pumice products [18]. Meireles reported 94.6 µm enamel wear. However increased amount of enamel wear (139 µm and 386 µm) was notified in the literature [19]. The potential erosive and abrasive effects depend on several parameters as force applied and revolutions per minute [20]. This difference is probably the result of different application method of microabrasion. Effect of number of applications and pressure can effectively influence the amount of enamel loss during microabrasion. Sundfeld reported 25 µm and 140 µm enamel wear after 3 and 15 applications, respectively. In this study 3 min application was done to all samples. This application duration was higher when compared to previous studies. However application duration was not increased the quantity of enamel and similar results that were obtain in this study. Enamel loss due to WSLs in the cavitation group was measured as 113.33 µm without any treatment, whereas microabrasion in the cavitation group enamel loss is approximately three-fold more (304.44 µm). Increased enamel loss was foreseen due to softer enamel could be removed easily. Barely, the most important factor contributing to the success of enamel microabrasion is the depth of the defect. Less enamel loss could be seen in a very beginning of cavities. For this reason “microabrasion technique is not proper treatment alternative for WSLs with cavitation” can not be implied as an outcome of this study. But a special care has to be taken for patients with cavitated WSLs. The clinical significance of the present study is that removing the enamel surface by microabrasion seems to be sufficient to flatten lesion as previous studies. The technique could provide a conservative alternative for some patients who might otherwise have received porcelain or composite resin veneer restorations.

Conclusion

This study show that microabrasion is a conservative treatment with a satisfactory outcome for mild and severe WSLs. However application requires special care has due to approximately 1/3 thickness of enamel loss was found in cavitated WSLs group.

References