

ORIGINAL RESEARCH

Influence of Standard Load Micro- and Nanopatterned in Surface Roughness of bleached Teeth and submitted to Different Surface Treatments

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ABSTRACT

The aim of this study was evaluate the dental enamel after whitening treatment with Opalescence Boost PF™ 38%, correlating the structural alterations in the surface of the enamel with its respective pH and verify if whitened teeth submitted to different finishing and polishing techniques show similar surface texture to healthy teeth (control group). Sixty premolars were divided in 6 groups (n = 10), which had been immersed in artificial saliva during all the experiment. Protocol whitening was performed according to the manufacturer recommendations, and then the specimens were submitted to different polishing technique with Sof-Lex Pop On™ disks, Flex Diamond™ felt disks using two different micrometric polishing pastes (Enamelize™ and Diamond Polish™) and two nanometric polishing pastes (Lummina-E Diamond and Lummina-E Alumina), according to the groups. Representative specimens were analyzed in scanning electronic microscopy (SEM). Whitening gel used in this experiment had modified the morphologic aspect of the enamel surface. It was found that two nanometric polishing pastes (G5 and G6) promoted a less rough surface compared to control group even after the whitening process.

Keywords: Dental enamel, Bleaching, Surface properties, Polishing.

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INTRODUCTION

Color changes in teeth can be resulting from intrinsic factors coming from congenital causes named fluorosis, enamel hypoplasia, dentinogenesis imperfecta or extrinsic factors, such as smoking, chromogenic substances derived from the diet and other.¹ To satisfy the expectations of the patient, conservative techniques is preferably indicated with treatments that no require wear on tooth structure, as well as whitening based on hydrogen peroxide or carbamide peroxide, which action mechanism is a reaction by oxidation resulting in fractionation of pigment particles,^{2,3} and uniform whitening of tooth structure.

Indications are according to the techniques and concentration, where it attends the individual needs of each patient.^{4,5} In-office technique is able to whiten teeth faster providing immediate results without the cooperation of the patient, however, high concentration products are required.⁶ At-home technique is necessary to have the discipline of the patient to follow the guidelines for the application and its correct use to achieve satisfactory results.⁷

Due to the intimate contact of the chemical composition of the whitening gel with the tooth surface, it is reported increases porosity and permeability of the enamel,⁸ reducing the resistance to fracture. The surface micromorphology is affected to different degrees, depending on the composition, concentration, time of application and pH of the gel.^{4,9}

Polishing with abrasive disks and polishing pastes can soften the effects caused by whitening on the enamel, where the association of microparticles and the mechanical friction obliterating the depressions and complicating the accumulate plaque, restoring the inherent characteristics of enamel.^{10,14}

Thus, knowing that the surface texture of the teeth after whitening show morphological changes, the aim of this study is evaluate two nanometer standard pastes

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and check the possibility of returning the original surface characteristics of whitened tooth.

MATERIALS AND METHODS

Sixty healthy human premolars were selected and stored in saline solution until the beginning of the study. The root of the teeth were included in acrylic resin in PVC mold of 2.5 cm diameter and 2 cm in height. The specimens were randomly divided into 6 groups (n = 10) (Table 1).

The teeth in groups 2 to 6 were covered by thin layer of 2 mm thickness of 38% hydrogen peroxide (Opalescence Boost PF™, Ultradent Products Inc, Salt Lake City, UT, USA).

Measurement of pH

Hydrogen potential (pH) of the whitening gel was measured by standardized system (Labmeter digital pH meter, pH 2 model, Serial N° 02639) before to the whitening treatment, according to Table 2.

Protocols for Surface Treatment

System of polishing abrasive disks and two abrasive polishers pastes associated with a felt disk were selected for the polishing. According with the group, samples

received surface treatment with different polishing systems after whitening technique described in Table 3.

Specimens (G3 to G6) were finished with abrasive disks (Sof-Lex Pop On™ —3M ESPE) for 30 seconds. Among the disks, the specimens were rinsed with air/water spray to remove residues. After finishing procedure, the specimens were submitted for polishing. The polishing pastes were employed using Flex Diamond™ felt disks with intermittent movements during 30 seconds.

When the bleaching treatment and polishing were completed, the specimens were sectioned longitudinally and in your cervical limit, so from obtaining the buccal surface as initially performed in preparation of the samples. Then the tooth portions were submitted to Denton Vacuum metal deposition (Desk Model III) for reading on a scanning electron microscope (SEM) system—JEOL™ (Model JSM—6380LV) in standard increases (1000×).

The criterious for analysis of images performed by SEM was based on the classification of structural changes on the enamel surface, presence of erosions and porosities, as well as the surface texture after finishing and polishing of the experimental groups.

RESULTS

Group 1 (Control—Artificial Saliva)

Morphology of enamel presented with irregular surface formed by undulations of the ridges and grooves characteristic of nonprismatic enamel. It can be viewed surfaces with large fissures and grooves as a result of physiological abrasion of toothbrushing (Fig. 1).

Table 1: Experimental groups

Groups	Whitening gel
1.	Control—Artificial Saliva
2.	Opalescence Boost PF™ 38%
3.	Opalescence Boost PF™ 38% + Sof-Lex Pop On™ + Diamond Polish™
4.	Opalescence Boost PF™ 38% + Sof-Lex Pop On™ + Enamelize™
5.	Opalescence Boost PF™ 38% + Sof-Lex Pop On™ + Diamond Polish™ + Lummina-E Diamond
6.	Opalescence Boost PF™ 38% + Sof-Lex Pop On™ + Enamelize™ + Lummina-E Alumina

Table 2: Experimental groups, pH and application protocol

Groups	Whitening gel	pH	Protocol
1	Control—Artificial Saliva	7,00	—
2 to 6	Opalescence Boost PF™ 38% HP*	7,11	3 applications with 15 minutes

(*)HP: hydrogen peroxide

Table 3: Materials used for the surface treatment

Material	Classification	Particle		Manufacturer	Lot / Reference
		Abrasive	Grit		
Sof-Lex Pop On™	Abrasive disks polyester	Aluminum oxide	Thick: 17.10 µm Medium: 7.10 µm Thin: 5.72 µm Ultra Thin: 1.68 µm	3M—ESPE Dental Products St Paul, USA	24054 2380B
Diamond Flex®	Felt disks with silicone	Abrasive none	—	FGM Dental Joinville, Brazil	010604-6 145
Diamond Polish Paste™	Abrasive paste	Diamond	0.5 µm	Ultradent Corporation Chicago, USA	5XW1 998
Enamelize™	Abrasive paste	Aluminum oxide	0.7 µm	Cosmedent Inc Chicago, USA	034832 242-4
Lummina-E Diamond	Abrasive paste	Diamond	<100 nm	Experimental Product	—
Lummina-E Alumina	Abrasive paste	Aluminum oxide	<100 nm	Experimental Product	—



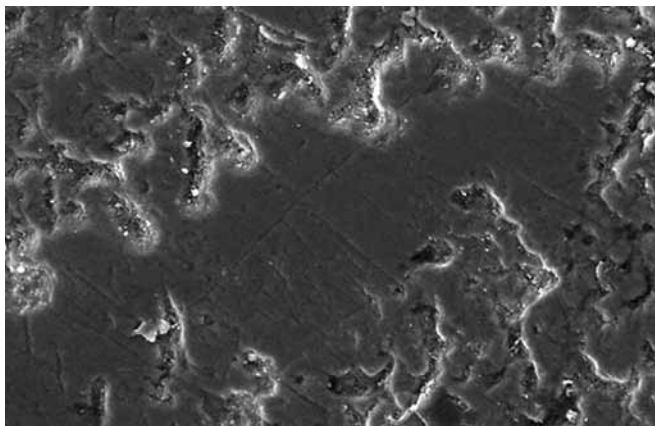


Fig. 1: Surfaces with large fissures and grooves are presented in control group

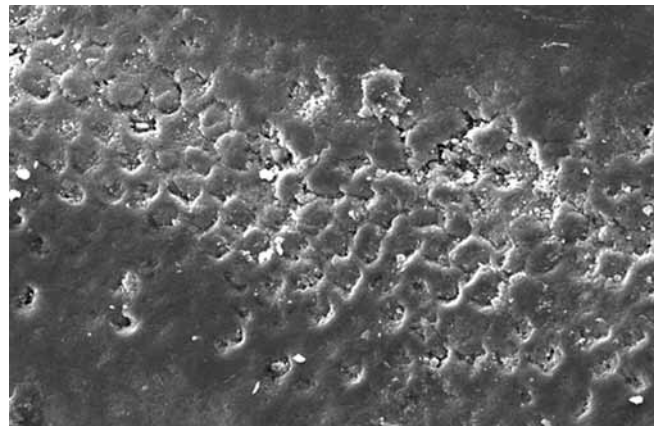


Fig. 2: The surface enamel was irregular with presence of uniform erosion

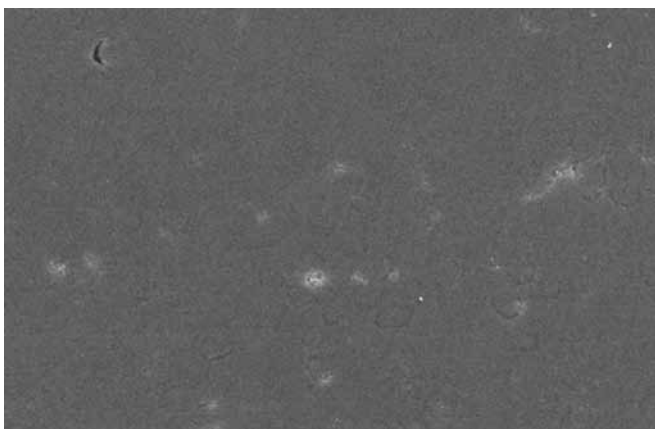


Fig. 3: Risks and grooves were found on enamel surface after polishing with Sof-Lex Pop On™ + Disk Felt Diamond Flex™ + Diamond Polish™



Fig. 4: Obliteration of erosion was found on enamel after polishing with Sof-Lex Pop On™ + Felt Disk Diamond Flex™ + Enamelize™

Group 2 (Opalescence Boost PF™ 38%)

Enamel showed an irregular surface characterized by the presence of uniform and generalized erosion, with wading depressions giving a peeling appearance due to strong projections (Fig. 2).

Group 3 (Opalescence Boost PF™ 38% + Sof-Lex Pop On™ + Diamond Polish™)

Specimens polished using Sof-Lex Pop On™ + Disk Felt Diamond Flex™ + Diamond Polish™ has been found an obliteration of erosions, however, it was noted the presence of risks and grooves (Fig. 3).

Group 4 (Opalescence Boost PF™ 38% + Sof-Lex Pop On™ + Enamelize™)

After polishing with Sof-Lex Pop On™ + Felt Disk Diamond Flex™ + Enamelize™ was observed total obliteration of erosion coming from the whitening process, eliminating the depressions, showing glassy appearance with smooth grooves (Fig. 4).

Group 5 (Opalescence Boost PF™ 38% + Sof-Lex Pop On™ + Diamond Polish™ + Lumina-E Diamond):

Specimens polished with Sof-Lex Pop On™ + Diamond Flex™ + Lumina-E-Diamond showed a glassy appearance with complete obliteration of erosion, removing deeper risks, however, it was noted the presence of some discrete lines (Fig. 5).

Group 6 (Opalescence Boost PF™ 38% + Sof-Lex Pop On™ + Enamelize™ + Lumina-E Alumina):

After polishing with disks Sof-Lex Pop On™ + Diamond Flex™ + Enamelize + Lumina-E-Alumina, obliteration of erosion was observed coming from the whitening treatment, eliminating the depression and giving a microcrystalline layer, without grooves (Fig. 6).

DISCUSSION

The results of this research showed that the whitening treatment causes surface changes on enamel. The changes would be more severe if the pH of the whitening gel deviates more of the neutrality (pH = 7.0). In this research we used the Opalescence Boost PF™ 38% with a more alkaline pH (pH = 7.11) that causes lower ionization provide less H⁺ ions to the oxidation reduction reaction, producing less change in tooth surface when compared to other whitening gel.¹¹



Fig. 5: Some discrete lines were found on enamel after Sof-Lex Pop On™ + Diamond Flex™ + Lummina-E-Diamond

In this study, the artificial saliva (G1: pH = 7,0) was used to simulate oral conditions. However, the potential for remineralization is equivalent to the *in vivo* natural saliva, and fluoride ions in the oral cavity are essential for the balance in the demineralization-remineralization process.¹²

The most severe effect of hydrogen peroxide 38% was due to the storage of specimens in distilled water; the effects of hydrogen peroxide 38% in our specimens were probably softened by immersion in artificial saliva.

Scanner electronic microscopy images showed dissolution of the organic layer of enamel surface (G2), but without loss of aprismatic layer, disagreeing of Dominguez et al,¹³ where there was a dissolution of aprismatic layer and exposure of prisms after long time application of agents with high percentage of hydrogen peroxide.¹⁰

In relation to the micrometric standard polishing pastes, the Enamelize™ softened the depressions and erosions coming the whitening. Already Diamond Polish™ obliterated the depressions and erosions more effectively, however, caused scratches or gouges. The abrasive used in the Enamelize™ is aluminum oxide (0.7 mM) having Knoop hardness of 2100 kg/mm² and the diamond abrasive is Diamond Polish™ (0.5 mM), which has a Knoop hardness 7000 to 10000 Kg/mm², much higher than the Knoop hardness of human enamel which is 350 to 380 kg/mm², so the occurrence of scratches and grooves after polishing with this polishing paste.¹⁴

Nanometer standard polishing pastes exhibited a surface texture superior to those images of micrometric standard polishing pastes. For nanotechnology are considered values below 100 units, so the Enamelize™ (700 nm) and the Diamond Polish™ (500 nm) can not be regarded as such. The prototypes Lummina E-Alumina and Diamond are designed to be within these parameters.¹⁵

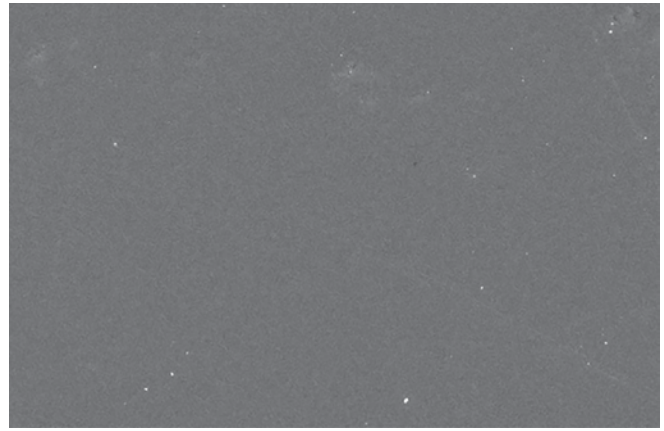


Fig. 6: Total obliteration of erosion was found on enamel after Sof-Lex Pop On™ + Diamond Flex™ + Enamelize + Lummina-E-Alumina

Considering erosions presence after the whitening process, this study determined the use of polishing techniques on the surface texture of otherwise healthy tooth enamel. It was noted that this hypothesis was true, since the polishing pastes in nanometer standard (G5 and G6) promoted a less rough surface that otherwise healthy even after the whitening treatment, resulting in a microcrystalline layer.

CONCLUSION

- The whitening gel used in this experiment altered the morphological appearance of the surface of the tooth enamel and correlation was found between the severity of the changes with the pH of the same, when compared to the control group.
- The polishing pastes in nanometer standard promoted a less rough surface that otherwise healthy even after the whitening process human enamel.

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