

A COMPARATIVE ANALYSIS OF BLEACHED AND SOUND ENAMEL STRUCTURE THROUGH SCANNING ELECTRON MICROSCOPY AND ATOMIC FORCE MICROSCOPY

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ABSTRACT

Objective: To analyze the effects of bleaching agent on enamel structure and to characterize the morphological and chemical changes in enamel due to bleaching.

Study Design: Experimental study.

Place and Duration of Study: School of Chemical and Material Engineering (SCME), NUST Islamabad from Feb to May 2013.

Materials and Methods: Ten recently extracted pre molars between the 12-22years age group were randomly assigned into two groups. Group one was a non-bleached control group with sound enamel. Group two was bleached with Everbrite In office tooth whitening system after specimen preparation, surface morphology was observed under SEM (scanned electron microscope) and AFM (Atomic force microscope).

Results: The detrimental effects of hydrogen per-oxide on enamel were evident in bleached specimens under SEM, and AFM analysis.

Conclusion: There were significant surface alterations found in the bleached specimens as compared to control group. However salivary buffering potentials could overcome the demineralizing effect of bleaching gel.

Keywords: Bleaching, Enamel, SEM.

INTRODUCTION

Tooth bleaching is one of the most demanded clinical procedures in dental practice¹. Despite the favorable results achieved with the bleaching, some adverse effects are also reported as a consequence of the treatment. These include toothache and sensitivity to hot and cold stimulus². The utilization of higher concentrations of bleaching agents and increased pH of the bleaching gel may result in tooth sensitivity (acceptable pH is within the range of 5.66- 7.35)³. Basically it is due to the removal of mineral content from enamel and dentine. In a study by McCracken and Heywood, they observed changes in the micro hardness of enamel and loss of mineral contents after bleaching with 10% carbamide per oxide⁴. In another study, Smidt et al also observed severe reduction in enamel hardness and distinct alteration in surface morphology⁵. However

Murchison, Charlton and Moore found no significant alteration in enamel after bleaching with 10% carbamide peroxide⁵. Similar results were obtained by Lee et al⁶. This study was carried out to analyze the effects of bleaching agent on enamel structure and to characterize the morphological and chemical changes in enamel due to bleaching.

MATERIAL AND METHODS

Ten recently extracted pre molars were selected from patients between 12-22 years of age. All teeth were examined under magnification (20×) to detect micro cracks or surface defects. Only pre molars without any defect were selected for this study.

Four specimens were used as a control for SEM evaluation and remaining six were bleached with a commercial bleaching agent Everbrite tooth whitening system (1866 E. San Jose CA91748 USA). This gel is a 36% hydrogen peroxide agent with carboxypolyethylene polymer (carbopol), having a pH=7.82.

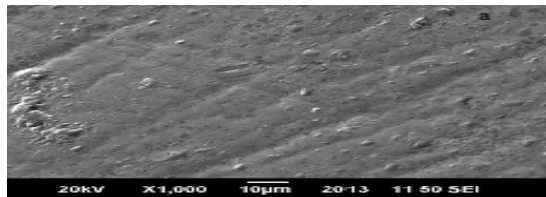
For SEM analysis all specimens were processed appropriately including fixation

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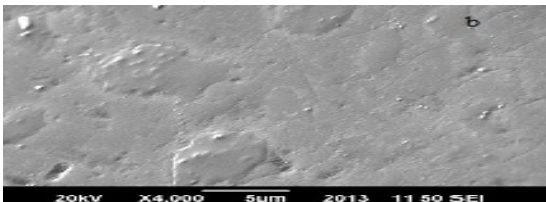
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Received: 11 Feb 2014; Accepted: 29 Apr 2014

in gluteraldehyde, dehydration in ascending concentration of ethanol and chemical drying. All specimens were prepared for electric conductance in high vacuum sputter coating machine (MED 010, blazers Union Liechtenstien) and analysed under SEM (JSM-6490A, Jeol, Japan). Several pictures were taken for each specimen. All figures obtained from SEM were analyzed by three observers in order



a



b

Figure-1: Enamel slabs from control group that were not submitted to any bleaching treatment at 1000 mgn (a) and at 4000 mgn (b).

to avoid individual bias, but only representative images for each group were selected to represent the characteristic features.

RESULTS

Scanning Electron Microscopy (SEM)

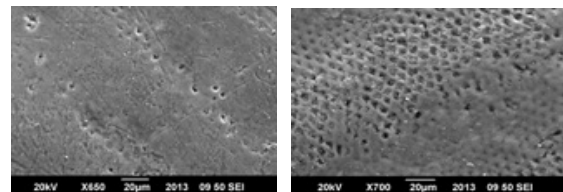
Representative SEM images are shown in Figure 1 and 2. This analysis was based on morphological assessment, and topo-graphical alteration in enamel surface. Figure -1(a) shows the appearance of the enamel surface from unbleached specimen at 1000 magnification and Figure-1(b) shows enamel surface at 4000 magnification. The uniform enamel pattern observed, including some uneven surfaces and elevations, which are due to polishing procedures.

More evident depressions or holes are observed in bleached specimens which indicates a higher mineral loss. This is due to dissolution of enamel rods. In some regions, it look like etched enamel (Fig-2a,b,c). Surface of enamel looks rough and porous. There is loss of

uniform aprismatic layer with significant microhardness loss and componential alteration of enamel surface. The damage of enamel surface due to bleaching showed sieve pattern (Fig-2b).

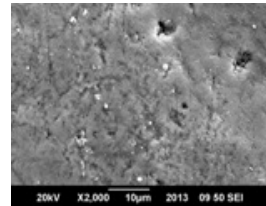
Atomic Force Microscopy (AFM)

On AFM, enamel surface of control group one was found smooth and flat, while bleached group two had comparatively rough and

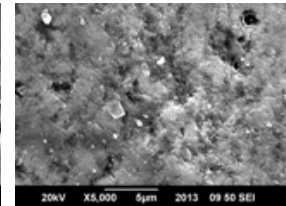


a

b



c



d

Figure-2 (a, b, c, d): Bleached enamel surface with distinct pore formation at the magnification of 650, 700, 2000, and 5000 magnification. Pronounced depressions are observed, surface resembled with acid etched enamel.

irregular surface (Fig-3).

DISCUSSION

Generally hydrogen peroxide and carbamide peroxide are practiced to lighten the dark teeth, and to treat the cases of mottled enamel, dental flourosis, tetracycline stained teeth as well as for other external and internal stains^{7,8}. Bleaching reaction ensue with the application of light or heat^{9,10}. Hydrogen peroxide acts as an oxidizing agent and forms free radicals. When hydrogen per oxide is applied on the tooth surface, it diffuses through the enamel into the enamel dentine junction and then into the dentine where it reacts with the chromophores, leading to the reduction in color¹¹.

Hydrogen peroxide has the capacity to denature protein. It increases tissue permeability and allows ions to move through the teeth¹². The degree of demineralization of

bleached enamel depends upon the pH and viscosity of the bleaching agent⁵. Other potential factors include acidic properties of

for providing funding and equipment for this research.

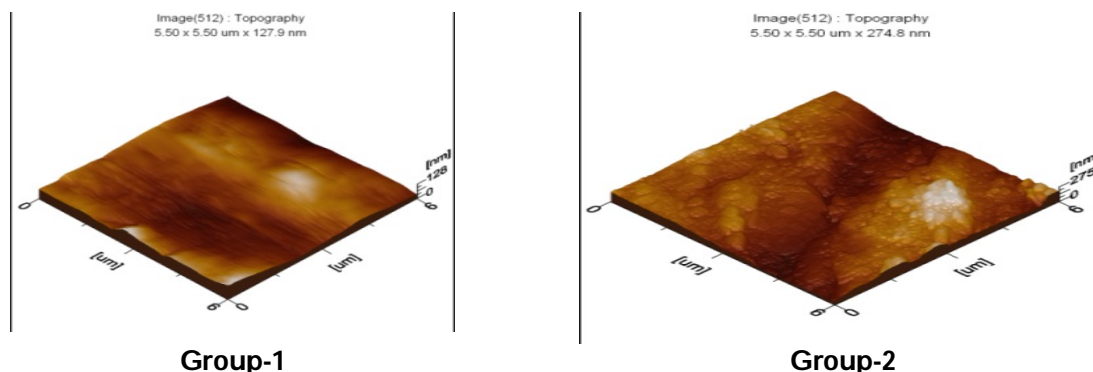


Figure-3: AFM of group 1 and group 2 showing change in surface roughness.

bleaching agents and prolonged contact between the bleaching agents and dental structure¹³.

In 1998, Smid et al stated that the buffering action and remineralization potential of saliva might overcome the detrimental bleaching effects in vivo⁵. Saliva has a cleaning as well as buffering system due to presence of bicarbonates and phosphates. The oral environment provides conditions for enamel remineralization. When the bleaching agent causes demineralization in enamel, ionic changes are induced; this increases the mineral uptake from the saliva, replacing the lost minerals in the enamel surface. Inorganic electrolytes contained in saliva such as Calcium, Phosphorus, and Fluoride take active part in remineralization process¹⁴.

CONCLUSION

This study demonstrated alteration in morphological and surface properties in bleached enamel as compared to non-bleached surface. The severity of condition depends upon the duration and pH of bleaching agent.

Acknowledgement

The authors acknowledge National University of Science and Technology (NUST)

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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