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ORIGINAL RESEARCH

A Comparative Study of Different Bleaching Agents on the Morphology of Human Enamel: An *in vitro* SEM Study

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ABSTRACT

The purpose of the study was to compare two different commercial bleaching agents, Opalescence with Colgate Platinum, and 30% phosphoric acid used as aggressive agent on the morphology of human enamel.

Materials and methods: Ten freshly extracted, noncarious, human maxillary central incisors extracted for periodontal reasons were used in this study. The labial surface of the disinfected teeth were polished using a polishing paste with the help of rubber cup and a slow speed handpiece. Each tooth was sectioned at cement-enamel junction and the crown was separated into four specimens, all taken from labial surface. Group 1 was treated with Colgate Platinum for 7 hours, group 2 with Opalescence for 7 hours, group 3 was treated with 30% phosphoric acid for 30 seconds and group 4 was untreated and used as control. After the treatment period, the specimens were washed with normal saline and stored in sterile bottle and sealed. Photomicrographs obtained from the scanning electron microscopy (SEM) after surface treatments were examined for no alteration, slight alteration, moderate alteration and severe alterations.

Results: The specimens treated with commercial bleaching agents revealed no enamel surface morphologic alterations compared to control group. The specimen treated with phosphoric acid showed severe alterations.

Conclusion: Ten percent carbamide peroxide evaluated in this study does not etch tooth enamel or alter enamel surface morphology as do conventional etching techniques.

Clinical relevance: Carbamine peroxide is a safe and effective tooth whitening agent even when used for extended period of time. The enamel surface remains smooth which reduces caries due to plaque collection.

Keywords: Opalescence, Colgate Platinum, Carbamide peroxide, Enamel morphology.

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INTRODUCTION

In this modern era, clean white teeth are considered as an asset which gives a psychological edge and confidence to a person. Several methods are available to restore discolored dentition. These include laminates or porcelain veneers, full coverage crowns, bonding and mechanical or chemical stain removal. Among these methods, laminates and full coverage crowns are considered more invasive because sound tooth structure is removed to achieve an acceptable level of esthetics. Bleaching, as a treatment modality, continues to hold its century old place as the simplest, most common, least invasive and least expensive means available to dentist to lighten discolored tooth and eliminate or diminish any stains in both vital and nonvital teeth.[13]

Bleaching agents may act as either oxidizing or reducing agents and are used as in-office bleaching agents or home-based bleaching agents. In-office bleaching gives faster results as it uses heat and light to increase the kinetics of stain removal. The bleaching agent used is 30 to 35% hydrogen peroxide (known commercially as 'Superoxol'). It has been demonstrated that Superoxol alone in combination with heat caused obliteration of odontoblasts, hemorrhage, resorption and inflammatory infiltration. This can also cause or aggravate hypersensitivity of the dentin. Some reports of enamel porosity have also been reported with use of Superoxol.

Carolina Baptista Miranda et al[3] in their study with 35% carbamide peroxide and 35% hydrogen peroxide in-office bleach found significant changes in enamel surface morphology and conclude that 'in-office bleaching materials may adversely affect enamel morphology and therefore should be used with caution'.[10,12]

Home-based carbamide peroxide bleaching technique is convenient to the patient, is tissue safe, and is comparatively less expensive.[6] Carbamide peroxide solutions are very

unstable and immediately disassociate into their constituent parts on contact with saliva and oral fluids.[7] The 10 to 15% carbamide peroxide solutions disassociate into 3 to 5% hydrogen peroxide and approximately 7% to urea.[9] The hydrogen peroxide further degrades into oxygen and water, and urea into ammonia and carbon dioxide.

Haywood et al[8] examined extracted premolars exposed to commercially available 10% urea peroxide/carbamide peroxide gels for 245 hours. Scanning electron microscopy (SEM) study of the samples showed no change in the enamel morphology.

Amparo et al[1] observed that tooth surfaces remained entire and the enamel surface structures remained normal when using 10% carbamide peroxide. The results showed that the chemical did not affect the enamel surface.

Sahar et al[5] conducted a study with 20 and 10% carbamide peroxide and 25% hydrogen peroxide on canine incisors and observed no significant differences among the bleaching groups; however, all bleaching agents produced a significant increase in the mean surface roughness of enamel compared to the untreated control group.

Few other studies conducted with carbamide peroxide and hydrogen peroxide has shown changes in enamel and dentin surface morphology and decrease in enamel surface hardness.[2,4]

In another study conducted by Nese Akal et al using 10 and 12% carbamide peroxide (Karisma and Yotuel), it was found that Karisma significantly decreased the hardness of enamel while Yotuel increased the microhardness of enamel.[8]

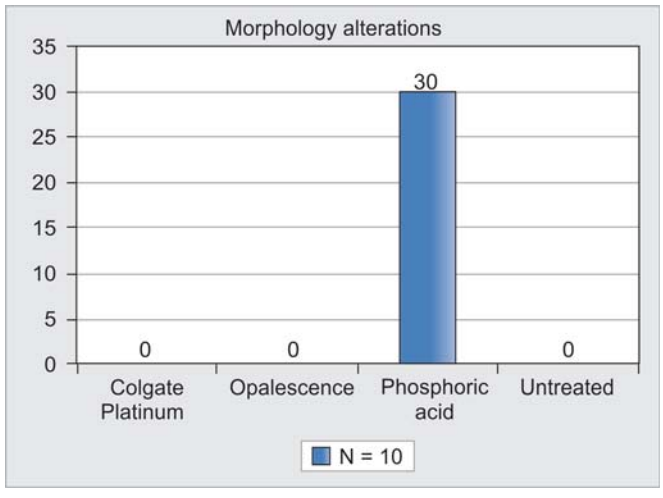
MATERIALS AND METHODS

Ten freshly extracted teeth noncarious human maxillary central incisors with intact enamel surface were collected and then disinfected with formalin for 1 hour. The labial surface of disinfected teeth were polished using a polishing paste with the help of rubber cup and a slow speed handpiece. The teeth were then sectioned at the cement-enamel junction using a diamond separating disk. Then each crown was separated into four enamel specimens, all obtained from the labial surface.

Experimental group: The specimens were distributed to four groups as shown in the Table 1. During the distribution period specimens were stored in normal saline.

RESULTS

The specimen were air dried and sputter coated with gold to a thickness of 10 nm and examined under scanning electron microscope (JOEL-JRC 1100E) at 20 kV and photographed at 3,000 magnification. The enamel alterations were classified as no alterations (score 0), slight alterations (slight alterations in surface roughness) (score 1), moderate alterations (deeper clefts) (score 2) and severe alterations (loss of superficial structure) (score 3). The SEM images obtained of the specimens exposed to the bleaching agents



Graph 1: Morphology alteration among four groups

Table 1: Distribution of specimens (N = 10)

	Group 1 (Colgate Platinum)	*Group 2 (Opalescence)*	*Group 3 (37% phosphoric acid)*	*Group 4 (Untreated)*
10 maxillary central incisors as specimens	1 section of labial surface from each tooth—total 10	1 section of labial surface from each tooth—total 10	1 section of labial surface from each tooth—total 10	1 section of labial surface from each tooth—total 10
Recommended duration of exposure	2 hours	Night wear	30 seconds	–
Duration of exposure	7 hours	7 hours	30 seconds	–

Table 2: Observation of specimens after bleaching (N = 10)

	Group 1 (Colgate Platinum)	*Group 2 (Opalescence)*	*Group 3 (37% phosphoric acid)*	*Group 4 (Untreated)*
Morphology alterations	No alteration in all 10 specimens	No alteration in all 10 specimens	Severe alteration in all 10 specimens	–
Score	10 × 0 = 0	10 × 0 = 0	10 × 3 = 30	

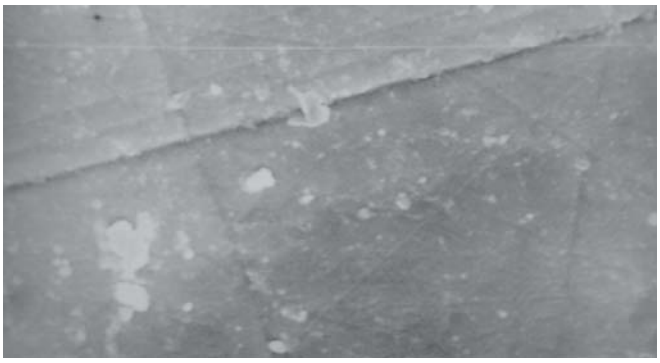


Fig. 1: Photomicrograph of untreated enamel specimen

Fig. 3: Photomicrograph of specimen treated with Colgate Platinum

Fig. 2: Photomicrograph of specimen treated with 37% phosphoric acid

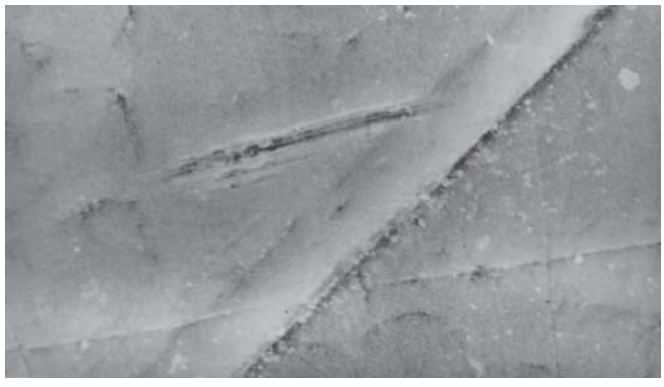


Fig. 4: Photomicrograph of specimen treated with Opalescence

revealed no enamel surface morphologic alterations when compared with the SEM images of the negative control surfaces. The enamel surfaces of the positive control, treated with phosphoric acid, showed severe alterations (Table 2). There are three agents and called as groups 1, 2 and 3. These treatments are subjected to one-way analysis of variance (ANOVA) and found that there is significant difference among the treatments. This was confirmed through least significance difference test and finally by observation that group 3 is more destructive as compared to groups 1 and 2 (Graph 1).

DISCUSSION

The untreated enamel specimen was used as control (Fig. 1). The bleaching agents Opalescence and Colgate Platinum caused no morphological changes (Figs 3 and 4) to the enamel surface as did phosphoric acid (Fig. 2). The effect of bleaching agents on the deeper enamel structure and any possible effect of them on the pulp are not studied in the present study. The exposure time recommended by each manufacturer is different (night wear for Opalescence and 2 hours for Platinum) however, there was no significant change in morphology when exposed for 7 hours.

Some studies has shown change in morphology with higher concentration of peroxides and change in hardness when two different commercial products were used. No study has been conducted to compare brands with different exposure time.

Colgate Platinum showed no change in morphology of enamel even when exposed to 7 hours when the recommended time is 2 hours. The excess of bleaching with platinum made no difference in morphology suggesting the safety of the material for clinical use. Carbamine peroxide can be safely used as effective tooth whitening agent.[11]

Enamel treated with 30% phosphoric acid showed severe morphological changes due to precipitation of enamel surface similar to etching.

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