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Colorimetric Evaluation, Scanning Electron Microscopy and µ-EDXRF spectrometry of Enamel Whitened with Violet Light Combined with Peroxides

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Abstract

The aim of this study was to evaluate in vitro color change, surface morphology and mineral content of enamel submitted to bleaching with violet LED(LED) combined or not with 35% hydrogen(HP) or 37% carbamide peroxide(CP). Bovine crowns stained with black tea were randomly distributed into whitening groups(n=10): LED/HP, HP, LED/CP, CP, LED and C – control. Color change(ΔE, ΔL, Δa e Δb) was spectrophotometrically determined among staining and 14 days elapsed from bleaching. Enamel surface was analyzed by means of SEM. Sixty additional enamel blocks were obtained, polished and submitted to initial surface michorhardness(KHN) for selection. One week elapsed from interruption of same protocols, calcium to phosphorous ratio(Ca/P) was determined under µ-EDXRF spectrometry. ΔE, ΔL and Ca/P ratio were tested with two-way ANOVA and Tukey's test. Δa e Δb were evaluated under Kruskal-Wallis and Mann-Whitney tests. Although ΔE and Δb were comparable among LED/HP and HP($p>0.05$), CP's was lower than LED/CP($p<0.05$). ΔE, ΔL, Δa and Δb for LED were significantly higher than C($p<0.05$). Even though whitening gels provoked irregularities, depressions and affected interprismatic spaces of enamel, LED did not exacerbate such condition. Even though CP's Ca/P was significant lower than C, LED did not influence impact of gels on Ca/P. Thus, LED enhanced the effectiveness of only CP, at the same time it did not exacerbate enamel surface and mineral changes caused by high-concentrated gels.

Key words: *Dental Enamel, Peroxides, LED*

Introduction

*Use of violet LED for in-office whitening by dentists[1,2] has raised concerns not only about its effectivennes, but also regarding its effect on enamel structure and mineral content.

*As it is known that aplication of HP or CP at high concentrations already causes enamel surface's irregularities[3] and decrease of Ca/P ratio[4], it has been questioned whether violet light would impact suce conditions.

Results and Discussion

Image 1. Summarized methodology employed in the study.

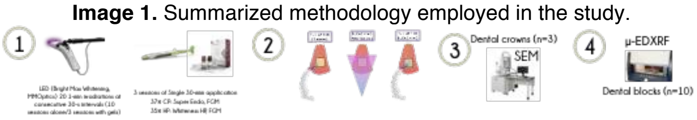


Table 1. Mean ΔE values and standard deviations, according to bleaching agentes and LED activation

Bleaching Gels	LED	No Activation
HP	32.1 (5.8) Aa	28.3 (8.2) Aa
CP	28.6 (6.8) Aa	20.6 (3.7) Bb
Without Gel	14.8 (4.2) Ba	4.7 (1.0) Cb

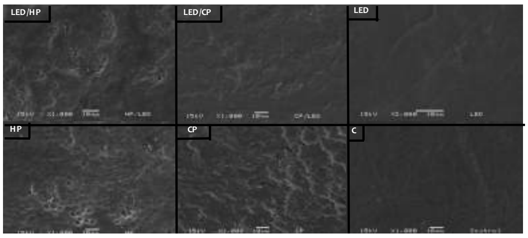
Means followed by different letters differ statistically at 5% significance level, according to two-way ANOVA and Tukey test. Uppercase letters compare the bleaching agents within presence or absence of LED, and lowercase letters compare the activation mode for each bleaching agent and interval.

Table 2. Mean values and standard deviations of enamel Ca/P weight ratios of enamel specimens submitted to bleaching with or without LED.

Bleaching Gels	LED	No Activation
HP	2.34 (0.04) Aa	2.35 (0.03) ABa
CP	2.31 (0.04) Aa	2.31 (0.05) Ba
Without Gel	2.35 (0.04) Aa	2.36 (0,05) Aa

Means followed by different letters differ statistically at 5% significance level, according to two-way ANOVA and Tukey test. Uppercase letters compare the bleaching agents within presence and absence of LED, and lowercase letters compare the activation mode for each bleaching agent and interval.

Image 2. SEM representative images of enamel surface after bleaching.



* LED alone promoted not only color change > C, but also increased luminosity and decreased redness (a*) and yellowness (b*) after 14 days of artificial saliva storage, which rejects hypothesis of tooth dehydration.

*Studies using other pigments and unstained enamel should be perform to clarify LED itself's mechanism of action. While it is believed that violet wavelength matchs pigments' absorbance peak[2], increase of gel's temperature[5] may have enhanced CP's effectiveness.

*CP's significal reduction to Ca/P ratio compared to C and pronounced impact on enamel morphology may be a result of low pH of gels brought syringes to increase product's shelflife[6]. However, the most important finding is that LED did not exacerbated such conditions.

Conclusions

LED enhanced the effectiveness of only CP, at the same time it did not exacerbate enamel surface and mineral changes caused by high-concentrated gels.

Acknowledgement

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