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Effect of Tooth Whitening with Violet LED and Peroxides on Enamel Stained with Cigarette Smoke, Coffee or Red Wine Solutions

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Abstract

Bovine dental enamel blocks were obtained and artificially stained with the extrinsic pigments (n=50): SK, CF, RW or control (C). Afterwards, specimens were treated with the following bleaching protocols: LED, LED/CP, CP, LED/HP and HP. Color change (Delta E) was measured considering after staining (T0), 24 hours elapsed from bleaching (TB) and 7 days after treatments (T7) times by means of digital spectrophotometry. Data was tested by two-way ANOVA and Tukey's Test. Enamel's surface morphology after treatments was analysed under scanning electron microscope (SEM). Type of staining and bleaching protocols significantly affected bleaching outcomes ($p<0.001$). Regardless of the extrinsic pigment, LED promoted statistically greater Delta E for stained groups in comparison to C ($p<0,05$). LED alone promoted clinical perceptible Delta E, but in less extent than for gels. LED/CP Delta E was significanty greater than CP's for CF, RW and C ($p<0.05$). Equal Delta E was found for LED/CP and HP for all pigments ($p>0.05$), except for CF ($p=0,020$). Only CF led LED/HP Delta E to be significantly higher than HP ($p=0.012$). Seven days elapsed from bleaching, outcomes were mantained. SEM images revealed that topography of enamel bleached with gels suffered alterations, but this was not exacerbated by LED irradiation.

Key words:
LED, Staining, Peroxide

Introduction

*Manufacturer indicates the use of violet LED (aproximatelly 405nm) without any whitening gels, stating that light could absorb pigments adhered to enamel surface.[1] However, LED is also being used combined with high-concentrated carbamide (CP) or hydrogen peroxide (HP) for patients with low or absent TS.[1,2]

*Therefore, the aim of this study was to evaluate the effect of cigarette smoke (SK), coffee (CF) and red wine (RW) on color alteration and surface morphology of enamel submitted to in-office whitening with violet LED combined or not with 37% carbamide (CP) or 35% hydrogen peroxide.

Results and Discussion

Image 1. Summarized methodology employed in this study.

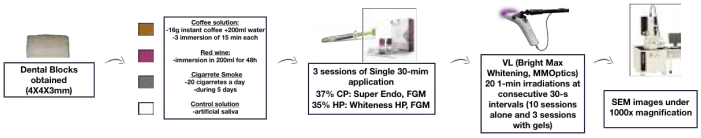


Table 1. Means values and standard deviation of ΔE (TB-T0) due to the adopted protocols.

Treatment	Staining			
	Coffee	Smoke	Red Wine	Control
LED	20,47 (7,58) BCa	19,56 (11,11) Ba	16,81 (9,62) Ca	6,61 (3,16) Cb
LED/HP	31,31 (8,29) Aa	27,18 (10,58) Aa	28,90 (14,16) ABa	17,09 (6,50) Ab
HP	19,93 (5,23) Cab	27,59 (5,83) Aa	27,00 (13,73) Aa	13,68 (6,36) ABb
LED/CP	30,01 (5,12) ABa	27,68 (10,33) Aab	33,82 (17,02) Aa	19,81 (10,03) Ab
CP	15,86 (5,53) Ca	19,08 (3,15) ABa	20,82 (7,86) BCa	8,08 (3,09) BCb

Means and standard deviations followed by distinct letters, demonstrate statistical differences after two-way ANOVA and Tukey test (5%). Upper case compare different materials with the same surface treatments (in columns). Lower case letters compare different surface treatments of the same material ($p<0.05$).

Table 2. Means values and standard deviation of ΔE (T_7-T_0) due to the adopted protocols.

Treatment	Staining			
	Coffee	Smoke	Red Wine	Control
LED	20,17 (7,79) Ca	19,80 (10,89) Ba	19,60 (10,24) Ca	6,47 (3,81) Bb
LED/HP	32,85 (8,01) Aa	33,26 (10,18) Aa	31,66 (13,44) Aa	18,60 (6,80) Ab
HP	20,40 (4,85) BCab	29,38 (5,65) Aa	28,74 (13,82) ABa	15,43 (6,32) Ab
LED/CP	28,36 (5,04) ABa	23,13 (10,47) ABab	32,74 (17,27) Aa	19,86 (10,65) Ab
CP	14,42 (2,76) Ca	19,35 (2,38) Ba	22,37 (9,04) BCa	8,52 (3,37) Bb

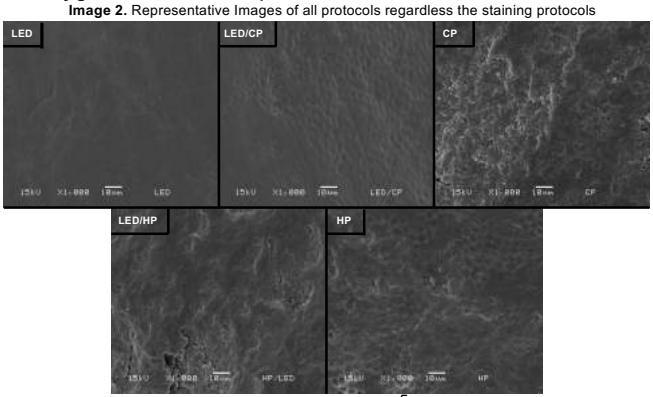
Means and standard deviations followed by distinct letters, demonstrate statistical differences after two-way ANOVA and Tukey test (5%). Upper case compare different materials with the same surface treatments (in columns). Lower case letters compare different surface treatments of the same material ($p<0.05$).

*Corroborating the findings of Gallinari et al. (2019)[3], LED groups promoted clinical perceptible bleaching outcomes. However, the violet light alone was more effective under the presence of extrinsic pigments.

*Therefore, the assumption that violet LED would act removing the extrinsic staining adhered to enamel especulated by Rastelli et al. (2018)[2] might be corrected.

*However, the mechanism of action responsible for increasing the effectiveness of CP under violet irradiation could be explained by the fact that light increased the temperature of the gel[4], thereby increasing decomposition of hydrogen peroxide into oxygen free radical species.

Image 2. Representative Images of all protocols regardless the staining protocols



*As reported by Berger et al. (2009)[5], who showed that blue LED and LED/Laser light sources did not, violet LED did not exacerbated the changes caused by peroxide gels.

*LED alone group presented flat surface, free of irregularities which were found in all other groups, e.g. depressions and affected inter-prismatic spaces.

Conclusions

Effectiveness of LED alone on tooth bleaching is enhanced in the presence of extrinsic pigments. Violet light activation influenced the effectiveness of CP and HP depending on staining type. LED did not change patterns of enamel surface morphology.

[1]Kury et al. (2019) Clinical application of violet LED in-office bleaching with or without traditional systems: case series. Oral Health Dent Stud 2:1-11. [2]Rastelli et al. (2018) Violet LED with low concentration carbamide peroxide for dental bleaching: A case report. Photodiagnosis Photodyn Ther 23:270-272. [3]Gallinari et al. (2019) A New Approach for Dental Bleaching Using Violet Light With or Without the Use of Whitening Gel: Study of Bleaching Effectiveness. Oper Dent 25 doi: 10.2341/17-257-L. [Epub ahead of print]. [4]Joiner A (2006) The bleaching of teeth: a review of the literature. J Dent 34:412-9. [5]Berger SB et al. (2010) Changes in surface morphology and mineralization level of human enamel following in-office bleaching with 35% hydrogen peroxide and light irradiation. Gen Dent 58:74