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Original Research Paper

Evaluation and Comparison of the Effect of Different Colors of Vape on Denture teeth Shade - A Vitro Study

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The use of electronic cigarettes(ECIGs) has recently increased as an alternative to conventional smoking tobacco productsTherefore, the objective of this study was to observe whether ECIG aerosol could alter the color of dental enamel. The initial color assessment was performed using a spectrophotometer (Easy Shade—Vita) and Dental enamel was exposed to 60 cycles. Seventy-two denture teeth were separated into three subgroups, according to the flavor of the e-liquid to which they would be exposed (light color, dark color, artificial saliva). Each group is subdivided into two exposures one cycle, and two cycles. The minimum sample size that should be used for statistical significance is not specified in the literature; however, most of the researchers use eight to ten samples for each group in a pilot study. In the current study, a sample size of six teeth is used as one set contains six teeth. The means and standard deviations for ΔE among study groups are presented in Table-I and Table-II. The color difference (ΔE) value for each study group was identified, the highest ΔE was observed in saline 20 cycle specimens (18.68 ± 2.43), however, the lowest ΔE was shown by the dark vape color 10 cycles specimens (12.68 ± 2.14). Overall, study group specimens showed significant color difference (ΔE) (ANOVA, $p<0.05$) ($p= 0.005573$). It is not clear that there is a relation between vape/vape color and color change of denture teeth. However, a larger sample and longer exposure time are recommended for future research

Keywords: Composite, Electronic cigarettes, vape, composite shade, denture teeth, and composite color.

INTRODUCTION

In recent years, a new type of smoking has emerged known as (electronic smoking), and under this new type, there are types such as (Vape or electronic cigarettes). This new type of smoking has attracted attention as a safe alternative to Cigarettes. Public perception of safe vaping may be misleading, as it causes many dental and medical problems. The assumption that vaping will change the color of the restoration may play a key role in start in patient education and motivation in the clinic. There are thousands of vape products in the market with different nicotine content, chemical compositions, and flavors. Understanding the effect of each factor is essential for future action and scientific-based conversation with the patient.

The e-cigarette devices consist of four different components, including (Geiss, 2016):

- A cartridge or reservoir holds a liquid solution (e-liquid or e-juice) containing varying amounts of nicotine, flavoring, and other chemicals.
- Heating element
- A power source
- A mouthpiece that the person uses to inhale.

In vaping, puffing activates the battery-powered heating device: reaching up to 250°C, which vaporizes the liquid in the cartridge. The person inhales the resulting aerosol or vapor (called vaping). The chemical composition of the liquid is generally comprised of high nicotine content, flavor ingredients in propylene glycol, formaldehyde and vegetable glycine. *Composite resin* is the primary aesthetic restorative material used with favorable properties and colors in dentistry.

Composites have many advantages of being well accepted by the patient, bond to tooth structure micromechanically, robust, low cost compared to ceramics, and mainly have excellent esthetic properties. Advances in composite restoration technology increase its use in the anterior teeth as veneers and luminaires. Oral habits such as vape smoking

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have been shown to influence the color stability of restorative materials (Vohra, 2020).

AIMS OF THE STUDY

The aim of the research is to assess the effect of vape smoking on color stability of denture teeth using three different groups: artificial saliva, light color vape, and dark color vape.

Hypothesis

Vape smoking changed the shade of denture teeth; the darker solution has been more changed in color than a lighter solution

Null Hypothesis

Vape smoking does not change the shade of denture teeth; the darker solution does not have more change in color than a lighter solution

MATERIALS AND METHODS

Study Design

This study was submitted for ethical committee clearance/exemption from Riyadh Elm University. In this study, color change parameters were assessed using denture teeth. The main parameters when denture teeth are exposed to vape will be the teeth color compared to exposure to artificial saliva (light color, dark color, and artificial saliva). Denture teeth are the specimen as they are chemically similar to the standard composite resin used in the clinic. Denture teeth are heat-cured acrylic that is subjected to thermocycling during manufacturing.

The material is then finished and polished to reach a specific degree of smoothness (Andrade de Freitas, 2018). The standardization of sample size is essential for the reliability of the result. The composite resin sample that the participant makes will not have standard smoothness, polymerization, and texture; such will affect the reliability of the result (Tavangar, 2018).

Specimen Exposure

Seventy-two denture teeth were separated into three subgroups, according to the flavor of the e-liquid to which they would be exposed (light color, dark color, artificial saliva). Each group is subdivided into twoexposures, one cycle, and two cycles. The minimum sample size that should be used for statistical significance is not specified in the literature; however, most of the researchers use eight to ten samples for each group in a pilot study. In the current study, a sample size of six teeth is used as one set contains six teeth.
The vape solution (Cartoon Vapor), 30 ml of liquid contains 3% Nicotine, 50% vegetable glycerin and 50% propylene glycol glycerin (figure 2). The blueberry lime flavor has a yellow light color and the grape flavor has a deep purple color. Nicotine fluid is s menthol free type with similar nicotine content.

The exposure consists of two cycles, in each cycle, the vape solution was changed ten times. Ametallic container was filled with 1.6ml and heated for 4 minutes. The liquid was changed every four minutes to avoid overheating, ten times for each cycle. A rough estimation of the vape dose is 200 puffs according to previous research (Pintado-Palomino, 2019). The prepared solution was placed in a metallic container and heated by ahot-plate stirrer in a fume hood device to absorb toxic vapor (Figures 3-4). The restoration was placed 2 mm away from the fluid. The study groups were subdivided according to the exposure cycle. Each cycle consists of 3 mm nicotine-containing fluid. This resulted in six study groups, each group consists of 8 samples, namely:

1. Restoration -Saline one cycle
2. Restoration -Saline two cycles
3. Restoration -light color nicotine one cycle
4. Restoration -light color nicotine two cycle
5. Restoration -dark color nicotine one cycle
6. Restoration -dark color nicotine two cycles

Color Analysis

Color readouts were performed on the specimens before and after exposure to ECIG aerosol using a calibrated spectrophotometer (Vita Easyshade, VITA Zahnfabrik, Bad Säckingen, Germany). To standardize the color measurement process, the specimens were dried with absorbent paper and colore was measured in a dark room, in the middle third of the buccal surface of each specimen. The initial and final color readouts were taken in the same position.

The color evaluation was based on a three-dimensional CIE L*a*b* color system established by the “Commission Internationale de l'Eclairage–CIE.” There are two chromatic axes, a* (red-green parameter difference) and b* (yellow-blue parameter difference), which are at right angles to one another, representing the saturationlevel and hue dimensions. The third axis, L*, perpendicular to thechromatic planes represents the value or lightness. The color difference (ΔE) among the baseline and post-exposure specimens was calculated by comparing ΔL, Δa and Δb and an overall ΔE using the following equation:

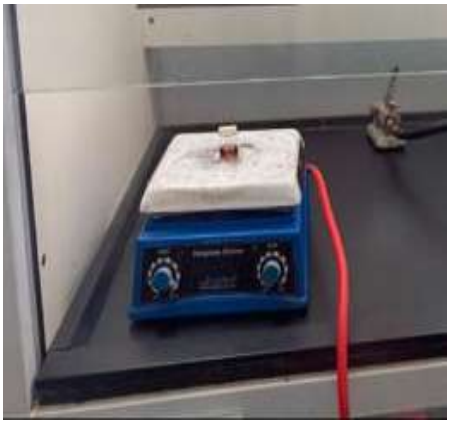
$$\Delta E = [(\Delta L)2 + (\Delta a)2 + (\Delta b)2]1/2$$

Statistical Analysis

The effect of the vapecolor (saline, light, and dark color) and exposure cycle (10 cycles, 20 cycles), and their possible interactions were analyzed with one-way ANOVA. For each color parameter (ΔL, Δa, Δb, ΔE), planned comparisons were carried outusing Analysis of Variance (ANOVA) and Tukey multiple comparisons test (Excel). A p-value of <0.05 was considered statistically significant.

RESULT

The means and standard deviations for ΔE among study groups are presented in Table-I and Table-II. The color difference (ΔE) value for each study group was identified, the highest ΔEwas observed in saline20 cycle specimens (18.68 ± 2.43),however, the lowest ΔE was shown by the dark vape color 10 cycles specimens (12.68 ± 2.14). Overall, study groupspecimens showedsignificant color difference (ΔE) (ANOVA, $p<0.05$) ($p= 0.005573$). To identify the differences between the groups, Tukey multiple comparisons test was used. The difference was in the controlled group and saline group that is exposed to 20 cycles. According to ANOVA and Tukey multiple comparisons test, the hypothesis “*Vape smoking will change the shade of denture teeth; the darker solution will have more change in color than a lighter solution”* is rejected and the null hypothesis is accepted.




GRAPES

Tukey multiple comparisons test		
Comparison	absolute diffrences	critical range
test to saline 10	2.05	3.975578487
test to saline 20	4.85	3.975578487
saline 10 to saline 20	2.8	3.975578487
test to light 10	1.05	3.975578487
test to light 20	3.35	3.975578487
ligh 10 to ligh 20	2.3	3.975578487
test to dark 10	0.733333333	3.975578487
test to dark 20	1.116666667	3.975578487
dark 10 to dark 20	1.85	3.975578487
saline 10 to light 10	1	3.975578487
saline 10 to dark 10	2.783333333	3.975578487
light 10 to dark 10	1.783333333	3.975578487
ligh 20 to dark 20	2.233333333	3.975578487

test group	first	second	third	forth	fifth	sixth	mean	STD
Δ E	12.2	15.2	13.1	12.3	12.8	14.9	13.41667	1.310598
Saline 10C								
Δ E	15.7	18.1	13.5	11.6	18.8	15.1	15.46667	2.722254
Saline 20C								
Δ E	21.5	16.2	17.4	16.2	21.1	17.2	18.26667	2.404718
light color10C								
Δ E	18.8	17.7	11.5	11.6	12.7	14.5	14.46667	3.142398
light color 20C								
Δ E	18.7	16.4	17.3	14.2	18.2	15.8	16.76667	1.657307
Dark color 10C								
Δ E	10.4	14.7	12.4	10.3	15.5	12.8	12.68333	2.144217
Dark color 20C								
Δ E	18.7	15.3	11	11.9	12.9	17.4	14.53333	3.106552

DISCUSSION

The present study was based on the hypothesis that Vape smoking changed the shade of denture teeth; the darker solution has more change in color than a lighter solution.
The experiment outcomes showed that the discoloration caused by vape aerosol was statistically insignificant from the control group. The assumption that vape aerosol will cause teeth discoloration is based on the fact that the heating of vape liquid will result in the release of metal ions, pigments, and particles on heating (Ayaz, Altintas, and Turgut., 2014).

Vape aerosol was found to cause discoloration in natural teeth, composite restoration, and ceramic restoration in other researches. in 2018, Palomino et al. studied the effect of vape smoking on color stability of natural bovine teeth. The study divided vape liquid into three types (neutral, menthol, and tobacco flavors). The study showed that vape smoking causes a perception change in enamel color' reducing the yellowness of enamel (Pintado-Palomino et al., 2019). In 2020, Vohra et al. studied the effect of vape smoking on color stability of composite and ceramics restoration. The study showed that vape smoking has a similar color change as conventional Cigarette smoking (Vohra et al., 2020). Both studies used a specialized smoke chamber that is designed for specimen exposure to electronic delivery system aerosol and Cigarette smoke. The current study used a regular laboratory hot-plate stirrer as a heating element for the e-liquid.

There is evidence-based information about the Cigarette smoking effect on the color of natural teeth and restorations. However, as vape is new in the market, there are little researches on the effect of vaping on the color change of dental restoration. In addition to that, future studies need to incorporate other esthetic analysis elements such as translucency, whitening index, and surface texture change on teeth and restorations. Smoking cessation counseling should consider other health-related issues such as cancers, lung-

related diseases, periodontitis, caries rate, and cardiac problems.

CONCLUSION

It is not clear that there is a relation between vape/ vape color and color change of denture teeth. However, a larger sample and longer exposure time are recommended for future research

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

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FINANCIAL SUPPORT

Nil

ETHICS STATEMENT

This study was registered in the Riyadh Elm University research center portal and received ethical approval.

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