ANALYSIS OF STABILITY OF COLOR RESIN COMPOSITE UNDER THREE CONCENTRATIONS CARBAMIDE PEROXIDE

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ABSTRACT

The objective of the present study was to analyze the color stability of a composed resin that was submitted to three performed at the Severino Sombra University's Odontology Laboratory - Vassouras, Rio de Janeiro State, Brazil. Forty specimens were prepared and divided into a groups for the preparation on the specimens a photopolymerizable resin Opallis®, (FGM, Joinville, SC): was used in the A3,5 color. For the photopolymerization of the specimens, a photopolymerizer (Coltoloux® LED) was used for two hours diary of exposure. There different concentrations of carbamide peroxide were selected 10%, 16% and 22%. The readings to evaluation of the colors were performed by the reflectance spectrophotometer (Vita, Germany). The results showed alteration of color in the specimens that were exposed to the tree concentrations of carbamide peroxide.

KEYWORDS: Carbamide peroxide, composed resin, bleaching.

1. INTRODUCTION

The concern with aesthetics is not unique to modern society, since there are reports that the Greeks, in ancient civilization, already used vinegar associated with abrasive substances in an attempt to whiten your teeth[1].

The constant and increasing demand for cosmetic procedures has led many patients and, sometimes dentists, to use indiscriminately therapy tooth whitening, viewed as a supposedly non-invasive procedure. However, a growing number of reports on the adverse effects of tooth whitening, as the induction of structural changes on dental hard tissues[2,3], in the oral soft tissues and also in restorative materials[4,5].

Many other professionals dedicated to the study of chemical solutions to lighten discolored teeth. Among them we can mention: Woodnutt (1860)[6] and Truman (1881)[7], liquor labarraque; M'Quillen (1867)[8], calcium hypochlorite; Harlan (1884)[9] aluminum associated with hydrogen peroxide 3%; Kirk (1893)[10], sodium dioxide; Abbot (1918)[11], hydrogen peroxide 30%; Prinz (1924)[12], sodium perborate; Salvas (1938)[13] sodium perborate and water; Nutting & Poe (1963)[14], sodium perborate with hydrogen peroxide (30%) and heat.

Historically, evaluating the aesthetic component of teeth, it is observed that the chromatic feature has always been one of its fundamental attributes, existing records of procedures aimed at letting the lighter teeth that date back more than 2000 years[15].

The change in color of teeth can be due exogenous, endogenous, pharmacological, and iatrogenic factors yet to trauma with rupture of blood vessels in the coronal pulp[15,16].

A technique that can be self administered by the patient under the supervision of the dentist is carbamide peroxide 10%. This concept has undergone several modifications over the years with respect to the concentration used[17].

To Jorgense & Carroll (2002)[18], the whitening is the least invasive cosmetic to improve the appearance of smile procedure and can be performed with a high success rate.

Jardim *et al.* (2002)[19] observed that changes found in the translucency of composite resins against bleaching agents may be related to the type of each composite particle. Therefore, before performing tooth-whitening treatment, the physician must inform the patient about the possibility of changes occur in the present restorations.

According Canay *et al.* (2003)[20], the concentration of the bleaching gel also affects the change in the material. The literature shows that bleaching agents with high concentrations of peroxides increase the chance of discoloration of the restorations.

Musanje & Ferracane (2004)[21], evaluated the effects of various types of surface treatment on the properties of the experimental composites containing nanoparticulate different concentrations of monomers TEGDMA, UDMA and BIS-GMA. The results showed that the organic matrix of these composites were changed when the whitening gel were exposed to the materials.

Anusavice (2005)[22], show that the resins are packed crosslinked polymeric materials, reinforced by a dispersion of amorphous silica, glass, crystals or particles of inorganic and/ or organic short fibers to the matrix resin together by a bonding agent loading. Due to the wide use of this aesthetic material, which is the highest number of stability studies towards treatment with bleaching agents?

During his research in the 90s, Anusavice (2005)[22] observed the effect of carbamide peroxide 10% compared to composites and noted an increase in the translucency of the restorative material to use this agent in homemade teeth whitening technique. This increased translucency of resin materials can occur through having exposure of free radicals in the decomposition of composite resin.

The vital tooth whitening is a dental procedure is performed through the application of gels based on hydrogen peroxide and / or carbamide different concentrations are used to varying the time of application[23].

The teeth whitening peroxide occurs due to its low molecular weight facilitating the penetration of the dental structures, associated with dental permeability, a feature that allows the diffusion of oxygen through the enamel and dentin to act on the organic structures of the tooth and thus lighten it[24].

Bagheri *et al.* (2005)[25] mention the addition of chemical compounds in the composition of restorative material such as changes of physical properties. For example, the use of different proportions of diluents such as TEGMA to modify the handling properties of the base material of Bis-GMA, can affect the aesthetic properties of the restorer material.

The carbamide peroxide decomposes after contact with saliva, giving as the final compound hydrogen peroxide, which is a strong oxidizing agent that acts on the protein degradation mechanism, causing change in interprismatic region formed by the enamel proteins amelogenin and non-amelogenins[26].

According Hubbezoglu *et al*. (2008)[27], this cleaning depends on the structure of the monomer, the volume of the resin matrix and the size and concentration of filler particles of the restorative material.

Yu *et al*. (2008)[28], demonstrated colorimetrically that carbamide peroxide 10%, 15% and hydrogen peroxide are able to modify the color of microhybrids composites of nanoparticles and microparticles. Moreover, these resins become more susceptible to surface staining, factors that may require replacement.

Silva *et al.* (2009)[29], disclosed that the majority of published research on the subject agree that the color change of composite restorations after bleaching occurs due to a cleaning surface that promotes whitening agent on the surface of the restorative material. The color stability is the property of the material.

In some cases, the teeth to be whitened feature composite resin restorations that often come in contact with bleaching agents. If so, the professional must be aware of the effects of bleaching agents on restorative materials so that it can indicate whether or not the replacement of the restoration. Thus, a relevant factor to be explored in the literature is the direct contact of the whitening gel in resin composite restorations alters the physical properties of the restorative material[30].

The color stability is the property of a material that allows the color to be maintained for a period of time in a given environment[31].

The objective methods of assessment objectives are quantified color in color parameters tests[32], and can be performed through two devices: colorimeter and spectrophotometer. The colorimeter is a laboratory equipment not intended for dental use. This equipment is able to detect color differences below the threshold of visual perception[33] and to perform reliably, the quantification of the color of the test specimens used[34]. Therefore, some authors have chosen to use this method when making color measurements, such as Pisani *et al.* (2012)[35] and Sato *et al.* (2005)[36]. Already spectrophotometer, unlike the colorimeter is intended donation dental use by its easy handling. The device is an easy color analysis system used to produce accurate color measurements in clinical conditions[37], is more accurate than the visual and eliminates subjective errors in the evaluation of color[35].

Many studies have evaluated changes caused by bleaching agents in teeth, but the literature does not show that the gels can cause the composite, since many teeth are restored with this material. The aim of this study was to analyze the color stability of a composite subjected to three concentrations of carbamide peroxide.

2. MATERIAL AND METHODS

This study was conducted at the University Severino Sombra – laboratory of Odontology - Vassouras, Rio de Janeiro State, Brazil.

Test specimens:

Altogether, 40 test specimens were divided into 4 groups made. The test specimens were mounted in a silicone matrix and were left with the following measures: 5.62 mm diameter by 2.80 mm thick (Figures 1, 2 and 3).

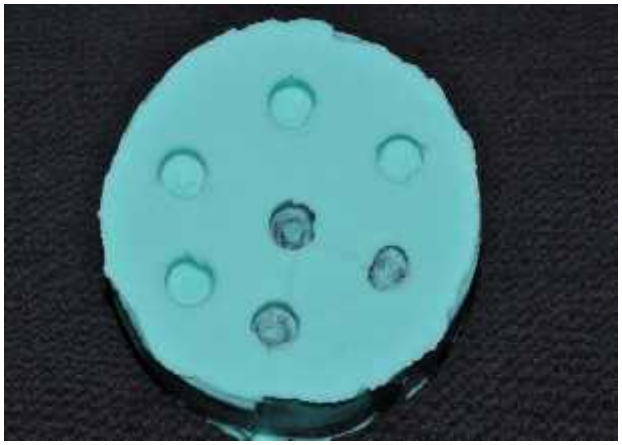

Figure 1. Silicone matrix where the test specimens were fabricated.

Figure 2. Diameter of the test specimens.

Figure 3. Thickness of the test specimens.

For mounting of the test specimens was used photopolymerizable resin Opallis® (FGM, Joinville, SC) The 3.5 in color (Figure 4).

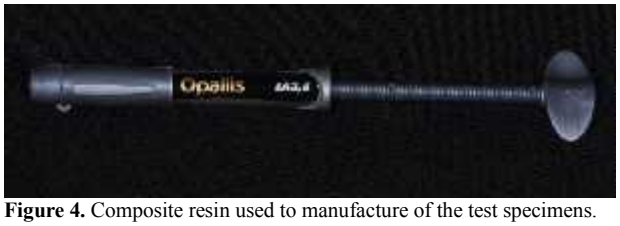

Figure 4. Composite resin used to manufacture of the test specimens.

For polymerization of the test specimens, the curing light (LED Coltolux®) was used for 60 seconds of exposure (Figure 5).

Figure 5. LED used for photopolymerization.

Three different concentrations of carbamide peroxide were listed have been selected (Table 1).

Table 1. Relationship of the concentration of carbamide peroxide in %.

Groups	Lightening Gel	%
GI (n=10)	Carbamide peroxide	10
GII (n=10)	Carbamide peroxide	16
GIII (n=10)	Carbamide peroxide	22
GIV (n=10) Control	_____	_____

The test specimens of composite resin were respectively subjected to exposure of the whitening gel composed of carbamide peroxide 10%, 16% and 22% Whiteness® (FGM, Joinville, SC) for 14 days for two hours a day (Figure 6).

Figure 6. Carbamide peroxide. Concentrations of 10%, 16% and 22%.

In the control group made no application of gel, just the color of the test specimens of composite resin before and after application of the gel in the other groups in order to validate the methodology used was evaluated.

Color Evaluation

The readings for color evaluation was performed by the technique of reflectance spectrophotometry using a hand-held spectrophotometer Easyshade Vita (Vita, Germany). This portable device for presenting the sensor tip with reduced diameter, allows assessment of small areas.

For the readings, each test specimen was placed in a room with controlled lighting (corresponding to the universal white). The readings were taken in the center of the test specimen. In addition, the spectrophotometer was calibrated before each reading. Each reading has always had the same angle of the sensor tip in contact

with the surface of the test specimens. A block of foam was used with the aim of reducing the entry of ambient light.

Vita Classical scale was mounted lighting tooth to verify the darker the color change points in facilitating the counting and statistical.

Figure 7. Vita Classical scale.

Data were recorded and stored using a spreadsheet. Initially, the first color evaluation, considered T0 was performed. At the end of 14 days of immersion in bleaching gels, the second reading of color (T1) was performed. The readings were performed by spectrophotometer. Before each measurement of each color specimen was gel was removed, washed with distilled water and dried with paper towels.

The color variation of gels of different concentrations of carbamide peroxide compared to the control group, was determined with regard to maintenance, lightening and darkening of the color of composite resin.

For more reliable to evaluate the effectiveness of different concentrations on changes in color of the composite results, ANOVA was applied and then the multiple comparison Tu-key-Kramer test, without considering the control group. Considering the control group, the "t" of paired samples with each concentration of carbamide peroxide test was applied. For both tests was considered the color change with values 01-05.

For all statistical inferences Microsoft Excel and GraphPad Software programs were used, with a significance level of 5% ($\alpha = 0,05$).

3. RESULTS

The control group, as expected, retained 100% of its color unchanged (Table 2, Figure 8) after 14 days without application of whitening gel.

The use of the composite carbamide peroxide Opallis® (FGM, Joinville, SC) containing 10% (Group 1), resulted in 100% resin whitening, as shown in Table 3 and Figure 9.

Table 2. Results of changes of the test specimens in the control group.

Control Group			
Test specimen	Before	After	Color Change
1	A3	A3	Remained
2	A3,5	A3,5	Remained
3	A3,5	A3,5	Remained
4	A3,5	A3,5	Remained
5	A4	A4	Remained
6	A3	A3	Remained
7	A3,5	A3,5	Remained
8	A4	A4	Remained
9	A3	A3	Remained
10	A4	A4	Remained

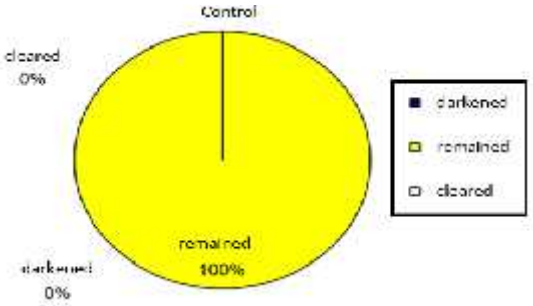

Figura 8. Control group.

Table 3. Results of changes of the test specimens with the use of 10% carbamide peroxide.

Group 1 - 10%			
Test specimen	Before	After	Color Change
1	A4	C2	Cleared
2	A4	B3	Cleared
3	A4	A3	Cleared
4	A4	A3,5	Cleared
5	A4	B4	Cleared
6	B4	B3	Cleared
7	A3,5	B3	Cleared
8	A4	B3	Cleared
9	A4	B3	Cleared
10	A4	B3	Cleared

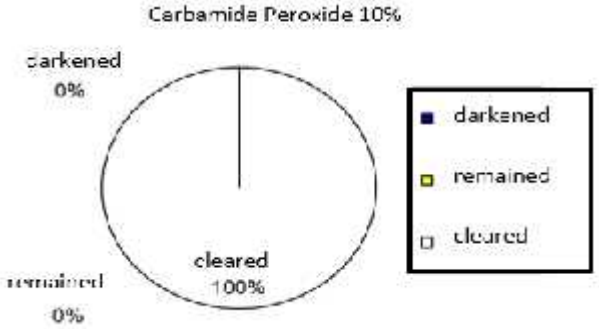

Figure 9. Changes of the group 1 (G1).

Regarding the use of the composite Opallis® carbamide peroxide (FGM, Joinville, SC) at a concentration of 16% (Group 2) resin resulted in a 50% bleaching, 40% no change of color and darkening of 10% (Table 4, Figure 10).

Table 4. Results of changes of the test specimens with the use of carbamide peroxide 16%.

Group 2 - 16%			
Test specimen	Before	After	Color Change
1	A4	B3	Cleared
2	A3,5	A3,5	Remained
3	B4	B3	Cleared
4	B3	B3	Remained
5	B4	A4	Darkened
6	B3	B3	Remained
7	A4	B3	Cleared
8	A4	A3,5	Cleared
9	B3	B3	Remained
10	A4	B3	Cleared

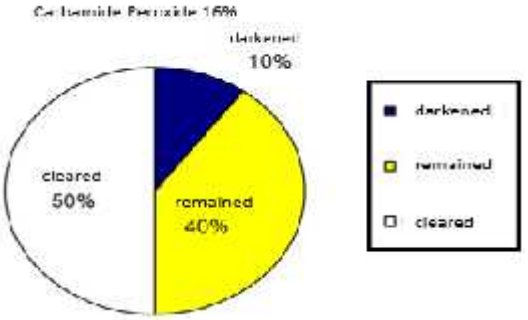

Figure 10. Changes in group 2 (G2).

The use of the composite carbamide peroxide Opallis® (FGM, Joinville, SC) with concentration of 22% (Group 3), 50% resin resulted in bleaching, 40% and 10% dimming without color change (Table 4, Figure 5).

Table 5. Results of changes of the test specimens with the use of carbamide peroxide 22%.

Group 3 - 22%			
Test specimen	Before	After	Color Change
1	A4	B3	Cleared
2	A4	B3	Cleared
3	A3	A3,5	Darkened
4	B4	B4	Remained
5	A3	B3	Darkened
6	B4	B3	Cleared
7	A3	B3	Darkened
8	A3,5	B3	Cleared
9	A3,5	A4	Darkened
10	A4	B4	Cleared

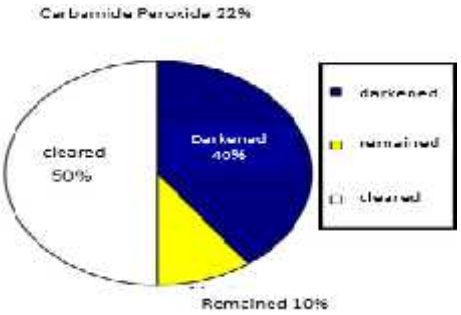

Figure 11. Changes in Group 3 (G3).

The ANOVA test showed that different concentrations showed significant differences (p = 0.0065, F = 4.806) for color (Figure 12). The Tukey-Kramer applied subsequently charged differences between the gel carbamide peroxide at 10% and bleaching with the use of carbamide peroxide at 22% gel.

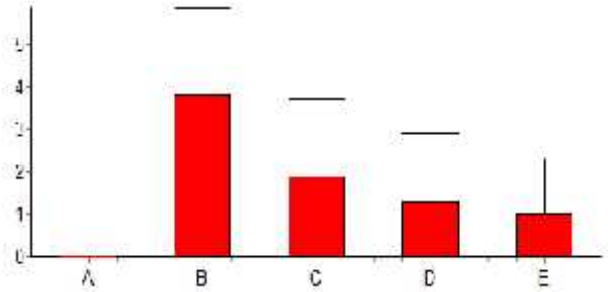

Figure 12. Changes in mean color change (from 01 to 05) in accordance with the different concentrations of carbamide peroxide, and also those who have kept the computed color. A: control group; B: carbamide peroxide gel than 10%; C: carbamide peroxide gel 16%; D. gel carbamide peroxide 22% with whitening; E. gel carbamide peroxide 22% with darkened. Vertical bars indicate standard deviation.

The "t" test applied between the means of the control group (zero) and the mean value of color variation of carbamide peroxide gel 10% (3.4 ± 1.350), showed highly significant differences (p <0, 0001, t = 7.965). In relation to mean the control group and the variation of color carbamide peroxide gel 16% (1.9 ± 1.792) showed significant differences (p = 0.0085, t = 3.353). Now, in relation to the mean of the control group and the color range of carbamide peroxide gel that cleared 22% (1.3 ± 1.636) and the color range of carbamide peroxide gel 22% which darkened (1.0 ± 1.333) showed significant differences: p = 0.0332, t = 2.512 and p = 0.0418, t = 2.372, respectively.

4. DISCUSSION

There are many studies on the effects of bleaching agents on the enamel and dentin. However, there are still few studies that talk about these changes in the composites. Measures such as targeted in this study are essential for the improvement of various types of composite resins

and gels and whitening for best results and satisfaction of patients who wish to have their teeth whitened.

The composites are filled crosslinked polymeric materials, reinforced by a dispersion of amorphous silica, glass, crystals or particles of inorganic and/ or organic short fibers to the matrix resin together by a bonding agent loading. When subjected to home whitening, modifications can be found in the translucency of resin composites. The organic matrix composites are changed when the whitening gel comes in contact with the materials[19,21,22]. In the current study, there was color change in different concentrations of carbamide peroxide, and 16% in the concentration of the specimens of composite resin remained stable in their colors in 40% of group.

Studies have shown that, by colorimetry, carbamide peroxide 10% and hydrogen peroxide are able to modify the color of microhybrid composites of nanoparticles and microparticles. What goes against the experiment of the present study where there was 100% bleaching of group I. Most of the published research on the subject agree that the color change of composite restorations after bleaching occurs due to a surface cleaning promotes the whitening agent on the surface of the restorative material[28,39], agreeing with the present study.

The concentration of the whitening gel also affects the change in the material. The literature shows that bleaching agents with high concentrations of peroxides increase the chance of discoloration of the restorations, as a strong oxidizing agent that acts on the degradation mechanism causes a change in interprismatic region formed by the enamel amelogenin proteins and not-amelogenins[20,26]. In the present study, there was a higher percentage of test specimens whitened proof when subjected to carbamide peroxide gel 10% (GI cleared 100%). The groups GII and GIII, also vary, but not significant in the rate of whitened as the GII. Interestingly, the gel concentration at 22% was able to darken 40% of the test specimens. Before performing the bleaching treatment, the physician must inform the patient about the possibility of changes occur in the present restorations. In this study, the test specimens of composite resin had its color changed in different concentrations of carbamide peroxide[19].

The objective methods of color evaluation are quantified in color parameters and tests can be performed through two devices: colorimeter and spectrophotometer. The colorimeter is a laboratory equipment not intended for dental use, but is able to detect color differences below the threshold of visual perception. Already spectrophotometer, unlike the colorimeter is intended for dental use is more accurate than the visual and eliminates subjective errors in the evaluation of color[39]. Agreeing with the above work, in the literature there are several authors who used the objective method in their research. For reading achievement of color in this research spectrophotometer Vita Easyshade that offered precision Vita Classical scale was used. To determine whether there was a color change, Vita Classical scale was mounted to the lighter darker, unlike which is sold as separate groups (A, B, C and D).

5. CONCLUSION

According to this study and based on the results obtained through the methodology, it was suggest:

- Among the different concentrations of carbamide peroxide, which presents with a concentration of 10% was able to clear all test specimens of composite resin (statistically significant).
- The carbamide peroxide at 16% cleared 50% of the test specimens of (statistically significant) composite resin.
- The carbamide peroxide at 22% cleared 50% of the test specimens of composite resin, darkened 40% (statistically significant).

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