

Effects of plaque disclosing agents on esthetic restorative materials used in pediatric dentistry

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The aim of study was to evaluate the color stability of tooth-colored restorative materials usually used in pediatric dentistry after the application of two plaque disclosing agents. Twenty specimens of each material: a resin-modified glass ionomer, a composite resin and an ion-releasing composite resin, were prepared. Baseline color evaluation was performed, samples were exposed to the plaque disclosing agents: a basic fuchsin solution and a fluorescent dye, and new color evaluations were made. The resin-modified glass ionomer stained with basic fuchsin presented the greatest color change in the present study, and the fluorescent dye did not show statistically significant changes among the restorative materials. In conclusion, basic fuchsin dyes should be carefully used in children with a great number of tooth-colored restorations.

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INTRODUCTION

Dental esthetics is desired by children and parents. The advent of tooth-colored restorative materials has been indispensable for this purpose. Nevertheless, the color stability has been considered a major esthetic failure in restorations with these materials.¹⁻⁸ The light-curing composite resins and the resin-modified glass ionomers are tooth-colored materials widely used in pediatric dentistry.⁹⁻¹¹

Children with high index of caries usually need a great number of restorations.¹²⁻¹⁵ After the restorative treatment, bacterial plaque control is an important step to prevent secondary caries¹⁶ and pigmentation around margin areas of restoration.²

Motivation of the patient is a valuable aspect to improve oral hygiene.¹⁷⁻¹⁹ The oral hygiene motivation should be reinforced during the treatment. Plaque disclosing agents enable the patient to detect dental plaque and improve the oral hygiene.¹⁷⁻²¹

Despite the importance of motivation of the children, the effect of the plaque disclosing agents on the color of restorative materials remains unclear. Thus, the aim of this *in vitro* study was to evaluate the color stability of tooth-colored materials used in pediatric dentistry after the use of two plaque disclosing dyes.

MATERIAL AND METHODS

Three tooth-colored restorative materials were used: a resin-modified glass ionomer, a composite resin and an ion-releasing composite resin (Table 1). The chosen shades of the tooth-colored materials are usually used to restore primary teeth. Ariston pHc presents only one shade, but it is appropriate to primary teeth restoration.

Twenty rectangle-shaped specimens of each material (7 mm in length, 4 mm in width and 1.5 mm thick) were prepared. The resin-modified glass ionomer was prepared according to instructions of the manufacturer and inserted in molds with a single insertion with a Centrix syringe. The composite resins were inserted in three increments. The specimens were light-cured for 40 seconds by using a light-curing unit with an average light output of 720 mW/cm² and incubated

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Table 1. Restorative materials and plaque disclosing dyes used in the study.

| Restorative Material | Product name | Manufacturer | Shade |
|-------------------------------|---------------|---|-------|
| Resin-modified glass ionomer | Vitremer | 3M, St. Paul, USA | Pedo |
| Microhybrid composite resin | Filtek Z250 | 3M, St. Paul, USA | B1 |
| Ion-releasing composite resin | Ariston pHc | Ivoclar Vivadent, Schaan, Liechtenstein | U |
| Plaque disclosing agent | Product name | Manufacturer | |
| Fluorescent dye | Plaquetest | Ivoclar Vivadent, Schaan, Liechtenstein | |
| 2% Basic fuchsin | Basic fuchsin | Fórmula e Ação, São Paulo, Brazil | |

at 100% relative humidity at 37°C for 24h. The samples were polished with polishing disks (Soflex, 3M, St. Paul, USA).

After polishing, the samples were rinsed, dried with paper tissue, and the baseline color measurements were performed. Color evaluations were made in reflectance spectrophotometer (Cintra 10 GBCUV, GBC Scientific Equipment, Dandenong, Australia), with color parameters based on average daylight (D65: 6504 K). The optical geometry of the system consisted of a 45° illumination angle and a 2° observation angle. Calibration was made in a white standard.

The samples of each material were divided in two groups (n=10). In the first group, 2% basic fuchsin solution was used as plaque disclosing agents, and in the other group, a fluorescent dye was used (Table 1). After the baseline color evaluations, the samples were exposed to the plaque disclosing agents for 60s. Then, the samples were brushed with a soft toothbrush (Johnson & Johnson Reach infantil, Johnson & Johnson, São José dos Campos, Brazil) and fluoride dentifrice (Tandy, Kolynos do Brasil, São Bernardo do Campo, SP, Brazil) for three minutes. A new toothbrush was used for each group, and the brushing was performed by one operator. During the toothbrushing, the operator was unaware about the material of each sample. The specimens were rinsed and dried, and final color evaluations were made.

The color stability was evaluated by the determination of color changes (ΔE^*) between the final (f) and the baseline (o) color evaluations, using the CIE $L^*a^*b^*$ measuring system. The mean values (ΔE^*) were calculated for each group. The color changes were calculated using the formula:

$$\Delta E^* = [(L_o^* - L_f^*)^2 + (a_o^* - a_f^*)^2 + (b_o^* - b_f^*)^2]^{1/2}$$

L^* is luminescence reflectance, $+a^*$ is red, $-a^*$ is green, $+b^*$ is yellow, and $-b^*$ is blue. The ΔE^* mean values of restorative materials after the use of two plaque disclosing agents were compared using two-way ANOVA. Pairs of mean were compared using Tukey test. The level of significance for all the tests was chosen as $p < 0.05$.

RESULTS

Regarding the restorative materials submitted to the dye application, the resin-modified glass ionomer presented the greatest change, and it was statistically significant ($p < 0.0001$). There was no statistically significant difference between the color changes with two composite resins ($p > 0.05$). The results obtained with the fluorescent dye did not present statistically significant differences among the restorative materials ($p > 0.05$) (Table 2).

When we compared the plaque disclosing agents, basic fuchsin showed a greater statistically significant color change in all the materials compared to the fluorescent dye (Table 2).

DISCUSSION

Despite the quality improvement of restorative materials, pediatric dentistry treatment reaches a better prognosis when the dental plaque control is done. The oral hygiene motivation should be made several times during the treatment.^{17,22} The plaque disclosing agents improved the motivation of the children.^{13,17,18,20,21}

Several plaque disclosing agents have been used: iodine solution, mercurochrome solutions, erythrosin, basic fuchsin and organic dye solutions.^{17,20,21} However, these agents also stain the oral mucosa. The use of fluorescent dyes reduced this problem.^{17,20,21}

Many studies have demonstrated suitable results with the use of plaque disclosing agents,^{18,23} although other authors have asserted that the use of plaque disclosing dyes is not essential to improve the plaque control.²⁴

The tooth-colored restorative materials provide better esthetic results. In the present study, we studied restorative materials and shades usually used in primary teeth restorations.⁹⁻¹¹ Nevertheless, the color stability of tooth-color materials remains a major problem. The color changes can be related to intrinsic changes, such as changes in filler, matrix or silane coating, or extrinsic factors, such as adsorption or absorption of soft drinks, juices, coffee, tea or products used in the dentist's office.^{2,5-8,25,26}

Thus, a side effect of the plaque disclosing agents could be the color change of the tooth-colored

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Table 2. Mean of color changes (ΔE^*) of the restorative materials (n=10) after the use of two plaque disclosing agents and brushing.

| Plaque disclosing dyes | Restorative materials Mean \pm SD | | | |
|------------------------|--|-------------------|-------------------|------------|
| | Ariston pHc | Vitremer | Filtek Z250 | |
| Basic fuchsin | 1.59 \pm 0.56 a | 5.95 \pm 1.07 b | 1.85 \pm 0.69 a | p < 0.0001 |
| Plaquestest | 0.69 \pm 0.26 c | 0.55 \pm 0.37 c | 0.86 \pm 0.48 c | ns |
| | p < 0.05 | p < 0.0001 | p < 0.05 | |

restorations. Because of this, the use of agents that do not induce staining in this kind of material is important. In our study, no tooth-colored restorative material showed color change after the use of the fluorescent plaque disclosing agent. However, when we used the basic fuchsin, the resin-modified glass ionomer presented greater color change than the color change of the two composite resins.

Fluoride releasing materials are more susceptible to staining. In general, hydrophobic materials (composite resins) showed greater stain resistance and better color stability than hydrophilic materials, such as resin-modified glass ionomers and compomers.⁶

Dietschi *et al.*³ studied the color stability of some materials in contact with erythrosin, a plaque disclosing agent similar to the fuchsin. The authors observed that the erythrosin raised the greatest color change for the composite resins tested. Nevertheless, the materials were kept in contact with the agent for a long period. Consequently, the color change (ΔE^*) was much higher than the color change in our study. The kind of dye used during the experiment influences the color changes.^{3,25}

The fluorescent dyes were produced because the other plaque disclosing agents stained soft tissues.¹⁷ This fact could be an advantage on the color stability of restorative materials. In the present study, we found smaller color changes of the tooth-colored materials with the use of the fluorescent dye.

In relation to the obtained color changes values, the resin-modified glass ionomer stained with basic fuchsin showed the greatest value ($\Delta E^*=5.95$). This value is considered visually perceptible by Ruyter *et al.*⁸ These authors consider as visually perceptible values above 3.3. However, the plaque disclosing agent was applied only one time on the samples. During the treatment, the child can be submitted to several contacts with the dye. Moreover, there is the action of other kind of products (soft drinks, tea, juices) that could increase the color changes of the restorations. Thus, despite the values obtained in our study be lower than the visually perceptible values proposed by Ruyter *et al.*,⁸ the changes observed with the basic fuchsin in the two composite resins could be significant when extrapolated to clinical situations.

CONCLUSIONS

The basic fuchsin solution changes the color of the tooth-colored restorative materials, especially in the resin-modified glass ionomer, while the fluorescent dye does not cause great changes. Thus, the basic fuchsin plaque disclosing agents should be carefully used on tooth-colored restorations and the use of the fluorescent plaque disclosing dye is preferable in children with a great number of esthetic restorations.

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