THE INFLUENCE OF EXTRINSIC COLORATION FACTORS ON COMPOSITES

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Abstract: Introduction: As we have observed the multiple color changes of composite restorative fillings, we decided to study the extrinsic factors that lead to their coloration. We have studied this visually and by computer, after a previous immersion of the composites in different colored and coloring substances, including cigarette smoke.

Purpose: To determine the substances that produce the color changes of composites (extrinsic coloration), in vitro study, also, the composites that remains aesthetic for a long period of time.

Method and material: In celluloid tooth shapes, we made 32 teeth, using four different composites shade A2, two nanocomposites and two microhybrid composites. We placed in each celluloid shape two layers of material, composites of the same group, resulting 16 teeth of nanocomposite and 16 teeth of microhybrid composite. After immersing them for 24 hours in purified water at 37°C, the mesial part of every tooth was polished. The teeth were immersed in 15 different substances and purified water was used as standard. After another 24 hours, we made a professional brushing and we evaluated their color again. Pictures were taken after every stage and they had been analyzed by a software.

Results: Some composites changed their color from A2 to A3 and A4, others, even to shades of B, C and D. The most intense coloration was produced by coffee and red wine.

Conclusions: The coloring drinks may produce significant alteration of the aesthetic of composites, which can be improved by professional brushing. Coloration depends not only on the coloring substance, but also on its pH level, the thickness of the composite, the texture of the surface and the immersion time.

Key words: restorative composites, color changes, extrinsic coloration.

INTRODUCTION

The coloration of composites is also a factor that determines the success of frontal direct restorations. The main reason why the frontal composite fillings are inaesthetic is the coloration of the material. This appears after about 3 years from the composites filling application. Composites can suffer in the patient’s mouth extrinsic, intrinsic and idiopathic colorations, even combinations between them. Nowadays composites are made to look as much as possible like the natural teeth.

Previous studies concerning color stability have shown that drinks such as coffee, tea, red wine, and cola drinks and mouth-rinses have varying degrees of staining effect on auto- and light-cured composite resin restorative materials. The staining potential of these drinks and solutions vary according to their composition, pH and properties [1,2].

Nanofilled composites have been recommended to be suitable for both anterior and posterior restorations by manufacturers in their product advertisements, although their longterm clinical performance and color
stability are yet to be known and proved. Further, studies that evaluate the discoloration properties of nanohybrid composites are severely lacking, such that limited dental literature is available to provide guidance on selection of nanohybrid resin composites for clinical usages [3,4,5,6].

PURPOSE

The purpose of this study was to determine the substances that produce the most intense color changes of composites, also, the composites that remain aesthetic for a long period of time. We used in this study some composites (C1, C2, C3 and C4) that are most available in Târgu Mureș.

C1 - Filtek Z 250 (3M ESPE) – microhybrid composite, shade A2
C2 - Filtek Supreme XT (3M ESPE) – nano-composite, shade A2
C3 - Charisma (Haereus Kulzer) – microhybrid composite, shade A2
C4 - Gradia Direct (GC) – nano-composite, shade A2

All of this composites were immersed in drinks staining agents and solutions.

MATERIAL AND METHODS

Using the four composites, we made 32 upper central incisors in polyester crown forms, size 70 (fig1).

We placed in each crown form two layers of material, composites of the same group, resulting 16 teeth of nano-composite and 16 teeth of microhybrid composite. We respected the producers indications: we applied layers of 2 mm of material, photopolymerizing them individually. After the photopolymerization, the teeth were immersed in purified water and placed in the thermostat for 24 hours at 37°C for hydration and to complete the polymerization. Then, the mesial third of each tooth was polished with finishing and polishing Sof Lex (3M ESPE) extrathin discs of four different granulations (coarse, medium, fine, ultrafine). The distal third of each tooth was protected with a composite sealant (OptiGuard-Kerr). The central third remained unmodified (fig.2).
The composite teeth were immersed in the following coloring substances for 24 hours at 37°C. Standard solution: purified water. We observed different color changes. A professional brushing was made to the teeth with an abrasive paste (Depural Neo - Spofa Dental) and we evaluated the color changes again. Photos were taken after every stage and they were analyzed by a special software ClearMatch (before and after the brushing).

Before each measurement software session, the photo camera was calibrated according to the manufacturer’s recommendations by using the supplied white calibration standard (refers to the lightness coordinate), and its value ranges from zero (black) to 100 (white). ClearMatch software system provide a topographical color map of the composite tooth in one image (fig.9). Measurements were repeated three times for each specimen. After baseline color measurements were made, each group was stored for 24 hours. Storage time of 24 hours was selected as the standard. The control group where specimens were stored in 37°C distilled water. After 24 hours of immersion, the specimens were rinsed with distilled water for five minutes and blotted dry with tissue paper before photos and software color measurement.

RESULTS

Some composites changed their color from A2 to A3 and A4, others, even to shades of B, C and D. We used a scale of value level, from 1 to 5 to identify the shade, with 1 being the lightest and least chromatic and 5 being the darkest and most chromatic (tab.I). Scale 0 served as the control group (shade A2) were specimens were stored in distilled water and artificial saliva. The most intense coloration was produced by grape juice, coffee, red vine, the oral antiseptic, pepper juice and lipstick (tab. I).

<table>
<thead>
<tr>
<th>Solution (pH)</th>
<th>C2</th>
<th>C4</th>
<th>C1</th>
<th>C3</th>
<th>C2</th>
<th>C4</th>
<th>C1</th>
<th>C3</th>
<th>C2</th>
<th>C4</th>
<th>C1</th>
<th>C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial saliva(6.8)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Coffee 10% (5.01)</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Red wine10,5%(3.7)</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<td>1</td>
<td>2</td>
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<tr>
<td>Fruit tea (4.21)</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Yellow tea (5.38)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Pepsi(2.43)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Conserved beetroot (5.0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Fresh beetroot (6.21)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Chocolate liqueur 25% (3.70)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
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With lighter shades, hue is difficult to discern because chroma is so low. ClearMatch software checks the tooth more yellowish (fig.8), more reddish (fig.3,4,5) or more blueish (fig.9, 10, 11) shade than the color sample of the group selected A2 shade, after immersing.
**Fig. 4.** Immersing the composite tooth in grape juice

**Fig. 5.** Composite tooth after polishing

**Fig. 6.** After immersing in red pepper

**Fig. 7.** Same composite tooth after polishing

**Fig. 8.** The color changes in shades of yellow
Computerised interpretation with software ClearMatch can provide a topographical color map of the composite tooth in one image with a detailed color distribution map using digital photography (fig.12,13,14,15).
DISCUSSION

Color determination in dentistry can be performed instrumentally using spectrophotometers and colorimeters. Instrumental colorimetry can potentially eliminate subjective errors in color assessment, and more importantly it is more precise than the naked eye in measuring slight differences in colored objects on flat surfaces [7,10]. Today’s digital shade analysis systems seek to mimic human visual system while eliminating the influence of negative visual illusion effects. Successful shade taking involves a combination of technology, shade tabs and reference photography [8,9,10,11,12].

In the present study, color change values for all resin composite restorative materials in tea, coffee, red wine, red pepper and oral antiseptic were greater than value 2. These values were considered visually perceptible as well as clinically unacceptable.

CONCLUSIONS

1. The resistance to coloring: nanocomposites were found to be more color stable to extrinsic coloration than universal resin composites.

2. When we chose a filling material, especially in the frontal area, we must pay attention to the patient’s eating habits.

3. Combining the multitude of coloring substances, the immersion time, the oral hygiene and smoking are factors which can influence the composites coloration.
4. Surprisingly, the drinks based on coke were not so coloring as we expected. Pepsi cola is more coloring than Coca cola, it also has a more acid pH. For all resin composite restorative materials tested, their color change values in tea, coffee, red wine, red pepper juice and oral antiseptics solutions were greater than value 2. In other words, their color change in these staining agents was visually perceptible as well as clinically unacceptable.

5. The coloring drinks may produce significant alteration of the aesthetic of composites, which in some cases can be improved by professional brushing.

6. As we have observed, the most resistant area to coloring was the polished surface, and the less resistant to coloring was the surface „protected” by the composite sealant.

7. Coloration depends not only on the coloring substance, but also on its pH level, the thickness of the composite and the texture of the surface.

8. In clinical practice, patients should be aware of the staining effects of the drinks tested in this study, while practitioners should take into consideration the staining susceptibility of the resin composites.

REFERENCES