Effect of Five Commercial Mouthrinses on the Microhardness and Color Stability of Two Resin Composite Restorative Materials

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Abstract: The aim of the present study was to investigate the effect of five commercially available mouthrinses in Egypt (namely; Antiseptol, Citroen-F, Flucal, Ezaflour, Listerine mouthrinses and distilled water was used as a control) on the microhardness and color stability of two resin composite restorative materials. A total of 120 specimens were fabricated and divided into two groups (Sixty each) for each measurement. Each group was subdivided into two subgroups, according to the hybrid resin-composite used (Tetric ceram;) and (Te-econom; non fluoride-containing). Each group of specimens was immersed after curing in distilled water for 24h, removed and blotted dry, then subjected to either microhardness measurement using a Vicker's microhardness tester or color measurement using spectrophotometer for the base line readings determination. Following that, each group was immersed in 20ml of the assigned treatment solution and incubated at 37°C for 24 hours. The specimens were then removed, rinsed, blotted dry and resubjected to microhardness or color measurement. The change in hardness value and in color difference was calculated for each sample. The results revealed that, all mouthrinses tested decreased the hardness of both tested resin-composites. The highest reduction in the hardness of both resin-composite restorative materials was found on using alcohol-containing mouthrinses. All tested mouthrinses produced a color change in both tested resin-composite. However, the greatest perceptible color change was observed on using sodium fluoride-containing mouthrinses with both resin-composites. It could be concluded that all mouthrinses tested in this study negatively affected the hardness and the color of the tested resin-composite, but the effect is both mouthrinse and material dependent. Mouthrinses with low pH are more detrimental to the hardness rather than to color stability. The combination between the active ingredients in a one mouthrinse might increase their adverse effect on the restorative materials.

Keywords: Commercial Mouthrinses, Color Stability, Resin Composite Restorative

INTRODUCTION

Nowadays caries is, more clearly than ever, viewed as an infectious disease process. Thus, medical model of treatment and non-restorative approaches including caries control measures and remineralization methods of initial lesions have been advocated.

For effective control of caries, interception with one or more of the necessary disease components, such as cariogenic bacterial plaque control, must be achieved. Given the difficulty of achieving acceptable levels of cariogenic plaque control with mechanical means, the chemoprophylactic agents may offer an adjunct (Devore, in 1990 and Fischman in 1994). Mouthrinses containing chlorhexidine and/or fluoride represent the simplest vehicle for chemoprophylactic agents. Reports stated that the alcohol in mouthrinses may soften the resin-composite restorations (Asmussen, in 1984). However, both alcohol-containing and alcohol-free mouthrinses could affect the hardness of the restorative materials (Gürgan et al., in 1997). As the hardness is related to material's strength and rigidity (Anusavice, in 1996), it has great implication on the clinical durability of restorations.

Another factor that affects the clinical longevity of anterior fillings is the unacceptable color match. Intrinsic factors due to changes in the filler, matrix or silane coating or extrinsic factors, such as adsorption or absorption of stains, may cause discoloration of esthetic materials. The intrinsic color of esthetic materials
may change when the materials are aged under various physical-chemical conditions, such as ultraviolet exposure, thermal changes and humidity. Therefore, discoloration of dental restorative materials has a multifactorial etiology (Iazzetti et al., 2000). It is also suggested that many internal and external factors may change the color of any aesthetic restorative material (Fruits et al., 1997). In an in-vivo situation, it is reported that saliva, food component and beverages may affect resin-composites (Lee et al., in 1998). In addition, proprietary mouthrinses are added also to these discolorizing factors (Penugonda et al., in 1994, Gürgan et al., in 1997).

Although the effect pattern of the mouthrinses on the restorative materials may be different depending on many factors that could not be replicated in-vitro, routine in-vitro testing of aesthetic restoratives is recommended for any new product (Gürdal et al., in 2002).

Based on such thinking, an in-vitro study to examine the effect of commercially-available mouthrinses in Egypt on the microhardness and the color change of two types of resin-composite restorative materials was conducted.

**MATERIALS AND METHODS**

**Materials:**

Two hybrid resin-composite restorative materials were used in the present study. The material brand name, specification, composition, shade, batch number and manufacturer are seen in table (1). Five types of commercially available mouthrinses in Egypt were used. The mouthrinse brand name, specification, composition and manufacturer are represented in table (2).

**Table 1:** The material brand name, specification, composition, shade, batch number and manufacturer.

<table>
<thead>
<tr>
<th>Material brand name (code)</th>
<th>Specification</th>
<th>Composition</th>
<th>Shade</th>
<th>Batch no</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetric Ceram (R)</td>
<td>Hybrid resin-composite (fluoride-releasing)</td>
<td>The organic part: Bis-GMA, urethane dimethacrylate and triethylene glycol (20.2% by weight). The inorganic part: Barium glass, ytterbium trifluoride Ba-Al-fluorosilicate glass, highly dispersed silicon dioxide and spheroid mixed oxide (79% by weight). The Filler size is (0.7ìm).</td>
<td>A₁</td>
<td>G08104</td>
<td>Ivoclar Vivadent Schaan, Liechtenstien</td>
</tr>
<tr>
<td>Te-econom (R)</td>
<td>Hybrid resin-composite (non-fluoride-releasing)</td>
<td>The organic part: Bis-GMA, urethane dimethacrylate and triethylene glycol dimethacrylate (18.8% by weight) and a small amount of catalyst, stabilizers and pigments (0.21% by weight). The inorganic filler (81% by weight). The filler size is (0.7ìm).</td>
<td>A₁</td>
<td>G10523</td>
<td>Ivoclar Vivadent</td>
</tr>
</tbody>
</table>

**Table 2:** The mouthrinse brand name, specification, composition and manufacturer.

<table>
<thead>
<tr>
<th>Mouthrinse brand name (color)</th>
<th>Specification (code)</th>
<th>Composition</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiseptol (red)</td>
<td>Chlorhexidine-containing mouthrinse (C)</td>
<td>-Chlorhexidine gluconate 0.1%, ponceaur 4R (E124), a synthetic &quot;coal tar&quot; dye and azodye.</td>
<td>Kahira pharmaceuticals and chemical Industries Co. Cairo-Egypt.</td>
</tr>
<tr>
<td>Citrolen-F (orange)</td>
<td>Chlorhexidine and fluoride-containing mouthrinse (CF)</td>
<td>-Chlorhexidine gluconate 0.02g, citramide 25mg, lidocaine HCL 50mg, sodium fluoride 50mg and FD&amp;C red 40.</td>
<td>Pharco pharmaceuticals Alexandria-Egypt.</td>
</tr>
<tr>
<td>Fluocal (green)</td>
<td>Sodium fluoride-containing mouthrinse (SF)</td>
<td>-Sodium fluoride 200mg, quinolyene yellow and methylene blue.</td>
<td>Alexandria Co.pharmaceuticals Alexandria-Egypt.</td>
</tr>
<tr>
<td>Ezafluor (green)</td>
<td>Amine fluoride-containing mouthrinse (AF)</td>
<td>-Cetylpyridinium chloride 0.05g, Bis(hydroxyethyl)-amino-propyl hydroxyethyl 1-octa decylaminedihydrofluoride 0.125g and brilliant blue no.1.</td>
<td>Kahira pharmaceuticals and chemical Industries Co. Cairo-Egypt.</td>
</tr>
<tr>
<td>Listerine (green)</td>
<td>Alcohol-containing mouthrinse (A)</td>
<td>-Eucapto (0.1%), methyl salicylate (0.07%), pluristic F-127, sorbitol solution, sodium saccharine, sodium citrate, acid citrate FD&amp;C Green No 3, thymol, Anthole Minyak spearmint, acid benzoic, water and alcohol (21.6%).</td>
<td>PT Pfizer Indonesia, Jakarta, Indonesia.</td>
</tr>
</tbody>
</table>
Methods:\n
Molds Fabrication:\nFor micro hardness measurement 12 circular Teflon plates were made. Each plate had a diameter of 30mm and a thickness of 2mm. In each plate, five holes with an internal diameter of 4mm were drilled. Regarding the color measurement, 60 specially constructed circular Teflon molds were fabricated. The mold was fabricated by drilling a central hole of 7.5mm diameter in a circular Teflon plate of 15mm diameter and 2mm thickness.

Specimens Preparation:\nEach mold was placed on a Mylar strip (Universal strips of acetate foil, Italy) that was placed on a microscopic glass slide. An amount of resin-composite sufficient to slightly overfill the mold was extruded from the tube. The material was then packed in place using a nitride plated resin-composite instrument (Aescolap, FIG.21B, Germany). Another Mylar strip was placed on the top of the mold and further covered with a second glass slide and pressed for 30 seconds to extrude the excess material and to obtain a uniformly smooth specimen surface.

Each specimen was light cured continuously for 40 seconds from the top then extra 40 seconds from the bottom of the specimen using Bluedent 3 (Halogen curing light, BG LIGHT LTD, Bulgaria) with a light intensity of not less than 450 mW/cm².

Grouping of the Specimens for Base Line Measurements:
A total of 120 specimens were fabricated. Sixty specimens for microhardness and 60 for color measurement. For each test, the 60 specimens were divided into two main groups, 30 specimens each, according to the resin-composite. Each specimen group was then immersed in 20ml of distilled water (pH = 7.14) in a dark bottle for 24 hours, prior to baseline assessment. The specimens were removed from distilled water using a twister and blotted dry using a filter paper. The baseline microhardness value of the specimens were determined using a Vicker's microhardness tester (HMV-2000 SHIMADZU, Japan).

The color was assessed using a spectrophotometer (Shimadzu, UV-3101 PC Schimadza Corporation, 1991). Colorimetric values of the specimens were determined using the L* a* b* system of the Commission Internationale de l'Eclairage (CIE L* a* b* color scale). The results obtained are considered baseline records for each specimen.

Immersion of the Specimens in the Treatment Solution:
The specimens were immersed in 20ml of the test solution contained within a dark bottle that was put in incubator (model 1545, Sheldon, England) at 37°C for 24 hours. Before and after immersion, the pH of the used solution was measured using a digital pH meter (Hand held pH/mv/ Temperature meter, 1Q140, USA) (table, 3).

<table>
<thead>
<tr>
<th>Treatment solution</th>
<th>pH before treatment</th>
<th>pH before treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antisepol (C)</td>
<td>6.73</td>
<td>7.15</td>
</tr>
<tr>
<td>Citroen F (CF)</td>
<td>5.83</td>
<td>5.95</td>
</tr>
<tr>
<td>Flucal (SF)</td>
<td>6.70</td>
<td>6.53</td>
</tr>
<tr>
<td>Ezaflour (AF)</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Listerine (A)</td>
<td>4.30</td>
<td>4.20</td>
</tr>
<tr>
<td>Distilled water (D)</td>
<td>7.14</td>
<td>7.3</td>
</tr>
</tbody>
</table>

After Treatment Measurements:
All specimens were removed after 24 hours of their immersion in treatment solution and incubation. Distilled water (pH=7.14) was used to thoroughly rinse each specimens for 120s. Each specimen was then blotted dry using a filter paper then subjected to either microhardness or color measurement. The change in hardness value between the baseline and after treatment measurement were calculated according to the following equation: \( \Delta VHN= VHN \text{ (after treatment)} - VHN \text{ (baseline)} \)

For the color assessment, each specimen was subjected to color measurement in the same way as the baseline. The color difference \( \Delta E^* \) was calculated for each sample using the following equation: \( \Delta E^* = \sqrt{\left( \Delta L^* \right)^2 + \left( \Delta a^* \right)^2 + \left( \Delta b^* \right)^2} \). The recorded data for the microhardness measurement and color assessment were collected and statistically analyzed between the groups using unpaired t-test and within the
same group using paired t-test. All statistical calculations were done using computer programs Microsoft Excel version 7 (Microsoft Corporation, NY, USA) and SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) statistical program. For all statistical tests performed a result was considered statistically significant at P<0.05. Table 3 shows the descriptive analysis of the samples of each group.

RESULT AND DISCUSSIONS

Results:
The paired t-test revealed that the overall difference in the mean VHN values of both resin-composite restorative materials at baseline and after treatment regardless the treatment solution type was statistically significant (P<-0.01).

Table (4) and figure (2) shows the mean ΔVHN values and standard deviation (SD) of Tetric Ceram compared to Te-econom treated with each treatment solution. For Antiseptol mouthrinse, statistical analysis revealed no significant difference (p >0.05) between both resin-composite restorative materials. While, in Citrolen F group the ΔVHN mean±SD value for Tetric Ceram was (-3.34±0.05) and for Te-econom was (-1.72±0.16), the difference in the ΔVHN mean±SD value was statistically significant (P<0.01). On using Flucal the ΔVHN mean±SD value for Tetric Ceram was (-1.86±0.44) and for Te-econom it was (-1.92±0.16), whereas, the difference between the ΔVHN mean±SD values was not statistically significant (p >0.05).

Table 4: The mean ΔAVHN values and standard deviation (SD) of Tetric Ceram compared to Te-econom treated with each treatment solution.

<table>
<thead>
<tr>
<th>Treatment solution</th>
<th>Tetric Ceram ΔAVHN (mean ± SD)</th>
<th>Te-econom ΔAVHN (mean ± SD)</th>
<th>P-value</th>
<th>S: Significant</th>
<th>ns: not significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiseptol (C)</td>
<td>-1.94 ± 0.23</td>
<td>-2.38 ±1.26</td>
<td>&gt;0.05</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Citrolen F (CF)</td>
<td>-3.34 ± 0.05</td>
<td>-1.72 ±0.16</td>
<td>&lt;0.01</td>
<td>s</td>
<td></td>
</tr>
<tr>
<td>Flucal (SF)</td>
<td>-1.86 ± 0.44</td>
<td>-1.92 ±0.16</td>
<td>&lt;0.05</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Ezaflores (AF)</td>
<td>-5.27 ±1.31</td>
<td>-3.22 ±0.58</td>
<td>&lt;0.05</td>
<td>s</td>
<td></td>
</tr>
<tr>
<td>Listerine (A)</td>
<td>-14.14 ± 0.56</td>
<td>-13.06 ± 0.76</td>
<td>&lt;0.05</td>
<td>s</td>
<td></td>
</tr>
<tr>
<td>Distilled water (D)</td>
<td>1.8 ± 0.29</td>
<td>2 ±0.60</td>
<td>&gt;0.05</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

S: Significant
ns: not significant

On using Listerine the ΔVHN mean ± SD value for Tetric Ceram was (-14.14±0.56) and for Te-econom it was (-13.06±0.76), the difference in the ΔVHN mean±SD was statistically significant (p <0.05). Distilled water revealed a ΔVHN mean±SD value for Tetric Ceram of (1.8±0.29) and for Te-econom it was (2±0.60), the difference in the ΔVHN mean±SD was not statistically significant (p >0.05).

Table (5) and figure (3) show the mean of ΔE values and standard deviation (SD) of Tetric Ceram compared to Te-econom treated with different treatment solutions. On using Antiseptol ΔE mean±SD value for Tetric Ceram was (1.69±0.72) and for Te-econom was (0.94±0.43), whereas, statistical analysis revealed no significant difference between them (p >0.05). In Citrolen F group ΔE mean±SD value for Tetric Ceram was (2.95±0.86) and for Te-econom was (8.15±0.59). The difference between these mean values was statistically significant (p <0.001). On using Flucal ΔE mean±SD value for Tetric Ceram was (16.13±1.55) and
Table 5: The mean of ΔE values and standard deviation (SD) of Tetric Ceram compared to Te-econom treated with different treatment solutions.

<table>
<thead>
<tr>
<th>Treatment solution</th>
<th>ΔE of Tetric Ceram (mean ± SD)</th>
<th>ΔE of Te-econom (mean ± SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiseptol (C)</td>
<td>1.69 ±0.72</td>
<td>0.94 ±0.43</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>Citrolean F (CF)</td>
<td>2.95 ±0.86</td>
<td>8.15 ±0.59</td>
<td>&lt;0.001 s</td>
</tr>
<tr>
<td>Flucal (SF)</td>
<td>16.13 ±1.55</td>
<td>11.96 ±0.66</td>
<td>&lt;0.001 s</td>
</tr>
<tr>
<td>Ezaflour (AF)</td>
<td>2.57 ±0.94</td>
<td>3.03 ±0.83</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>Listerine (A)</td>
<td>1.95 ±0.69</td>
<td>2.12 ±1.17</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>Distilled water (D)</td>
<td>1.95 ±0.89</td>
<td>3.02 ±0.67</td>
<td>&gt;0.05 ns</td>
</tr>
</tbody>
</table>

S: Significant  
nS: not significant

Fig. 3: Column chart showing mean of ΔE values of Tetric Ceram compared to Te-econom treated with different treatment solution.

for Te-econom was (11.96±0.66). This difference in the mean was also statistically significant (p <0.01). While, on using the ΔE mean±SD values for Tetric Ceram and for Te-econom in Ezaflour group were (2.57±0.94) and (3.03±0.83) respectively, which was not statistically significant (p >0.05). On using Listerine the ΔE mean±SD value for Tetric Ceram was (1.95±0.69) and for Te-econom it was (2.12±1.17). The change was not statistically significant (p >0.05). Distilled water group samples revealed a ΔE mean SD value of (1.95±0.89) for Tetric Ceram and (3.02±0.067) for Te-econom. The difference between these mean values was not statistically significant (p >0.05).

Discussion:

In an in vivo situation, it is reported that food components and beverages may affect resin-composites (Lee et al., 1998). Though mouthrinses are considered one of these affecting factors (Penugonda et al., in 1994; Gürgan et al., 1997), and their use has become popular recently (Gagari and Kabani, 1995 and Walsh, 1996) not only as a result of their effectiveness in caries and gingivitis control but also because people tend to use mouthrinses for social and cosmetic reasons, the studies about their effect on both the microhardness and color stability of the tooth-colored restorative materials are very limited (Gürdal et al., in 2002). This motivated us to conduct the present study, especially; the selected mouthrinses are from the commonly used mouthrinses in the Egyptian market.

Two hybrid resin-composite restorative materials of shade (A₄) were selected for this study. Both resin-composites were from the same manufacturer to eliminate any difference in the composition of the organic component of the resin-composite restorative material, hence exclude any variable rather than the filler factor. The selected shade was a universal color for both resin-composite restorative materials, as the lighter shades of composites were likely to be subject to higher color change (Uchida et al., in 1998).

For color measurement a specially constructed mold was fabricated for each specimen to eliminate any contact with the resin-composite restorative materials. The specimens were packed against a celluloid strip to minimize the oxygen inhibition layer (Finger and Jorgensen, in 1976), and to obtain the smoothest possible surface (Dietschi et al., in 1994; Yap et al., in 1997; Stoddard and Johnson, in 1999).
After curing, the specimens used for both testing were immersed in distilled water for 24 hours, for elution of unreacted components from the resin-composites (Ferracane and Condon, in 1990) and to allow for post-irradiation and post setting polymerization to occur (Yap et al., in 1997, Gürdal et al., in 2002). The specimens were immersed in the treatment solution for 24 hours which is equivalent to a minimum of two years of two minutes use as described by El Badrawy et al., in 1993.

The relative importance of a microhardness test lies in the fact that it sheds light on the mechanical properties of the material (Braem et al., in 1989). So, as hardness is related to a material’s strength and rigidity (Anusavice, in 1996), any chemical softening resulting from the use of mouthrinses would have implications on the clinical durability of the restorations.

The result of the present study revealed that, all mouthrinses in the present study increased the hardness of both tested resin-composites (table 5). This was in agreement with Penugonda et al., in 1994 and Gürgan et al., in 1997, who had reported that both alcohol containing and alcohol-free mouthrinses affected the hardness of the resin-composites and that alcohol is not the only factor that has softening effect on resin-composite restorative materials.

The highest reduction in the hardness of both resin-composite restorative materials was found on using alcohol-containing mouthrinses (Listerine). This finding was in accordance with Kao et al., in 1989 which revealed that, both BisGMA and UDMA-based polymers are susceptible to chemical softening by ethanol. This softening effect was found to be directly related to the percentage of alcohol in the mouthrinses (Penugonda et al., in 1994). Furthermore, Listerine have low pH and high alcohol percentage so it greatly affects the hardness of resin-composite. (Weiner et al., in 1997, Yap et al., in 2003, Gürdal et al., in 2002 and Fraizer et al., in 2006).

On using the sodium fluoride-containing mouthrinses (Flucal), the hardness of both resin-composite was equally decreased. This was in accordance with Yap et al., in 2003. While on using amine fluoride-containing mouthrinses (Ezafluor), the hardness of both resin-composite restorative materials was markedly decreased. This finding is not supported by a pervious study. Although both contain fluoride, the effect of the two fluoride containing mouthrinses Flucal (SF) and Ezafluor (AF) was different, where Ezafluor was more detrimental to both tested resin-composites. This finding suggests that it is not only the role of the active ingredient that may affect the properties of the material, but other factors may have a direct influence. This reduction in hardness may be due to the low pH (5) of the Ezafluor mouthrinse. Previous research by Diaz-Arnold et al., in 1995, showed that low pH media affect the chemical erosion of the hybrid restorative materials by acid etching the surface and leaching the principal matrix-forming cations (Ca, Na, Al, Sr).

On using the chlorhexidine-containing mouthrinses (Antiseptol) the hardness of Tetric-Ceram resin-composite was decreased while Te-econom was not significantly affected. On using the chlorhexidine and sodium fluoride-containing mouthrinse Citrofen (Citrolen F), the hardness of both resin-composite restorative materials was decreased, but still the hardness of Tetric-Ceram was more affected than that of Te-econom. This finding is not supported by a pervious study, but this may be attributed to, the potentiating effect of chlorhexidine on the present sodium fluoride, as the existence of chlorhexidine in the mouthrinse may have activated and facilitated the active interaction with the fluoride present in the filler of Tetric-Ceram. Such finding required further investigations.

On the other hand, immersion in distilled water showed an increase in the hardness of both resin-composite restorative materials. This was in accordance with Badra et al., in 2005. This may be due to elution of unreacted components from the resin-composites and post-irradiation and post setting polymerization that occur as previously mentioned.

Color is one of the most important attribute to aesthetic restorations. The color of aesthetic materials is affected by matrix, filler composition, filler content, minor pigment addition, initiation components and filler coupling agents, and the interactions of each of these components might have a role in color stability of the material (Johnston and Reisbick, in 1997). Also both of the internal and external factors may change the color of the tooth-colored restorative materials (Fruits et al., in 1997).

Because the ability of the human eye to appreciate differences in color differs from individual to individual (as it is a combination of eye characteristics and skill of the operator), three different intervals were used for distinguishing color differences. Values of $E < 1$ were regarded as not appreciable by the human eye. If $3.3 > E > 1$, this color difference is appreciable by skillful operator but considered clinically acceptable. Whilst values of $E > 3.3$ are appreciable by non skilled persons and considered clinically unacceptable (Miyagawa et al., in 1981 and Um and Ruyters in 1991).

Although, staining of teeth and oral mucous membranes is a well known side-effect with chlorhexidine mouthrinses (Addy, et al., in 1995), no perceptible color change of both tested resin-composite restorative
materials was observed after immersion in Antiseptol mouthrinse. This finding was in accordance with Lee et al., in 2000. This result may be due to the fact that there were no food additives in the immersion solution which are considered as dietary chromogens that may modify the resultant effect, playing an important role on the color change.

The greatest perceptible color change was observed on using sodium fluoride-containing mouthrinses (Flucal) with both resin-composites. These results were in disagreement with Lee et al., in 2000, who reported that sodium fluoride-containing mouthrinses (Rembrandt) which was used in their study does not cause a perceptible color change. This may be due to that the percentage of sodium fluoride in Flucal (0.2%) was higher than that found in Rembrandt (0.05%).

On using Citrolen F, there was no perceptible color change found with Tetric Ceram. While, there was on using Te-econom restorative material, thus may be due to the combination between the sodium fluoride and chlorhexidine had potentiated the effect of this mouthrinse on Te-econom. This finding was not supported by previous studies. This further indicates lack of correlation between color change and microhardness where the color change results are completely reversed compared to the microhardness results regarding the same mouthrinse. This finding is in agreement with Schulze et al., in 2003 who reported on absence of correlation of color change with surface hardness changes after material aging.

On using amine fluoride-containing mouthrinses (Ezafluor), in spite of its low pH it does not cause perceptible color change on both resin-composite used. In spite of a high alcohol content and low pH of Listerine it did not appear to cause perceptible color change on both resin-composite restorative materials tested. This result was in accordance with Lee et al., in 2000 and Gürdal et al., in 2002.

On immersion in distilled water no perceptible color change was found with both resin-composite despite that it caused more color change than that obtained with chlorhexidine-containing and alcohol-containing mouthrinses, this result was in accordance with Lee et al., in 2000.

Considering the clinical conditions, effective influence pattern of mouthrinses on restorative materials may be different depending on many factors that could not be replicated in-vitro. Saliva, salivary pellicle, foods and beverages consumed may have additive mitigating effects on the physical and aesthetic properties of this group of restorative materials. Therefore, studies are necessary to evaluate these parameters in-vivo conditions.

Conclusions: Under the Conditions of the Present Study the Following Conclusions Could Be Derived:

- All mouthrinses tested in this study negatively affected the hardness of the tested resin-composite, but the effect was both mouthrinse and material dependent.
- The alcohol-containing mouthrinse was most detrimental to the hardness of both resin-composite restorative materials.
- Mouthrinses with low pH are more detrimental to the hardness rather than to color stability.
- All mouthrinses tested in this study caused a color shift in the tested resin-composite, but the color shift was both mouthrinse and material dependent.
- The high concentration sodium fluoride-containing mouthrinse is capable of producing perceptible color change of both resin-composite restorative materials.
- The combination between the active ingredients in a one mouthrinse might increase their adverse effect on the restorative materials.

Clinical Recommendations:

- Dentist should instruct patients having resin-composite restoration, especially in posterior region, to avoid use of alcohol containing mouthrinses due to its softening effect.
- Patients having resin-composite restorations in the esthetic zone should avoid using mouthrinses of high concentration of sodium fluoride.

REFERENCES


