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

[1]Diab M; [1]Zaazou M.H., [2]Mubarak E.H and [3]Olaa M.I. Fahmy

[1]Oro-dental Research department, National Research Center.
[2]Operative Dentistry Department, faculty of Oral and dental Medicine, Cairo University.
[3]Operative Dentistry Department, faculty of Oral and dental Medicine,
Misr International University, Cairo, Egypt.

Abstract: The aim of the present study was to investigate the effect of five commercially available mouthrinses in Egypt (namely; Antiseptol, Citrolen-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 longevey 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

---

Corresponding Author: Diab M, Oro-dental Research department, National Research Center, Egypt.

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*., in 2000). It is also suggested that many internal and external factors may change the color of any aesthetic restorative material (Fruits *et al*., in 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.

Material brand name (code)	Specification	Composition	Shade	Batch no	Manufacturer
Tetric Ceram (R_1)	Hybrid resin-composite (fluoride-releasing)	The organic part: Bis-GMA, urethane dimethacrylate and triethylene glycol (20.2% by weight).	A_3	G08104	Ivoclar vivadent Schaan, Liechtenstien
		The inorganic part: Barium glass, yetterbium trifluoride Ba-Al-fluorosilicate glass, highly dispersed silicon dioxide and spheroide mixed oxide (79% by weight). The Filler size is (0.7μm).	A_3	G10523	Ivoclar vivadent
Te-econom (R_2)	Hybrid resin- composite (non fluoride-releasing)	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 (0.7μm).			Schaan, Liechtenstien

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

Mouthrinse brand name (color)	Specification (code)	Composition	Manufacturer
Antiseptol (red)	Chlorhexidine-containing mouthrinse (C)	-Chlorhexidine gluconate 0.1%, ponceaur 4R (E124), a synthetic "coal tar" dye and azodye.	Kahira pharmaceuticals and chemical Industries Co. Cairo-Egypt.
Citrolen-F (orange)	Chlorhexidine and fluoride -containing mouthrinse (CF)	-Chlorhexidine gluconate 0.02g, citramide 25mg, lidocaine HCL 50mg, sodium fluoride 50mg and FD&C red 40.	Pharco pharmaceuticals Alexandria-Egypt.
Fluocal (green)	Sodium fluoride -containing mouthrinse (SF)	-Sodium fluoride 200mg, quinolyene yellow and methylene blue.	Alexandria Co.pharmaceuticals Alexandria-Egypt.
Ezafluor (green)	Amine fluoride-containing mouthrinse (AF)	-Cetylpridinium chloride 0.05g, Bis(hydroxyethyl)-amino-propyl hydroxyethyl 1-octa decylaminedihydro -fluoride 0.125g and brilliant blue no.1.	Kahira pharmaceuticals and chemical Industries Co. Cairo-Egypt.
Listerine (green)	Alcohol-containing mouthrinse (A)	-Eucaptol (0.1%), methyl salicylate (0.07%), pluronic F-127, sorbitol solution, sodium saccharine, sodium citrate, acid citrate FD& Green No 3, thymol, Anthole Minyak spearmint, acid benzoic, water and alcohol (21.6%).	-PT Pfizer Indonesia, Jakarta, Indonesia.

Methods:
Molds Fabrication:
For 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:
Each 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/cm^2.

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 twizer 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 3: The pH values of different treatment solutions before and after treatment for both resin composites.

Treatment solution	pH before treatment	pH before treatment	
		Te-econom	Tetric Ceram
Antiseptol (C)	6.73	7.15	5.45
Citrolen F (CF)	5.83	5.95	5.85
Flucal (SF)	6.70	6.53	7.30
Ezaflour (AF)	5.00	5.00	5.00
Listerine (A)	4.30	4,20	4.20
Distilled water (D)	7.14	7.3	6.95

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: ΔVHN= VHN (after treatment) – VHN (baselin

For the color assessment, each specimen was subjected to color measurement in the same way as the baseline. The color difference ΔE* was calculated for each sample using the following equation: $\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{\frac{1}{2}}$. 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). In Ezaflour group the ΔVHN mean±SD value for Tetric Ceram was (-5.27±1.31) and for Te-econom was (-3.22±0.58), the difference in the ΔVHN mean±SD was statistically significant (p <0.05).

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

Treatment solution	Tetric Ceram ΔVHN (mean ± SD)	Te-econom ΔVHN (mean ± SD)	P-value	
Antiseptol (C)	-1.94 ± 0.23	-2.38 ±1.26	>0.05	ns
Citrolen F (CF)	-3.34 ± 0.05	-1.72 ±0.16	<0.01	s
Flucal (SF)	-1.86 ± 0.44	-1.92 ±0.16	>0.05	ns
Ezaflour (AF)	-5.27 ±1.31	-3.22 ±0.58	<0.05	s
Listerine (A)	-14.14 ± 0.56	-13.06 ±0.76	<0.05	s
Distilled water (D)	1.8 ± 0.29	2 ±0.60	>0.05	ns

S: Significant
ns: not significant
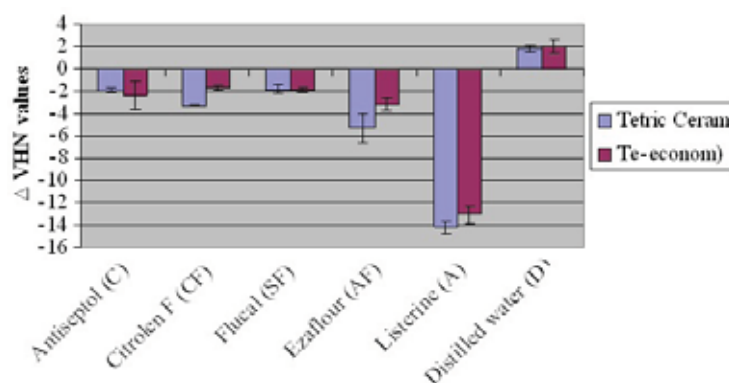
Fig. 2: Column chart showing the mean ΔVHN values and standard deviation of Tetric Ceram compared to Te-econom treated with each treatment solution.
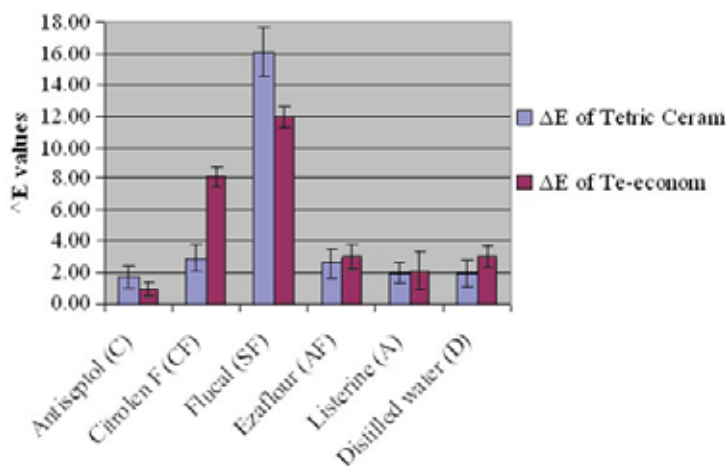
On using Listerine the ΔVHN mean ± SD value for Tetric Ceram was (-14.14±0.56) and for Te-econom it was (-13.06±0.76), the difference in the ΔVHN mean±SD was statistically significant (p <0.05). Distilled water revealed a ΔVHN mean±SD value for Tetric Ceram of (1.8±0.29) and for Te-econom it was (2±0.60), 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.

Treatment solution	ΔE of Tetric Ceram (mean ± SD)	ΔE of Te-econom mean ± SD))	P-value	
Antiseptol (C)	1.69 ±0.72	0.94 ±0.43	>0.05	ns
Citrolen F (CF)	2.95 ±0.86	8.15 ±0.59	<0.001	s
Flucal (SF)	16.13 ±1.55	11.96 ±0.66	<0001	s
Ezaflour (AF)	2.57 ±0.94	3.03 ±0.83	>0.05	ns
Listerine (A)	1.95 ±0.69	2.12 ±1.17	>0.05	ns
Distilled water (D)	1.95 ±0.89	3.02 ±0.67	>0.05	ns

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 gruop 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 reavealed 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 (A_3) 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-irridation 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 decreased 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 (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-irridation 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

Addy, M., J. Moran and R. Newcombe, 1995. The comparative tea staining potential of phenolic, chlorhexidine and anti-adhesive mouthrinses. Journal of Clinical Periodontology; 22: 923-928.

Anusavice, K.L., 199.: Mechanical properties of dental materials. Phillip's Science of Dental Materials 10th edition Philadelphia WB Saunders Co, USA; page: 69.

Asmussen, E., 1983. Factors affecting the color stability of restorative resins. *Acta Odontologica Scandinavia;* 4: 11-18.

Asmussen, E., 1984. Softening of BISGMA-based polymers by ethanol and by organic acids of plaque. Scandinavian Journal of Dental Research; 92: 257-261.

Badra, V.V., J.J. Faraoni, R.P. Ramos and R.G. Palma Dibb, 2005. Influence of different beverage on the microhardness and surface roughness of resin-composites. Operative Dentistry; 30: 213-219.

Braem, M., W Finger, V.E. Van Doren, P. Lambrechts and G. Vanherle, 1989. Mechanical properties and filler fraction of dental composite. Dental Materials, 5: 346-348.

Devore, L.R., 1990. Antimicrobial mouthrinses: impact on dental hygiene. Journal of the American Dental Association, 125: 235-285.

Diaz-Arnold A.M., D.W. Wistrom and E.l.J. Swift, 1995. Topical fluoride and glass ionomer microhardness. American Journal of Dentistry, 8: 134-136.

Dietschi, D., G. Campanile, J. Holz and J. Meyer, 1994. Comparison of color stability of ten new generation composites: An *in-vitro* study. Dental Materials, 10: 353-362.

El-Badrawy, W.A.G., D. McComb and R.E. Wood, 1993. Effect of home-use fluoride gels on glass-ionomer and composite restorations. Dental Materials, 9: 63-67.

Ferracane, J.L., J.R. Condon, 1990. Rate of elution of leachable components from composite. Dental Materials, 6: 282-287.

Finger, W. and D.S. Jorgensen, 1979. Inhibition of polymerization by oxygen in composite filling materials and enamel sealer. Schweizerissche Monatsschrift Fur Zahnheilkunde, 86: 812-824.

Fischman, S.L., 1994. A clinican's perspective on antimicrobial mouthrinses. Journal of the American Dental Association, 125: 20-22.

Frazier, Kevin, Wataha and John, 2006. Evaluation of the effect of mouthrinses on the hardness of esthetic restorative materials. Dental Newspaper.

Fruits, T.J., M.G. Duncanson and F.J. Miranda, 1997. In vitro weathering of selected direct esthetic restorative materials. Quintessence International, 28: 409-414.

Gagari, E. and S. Kabani, 1995. Adverse effects of mouthwashes use. A review. Oral Surgery Oral Medicine Oral pathology Oral Radiology and Endodontics, 80: 432-439.

Gürdal, P., B. Güniz, Akdeniz and S.E.N. Hakan, 2002. The effects of mouthrinses on microhardness and colour. Journal of Oral Rehabitulation, 29: 895-901.

Gürgan, S., A. Onen and Koprülü, 1997. *In-vitro* effect of alcohol-containing and alcohol-free mouthrinses of some restorative materials. Journal of Oral Rehabitulation, 24: 244-246.

Iazzetti, G., J.O. Burgess, D. Gardiner and A. Ripps, 2000. Color stability of fluoride-containing restorative materials. Operative Dentistry; 25: 520-25.

Johnston, W.M. and M.H. Reisbick, 1997. Color and tranculucency changes during and after curing of esthetic restorative materials. Dental Materials, 13: 89-97.

Kao, E.C., 1989. Influence of food-simulating solvents on resin composites and glass-ionomer restorative cement. Dental Materials, 5: 201-208.

Lee, S.Y., H.M. Huang, C.Y. Lin and Y.H. Shih, 1998. Leached components from dental composites in oral simulating fluids and the resultant composite strengths. Journal of Oral Rehabilitation, 25: 575-588.

Lee, Y.K., M. Zawahary and K.M. Noaman, 2000. Effect of mouthwash and accelerated aging on the color stability of esthetic restorative materials. American Journal of Dentistry; 13: 159-161.

Miyagawa, Y., J.M. Powers, W.J. O'Brien, 1981. Optical properties of direct restorative materials. Journal of Dental Research, 60: 890-894.

Penugonda, B., L. Settemmrini, W. Scherer, E. Hittellman and H. Strassler, 1994. Alcohol-containing mouthwashes: effect on composite hardness. The Journal of Clinical Dentistry; 5: 60-62.

Schulze, K., S.J. Marshall, S.A. Gansky and G.W. Marshall, 2003. Color stability and hardness in dental composite after accelerated aging. Dental Materials, 19: 612-619.

Stoddard, J.W. and G.H. Johnson, 1999. An evaluation of polishing agents for composite resin. Journal of Prosthetic Dentistry, 65: 491-495.

Uchida, H., J. Vaidyanathan, T. Viswanadhan and T.K. Vaidyanathan, 1998. Color stability of dental composite as a function of shade. Journal of Prosthetic Dentistry, 79: 372-377.

Um, C.M. and I.E. Ruyters, 1991. Staining of resin-based veneering materials with coffee and tea. Quintessence International, 22: 377-386.

Walsh, T.F., 1996. Mouthrinses as adjuncts in periodontal therapy. Dental Update, 23: 144-147.

Weiner, R., P. Millstein, E. Hoang and D. Marshall, 1997. The effect of alcoholic and non alcoholic mouthwashes on heat treated composite resin. Operative Dentistry, 22: 249-253.

Yap, A.U., K.W. Lye and C.W. Sau, 1997. Surface characteristic of tooth-colored restoratives polished utilizing different polishing systems. Operative Dentistry; 22: 260-265.

Yap, A.U.J., B.W.Y. Tan, L.C. Tay, K.M. Chang, T.K. Loy and B.Y.Y. Mok, 2003. Effect of mouthrinses on microhardness and wear of composite and compomer restoratives. Operative Dentistry; 28: 740-746.