EFFECT OF TWO DIFFERENT COMMONLY AVAILABLE ENERGY DRINKS ON SURFACE MICRO HARDNESS OF TOOTH COLOR RESTORATIVE MATERIALS

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ABSTRACT

AIM: The objective of present study was to assess the effect of commonly used energy drinks on surface micro hardness of tooth color restorative materials. **MATERIAL AND METHODS:** Sixty discs of all material were prepared in polytetrafluoroethylene mold which was 10 mm in diameter and 2 mm in thickness. Two groups were made for each material containing 10 discs; G1/G2 (vitofil), G3/G4 (vitremere), G5/G6 (Filtek Z350). After 24 hours, the discs were polished. Group 1, group 3 and group 5 were immersed in red bull for 2 minutes during whole expereiment. Group 2, group 4 and group 6 were immersed in jolt cola for 2 minutes during whole expereiment. Microhardness test were performed in digital micro hardness tester before and after immersion at different time interval. The results were statistically analyzed with the help of two-way ANOVA with repeated measurement and Tukey's test. **RESULTS:** According to time interval for vitofil and vitremere there is insignificant difference between baseline and day 1 surface micro hardness values ($p>0.001$). Significant difference is seen between baseline micro hardness and day 7 day 14,day 30 ($p<0.001$). Inverse is true for Filtek Z350 there is significant difference between base line and day 1 micro hardness values($p<0.001$). The difference between base line, day 7, day 14 and day 30 is insignificant ($p>0.001$). According to immersion media there is insignificant difference between both of them ($p>0.001$). **CONCLUSION:** The effect of energy drinks on the surface micro hardness of a restorative material depends on the duration of contact time and the material composition not on the type of drink.

KEYWORDS

Surface micro hardness. Energy drinks. Tooth color restorative materials. Deionized water. Immersion medium.

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INTRODUCTION

In recent years among young generation especially 18- to 35-year-olds the consumption of sports and energy drinks has gained high popularity.[1] The purpose of its popularity is to prevent dehydration during physical activity and enhance performance during work. Many young students take these kinds of drinks during exam.[2] Although, previous researches have shown that these energy drinks potentially cause dental erosion and, due to their low pH, may be unfavorable to the properties of restorative materials.[2,3]

A variety of restorative materials are used to treat erosive lesions, including glass ionomer cement, resin modified glass ionomer cement, compomer, and resin composite. In dentistry to restoring erosive lesions Glass ionomer cement (GIC) has been widely used because of its favorable properties such as fluoride release, esthetic appearance and ability to establish good bond to enamel and dentine.[4]

In conventional glass ionomer cement poly acid were altered with a suspended methacrylate group and Resin-modified glass ionomer cement (RMGIC) was made.[5] Some researches declared that mechanical properties of resin modified glass ionomer cement are enhanced in comparison to glass ionomer cement.[6,7] However, occlusal restoration with RMGIC still has a high rate of degradation when compared to resin composite and amalgam.[8,9]

The use of resin composite has significantly increased over the past few years because of their excellent aesthetic appearance, enhancement in formulations, easy use, and capability to create a bond to dental hard tissues.[10,11] Recent advancements in the organic matrix of nano composite with compact size of particles and increased loading of filler, and have resulted in improved mechanical properties and aesthetics.[12,13]

For successfully restoring erosive lesion, acid resistance is the property required by restorative material to have long-term retention.[14] It is not only depends up on the intrinsic characteristics of the materials, but also on the oral environment in which they are exposed.[15] Oral cavity is a complex environment where the restorative material is in contact with saliva. In addition, other factors such as temperature variation, low pH due to acidic foods and drinks.[16] previous researches claimed that variety of foods and beverages that have low pH can reduce micro-hardness of these materials.[17,18]

Physical properties of restorative materials are an important factor when determining suitable restorative materials because they powerfully affected longevity of restoration.[19] One of the most important property is the material's micro-hardness, which is mainly associate with compressive

strength, resistance to acidic challenges, and degree of conversion.[20] A reduction in surface hardness value is mainly related to inadequate wear resistance which deleteriously affect the fatigue strength and result in failure of the restoration.[11]

These commonly used drinks can significantly reduce the surface hardness of glass ionomer cement, but cause insignificant changes to the resin modified glass ionomer cement and resin composite.[18] Little is known about the effect of commonly available energy drinks on these restorative materials. Thus, the objective of current study was to investigate the effect of two commonly available energy drinks on surface micro hardness of three restorative materials: Glass ionomer cement, resin-modified glass ionomer cement, and resin composite. The null hypothesis tested was that there was no difference in the surface micro-hardness of these restorative materials after immersion in the energy drinks being tested.

MATERIAL AND METHODS

In the current study materials used included conventional glass ionomer cement and resin modified glass ionomer cement and nano composite. Two commonly used worldwide energy drinks named Red bull and Jolt cola was used. Details of materials are shown in Table I.

SAMPLE PREPARATION:

Total sixty specimens twenty of each restorative material were made using polytetrafluoroethylene mold (10 mm diameter 2 mm of thickness). vitremer and vitrofil were mixed manually according to manufacturer's instructions. After mixing, molds were overfilled, to avoid air bubbles and inclusions molds were covered with Mylar strip and compressed with glass slides from the upper and lower surfaces. Vitremer were light cured at the distance of 1 mm for 40 seconds on each side with LED curing lamp Mectron (intensity 1.000 mw/cm2 starlight pro-led curing lamp, Italy). Vitrofil specimens were left for 5 minutes for setting. After setting, glass slides and mylar strips were removed. Discs with voids, bubbles and uneven rough surface texture were removed.

Filtek_ Z350 was supplied as a single-component paste. The uncured paste was molded in a similar manner and cured using 20-s exposures on each side.

All samples were stored for 24 hours in deionized water. After 24 hours, the samples discs were polished with fine and ultra fine aluminum oxide abrasive disks (Sof-Lex Pop-on, 3M Dental products, Saint Paul, MN, USA) in the presence of water to obtain a flat polished surface.

IMMERSION OF SPECIMENS IN SOLUTIONS:

After the baseline micro-hardness evaluation, 10 samples of each group immersed in test tube containing 10 ml of energy drink details of groups given below Group-1: Vitrofil immersed in red bull (Red Bull GmbH, Am, Brunnen, Austria; pH 3.54) Group-2: Vitrofil immersed in jolt cola (Jolt Co Inc, United state; pH 3.4) Group-3: Vitrmere immersed in red bull Group-4: Vitremere immersed in Jolt cola. Group-5: Filtek Z350 immersed in red bull, Group-6 Filtek Z350 immersed in jolt cola all samples immersed for 2 minutes daily at room temperature 37°C. After the immersion period in the test solutions, the samples were washed with deionized water and the samples were maintained in deionized water at 37°C during the rest of the day.

Table 1. Material used in the present study.

SNO	MATERIALS	Manufacturer	Lot no
1-	Vitrofil FAS: aluminium fluorosilicate glass, PPA: polyacrilic acid, water	DFL dental product, Brazil	1081066
2-	Vitremer FAS: aluminium fluorosilicate glass, PMAA: polymethacrylic acid HEMA: hydroxyethylmethacrylate	3M Dental Products, St. Paul, MN, USA.	20090630
3-	Filtek Z350 : ZrO2/SiO2 nanocluster,SiO2 5-20 nm, Bis-GMA, Bis-EMA,UDMA, TEGDMA	3M ESPE dental product USA	20090221

All the solutions were refreshed and the pH of the solutions were noted daily with a pH meter before sample immersion.

MICRO HARDNESS EVALUATION:

Each material was divided in two groups, each group contained 10 specimens. The Vicker's microhardness measurements were done after 24 hours in digital microhardness tester (Microvicker's hardness tester, Wolpert group, China) with 200 g of load and 15 second dwell time. In each specimen three measurements were accomplished, subsequently, after immersion in order to evaluate the change in surface hardness over time, the micro hardness test was carried out before immersion and after immersion at 1 day, 7 day, 14 day and 30 day and the mean was used for subsequent statistical analysis.

STATISTICAL ANALYSIS:

Data was entered in Statistical Package for Social Sciences (SPSS) version 16. Descriptive analysis was executed in the form of mean ± standard deviation for surface micro hardness. The level of significance (P) was calculated with the help of repeated measure

ANOVA.For multiple comparisons, Tukey's Honestly Significant Difference (HSD) was used.

Table 2. Mean ± standard deviation surface micro hardness values of tested materials before and after immersion in both mediums.

Material	Media	baseline	1day	7day	14day	30day
Vitrofil	Red bull	39.77 ± 2.58	38.8 ±2.35	34.6 ± 3.06	20.7 ± 6.34	17.5 ± 2.12
	Jolt cola	39.82 ± 3.31	38.97 ± 2.94	30.8 ± 3.49	20.7 ± 4.47	17.6 ± 2.01
	Total	39.79 ± 2.89	38.89 ± 2.59	32.7 ± 3.74	20.7 ± 5.34	17.55 ± 2.01
Vitremere	Red bull	52.4 ± 2.41	52 ± 2.21	49.3 ± 3.23	46.9 ± 3.84	46.6 ± 4.17
	Jolt cola	51.8 ± 2.20	51.5 ± 2.07	48.6 ± 3.34	46.3 ± 3.77	45.9 ± 4.12
	Total	52.1 ± 2.27	51.75 ± 2.09	48.95 ± 3.22	46.6 ± 3.72	46.25 ± 4.05
Filtek Z350	Red bull	95.1 ± 2.31	97.27 ± 2.51	95.7 ± 2.26	93.6 ± 2.79	92.5 ± 2.79
	Jolt cola	95.7 ± 2.49	97.27 ± 2.52	95.7 ± 2.26	93.6 ± 2.80	92.5 ± 2.80
	Total	95.41 ± 2.36	97.27 ± 2.44	95.7 ± 2.20	93.6 ± 2.72	92.5 ± 2.72
Total	1	62.43 ± 24.19	62.69 ± 25.57	59.87 ± 26.63	53.73 ± 30.98	52.2 ± 31.55
	2	62.44 ± 24.57	62.58 ± 25.60	58.37 ± 28.01	53.53 ± 30.93	52 ± 31.55
	Total	62.43 ± 24.18	62.64 ± 25.37	59.12 ± 27.11	53.63 ± 30.69	52.1 ± 31.28

Table 3. Comparison of P values at different time interval.

Comparison (P Values)	Overall	Vitrofil	Vitremere	Filtek Z350
Baseline vs Day 1	>0.9999	0.007	>0.9999	0.001
Baseline vs Day 7	<0.0001	<0.0001	<0.0001	>0.999
Baseline vs Day 14	<0.0001	<0.0001	<0.0001	0.179
Baseline vs Day 30	<0.0001	<0.0001	<0.0001	0.007
Day 1 vs Day 7	<0.0001	<0.0001	<0.0001	0.005
Day 1 vs Day 14	<0.0001	<0.0001	<0.0001	<0.0001
Day 1 vs Day 30	<0.0001	<0.0001	<0.0001	<0.0001
Day 7 vs Day 14	<0.0001	<0.0001	<0.0001	<0.0001
Day 7 vs Day 30	<0.0001	<0.0001	<0.0001	<0.0001
Day 14 vs Day 30	0.001	0.088	0.352	<0.0001

RESULTS

The mean microhardness value for Filtek Z350 was highest in comparison to vitremere and vitrofil.

The mean and standard deviations of surface hardness values for the three restorative materials before and after storage for two minutes in both media at day 1, day 7,day 14 and day 30 is summarized in table 2 and 3.

According to time interval for vitofill and vitremere there is insignificant difference between baseline and day 1 surface micro hardness values ($p>0.001$). Significant difference is seen between baseline micro hardness and day 7 day 14,day 30 ($p<0.001$). Inverse is true for Filtek Z350 there is significant difference between base line and day 1 micro hardness values ($p<0.001$). The

difference between base line, day 7,day 14 and day 30 is insignificant (p>0.001).

According to immersion media there is insignificant difference between both of them. (p>0.001)

DISCUSSION

Oral cavity is the complex environment in which restorative materials faces different erosive challenges and immersed in various aqueous solutions, and subjected to continuous erosion over time. One of the most desirable properties that establish the longevity of dental materials in the oral cavity is their resistance to erosion and disintegration.[18]

Erosion is a condition with a complex etiology with multiple factor. Erosion is caused by some intrinsic and extrinsic factors. Extrinsic tooth erosion is included medicaments (vitamin C, aspirin), tooth bleaching procedures, life style diet and beverages. [21, 22]

The current study was designed to evaluate micro hardness of esthetic restorative materials after contact with different energy drinks. During consumption, these drink come in contact with teeth and restoration for short period of time, on the other hand, in previous researches, restorative materials usually had contact with acidic food or drink for a prolonged period of time.[23,24] For that reason, in the current study, due to the acidity and erosive nature of energy drinks, the materials were immersed in these drinks for 2 min a day and then stored in deionized water for the remaining day to simulate the washing effect of saliva and represent a short-term contact period.

In recent years, due to the increased popularity of energy drinks among the general population to enhancing performance and stamina the authors decide to estimate the effect of most commonly consumed energy drinks on the surface hardness of commonly used tooth color restorative materials.[1]

Previous researches have revealed that some drinks like cola soft drinks, apple juice, and orange juices are detrimental to tooth color restorative materials, but more researches are required to known about the effect of these commonly energy drinks on restorative materials. [25-27]

The current study results reveal that all restorative showed significant reduction in surface hardness after storage irrespective of immersion media used. Therefore null hypothesis which stated there was no significant difference in the surface micro-hardness of these restorative materials after immersion in the energy drinks being tested was rejected.

The surface hardness values of composite materials after 7-day, 14 day and 30day of storage Is insignificant than the baseline surface hardness values. This could

possibly be attributed to the higher monomer conversion and/or added post-curing cross-linking reactions in the resin time.[11]

In general, regardless of the solutions used, all restorative materials showed reduction in surface micro hardness after storage this is due to the materials deteriorate by way of liquid absorption.

Present study result is an agreement with Ugur Erdemir etal.[28]

Even though this study could not completely replicate the oral environment but it confirms harmful effects of some commercially available energy drinks on restorative materials, which patients should be aware of.

CONCLUSION

Within the limitations of this study, the following conclusions were drawn: 1. Surface micro hardness of the composite resin materials were significantly decreased at day 1 but insignificant reduction seen after the 1-month evaluation period; 2. Surface micro hardness of the Vitrofil and Vitremere were significantly decreased at different time interval during the 1-month evaluation period; 3. Nano composite exhibited less reduction than vitrofil and vitremere on surface micro hardness values of specimens over time; 4. According to immersion media there is insignificant difference between both of them.

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