

Effect of Pepsi cola beverage on microhardness of composite resin polymerized with different curing lights (In vitro study)

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ABSTRACT

Background: Pepsi cola was reported to reduce composite surface microhardness also the microhardness of composite resin affect by the type of light curing device, so the aim of this study was to compare between the effect of Pepsi cola on microhardness of composite resin cured with conventional and LED light cures.

Material and methods: Sixteen disc specimens (10* 2mm) were fabricated from one type composite resin (Composan LCM.). Half of the specimens were polymerized with (Astralis 5) conventional LC and the other half with (Woodpecker) LED light cure. Vickers surface microhardness (VHN) was analyzed after 24 hrs aging in distilled water. The specimens submitted to a five minutes immersion in Pepsi cola three times daily interrupted by immersion in distilled water at (37 C°). Surface microhardness measurements were done at 30, 60 day intervals. Data were submitted to paired t-test.

Results: In comparison with the baseline readings there were high significant differences (P<0.000) in microhardness of tested composite for both differently cured groups at the 1st and 2nd moths immersion period. No statistical significant difference was found in microhardness for conventional and LED cured composite neither for baseline, and nor for post immersion periods values.

Conclusion: Pepsi cola reduce microhardness of both differently cure composite groups and this reduction in microhardness was increased with time. The difference in light curing device did not interfere with the softening effect of Pepsi cola on composite resin.

Key words: Beverage, Pepsi cola, LED, composite microhardness. (J Bagh Coll Dentistry 2010;22(2):12-15).

INTRODUCTION

In a composite restorative procedure photopolymerization of the composite is of fundamental importance because adequate polymerization is a crucial factor for optimization of the physical and mechanical properties and clinical results of the composite material ⁽¹⁾. Light-activated composite materials polymerize by free radical polymerization when exposed to light at wavelengths in the 400 to 500 nm range. The photoinitiator absorbs light energy emitted from the light-curing unit, and directly or indirectly initiates polymerization. Camphorquinone is a commonly used photoinitiator that absorbs energy and reacts with a photo reducer to begin the polymerization process ⁽²⁾. Halogen light curing units are most widely source for composite activation; however, they have some drawbacks. For instance, their bulbs have a limited life span (40–100 hours); as the performance of the bulb progressively diminishes, a decrease in favorable properties of composite materials occurs ^(1,3).

In addition the vitality of the pulp can be affected by rising temperatures during polymerization ⁽⁴⁾.

Innovative light-emitting diode (LED) technology has been improved for light curing dental materials in order to overcome the inadequacies of the halogen light cures ^(5,6). LED light curing units are inexpensive, low voltage devices which have a long life expectancy. They are very compact and can be designed to emit specific light waves. The units have better resistance to shock and vibration, and they are also portable and safe ^(1,6). Although they have lower light emission, LEDs have the ability to cure like other light sources or slightly less ^(5,6). In addition, the temperature increase is significantly less and does not pose a threat to pulpal tissue ⁽¹⁾.

Composite resin restorative materials placed in the oral environment are subjected to a large number of adverse conditions that challenge their integrity and longevity. The aqueous oral environment was reported to interfere with the characteristics of composite resins and eventually lead to hydrolytic degradation over time ⁽⁷⁾. Consumption of certain beverages, such as cola drinks may alter some physical properties of the composite

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resins affecting the quality of restorations^(7,8). Pepsi cola is one of the cola drinking beverages, who contain orthophosphoric acid that have been found to decrease microhardness of composite resins⁽⁸⁻¹¹⁾. It is well known that orthophosphoric acid will dissolve the protective pellicle layer deposited by saliva onto the surfaces of tooth and restoration, and eroded these surfaces⁽⁹⁾.

There are no reports in the dental literatures on whether the type of curing device may affect composite surface resistance to the acidic beverage like Pepsi cola. So the aim of this study was to evaluate the effect of Pepsi cola beverage on microhardness of composite resin cured with conventional and light emitting diode light curing units.

MATERIAL AND METHODS

Sixteen disc specimens of Compositan LCM (Promedica Neumunster/Germany), shade A2, restorative composite resin material were fabricated using steel mould splited rings (10 mm internal diameter and 2 mm thickness). The mould was placed on a transparent matrix strip and glass slide then the material was put into the mould. The filled mould was covered with a second transparent matrix strip and glass slide; light pressure was applied to expel excess material from the mould. Half of the specimens (8 specimens) were polymerized with halogen light cure (Astralis 5, Vivadent, Austria) called group I, and the other half of the specimens were polymerized with LED (LED.G Built-in. Woodpecker Medical Instrument. CO., LTD. China) called group II. Each specimen was polymerized for 40 second from the both sides. The set disc was then separated from the mould; the excess material was removed with a scalpel blade, and then all specimens were then immersed in 20 ml of distilled water at 37° C for 24 hours for aging of the samples.

Baseline (pre treatment) surface microhardness measurement of each specimen was determined using Model HVS-100 Digital microhardness tester (TIME Group Inc. China) with a diamond Vickers indenter (Figure 1). A load of 9.8N was applied to the surface of the specimens for 12 seconds, after which time the indentation depth number was taken. A total of four indentations were made on each specimen. After baseline measurements were performed the samples in each group were immersed in

Pepsi cola (Baghdad soft drink company, Baghdad, Iraq) container of 20 ml. Each group was immersed for 5 minutes three times daily (every 8 hours) represent a medium frequency of intake. Before and after immersion in the Pepsi cola drink, specimens were rinsed with distilled water. Specimens, when not exposed to the drink, were stored in distilled water. After 30 days (1st period) second microhardness measurements were taken, then the cycle of immersion was continued for other 30 days (2nd period) and third microhardness measurements were taken.

Vickers hardness numbers of the baseline and post-immersion for 1st month, and 2nd month periods measurements were compared using paired t-test.

RESULTS AND DISCUSSION

Mean and standard deviation values of the microhardness (VHN) of group I (conventional light cured) and group II (LED cured) for pre and post immersion in Pepsi cola beverage at the two periods of the study are presented in Table 1 and Figure 2. Table 2 shows paired T-test comparing between the different time intervals of the study at each group. In Table 3 paired T-test comparing between the two groups at different time intervals of the study.

Hardness is an important parameter that has a bearing on the behavior of composite resin restorations in the oral environment. The surface hardness is most common methods for evaluation of composite polymerization⁽¹²⁾ or to demonstrate the composite surface effect to different softening material, like cola drinking beverage^(9,10,11). Pepsi cola is one of the more familiar cola drinks in Iraq which could be taken by people at different age groups. Under these backgrounds, present study used Vickers microhardness test to measure Pepsi cola surface effectiveness on composite samples polymerized with two different types of light cure (conventional and light emitted diode light cures) and compare between them.

The method used in the present study of cyclic immersion of the samples on the Pepsi cola based on the method done by Badra etal⁽¹⁰⁾, may resemble the normal daily consumption of 3 cans of Pepsi cola. This cycle of immersion were continued for 30 days and then for 60 days (with total 450 and 900 minutes emersion time respectively) for

measuring the accumulative effect of Pepsi cola on surface microhardness of composite groups.

Most restorative resin materials are expected to demonstrate partial surface alterations upon immersion in an aqueous environment which could be attributed to water absorption and hydrolytic degradation of the filler surface caused by filler/matrix cracking⁽¹³⁾. Bis-GMA copolymer is highly susceptible to chemical softening, with a broad increasing range of solubility parameters⁽¹⁴⁾. The extent of softening of Bis-GMA copolymer depended on the soaking chemicals⁽¹⁵⁾. Pepsi cola is a low PH drink containing orthophosphoric acid which has a high softening effect on the composite matrix^(8,10,11).

Both in group I and group II there were a high statistical significantly decrease ($p < 0.000$) in composite microhardness when comparing the baseline with post emersion values at the two periods of the study (Table 2). There was high statistical significant decrease in microhardness when comparing 1st month with the 2nd month values for the two groups. This significant decrease in microhardness may have occurred due to the higher softening effect and the acidic aggressiveness of Pepsi cola beverage on Bis-GMA copolymer on the both differently cured composite groups, as compared to their baseline microhardness readings before emersion, and this matrix softening effect is time related, i.e. the composite microhardness decrease when immersion period in Pepsi cola was increase. This agrees with Wongkhantee et al⁽⁸⁾, Badra et al⁽¹⁰⁾ and Yanikoglu et al⁽¹¹⁾ who show that microhardness of different type composite resin decrease after emersion in cola drink.

In the present study there were no significant differences between the mean baseline microhardness (pre treatment values) for the two groups as shown in Table 3. This agrees with the results of other studies^(2,5,6), who show that the properties of resin composites polymerized with LED curing units were equal or slightly inferior to properties obtained after halogen light curing. While Champregher and, Samuel⁽²⁾ show that the hardness obtained by LED light cures are more than that with halogen light cure.

According to the condition of this study, there were no statistical significant difference between group I and group II at the 1st and 2nd month immersion periods. This may be due to that composite matrices polymerized with conventional light cure and with LED light cure had relatively the same degree of polymerization, and so they had similar surface changes after immersion in Pepsi cola. So according to the composite type used in this study (Composan LCM), the softening effect of Pepsi cola on composite matrix did not affected with the use of different light curing device.

The experimental results obtained in this study are not the only predictor of clinical outcome. Salivary protective effect plays a major role in moderating the extent of acidic dissolution or erosion in the mouth^(8,10). Tooth brushing or abrasion of the tooth and restorations, on the other hand, may intensify the action of acidic process⁽¹⁶⁾. Further research to better understand the exact mechanism in the progression of acidic erosion is needed.

Table 1: Descriptive Statistics

	Mean	SD
Group I baseline	65.65	4.18
Group I 1 st month	46.05	4.65
Group I 2 nd month	36.19	1.89
Group II baseline	64.05	5.55
Group II 1 st month	45.58	2.30
Group II 2 nd month	37.76	3.85

Table 2: Paired T-test of different time intervals for each group.

Type of light cure	Immersion time		
	Baseline	1 st month	2 nd month
Conventional light cure		0.000 (HS)	0.000 (HS) 0.002 (HS)
LED light cure		0.000 (HS)	0.000 (HS) 0.001 (HS)

Table 3: Paired T-test between the two groups at the same time interval.

Time Interval	Type of light cure	
	Conventional light cure	LED light cure
Baseline	•	• 0.420 (NS)
1 st month	•	• 0.420 (NS)
2 nd month	•	• 0.420 (NS)



Figure 1: Model HVS-100 Digital microhardness tester with a Vickers diamond indenter.

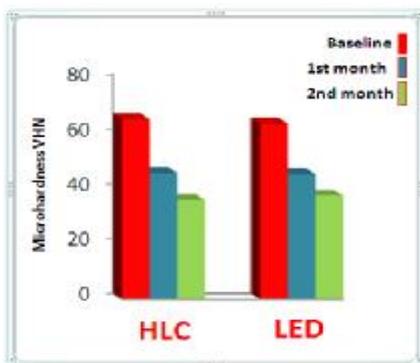


Figure 2: Bar chart show microhardness values for group I (HLC) and group II (LED).

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