The Surface Hardness Value of a light cured Hybrid Composite Resin after 12 Hours Immersion in three alcohol-free mouthwashes

Original Article

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Received: Aug 13, 2013
Accepted: Sep 30, 2013

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Abstract

Introduction: Mouthwashes which prevent and control caries and periodontal diseases are commonly used even without professional prescription. Long-term use of mouth-washes may cause softening of restorative composites and lowering the longevity of restoration. The aim of this study was evaluation of surface hardness value of a microhybride composite (Filtek Z250) after 12 hours immersion in three kinds of alcohol-free mouthwashes.

Materials and Methods: 72 Cylinderical specimens of a microhybride composite 5mm wide were prepared, using drinking straw as a mold. Specimens were light-cured continuously for 40 seconds on each side with Elipar(3M,ESPE) curing light. The specimens were immersed in 50ml of distilled water for12 hours. After that, all of them were finished with silicone carbide papers under constant water as coolant. The specimens were divided into 4 groups, each with 18 samples, the first group immersed in Colgate plax , the second in Crest (pro-health for me) , group3 in OraCare and group4 in water as the control group for 12 hours, which is equivalent to 1 year of daily mouthwash use at 2 minutes per day. Hardness measurement was taken by Vickers hardness tester with 1 kilogram load and 10 seconds loading time.

Result: Statistical analysis according to t-test and One-Way ANOVA test showed that there was no significant difference in surface hardness value of composite after 12 hours immersion between groups of mouthwashes and water(P value=0.353)

Conclusion: Based on the present study, alcohol-free mouthwashes didn't affect the surface hardness of Filtek(Z250) composite.

Key Words: **•Mouthwashes • Composite Resins • Hardness Test**

Introduction

Composite restorative materials consist of a continuous polymeric or resin matrix in which an inorganic filler is dispersed. This inorganic filler phase significantly enhances the physical properties of the composite.

For a composite to have good mechanical properties, a strong bond must exist between the organic resin matrix and the inorganic filler. This bond is achieved by coating the filler particles with a silane coupling agent, which not only increases the strength of the composite but also reduces its solubility and water absorption.[1] Restorative filling materials used in dentistry are required to have long term durability in the oral cavity.

One of the most important physical properties of restorative material is hardness which is related to compressive strength and abrasion resistance. The most common concept of hard and soft substances is their relative resistance to indentation. Hardness is therefore a measure of the resistance to plastic deformation and is measured as a force per unit area of indentation.

Base on this definition of hardness, it is clear why this property is of great importance in dentistry. A decrease in surface can be expected to affect clinical properties of resin materials such as wear-resistance.[2] Wear resistance is the material ability to resist against abrasive contact stress with opposing teeth and restorative material, food mass, and such items as tooth bristles and tooth picks.[3] On the other hand, chemical compound, weak acids in artificial saliva, citric acid, lactic acid, heptanes, and ethanol can cause chemical degradation of composite resin which leads to decrease in abrasion resistance of composite resin.[4-6]

For this goal, there are different ways such as using mechanical devices or chemical solutions (mouthwashes).[7]

The formulations of mouthwashes consist of water, antimicrobial agents, salts and in some cases, alcohol. Different concentration of these substances can affect the pH of mouthwashes.[8] Mouthwash rinses are effective caries and gingivitis control agents.[9]

They are part of people's routine oral hygiene,[10,11] and tend to be used for better social relations and cosmetic purposes. Frequent mouthwash use may have effects on oral tissues,[12] but there are limited studies about their effects on the restorative materials.[13]Most of previous studies concentrated on effect of alcohol-containing products on composites.[12, 14-17] So, the present study particularly evaluated the effect of alcohol-free mouthwashes. The effect of the mouthwashes on the restorative materials may be different depending on many factors that could not be replicated in vivo. Therefore, an in vitro test is recommended for any new product. In this study, the aim was to evaluate the effect of 3 commercial alcohol-free mouthwashes including Plax(Colgate), PRO HEALTH FOR ME (Crest), and OraCare on the surface hardness of commonly used aesthetic resin based composite Filtek(Z250).

The null hypothesis was that there would be no significant different in the surface hardness value of the composite resin after immersion in these mouthwashes.

Materials and Methods

A commercially available light-cured micro-hybrid composite resin restorative material Filtek Z250(3 M/ESPE, St. Paul. USA) with shade A_1(Table 1) was selected as the test material to be immersed in3alcohol-free mouthwashes: Plax(Colgate-Palmolive, NewYork, USA), PRO HEALTH FOR ME(Crest Cavity Protection Procter & Gamble Co., Cincinnati, OH, USA), and OraCare (Quezon city, Philipine)as the test agents and distilled water as the control group (Table 2). 72 Cylindrical specimens with 5mm width and 10mm height were prepared using drinking straw as a mold. Such mold was placed on a thin glass slab

and incrementally filled with composite resin. The composite-filled mold was covered with another glass slab, and with little pressure, the excess material was extruded to obtain a uniformly smooth specimen surface. The composite resin was light-cured continuously for 40 seconds on each side with Elipar(3M/ESPE, St.Paul, USA).

The intensity of curing light was over 1000 mW/cm^2. After removing the cured composites from the molds, all specimens were finished with silicone carbide papers under constant water as coolant. After that, the specimens were immersed in 50 ml of distilled water for 12 hours and were divided into four groups with 18 samples for the test agents and control groups.

The first group including 18 specimens was immersed in Colgate plax(Colgate-Palmolive, NewYork,USA), group2 immersed in Crest PRO HEALTH FOR ME, group3 immersed in OraCare (Quazon City, Philippine), and group 4 immersed in water for 12 hours. It is equivalent to one year of daily mouthwash use at two minutes per day. After this period, the specimens were washed with abundant water and the hardness measurement were taken by Vickers hardness tester machine(Wolpert, Norderhein ,Germany), with 1 kilogram load and 10 seconds loading time.The Vickers hardness test measures the hardness of a sample by producing an indentation at a predetermined force. It has a pyramidal diamond with four faces and 136 apex angle. Hardness reading was summarized by getting the mean and standard deviation of each group and was compared using one-tailed student's T-test at P≥ 0.05 and one-way ANOVA test.

Results

Table 2&3 shows the mean Vickers hardness values and standard deviations of composite resin specimens after immersion in each solution. Comparing the means of all four groups revealed that these means were not too different from the control group. Statistical analysis with one-way ANOVA and independent samples T test showed that there was no significant difference in the surface hardness value of the composite after 12 hours immersion in each group of mouthwashes and water. So, the null hypothesis of equal means among 3 test groups was not rejected. Therefore, the tested mouthwashes did not affect the surface hardness of tested hybrid composite resin.

Table1. Tested composite resin

Composite	Type	Composition
FiltekZ250 (3M, ESPE)	Microhybride	Bis-GMA, Bis-EMA, UDMA, TEGDMA, Zirconia/silica (0.01-3.5µm, 60 vol%)

Table2. Comparison between effects of three groups of mothwashes by One Way ANOVA

Group	N	Mean ± SD	F	P-Value
Colgate(Plax)	18	98.11±3.60		
Crest(HEALTH FOR ME)	18	100.28±4.06	1.06*	0.42
OraCare	18	104.61±22.97		

* F test

Table3. Comparison between the effect of mouthwashes and water (control group)

Group	Mean± SD	P-Value
Water	100.11±4.13	
Crest(HEALTH FOR ME)	100.28±4.06	0.91
Colgate(Plax)	98.11±3.60	0.13
OraCare	104.61±22.97	0.42

Discussion

The importance of a microhardness test is that it may affect the mechanical properties

of the material.[18] So hardness is related to material's strength and rigidity.[2] Any chemical softening resulting from use of mouthwashes would have implications on the clinical durability of the dental restorations.

The result of the present study revealed that the tested mouthwashes have not any effect on the surface hardness of the tested resin composite. This was not in agreement with Gurgan et al. and Yap et al. and Cavalcanti et al. who had reported that both alcohol containing and alcohol-free mouthwashes affected the surface hardness of the resin composites[14 -19,20]. In the study of Cavalcanti et al., samples were immersed daily for 14 days in 20ml solutions for 2 minutes twice a day with 12 hours interval between exposures.[14] This treatment method is different from what we did in the present study which was the immersion of all samples in mouthwashes for 12 hours continuously. This discrepancy might account for the dissimilar result. The comparison of the study of Yap et al. with the present study revealed that the test duration was longer than ours(12 hours).[20] This period is established as the proper length of time to determine the effect of 1year use of mouthwashes 2 minutes daily.[19]

The result of this study was parallel to Von Fraunhofer et al.[21]which indicated that the routine use of mouthwashes containing essential oils had no adverse effects on restorative materials that might be expected to react to such mixtures because of chemical compositions. It was concluded that active mouthwashes do not appear to have any adverse effects on a variety of restorative biomaterials. It also confirmed the findings of Gurdal et al.[12]that there were no significant adverse effect of the tested mouthwashes on micro hardness of esthetic restorative resins. According to Nuran et al.[22] the effect of mouthwash on the surface hardness of hybrid composite resin was the same as distilled water, providing further confirmation of the present study.

Miranda et al[7], Pengugonda et al.[15] and Weiner et al. found that alcohol or hydrogen peroxide containing mouthwashes present a higher potential to change of the hardness of composite.[23] However, in the present study, the tested mouthwashes had other kinds of active ingredients: cetylpiridinum chloride and chlorine dioxide which did not show any adverse effect on hardness of composite. According to Yap et al.[24], low PH of active ingredient of mouthwashes may affect the hardness, gloss, color and wear of composite restorations. Rahawi et al.[25] Found that all tested restorative materials showed decreased microhardness but it was related to their low PH after each period of time. But in the study of Shabanian et al.[26] the composite had the lowest susceptibility to low PH. None of the mouthwashes in the present study showed a decreasing effect on surface hardness of composite resin. Pro Health and plax with active ingredient of Cetylpyridinum chloride and OraCare with chloride dioxide as an active ingredient had the same result as water on the surface hardness of the composite.Limitations and suggestions: The effect of mouthwashes on restorative materials depends on many factors that could not be replicated in-vitro.

Saliva, salivary pellicle, foods and beverages may have negative effects on the physical and aesthetic properties of this group of restorative materials. Therefore, further studies are necessary to evaluate these parameters in-vivo.

Conclusion

Based on the finding of the present study, it can be concluded that the alcohol-Free mouthwashes did not affect the surface hardness of 3M (Z250) light cured hybrid composite.

Acknowledgement

This study was supported by Guilan University of Medical Sciences, Dentistry School and the University of East, college of dentistry. My grateful thanks go to Professor Ferancisco Jimenez in university of the East, the previous supervisor of the research.

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