

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

Original Article

Reza Davaloo¹, Maryam Tavangar¹, Farideh Darabi¹,
Zahra pourhabibi², Niloufar Alaei Alamouti³

¹Assistant Professor, Department of Operative Dentistry, Guilan University of Medical Sciences, Dental School, Rasht, Iran.

²Biostatist, Guilan University of Medical Science, Dental School, Rasht, Iran.

³Undergraduate student, Guilan University of Medical Sciences, Dental School, Rasht, Iran

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Corresponding Author:

Reza Davaloo

Address: Department of Restorative Dentistry ,
Dentistry school of Guilan University of Medical
Sciences , Rasht ,Iran

Telephone: 019111325594

Fax: +98-131-3263623

E-mail: rezadavaloo@gums.ac.ir

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 Cylindrical 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 for 12 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 A₁(Table 1) was selected as the test material to be immersed in 3alcohol-free mouthwashes: Plax(Colgate-Palmolive, NewYork, USA), PRO HEALTH FOR ME(Crest Cavity Protection Procter & Gamble Co., Cincinnati, OH, USA), and OraCare (Quezon city, Philippine)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/cm². 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, Phillipine), 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 $P \geq 0.05$ 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

Compos ite	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±22.9 7		

* 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 1 year 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: cetylpyridinium 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 Cetylpyridinium 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.

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References

1. Heymann H, Swift E, Ritter A. Sturdevant's Art and Science of Operative Dentistry. 6th Edition. USA: Elsevier/Mosby Co; 2013: 218-22.
2. Sakaguchi R, Powers J. Craig's Restorative Dental Materials. 13 th Edition. USA: Elsevier/Mosby Co; 2012: 48-190.
3. Yap AU, Tan SH, Wee SS, Lee CW, Lim EL, Zeng KY. Chemical degradation of composite restoratives. *J Oral Rehabil.* 2001; 28(11):1015-21.
4. Medeiros IS, Gomes MN, Loguercio AD, Filho LE. Diametral tensile strength and Vickers hardness of a composite after storage in different solutions. *J Oral Sci* 2007 Mar;49(1):61-6.
5. Wongkhantee S, Patanapiradej V, Maneenut C, Tantbirojn D. Effect of acidic food and drinks on surface hardness of enamel, dentine, and tooth-coloured filling materials. *Journal of Dentistry* 2006; 34(3): 214-20
6. Walsh TF. Mouthrinses as adjuncts in periodontal therapy. *Dent Update* 1996; 23(4):144-7.
7. Miranda D, Bertoldo C, Aguiar F, Lima D, Lavadino J. Effects of mouthwashes on Knoop hardness and surface roughness of dental composites after different immersion times. *Braz Oral Res.* 2011; 25(2):168-73.
8. Fischman SL. A clinician's perspective on antimicrobial mouthrinses. *J Am Dent Assoc.* 1994; 125Suppl 2:20S-22S.
9. Mandel ID. Antimicrobial mouthrinses: overview and update. *J Am Dent Assoc.* 1994; 125Suppl 2:2S-10S.
10. Gagari E, Kabani S. Adverse effects of mouthwash use. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1995; 80(4):432-9.
11. Werner CW, Seymour RA. Are alcohol containing mouthwashes safe?; *Br Dent J.* 2009;207(10):E19; discussion 488-9
12. Gürdal P, Akdeniz BG, Hakan Sen B. The effects of mouthrinses on microhardness and colour stability of aesthetic restorative materials. *J Oral Rehabil.* 2002; 29(9):895-901.
13. Asmussen E. Softening of BISGMA-based polymers by ethanol and by organic acids of plaque. *Scand J Dent Res.* 1984;92(3):257-61.
14. Cavalcanti AN, Mitsui FH, Ambrosano GM, Mathias P, Marchi GM. Effect of different mouthrinses on Knoop hardness of a restorative composite. *Am J Dent.* 2005; 18(6):338-40.
15. Penugonda B, Settembrini L, Scherer W, Hittelman E., Strassler H. Alcohol-containing mouthwashes: effect on composite hardness. *J Clin Dent.* 1994; 5(2):60-2.
16. Ferracane JL, Berge HX. Fracture toughness of experimental dental composites aged in ethanol. *J Dent Res.* 1995; 74(7):1418-23.
17. Anusavice K., Philip's Science of Dental materials, 11 th Edition, USA: Elsevier Science 2003; 402-403.
18. Yap AU, Mok BY. Effects of professionally applied topical fluorides on surface hardness of composite-based restoratives. *Oper Dent.* 2002;27(6):576-81

19. Gürgan S, Onen A, Köprülü H. In vitro effects of alcohol-containing and alcohol-free mouthrinses on microhardness of some restorative materials. *J Oral Rehabil.* 1997 Mar; 24(3):244-6.
20. Yap AU, Tan BW, Tay LC, Chang KM, Loy TK, Mok BY. Effect of mouthrinses on microhardness and wear of composite and compomer restoratives. *Oper Dent.* 2003; 28(6):740-6.
21. Von Fraunhofer JA, Kelley JI, DePaola LG, Meiller TF. The effect of a mouthrinse containing essential oils on dental restorative materials. *Gen Dent.* 2006; 54(6):403-7.
22. Yanikoglu N, Duymus Z, Yilmaz B. Effects of different solutions on the hardness of composite resin materials. *Dent Mater J* 2009 May;28(3):344-51.
23. Weiner R, Millstein P, Hoang E, Marshall D. The effect of alcoholic and nonalcoholic mouthwashes on heat-treated composite resin. *OperDent.* 1997; 22(6):249-53.
24. el-Badrawy WA, McComb D, Wood RE. Effect of home-use fluoride gels on glass ionomer and composite restorations. *Dent Mater* 1993; 9(1):63-7.
25. Rahawi OS., The effect of colored drinks on the surface hardness of composite resin. *AL-Rafidain Dent J.* 2010; 10(2):322-331.
26. Shabanian M, Richards LC. In vitro wear rates of materials under different loads and varying pH. *JProsthet Dent.* 2002; 87(6):650-6.