

In vitro assessment of the various mouthwashes in surface micro hardness of bulk fill composites

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Abstract

Background: The concern of the surface loss in the bulk fill composites from routine wear and tear and various mechanical and chemical agents used for oral hygiene is significant. However, literature data is scarce for role of mouthwashes on surface microhardness of bulk-fill composites.

Aim: The present study was aimed to assess the effect of using various mouthwashes in surface micro hardness of bulk fill composites.

Methods: The study assessed 80 specimens from the bulk-fill composite in that were light cured in an in-vitro set-up. These samples were assessed utilizing the Teflon mould and Vickers microhardness. These samples were divided into 4 groups and immersed for 24 hours in artificial saliva, alcohol-free mouthrinse, desensitizing

mouth rinse, or alcohol containing mouthrinse. The data gathered were statistically analyzed.

Results: The study results showed that the mouthwashes considered in the study resulted in reduction of the surface microhardness of the bulk-fill composites with the major factors being low pH and the alcohol content that resulted in their deterioration.

Conclusion: The present study concludes that mouthwashes that result in low pH and have alcohol in their composition result in the decreased micro hardness of the bulk composite. However, the present study was in-vitro and further studies in in-vivo set up are needed to reach a definitive conclusion.

Keywords: Bulk-Fill Composite, Composite Restoration, Microhardness, Mouth Rinses, Vickers Hardness.

Introduction

Resin-based composites have been used widely in the modern dentistry to make esthetic restorations that are esthetic based and these composites have largely replaced the dental amalgam owing to the adverse and negative effects of mercury on the health and preference of the patients for tooth-colored restorations. Despite of the high success rates, conventional composites have various limitations as clinical complications most commonly the polymerization contraction and incremental layering which is a time-consuming and meticulous method and is vital to attain the needed depth of cure. To discuss these limitations, a new category of materials was developed which is known as bulk-fill resin composites.¹

These materials are made with low polymerization stress, high conversion, the photo-initiator systems optimized in that they can be placed in 4- 5 mm increments, the photo-initiator systems optimized in that they can be placed in 4- 5 mm increments, and improved light transmission. These placement protocols make them very attractive owing to the decreased chairside time. Despite mechanical properties of bulk-fill composites are reported well, their survivability and functionality are based on their stability in the oral environment which is dynamic. Oral cavity has been subjected to continued exposure to the chemical agents like oral mouthwashes or mouth rinses which are given as a therapy for management of dentinal hypersensitivity, gingivitis, and dental caries.²

Fluoride or chlorhexidine is one of the main and active ingredients in these formulations along with solvents and vehicles where ethanol is one of the most commonly used ones. The role of ethanol which is alcohol is increase in the penetration and dissolution of the active

components; however, it is also consider to cause a negative effect on the resin-based materials. Alcohol can also be used as a plasticizer as it drains off unreacted monomers and oligomers, enter the swelling and softening framework, and enters the polymer framework which can deteriorate the mechanical characteristics of composites as surface hardness. Literature studies have been done on effect on mouthwashes on the dental restorations.³

Mouthwashes that contain alcohol have highest impact on the surface roughness of nanohybrid resin composite where other studies have also reported comparable reduction of micro hardness in the bulk-fill composites. Recent literature data has focused on damage caused by alcohol-based mouth rinses from the low pH which can wear off the bulk-fill resin composite over a long period of time. Hence, it is vital to compare the Vickers surface microhardness on bulk-fill resin composite exposed to three different mouthrinses as alcohol free, desensitizing, and alcohol containing mouthwashes.⁴ The present study was aimed to assess the effect of using various mouthwashes in surface micro hardness of bulk fill composites.

Materials and methods

The present experimental in vitro study was aimed to assess the effect of using various mouthwashes in surface micro hardness of bulk fill composites. The study subjects were from Department of Dentistry of the Institute. Verbal and written informed consent were taken from all the subjects before study participation.

The study assessed 80 specimens from the bulk-fill composite in that were light cured in an in-vitro set-up. These samples were made from a commercially available bulk-fill restorative composite. This composite material was divided into 3mm high and 3mm diameter

mould made of high Teflon which was set on the glass slab followed by the addition of little more material followed by second polymer strip and the glass slide was placed on the top. The material was compacted gently using hand pressure for removal of any extra material and make it smooth and at surface level. Following the recommendation by the manufacturers, each specimen was subjected to light cure for 40 seconds using the LED curing device having input intensity in the range of 450 to 500 mW/cm². While curing the specimen, they were taken out from the mould and kept in distilled water for 24 hours at 37 degrees Celsius until they were ready for testing.

These 80 specimens were divided randomly in the four groups with 20 specimens in each group. These samples were divided into 4 groups and immersed for 24 hours in artificial saliva (Group I- control), alcohol-free mouthrinse containing sorbitol, Cetylpyridinium Chloride, menthol and Camellia Sinensis Leaf Extract with pH of 7.2 (Group II), desensitizing mouth rinse having sodium fluoride, potassium nitrate, sorbitol, glycerine, and aqua having pH of 6.7 (Group III), or alcohol containing mouthrinse having Ethanol 21.6% v/v, Menthol 0.04%, Eucalyptol 0.09%, and 0.06% Thymol having pH of 4.2 (Group IV). Each specimen was stored individually in the sealed container having 20 mL of solution for 24 hours at 37 degrees Celsius to get intensive and short-term exposure. The pH of each mouth wash was measured with calibrated digital pH meter.

Vickers micro hardness tester was used for testing the microhardness and to measure the surface of the micro hardness. These specimens were assessed twice before immersion and 24 hours after the immersion. The material was subjected for 15 seconds with 200-gram

weight. The Vickers Hardness Number (VHN) was assessed with three indentations on top surface of each specimen with minimum 1mm spacing in each indentation and then mean of diagonal length was taken. Mean of three VHN readings was considered.

The collected data were statistically analyzed using SPSS (Statistical Package for Social Sciences) software version 26.0 (IBM Corp., Armonk, NY, USA) where ANOVA (analysis of variance) was used along with descriptive analysis to assess any statistically significant difference between the groups. The p-value of <0.05 was considered as statistically significant.

Results

The present experimental in vitro study was aimed to assess the effect of using various mouthwashes in surface micro hardness of bulk fill composites. The study assessed 80 specimens from the bulk-fill composite in that were light cured in an in-vitro set-up. These samples were assessed utilizing the Teflon mould and Vickers microhardness. These samples were divided into 4 groups and immersed for 24 hours in artificial saliva, alcohol-free mouthrinse, desensitizing mouth rinse, or alcohol containing mouthrinse. At baseline the measurement of microhardness was highly consistent in all the samples which confirmed the homogeneity in samples before immersion.

It was seen that for Vickers microhardness at baseline and after immersion in four solutions in study subjects, at baseline, mean VHN was 55.52 ± 0.21 . After 24 hours of immersion, the mean VHN was highest in control group having artificial saliva with 53.58 ± 1.0 followed by 51.78 ± 1.52 in Group II (alcohol free mouth rinse), 50.18 ± 3.18 in Group III (desensitizing mouth rinse), and least 44.48 ± 1.23 in Group IV (alcohol-containing mouth rinse) (Table 1). The mean post immersion VHN

depicted a statistically significant difference with $p < 0.001$.

The study results showed that concerning comparison of mean microhardness after immersion in different study groups, for comparison of Group I (artificial saliva) to Group IV (alcohol-containing mouth rinse) mean VHN was 9.08 ± 1.10 which was statistically significant with $p < 0.001$. For Group I (artificial saliva) to Group III (desensitizing mouth rinse), mean VHN was 3.38 ± 1.10 which was significant with $p = 0.01$.

Concerning Group I (artificial saliva) to Group II (alcohol free mouth rinse), mean VHN was 1.78 ± 1.10 showing a non-significant difference with $p = 0.368$. For Group IV (alcohol-containing mouth rinse) to Group III (desensitizing mouth rinse), mean value was -5.68 ± 1.10 10 which was statistically significant with $p < 0.001$. Considering comparison of Group IV (alcohol-containing mouth rinse) to Group II (alcohol free mouth rinse), mean value was -7.28 ± 1.10 10 which was statistically significant with $p < 0.001$. For Group III (desensitizing mouth rinse) to Group II (alcohol free mouth rinse), mean VHN was -1.58 ± 1.10 which was non-significant with $p = 0.483$ (Table 2).

Discussion

The present study assessed 80 specimens from the bulk-fill composite in that were light cured in an in-vitro set-up. These samples were assessed utilizing the Teflon mould and Vickers microhardness. These samples were divided into 4 groups and immersed for 24 hours in artificial saliva, alcohol-free mouthrinse, desensitizing mouth rinse, or alcohol containing mouthrinse. At baseline the measurement of microhardness was highly consistent in all the samples which confirmed the homogeneity in samples before immersion. This design was identical to the study design used in the previous

studies of Khan AA et al⁵ in 2015 and Al-Samadani KH et al⁶ in 2017 where study design similar to the present study was also used by the authors in their studies.

The study results showed that for Vickers microhardness at baseline and after immersion in four solutions in study subjects, at baseline, mean VHN was 55.52 ± 0.21 . After 24 hours of immersion, the mean VHN was highest in control group having artificial saliva with 53.58 ± 1.0 followed by 51.78 ± 1.52 in Group II (alcohol free mouth rinse), 50.18 ± 3.18 in Group III (desensitizing mouth rinse), and least 44.48 ± 1.23 in Group IV (alcohol-containing mouth rinse) (Table 1). The mean post immersion VHN depicted a statistically significant difference with $p < 0.001$. These results were consistent with the findings of Poggio C et al⁷ in 2017 and Morais Sampaio GA de et al⁸ in 2021 where results for Vickers microhardness at baseline and after immersion reported by the authors was comparable to the results of the present study.

It was seen that concerning comparison of mean microhardness after immersion in different study groups, for comparison of Group I (artificial saliva) to Group IV (alcohol-containing mouth rinse) mean VHN was 9.08 ± 1.10 which was statistically significant with $p < 0.001$. For Group I (artificial saliva) to Group III (desensitizing mouth rinse), mean VHN was 3.38 ± 1.10 which was significant with $p = 0.01$. These findings were in agreement with the results of George R et al⁹ in 2017 and Shah Y et al¹⁰ in 2018 where concerning comparison of mean microhardness after immersion in different study groups comparable to the present study was also reported by the authors.

For consideration of Group I (artificial saliva) to Group II (alcohol free mouth rinse), mean VHN was 1.78 ± 1.10 showing a non-significant difference with $p = 0.368$. For

Group IV (alcohol-containing mouth rinse) to Group III (desensitizing mouth rinse), mean value was -5.68 ± 1.10 10 which was statistically significant with $p < 0.001$. Considering comparison of Group IV (alcohol-containing mouth rinse) to Group II (alcohol free mouth rinse), mean value was -7.28 ± 1.10 10 which was statistically significant with $p < 0.001$. For Group III (desensitizing mouth rinse) to Group II (alcohol free mouth rinse), mean VHN was -1.58 ± 1.10 which was non-significant with $p = 0.483$. These results correlated with the findings of James V et al¹¹ in 2019 and Comba A et al¹² in 2020 where results comparable to the present study was also reported by the authors.

Conclusion

Considering its limitations, the present study concludes that mouthwashes that result in low pH and have alcohol in their composition result in the decreased micro hardness of the bulk composite. However, the present study was in-vitro and further studies in in-vivo set up are needed to reach a definitive conclusion.

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Legend Tables

Table 1: Vickers microhardness at baseline and after immersion in four solutions in study subjects

Sn.	Time	pH	Mean VHN
1.	Baseline		55.52±0.21
2.	Post-immersion		
a)	Group I (artificial saliva)	7.2	53.58±1.0
b)	Group II (alcohol free mouth rinse)	7.2	51.78±1.52
c)	Group III (desensitizing mouth rinse)	6.7	50.18±3.18
d)	Group IV (alcohol-containing mouth rinse)	4.2	44.48±1.23

Table 2: Comparison of mean microhardness after immersion in different study groups

Sn.	Comparison	Mean	p-value
1.	Group I (artificial saliva) to Group IV (alcohol-containing mouth rinse)	9.08±1.10	<0.001
2.	Group I (artificial saliva) to Group III (desensitizing mouth rinse)	3.38±1.10	0.01
3.	Group I (artificial saliva) to Group II (alcohol free mouth rinse)	1.78±1.10	0.368
4.	Group IV (alcohol-containing mouth rinse) to Group III (desensitizing mouth rinse)	-5.68±1.10	<0.001
5.	Group IV (alcohol-containing mouth rinse) to Group II (alcohol free mouth rinse)	-7.28±1.10	<0.001
6.	Group III (desensitizing mouth rinse) to Group II (alcohol free mouth rinse)	-1.58±1.10	0.483