



Original Article

Effect of commercially available herbal mouthrinse on microhardness of various restorative composite resin materials- An in vitro study

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Received: 17-05-2026

Accepted: 08-06-2026

Available online: 30-06-2026

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ABSTRACT

Background: Dental composite has become a material of choice for direct restoration and hence are expected to have long term durability in the oral cavity. Use of mouth rinses can affect the hardness of these restorations. **Objective:** To evaluate the effect of commercially available herbal mouth rinse on microhardness on different restorative composite resin materials. **Method:** Fifty-four specimens (6mm in diameter and 2mm in height) were prepared for composite resin material groups (Reveal HD Bulk fill, Filtek Z350 XT nanohybrid and P60 microhybrid) and for storage solution groups (Artificial saliva and Hiora K mouthrinse). Baseline Knoop microhardness values were recorded for all specimens. The specimens were then stored in 20 ml mouthwash and artificial saliva at 37° C for 12 hours. Post immersion Knoop microhardness values were also recorded for all specimens. Data were subjected to one-way Anova and Independent t test at statistical significance level of 0.05. **Results:** The microhardness was found highly significant in all study groups, with the greatest microhardness for P 60 Microhybrid followed by Filtek Z350 XT Nanohybrid and Reveal HD Bulk fill. There was a statistically significant reduction observed in the post immersion microhardness in Filtek Z 350 XT Nanohybrid and P60 Microhybrid compared to the baseline values in both the immersion medium. **Conclusion:** Hiora K mouthrinse showed significant reduction in microhardness of composite resin restorative materials.

Keywords: Composite resins, Herbal Mouthwashes, Microhardness, Artificial saliva, Filtek Z350.

INTRODUCTION

In the recent years, restorative dentistry has advanced greatly, leading to increased use of composite resins as aesthetics have become important concern for patients.¹ Dental composite has become a material of choice for direct restoration.² The restorative materials should last long in the oral cavity. Surface hardness, which is the resistance of the material to indentation or penetration is an important property because it effects the proportional limit, ductility and strength. The hardness of a material serves as an indicator to predict its wear resistance and potential to abrade or be abraded by dental structures and other materials.³ Resin composites consist of polymeric matrix, filler particles, and silane-coupling agent that links the matrix to fillers. In the oral environment, these materials can degrade over time due to water absorption, temperature changes and mechanical stress. Water plays a major role in this process by weakening the resin matrix, leading to reduced hardness and the deterioration of resins physical and mechanical properties.⁴ Although the polymerized composite material initially have sufficient hardness to withstand the masticatory load, they begin to degrade when exposed to oral environment. Factors such food, organic solvents, water, thermal changes, mechanical cycling influence surface degradation, crack propagation and hardness of the material. This degradation may lead to material break down over time, ultimately influencing the clinical longevity of the restoration.² In an in vivo situation, food components and beverages has been reported to affect properties of resin composites. Mouthrinses are among the factors that affect resin restorations, and have gained widespread popularity in recent years. They are commonly recommended by clinicians for prevention and control of dental caries, periodontal diseases, plaque reduction and in management of oral malodor.³ Mouthrinses can be alcohol, peroxide, or fluoride containing.⁵ Mouthrinses contain water, antimicrobial agents, salts, preservatives and sometimes alcohol. Variations in the concentration of these components affect the pH of mouth rinses. Alcohol containing

mouth rinses may soften the resin restorations, with the effect increasing as the alcohol concentration rises. Additionally, low Ph enhance sorption, solubility and surface degradation of resin composites.⁶ Ayurvedic mouthwashes are typically alcohol and chemical free, containing time-tested herbal oils and extracts – like neem oil, clove, and peelu – that support oral health. Hence, they serve as a viable alternative to the chemical mouthwashes. However, frequent mouth rinse use may adversely affect oral tissues and restorative materials. They can alter the surface roughness of dental materials potentially increasing plaque retention, staining, and compromising patient comfort.⁵ The type of restorative material also influences the degradation of restorative materials.⁶ Previous studies have indicated conflicting findings regarding the influence of mouthrinses on the mechanical and physical properties of composites, including hardness and roughness.⁷ Furthermore, many commercially available mouthrinses have not yet been evaluated for their impact on the restorations.⁶ Hiora K mouth rinse is commercially available alcohol free mouth rinse enriched with herbal ingredients. It also contains natural potassium that reduces tooth sensitivity from varied etiologies and also restores the mineral composition of teeth, strengthening them as a result.⁸ Hence the aim of this in vitro study was to evaluate the effect of commercially available herbal mouthrinse on microhardness of various restorative composite resin materials.

MATERIALS AND METHODS

The 3-month in-vitro study was conducted in the Department of Pediatric and Preventive Dentistry, College of Dental Sciences, Davangere, in collaboration with the Department of Mechanical Engineering, Manipal Institute of Technology, Manipal, India. The study evaluated three restorative materials divided into three groups: Group I (Reveal HD Bulk fill, BISCO, USA), Group II (Filtek Z350 XT Nanohybrid, 3M ESPE, USA), and Group III (Filtek P60 Microhybrid, 3M ESPE, USA).

Specimen preparation:

A total of 54 cylindrical specimens were fabricated using a Teflon mold, with 18 specimens prepared for each composite material group, measuring 6mm in diameter and 2mm in thickness. The mold was then placed on a glass slide and filled with resin composite to a slight excess using composite filling instrument covered with a clear matrix strip and another glass slide was placed on top and gently pressed for 30 s to extrude excess material to obtain a smooth surface. Each specimen was cured for 40 s from the top and another 40 s from the bottom using LED light cure unit (Blue phase C8, Ivoclar Vivadent, Astria) at 800 mW/cm². Immediately following polymerization, the specimens were stored in distilled water in a dark container that were maintained in a humidior at 37°C for 24 hours, to allow post-polymerization, before taking the baseline microhardness measurement. After 24 hours, the specimens were subjected to surface polishing with abrasive disks (Sof-Lex, 3M ESPE, St. Paul, USA) under continuous water irrigation. Abrasive disks were applied in decreasing order of abrasiveness (10 s each), in a slow-speed handpiece. To avoid micro-crack formation polishing time was limited to 10 s for each step. The samples were inspected visually before and after testing to confirm the absence of any surface defects or pores. Each group had 18 specimens. The specimens were further divided into two different subgroups (n = 9) in terms of immersion medium (artificial saliva and herbal mouthrinse) to test the microhardness of each composite resin materials.

For Microhardness Assessment:

The specimens were divided into three main groups according to composite resin materials. Each group was then subdivided into two different subgroups (n = 9) according to the immersion mediums artificial saliva and herbal mouth rinse. The pre immersion baseline micro hardness values of the specimens were recorded using Knoop micro hardness tester (Buehler Mmt- 3, Waukagen Lake, Bluff, IL, USA) with a dwell time of 15 s and a load of 50 gf. Next, the specimens were then immersed in 20 ml of immersion mediums artificial saliva and herbal mouth rinse respectively. They were then kept in a dark glass container in an incubator at 37°C for 12 h. Following immersion, each specimen was blotted dry with a filter paper and checked for post immersion micro hardness using the same micro hardness tester previously mentioned for base line values. The data was tabulated and subjected to statistical analysis.

Statistical Analysis: The recorded values were entered in Microsoft Excel and subjected to statistical analysis by SPSS. One way ANOVA and Independent t test were performed to assess the microhardness. P value < 0.05 was considered statistically significant.

RESULTS

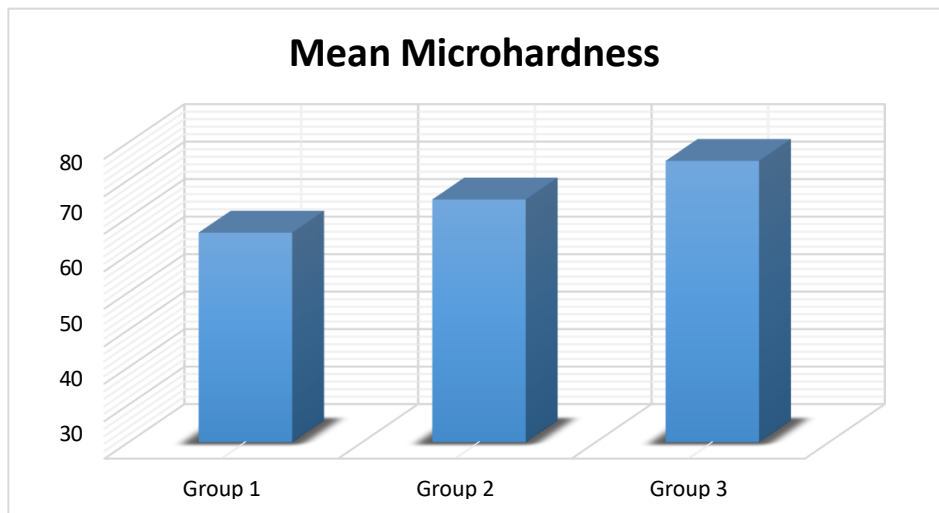
Table 1 & Graph 1: The table and graph shows the mean, standard deviation and comparison of microhardness of the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nanohybrid, P 60 Microhybrid). In Group I, the mean and standard deviation showed the value of 55.90 ± 3.58, while in group II, the mean and standard deviation showed the value of 64.75 ± 3.45. In Group III, the mean and standard deviation showed the value of 75.05 ± 9.85. On intergroup comparison a statistically significant difference was found in the microhardness among the three groups (p value < 0.001).

Groups	N	Mean	SD	SE	F value	p value
Group I	18	55.909	3.5804	.8439		

Group II	18	64.750	3.4598	.8155	18.74	<0.001*
Group III	18	75.050	9.8553	2.3229		

Table 1

One way Anova, sig. 2 tailed, $p < 0.05$



*= Statistically significant difference with $p < 0.05$ Std. Deviation = SD, Std. Error = SE

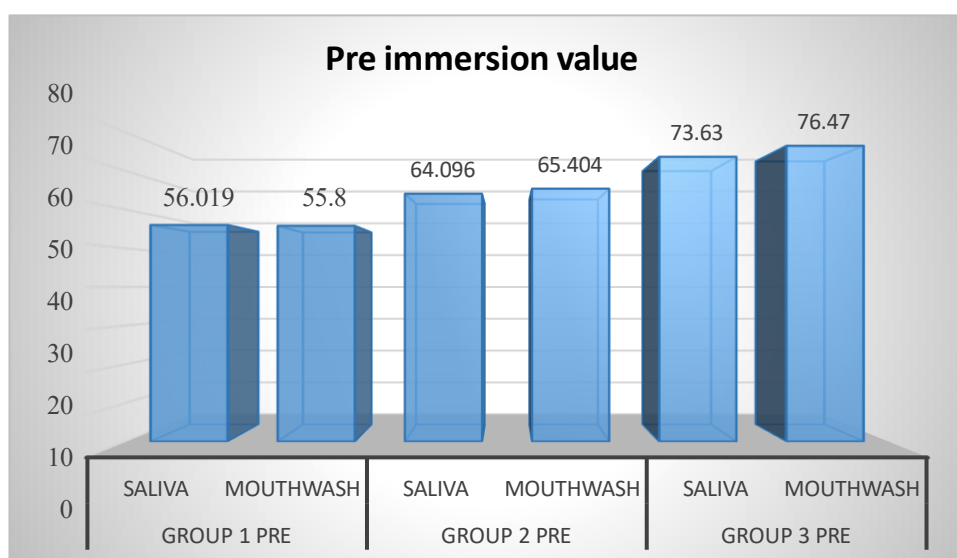
Graph 1: Comparison of mean value of microhardness of the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nano hybrid, P 60 Micro hybrid)

Table 2 & Graph 2: The table and graph shows mean, standard deviation and comparison of pre immersion micro hardness in both the immersion mediums (Artificial saliva & Mouthrinse) among all the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nano hybrid, P 60 Micro hybrid). In Group I, the mean and standard deviation showed the value of 56.01 ± 3.44 and 55.80 ± 3.91 , in group II, the mean and standard deviation showed the value of 64.09 ± 3.87 and 65.40 ± 3.06 while in group III, the mean and standard deviation showed the value of 73.63 ± 12.96 and 76.47 ± 5.81 in artificial saliva & mouthrinse respectively. On comparison no statistically significant difference was found in the pre immersion microhardness among all the three groups (Group I: p value of 0.127, Group II: p value of 0.137 & Group III: p value of 0.745).

Table 2

Groups	Immersion medium	N	Mean	SD	SE mean	t test	p value
Group I	Artificial saliva	9	56.019	3.4425	1.1475	0.87	0.127
	Mouthrinse	9	55.800	3.9195	1.3065		
Group II	Artificial saliva	9	64.096	3.8796	1.2932	0.66	0.367
	Mouthrinse	9	65.404	3.0699	1.0233		
Group III	Artificial saliva	9	73.630	12.9611	4.3204	1.74	0.745
	Mouthrinse	9	76.470	5.8194	1.9398		

Independent t test, sig 2 tailed, $p < 0.05$ Std. Deviation = SD, Std. Error = SE



Graph 2: Comparison of pre immersion micro hardness in both the immersion mediums (Artificial saliva & Mouthrinse) among all the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nanohybrid, P 60 Microhybrid)

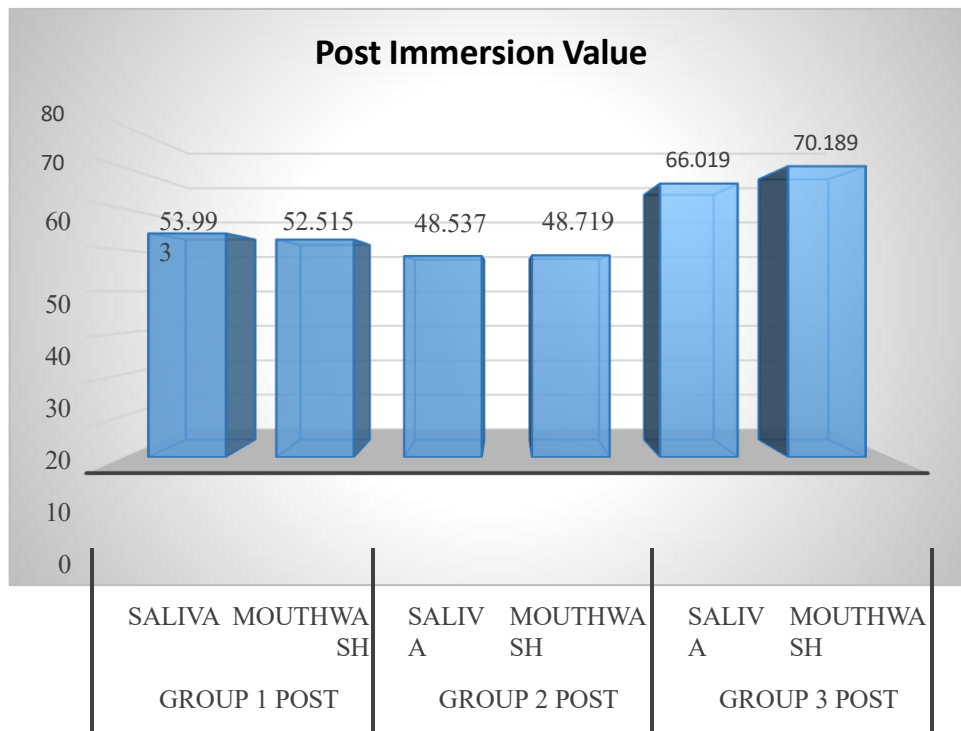
Table 3 & Graph 3: The table and graph shows mean, standard deviation and comparison of post immersion micro hardness in both the immersion mediums (Artificial saliva & Mouthrinse) among all the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nanohybrid, P 60 Microhybrid). In Group I, the mean and standard deviation showed the value of 53.99 ± 5.56 and 52.51 ± 2.19 , in group II, the mean and standard deviation showed the value of 48.53 ± 4.71 and 48.71 ± 3.49 while in group III, the mean and standard deviation showed the value of 66.01 ± 8.47 and 70.18 ± 6.72 in artificial saliva & mouthrinse respectively. On comparison no statistically significant difference was found in the pre immersion microhardness among all the three groups (Group I: p value of 0.47, Group II: p value of 0.09 & Group III: p value of 0.82).

Table 3

Groups	Immersion medium	N	Mean	SD	SE mean	t test	p value
Group I	Artificial saliva	9	53.993	5.5638	1.8546	1.74	0.47
	Mouthrinse	9	52.515	2.1934	.7311		
Group II	Artificial saliva	9	48.537	4.7196	1.5732	0.74	0.09
	Mouthrinse	9	48.719	3.4991	1.1664		
Group III	Artificial saliva	9	66.019	8.4724	3.2236	1.36	0.82
	Mouthrinse	9	70.189	6.7241	2.9075		

Independent t test, sig 2 tailed, $p < 0.05$

Std. Deviation = SD, Std. Error = SE



Graph 3: Comparison of post immersion micro hardness in both the immersion mediums (Artificial saliva & Mouthrinse) among all the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nanohybrid, P 60 Microhybrid)

Table 4 & Graph 4: The table and graph shows the comparison of pre and post immersion microhardness in terms of immersion medium (Artificial saliva) among all the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nanohybrid, P 60 Microhybrid). On comparison no statistically significant difference was found in group I (p value of 0.413) while a statistically significant difference was found in group II and group III (p value of < 0.001 & 0.007 respectively).

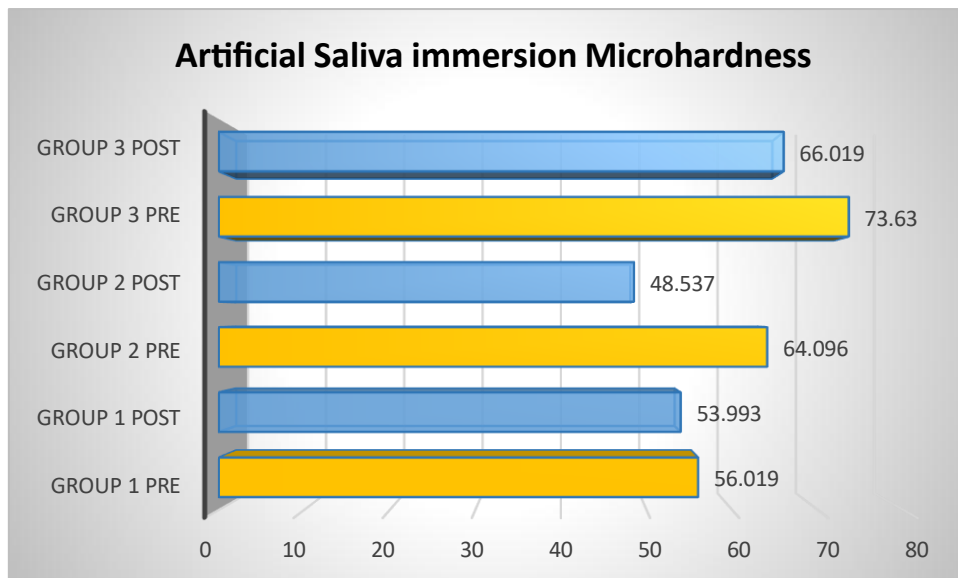
Table 4

ARTIFICIAL SALIVA Groups		Mean	N	SD	SE mean	t test	p value
Group I	Pre	56.019	9	3.4425	1.1475	0.863	0.413
	Post	53.993	9	5.5638	1.8546		
Group II	Pre	64.096	9	3.8796	1.2932	10.247	<0.001*
	Post	48.537	9	4.7196	1.5732		
Group III	Pre	73.630	9	12.9611	4.3204	4.78	0.007*
	Post	66.019	9	8.4724	3.2236		

Paired t test, sig 2 tailed, $p < 0.05$

Std. Deviation = SD, Std. Error = SE

*= Statistically significant difference with $p < 0.05$



Graph 4: Comparison of pre and post immersion microhardness in terms of immersion medium (Artificial saliva) among all the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nanohybrid, P 60 Microhybrid)

Table 5 & Graph 5: The table and graph shows the comparison of pre and post immersion microhardness in terms of immersion medium (Mouthrinse) among all the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nanohybrid, P 60 Microhybrid). On comparison no statistically significant difference was found in group I (p value of 0.051) while a statistically significant difference was found in group II and group III (p value of < 0.001 & 0.041 respectively).

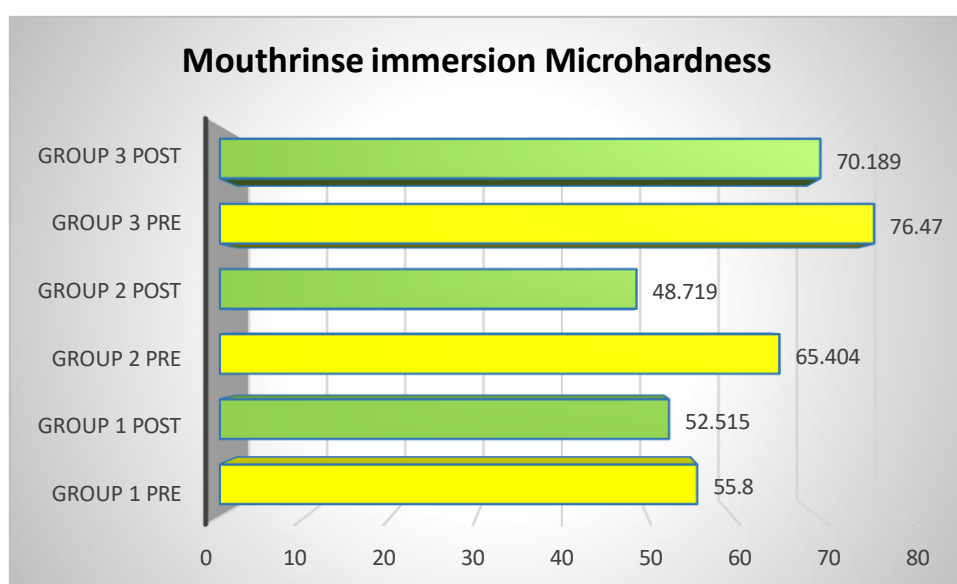
Table 5

MOUTHRINSE Groups		Mean	N	SD	SE	t test	p value
Group I	Pre	55.800	9	3.9195	1.3065	2.295	0.051
	Post	52.515	9	2.1934	.7311		
Group II	Pre	65.404	9	3.0699	1.0233	10.057	<0.001*
	Post	48.719	9	3.4991	1.1664		
Group III	Pre	76.470	9	5.8194	1.9398	4.08	0.041*
	Post	70.189	9	6.7241	2.9075		

Paired t test, sig 2 tailed, $p < 0.05$

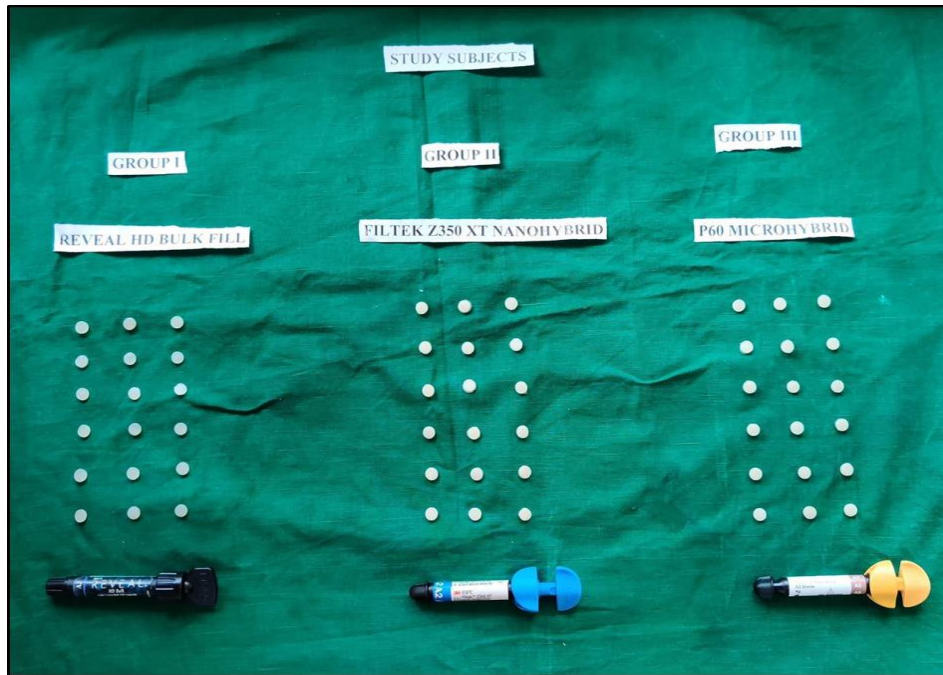
Std. Deviation = SD, Std. Error = SE

*= Statistically significant difference with $p < 0.05$



Graph 5: Comparison of pre and post immersion microhardness in terms of immersion medium (Mouthrinse) among all the three groups (Reveal HD Bulk fill, Filtek Z350 XT Nanohybrid, P 60 Microhybrid)

Figure 1: Armamentarium used in the study



Specimens used in the study Figure 2: Specimens for microhardness test (6mm × 2mm)

Procedure for microhardness evaluation



Figure 3: Teflon mould (6mm × 2mm)



Figure 4: Restorative material placed in mould



Figure 5: Restorative material pressed with slide on top

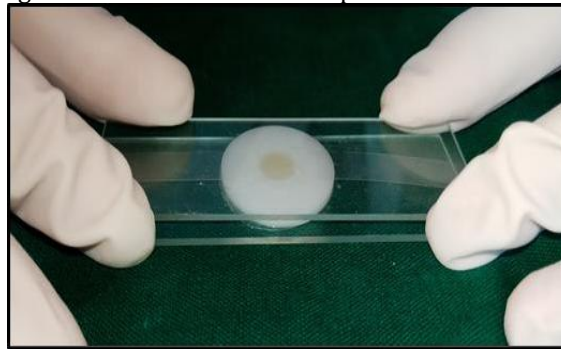


Figure 6: Prepared specimen



Figure 7: Specimens stored in distilled water



Figure 8: Division of groups specimens

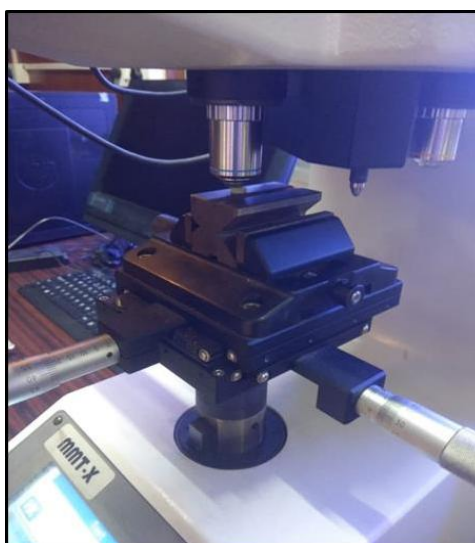


Figure 9: Specimen placed in microhardness tester for microhardness evaluation

DISCUSSION

Today, caries is increasingly recognized as an infectious disease process. Because of this, clinicians now prefer to treat it like a medical illness than just drilling and filling. Treatment focuses on control measures and remineralization methods of initial lesions. Effective control of caries requires interception of key disease factors, particularly cariogenic bacterial plaque. Since the mechanical plaque control alone is often inadequate, chemo prophylactic agents such as Chlorhexidine and fluoride containing mouth rinses serve as useful adjuncts in caries control.³² In clinical dentistry, restorative composites are widely used because of their adhesion ability to dental structures and aesthetic quality. The enhanced mechanical properties of these materials have led to a universal application and versatility, being indicated for both anterior and posterior teeth. Despite effective polymerization, composites exhibit instability and can interact with the oral

environment. In the oral cavity, these materials are able to absorb water and release chemical substances. The process of sorption and solubility may initiate various physical and chemical processes that can adversely affect the structure integrity and function of the polymeric material.³³ In recent years, the popularity of tooth colored restorative materials has promoted a rapidly increasing use of resins to meet the cosmetic expectations of the patients. The longevity and durability of the esthetic restorative materials in the oral environment are important factors for the proper selection of the material. The use of antimicrobial mouth rinses is an approach to limiting the accumulation of dental plaque with a primary objective of controlling the development and progression of periodontal disease and dental caries.²² Today, mouthrinses are the part of people's routine oral hygiene. They are commonly used even without professional prescription. Long term use of mouthrinses can lower the longevity of restoration and may affect the oral tissues.²⁴ Various internal and external factors influence the longevity, durability, and degradation of dental composite resins. Failure of resin restoration may occur due to change in the mechanical and chemical properties of the composite resin material. Both of them are inter-dependent on each other. Mechanical properties may be altered as the resin is exposed to unwanted compressive and tensile forces while chemical properties of resin is altered by the internal environment of oral cavity, food or other materials used; which further affects the mechanical properties.²⁷ Hardness is the resistance of material to indentation, and it correlates well to material's strength and rigidity, while the microhardness is nondestructive laboratorial test specifically located, that supplies fundamental data about the material.¹⁵ Hardness is critical parameter of the restorative materials, as it contributes to the long term durability in the oral environment. So reduction in the hardness of a material may result in premature failure of a restoration requiring its replacement.²² Hiora K herbal mouthrinse is newly introduced in market and its effect on composite resin materials is not known. Also literature on the effect of mouthrinses on newly introduced composite resin material is limited. Hence the aim of this in vitro study was to evaluate the effect of commercially available herbal mouthrinse on microhardness of various composite restorative materials. The results of the present study demonstrated that the mean microhardness of group III (P60 Microhybrid) was found to be highest followed by group II (Filtek Z350 XT Nanohybrid) and group I (Reveal HD Bulk fill). The three composite restorative materials tested here differed statistically in terms of compressive strength with a p-value of <0.05. The result was in accordance with a previous studies done by George et al.,²⁶ and Yesilyurt et al.³⁴ This could be attributed to the fact that Filtek P60 consists of three major components. The majority of TEGDMA has been replaced with a blend of UDMA and Bisphenol A polyethylene glycol diether dimethacrylate (Bis-EMA). Both of these resins are of higher molecular weight and therefore have fewer double bonds per unit of weight. The high molecular weight materials also impact the measurable viscosity. The higher molecular weight of the resin results in less shrinkage, reduced aging, and a slightly softer resin matrix. In addition, these resins impart a greater hydrophobicity and are less sensitive to changes in atmospheric moisture. In the present study there was a statistically significant reduction observed in post immersion microhardness in group II (Filtek Z 350 XT Nanohybrid) and group III (P60 Microhybrid) compared to the baseline values in both the immersion mediums. The results were in accordance with the previous studies done by Dieb et al.,¹³ and Jyothi KN et al.⁶ This may be because of the acidic pH of the mouthrinses which would have caused acid erosion of the resin composite by acid etching and leaching the principle matrix forming cations. However contrasting results were found in previous studies performed by Gurdal P et al.,³⁵ and Rios et al.³⁶ where there was no statistically significant effect of mouthrinse found on microhardness of the tested composite restorative resin materials. Every study is formed with few strengths and limitations side by side. The strength of the present study includes the use of evaluation of newly introduced herbal mouthrinse Hiora K for the first time as per our knowledge on microhardness of various restorative composite resin materials.

The limitation of this study is that the in vivo oral conditions are different from in vitro experimental conditions. Several other factors need to be taken into consideration, such as saliva which may dilute or buffer the mouth rinse, salivary pellicle that might have a protective effect, food habits, beverages, temperature changes and change in pH, oral care products, which may isolate and interfere with the physical and mechanical properties of the materials, influencing the durability of the restorative treatment. Therefore, further studies are necessary to determine the effects of mouthrinses in vivo..

CONCLUSION

Based on the observations and results obtained from the present study it could be concluded that: There was a statistically significant difference observed between Group I (Reveal HD Bulk fill), Group II (Filtek Z350 XT Nanohybrid) and Group III (P 60 Microhybrid) in terms of microhardness. Group III (P 60 Microhybrid) showed higher microhardness followed by Group II (Filtek Z350 XT Nanohybrid) and Group I (Reveal HD Bulk fill). There was a statistically significant reduction observed in the post immersion microhardness in group II (Filtek Z 350 XT Nanohybrid) and group III (P60 Microhybrid) compared to the baseline values in both the immersion mediums. Group I (Reveal HD Bulk fill) did not show any statistically significant reduction in post immersion microhardness compared to baseline values in both the immersion mediums. As per the results and statistical evaluation outcome, Hiora K (alcohol free) mouthrinse did show statistically significant reduction in microhardness in two of the tested composite restorative materials. Alcohol content is not the only factor in mouth rinses that can degrade materials. Also changes in microhardness of composite resins may be material dependent. Hence further in vivo studies are recommended to substantiate the results of this present study.

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