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ORIGINAL RESEARCH

Comparative Evaluation of Erosive Potential of a Chemical and Herbal Mouthwash on the Surface Roughness of Resin-modified Glass Ionomer Restorative Materials: An *in vitro* Study

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ABSTRACT

Aim: The aim of this study was to comparatively evaluate the erosive potential of herbal mouthwash and chlorhexidine on the surface roughness of restorative materials.

Materials and methods: A sample size of 60 restorative pellets was taken, out of which 20 pellets of giomer, 20 of compomer, and 20 of light-cured glass ionomer cement (LC GIC) were made. The baseline surface roughness values were evaluated with an optical profilometer. The restorative pellets were subjected to tooth brushing twice a day for 1 minute with a toothpaste. Same electronic brush was used for brushing all the restorative pellets. All the pellets were immersed in herbal mouthwash and chlorhexidine mouthwashes according to the manufacturer's instruction. The process was repeated for 30 days. Postimmersion surface roughness was evaluated by profilometer after 30 days, and these values were compared with the baseline values and statistically analyzed.

Results: The mean percentage increase of surface roughness with herbal mouthwash in group A (giomer) was 129.66%, in group B (compomer) 204.79%, and in group C (LC GIC) 272.24%. The mean percentage increase of surface roughness with chlorhexidine in group A (giomer) was 98.63%, in group B (compomer) 141.38%, and in group C (LC GIC) 164.96%. Among the restorative materials the increase in surface roughness was least in giomer followed by compomer and LC GIC.

Conclusion: The maximum erosive potential was seen with herbal mouthwash followed by chlorhexidine. All the restorative materials giomer, compomer, and LC GIC used in this study showed an increase in the surface roughness after treating with mouthwashes wherein LC GIC showed the maximum increase in surface roughness followed by compomer and giomer.

Keywords: Compomer, Giomer, Mouthwashes, Surface roughness.

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INTRODUCTION

Oral health is very important to the appearance and sense of well-being. Emerging evidence has shown a strong link between the effects of oral health on the general health. Good oral hygiene can be maintained on a regular basis by using different plaque control methods which include mechanical and chemical methods.[1] Chemical methods include the use of mouthwashes. These mouthwashes can be alcohol-, peroxide-, or fluoride containing. The most commonly used mouthwash is chlorhexidine. It is antiseptic in nature and has immediate bactericidal action and prolonged bacteriostatic action due to absorption onto pellicle-coated enamel surface; however, it has certain disadvantages like unpleasant taste and staining of teeth.

Ayurvedic mouthwashes are alcohol-free and chemical-free and contain time-tested herbal oils and extracts – like neem oil, clove, and peelu – that actually promote oral health. Hence, they can be a viable alternative to the chemical mouthwashes. However, frequent mouthrinse use may exert detrimental effects on oral and dental tissues as well as dental restorative materials. The mouthrinses can alter the surface roughness of dental materials,

Table 1: Composition of restorative materials

Sl. no.	*Material*	*Composition*	*Filler particle size*	*Filler content*
1	Giomer (Beautifil II, Shofu, Japan)	Surface reaction type prereacted GIC (S-PRG); multifunctional glass filers based on fluoroboroaluminosilicate glass; Bis-GMA; TEGDMA; UDA	0.1–4.0 μm	68.6% by volume
2	Compomer (Dyract-XP, Dentsply)	Strontium-aluminum-sodium-fluoro-P-silicate glass; strontium fluoride; UDMA; TCB resin; highly cross-linking methacrylate monomer	0.8 μm	47% by volume
3	Light cure GIC (GC Fuji II)	Aluminum, fluorosilicate glass; HEMA; tartaric acid; polyacrylic acid; water	0.1–25 μm	60% by volume

GIC: Glass ionomer cement; GMA; TEGDMA; UDA; UDMA; TCB; HEMA

which is very important for plaque retention, staining, and patient comfort.

Thus, the present study was conducted to check the effect of commonly used chemical mouthrinses like chlorhexidine and compare it with herbal mouthwash and to comparatively evaluate their erosive potential on various restorative materials.

MATERIALS AND METHODS

Sixty autoclavable molds measuring 9×3 mm in dimension were selected for the study. Out of 60, 20 pellets of giomer (group A), 20 of compomer (group B), and 20 of light-cured glass ionomer cement (LC GIC [group C]) were made. The composition of various materials used is depicted in Table 1. For giomer, the material was filled in an incremental pattern and cured for 40 seconds with the help of light-emitting diode curing light (Dentsply, York, PA, USA). Similarly, 20 molds were filled with compomer and 20 with LC GIC. The molds were split into two with metal disk and the restorative pellets were taken out. All the groups were further divided into two subgroups, each (i) and (ii). Subgroup A(i) was treated with herbal mouthwash and group A(ii) with chlorhexidine. Similarly, groups B and C were divided into subgroups (i) and (ii). The composition of the mouthwashes is shown in Table 2.

The pH evaluation of each mouthwash was done with the help of electronic pH meter (Ultra Watech System). The restorative pellets were stored in distilled water for 24 hours. The baseline surface roughness values of the restorative pellets were recorded with the help of optical profilometer (Wyko, NT Series Optical Profiler).

Table 2: Composition of mouthwashes

Sl. no.	*Mouthwash*	*Ingredients*	*pH*
1	Chlorhexidine (Rexidine)	Diluted chlorhexidine gluconate 0.2% w/v	5.3
2	Herbal mouthwash	Extracts: Bibhitaka 10 mg, Nagavalli 10 mg, Pilu 5 mg Powder: Peppermint satva 1.6 mg, Yavanisatva 0.4 mg Oils: Gandhapurataila 1.2 mg, Ela 0.2 mg	4.7

The pellets were brushed with electronic brush (Colgate) using Colgate toothpaste for 1 minute in the morning and 1 minute in the evening. After brushing, the restorative pellets were treated with mouthwashes twice a day according to the manufacturer's instruction. The procedure was repeated for 30 days. The restorative pellets were checked for postimmersion surface roughness by profilometer at the end of 30 days and were then compared with the baseline values. The data were tabulated and subjected to statistical analysis.

RESULTS AND OBSERVATIONS

The mean percentage increase in surface roughness among various groups was more with Hiora than chlorhexidine as shown in Table 3 and Graphs 1 and 2.

Further, on applying one-way analysis of variance (ANOVA) it was found that the increase in the surface roughness in all the groups, when treated with various mouthwashes, had significant difference with $p < 0.001$ at 95% confidence level (Table 4). However, when the intergroup comparison was done using the Dunnett test, LC GIC showed the maximum increase in mean percentage increase of surface roughness followed by compomer and least was seen in giomer as shown in Table 5.

DISCUSSION

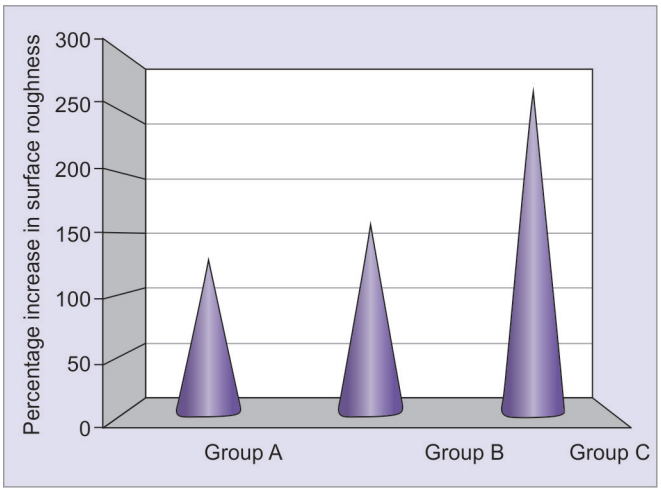
The present *in vitro* study was designed to check the effect of a chemical mouthwash and a herbal mouthwash on the surface of various restorative materials used in pediatric dentistry. Frequent use of mouthrinses can affect the surface roughness of resin-based restorative materials. In the present study, there was an increase in the surface roughness in various restorative materials and it was seen more with herbal mouthwash than with chlorhexidine. The pH of herbal mouthwash is 4.7 and that of chlorhexidine is 5.7. The pH of the mouthrinses is a possible preponderant factor for restorative material degradation.

Jyothi et al[2] conducted an *in vitro* study to check the effect of various mouthrinses on the microhardness of restorative materials. It was concluded that mouthrinses

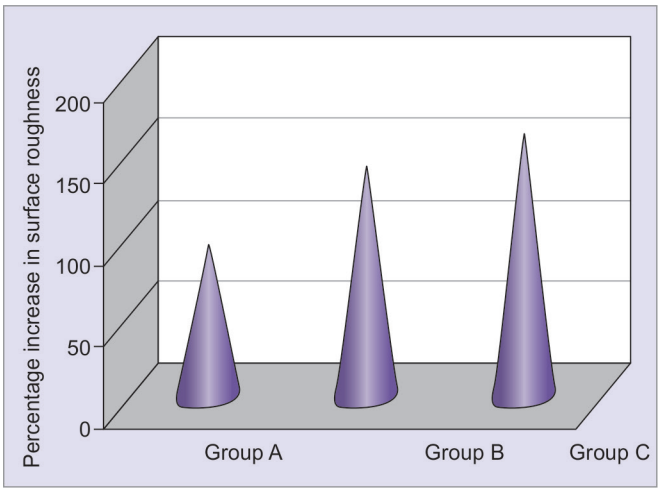
Table 3: Mean percentage increase in surface roughness with herbal mouthwash and chlorhexidine

						95% confidence interval for mean			
Surface roughness	*Groups*	*N*	*Mean % increase*	*Std. deviation*	*Std. error*	*Lower bound*	*Upper bound*	*Minimum*	*Maximum*
Percentage increase with herbal mouthwash	Group A (Giomer)	10	129.66	9.59364	4.29041	117.7480	141.5721	117.00	141.34
	Group B (Compomer)	10	204.79	13.81526	6.17837	187.6394	221.9472	192.82	221.20
	Group C (LC GIC)	10	272.24	24.67063	11.03304	241.6031	302.8683	234.50	299.71
Percentage increase with chlorhexidine	Group A (Giomer)	10	98.6359	15.45459	6.91150	79.4465	117.8253	80.02	118.40
	Group B (Compomer)	10	141.38	10.70472	4.78730	128.0928	154.6761	134.97	160.25
	Group C (LC GIC)	10	164.96	3.56882	1.59603	160.5241	169.3866	160.39	170.27

LC GIC: Light-cured glass ionomer cement



Graph 1: Mean percentage increase in surface roughness among various groups when treated with herbal mouthwash



Graph 2: Mean percentage increase in surface roughness among various groups when treated with chlorhexidine

Table 4: Distribution of variance between and within groups using ANOVA test

		ANOVA				
Surface roughness	*Various groups*	*Sum of squares*	*Df (degree of freedom)*	*Mean square*	*F (variance ratio)*	*p-value*
Percentage increase in herbal mouthwash	Between groups	50,868.822	2	25,434.411	85.586	00.000
	Within groups	3,566.157	12	297.180		
	Total	54,434.980	14			
Percentage increase in chlorhexidine	Between groups	11,302.181	2	5,651.090	46.299	00.000
	Within groups	1,464.687	12	122.057		
	Total	12,766.868	14			

ANOVA: Analysis of variance

with lowest pH showed significant reduction in the microhardness. Similarly, Sadaghiani et al[1] did an *in vitro* study to check the effect of different mouthrinses on the surface roughness of resin-modified restorative materials and concluded that the mouthwashes with lowest pH resulted in the greatest increase in the surface roughness.

The higher acidity with lower pH may have altered the polymeric matrixes of the resin-based restorative materials by catalysis of the ester groups from dimethacrylate monomers present in their compositions (Bis-GMA, TEGDMA, etc.). The hydrolysis of these ester groups may have formed alcohol and carboxylic acid molecules, which accelerate the degradation of the resin composites, due to the decrease of pH inside resin matrix.[3] Also, the low pH of solutions may induce phenomena of sorption and hygroscopic expansion, due to the production of methacrylic acid, the result of the degradation process of the enzymatic hydrolysis.[4,5]

Naga and Yousef[6] did an *in vitro* study to evaluate the different restorative materials after exposure of chlorhexidine and concluded that exposure to chlorhexidine for 1 month showed increase in the mean surface roughness values in the restorative materials.

Table 5: Intercomparison of mean percentage increase in surface roughness among various groups

Percentage increase in surface roughness	*I group*	*J group*	*Mean difference (I − J)*	*Std error*	*95% confidence interval*		*p-value*
					Lower bound	*Upper bound*	
Percentage increase in herbal mouthwash	Group A (Giomer)	Group B	−28.96	10.90284	−98.8885	−51.3780	00.000
		Group C	−142.57	10.90284	−166.3309	−118.8204	00.000
	Group B (Compomer)	Group A	28.96	10.90284	51.3780	98.8885	00.000
		Group C	−113.62	10.90284	−91.1976	−43.6871	00.000
	Group C (LC GIC)	Group A	142.57	10.90284	118.8204	166.3309	00.000
		Group B	113.62	10.90284	43.6871	91.1976	00.000
Percentage increase in chlorhexidine	Group A (Giomer)	Group B	−42.74862*	6.98734	−57.9727	−27.5245	00.000
		Group C	−66.31951*	6.98734	−81.5436	−51.0954	00.000
	Group B (Compomer)	Group A	42.74862*	6.98734	27.5245	57.9727	00.000
		Group C	−23.57088*	6.98734	−38.7950	−8.3468	00.006
	Group C (LC GIC)	Group A	66.31951*	6.98734	51.0954	81.5436	00.000
		Group B	23.57088*	6.98734	8.3468	38.7950	00.006

LC GIC: Light-cured glass ionomer cement

Intergroup comparison revealed that LC GIC showed the maximum increase in surface roughness both with herbal mouthwash and with chlorhexidine. The reason can be that fillers of the resin-based restorative materials contain alkaline earth metals like barium-aluminum-silicate, which are more sensitive to stress corrosion especially under hydrogen ion influences, resulting in leaching of filler components and facilitating filler plug out under abrasive conditions.[7]

In the present study, the surface roughness of giomer was comparatively less than that of compomer and LC GIC. Similar to traditional methacrylate-based composites, the chemical composition of giomer comprises inorganic filler particles and organic resin matrix. Instead of using purely glass or quartz as the typical fillers, giomer incorporates inorganic fillers that are derived from the complete or partial reaction of ion-leachable glasses with polyalkenoic acids in water before being interfaced with organic matrix.[8] Therefore, no absorption of moisture is required in the matrix. Thus, glass ionomer phase in giomers is not affected by water uptake in the restoration, whereas it was significantly affected by water uptake in conventional GIC, resin-modified GIC, and compomer.[9] So, giomer is a more stable restorative material than compomer and LC GIC.

Tanthanuch and Patanapiradej[10] investigated the effect of acidic rinses on surface roughness and erosion of various tooth-colored restorative materials, namely, GIC, resin-modified GIC, giomer, compomer, and resin composites. The study showed that the maximum increase in surface roughness was seen in conventional GIC followed by resin-modified glass ionomer, compomer, giomer, and least in resin composites. The results are in accordance with the present study. Further, the volume of holes and peaks was evaluated on the surface of restorative materials and maximum holes were seen on the surface of resin-modified GIC followed by conventional GIC and by compomer, and a similar volume was observed between the giomer and resin composites being the least.

Herbal mouthwash showed an increase in the surface roughness of restorative materials more than chlorhexidine. It is an alcohol-free ayurvedic mouthwash which has been recently introduced. The increase in the surface roughness can be attributed to the low pH of the mouthwash and secondly the hygroscopic nature of the resin-based restorative materials.[2]

But very few studies have been done on herbal mouthwash, checking its effect on restorative materials, so further studies are required to authenticate the results. At the same time the results of this *in vitro* study may not be directly related to the clinical situation where saliva may dilute or buffer the mouthrinses. Hence, further *in vivo* studies are recommended.

CONCLUSION

All the restorative materials giomer, compomer, and LC GIC used in this study showed an increase in the surface roughness after treating with mouthwashes. The maximum erosive potential was seen with herbal mouthwash followed by chlorhexidine.

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