

## Original Research Article

### **Effect of mouthwashes and brushing simulation on the surface roughness of a bulk filled composite resin - An invitro study**

#### **Abstract**

INTRODUCTION: Dental caries is one of the most common chronic diseases seen in the world and it's restoration is one among the most common procedures done by dentists throughout. In this article the influence of mouthwashes and simulated tooth brushing on the surface roughness of a bulk filled composite resin is checked. The aim of the study is to analyse the effect of mouthwashes and brushing simulation on the surface roughness of a bulk filled composite resin.

MATERIALS AND METHODS: The present study was an in vitro study conducted in a university dental hospital located in Chennai. The composite resin (ivoclar vivadent) was manipulated into putty moulds. The surface roughness of these specimens was calculated before immersion in mouthwash. They were subjected to brushing by means of Toothbrush simulator ZM3.8.

RESULTS: From the raw data we can conclude that the surface roughness of composite rinsed in both CHX and Povidone remains the same before and after brushing simulation. The difference of Ra, Rq and Rz values of surface roughness before and after brushing simulation was analysed and the composite discs immersed in both the mouthwashes ie CHX and Povidone were analysed and they did not show much deviation after brushing simulation.

CONCLUSION: Within the limitations of this in vitro study, we concluded that the surface roughness of a bulk filled composite resin can be influenced by mouthrinse solutions when it is associated with toothbrushing; however, mouthrinse by itself does not affect the surface roughness of composite.

**KEY WORDS:** surface roughness, composite, restorative material, brushing simulation, mouthwashes

## **INTRODUCTION**

Dental caries is one of the most common diseases of the world and their prevention is key for maintaining proper oral hygiene. Prevention starts right at home with brushing, flossing and the use of mouthrinses(1). Removal of caries can be done by excavating them and sealing the cavity with a dental restorative cement such as composite resin or glass ionomer cement. The main aim of using a dental restorative cement is to restore all the mechanical and biological functions of a natural tooth(2). Dental restorative cement like composite is one of the most commonly used restorative cement by dentists owing to its excellent properties and aesthetics. Maintenance of oral hygiene still stays important after removal of caries and is key to prevent the formation of secondary caries(3).

Mouthrinses often complement brushing in patients with splints or prostheses, implants, orthodontic braces. In this article the influence of mouthwashes and simulated tooth brushing on the surface roughness of a bulk filled composite resin is checked. The mechanical properties of composite resin can be influenced by tooth brushing. The surface roughness can increase due to wearing of the surface from brushing teeth. Brushing can expose the filler particles and cause them to loosen due to continuous wearing leading to abrasion of the surface of composite. A tooth brushing simulator is a device that will simulate various tooth brushing movements on the surfaces of teeth and test pieces. The brushes present in the simulator are controlled by a central

driven system and hence the movement of brushing is the same for all the brushes present in the simulator(4). The motion sequence for cleaning teeth can be a combination of backward, forward or circular motion.

A mouthrinse or a mouthwash is a medicated liquid that is used for maintenance of oral hygiene. There is a wide range of options for the kinds of mouthrinses available and they all differ in their antimicrobial and analgesic or astringent properties. Chlorhexidine is a prescription germicidal mouth rinse with excellent antibacterial properties. It is an effective antiseptic mouthwash. CHX is highly effective and is commonly prescribed for maintenance of good oral hygiene(5). Betadine containing povidone-iodine is an effective antiseptic and disinfectant agent that is used as a mouthwash to kill germs that cause infections of the mouth(6,7). It also relieves dryness of the mouth and sore throat. Betadine mouthrinse is also prescribed in COVID-19 patients owing to its excellent antimicrobial properties. Composite restorations have become an indispensable element for posterior teeth restorations in modern dentistry. In many clinical trials and studies, the performance of composite restorations bearing the mastication load in the posterior teeth areas has been proven conclusively. Apart from the highly aesthetic properties of composite it also has the demand for the most efficient and economic restorative material in the market. The aim of the study is to analyse the effect of mouthwashes and brushing simulation on the surface roughness of a bulk filled composite resin.

## **MATERIALS AND METHODS**

8 specimens were prepared with bulk filled composite resin. The composite resin (ivoclar vivadent) was manipulated into putty moulds and they were pressed with a glass slab to smoothen the surface. Finally the samples were mounted on die stone (Figure 1). They were then cured for 20 seconds using an LED light curing unit. The cured specimens were removed and polished. The surface roughness of these specimens was calculated before immersion in mouthwash. The specimens were divided into two groups, group 1 and group 2. Two mouthwashes were selected namely chlorhexidine gluconate and betadine 2%. Group 1 was subjected to immersion in chlorhexidine gluconate and group 2 was subjected to immersion in betadine. During a period of 5 days, each sample was immersed in 20 mL of mouthrinse for one minute under manual agitation, once a day (24 hour interval between exposures). After 5 days of immersion, they were subjected to brushing by means of a brushing simulator (Toothbrush simulator ZM3.8). The machine allows 8 specimens to be brushed simultaneously (Figure2). The brushing was performed, with a dentifrice slurry (Colgate and distilled water ratio). Each specimen was subjected to toothbrushing with a soft toothbrush. The specimens underwent 1000 cycles of brushing after which the surface roughness analysis was performed. Toothbrush simulator ZM 3.8 and a stylus profilometer (Mitutoyo SJ-310) was used.

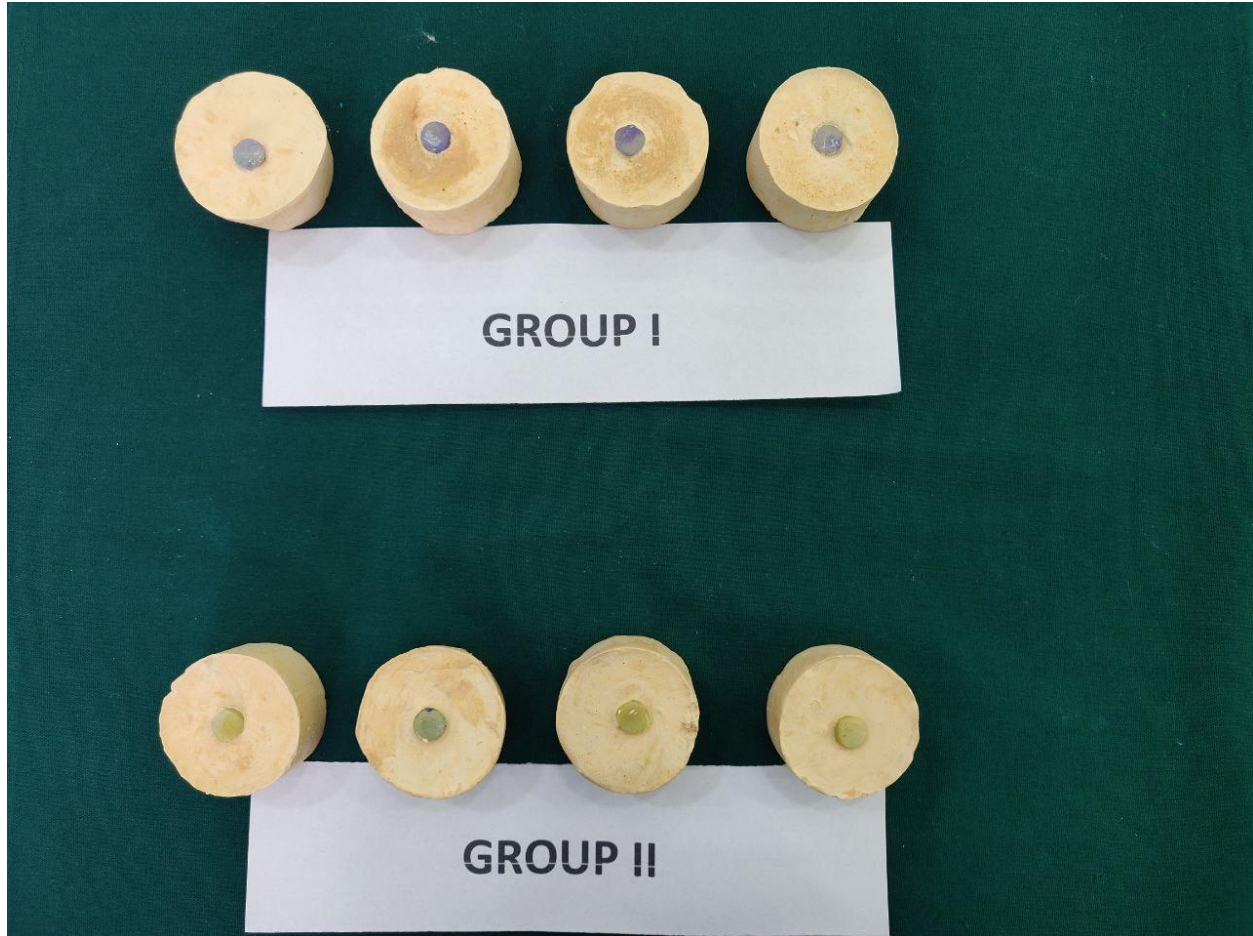


Figure 1: Group I sample immersed in CHX and Group II sample immersed in povidone iodine mouthwash.



Figure 2: Samples before they underwent brushing simulation

## RESULTS AND DISCUSSION

Table 1: This table represents the Ra, Rq and Rz values of composite rinsed in CHX and Povidone before and after brushing simulation

Samples	Surface roughness value prior to brushing simulation			Surface roughness value after brushing simulation		
	Ra	Rz	Rq	Ra	Rz	Rq
CHX 1	0.003	0.022	0.004	0.003	0.021	0.004
CHX 2	0.003	0.025	0.004	0.003	0.020	0.004
CHX 3	0.003	0.023	0.004	0.003	0.019	0.004
CHX 4	0.003	0.022	0.004	0.003	0.021	0.004
Povidone 5	0.003	0.024	0.004	0.003	0.019	0.003
Povidone 6	0.003	0.027	0.004	0.003	0.020	0.003
Povidone 7	0.003	0.024	0.004	0.003	0.021	0.003
Povidone 8	0.003	0.024	0.004	0.003	0.021	0.003

Table 2: Significant testing on surface roughness between groups before and after brushing simulation

	<b>Mean</b>	<b>N</b>	<b>Standard deviation</b>	<b>Standard Error mean</b>	<b>P value</b>
<b>preRa</b>	<b>0.0030</b>	<b>8</b>	<b>0.0000</b>	<b>0.0000</b>	<b>0.000</b>
<b>post Ra</b>	<b>0.0030</b>	<b>8</b>	<b>0.00000</b>	<b>0.00000</b>	
<b>preRq</b>	<b>0.0239</b>	<b>8</b>	<b>0.00164</b>	<b>0.00058</b>	<b>0.134</b>
<b>postRq</b>	<b>0.0215</b>	<b>8</b>	<b>0.00312</b>	<b>0.00110</b>	



<b>preRz</b>	<b>0.0030</b>	<b>8</b>	<b>0.00000</b>	<b>0.00000</b>	<b>0.033</b>
<b>postRz</b>	<b>0.0035</b>	<b>8</b>	<b>0.0053</b>	<b>0.00019</b>	

**\*Independent sample t test was used and p value of less than or equal to 0.005 is considered statistically significant.**

From the results obtained, the Ra, Rq and Rz values of Chlorhexidine and Povidone for pre and post surface roughness was obtained (Table 1). From the raw data we can conclude that the surface roughness of composite rinsed in both CHX and Povidone remains the same before and after brushing simulation. The difference of Ra, Rq and Rz values of surface roughness prior to brushing simulation and after brushing simulation was analysed and the composite discs immersed in both the mouthwashes ie CHX and Povidone was analysed and they did not show much deviation after brushing simulation. The independent paired t test was done for the composite immersed in both the mouthwashes surface roughness values for both prior and after brushing simulation using SPSS statistics version 22.0. The mean value of pre Ra and post Ra is 0.030 and the p value is 0.000. The mean value of pre Rq and post Rq is 0.0239 and 0.0215 respectively and the p value was found out to be 0.134. The mean value of pre Rz and post Rz is 0.0030 and 0.0035 respectively and the p value is found to be 0.033. (Table 2). For discs immersed in both CHX and povidone the surface roughness value before brushing simulation

was equal to the surface roughness after. This difference was statistically not significant.

Our team has extensive knowledge and research experience that has translated into high quality publications.(8–20),(21–25) (26) (27) Composite materials can degrade due to any mechanical or chemical factors from the oral environment including the composition of saliva, masticatory stress exerted, toothpaste used, force of brushing, textures of food particles etc(28). Any of these factors can cause changes in the surface roughness of the composite resin, it's discolouration, loss of gloss, and polish affecting the aesthetics of the restorative materials. All these changes have been attributed to the degradation of composite and the loss of inorganic filler particles. In a non stress bearing area, the change arises due to the interaction between oral hygiene materials like toothpaste or mouthwashes. The side effects of mouth rinsing followed by tooth brushing need to be evaluated as it could affect the surface smoothness of the restorative material(29).

The degradation of a certain type of composite material, bulk filled composite in this case, depends on varying factors like volume and type of inorganic filler. In the study done by *Keico et.al* different results of surface roughness have been obtained. The specimens were immersed in artificial saliva first during the experimental period. This procedure influenced roughening from toothbrushing, because the saliva contains specific proteins and ions that may diminish the roughening effect of the toothbrush. However, in our study, the specimens were directly immersed in mouthwashes followed by toothbrushing. Hence the surface roughness values between both the studies gave varied results, with *Keico et.al* s results showing lower surface roughness values for Colgate Plax Fresh Mint ( $p < 0.05$ ). All other groups tested (Oral B, Cepa-

col, Colgate Plax, artificial saliva) exhibited no statistically significant differences between surfaces, whether subjected to toothbrushing or not (30)

The limitations of this study were less sample size. Only composite was used as a restorative material and the study could have used more restorative materials. More parameters could have also been included in the study apart from surface roughness. The brushing simulations on the restorative materials underwent only 1000 cycles and more cycles could have been included. Povidine and chlorhexidine were the only mouthwashes tested when many other mouthwashes which were commercially available could have been used.

## **CONCLUSION**

Within the limitations of this in vitro study, we concluded that the surface roughness of a bulk filled composite resin can be influenced by mouthrinse solutions when it is associated with toothbrushing; however, mouthrinse by itself does not affect the surface roughness of composite.

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## **CONFLICT OF INTEREST**

The author declares no conflict of interest.

## **AUTHOR CONTRIBUTIONS:**

Rajasri Pradeep and Balaji Ganesh S designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Balaji Ganesh S managed the analyses of the study. All authors read and approved the final manuscript

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