



Comparing the Surface Roughness of Light Cure Resin After Exposure to various Hot Beverages: An In Vitro Study

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Abstract

Introduction: The advancement in the field of dental materials has prompted the advancement of different composite materials that display expanded strength, better surface properties and color stability and polishability for better optical properties. Aim of the study is to evaluate the surface roughness of the light cure resin material post exposure to the various hot beverages.

Materials and Methods: Commercially available light cure resin was used for the present study. Using silicone molds ten pellets of light cure resin material was prepared. And before and after immersion values of surface roughness of the material were calculated and the mean value was noted. The correlation test was done using SPSS software version 23.0

Results: Surface roughness was time dependent as it increased with time. Greater surface roughness was observed in all the groups at tested time intervals. Ra and Rz values of post immersion value is less than pre immersion values (0.027).

Discussion: In previous studies it was reported that Ra, Rq and Rz values were assessed and the baseline values were determined and only minor variations were observed in the values of surface roughness between two different light cure resins.

Conclusion: From the present study it can be resulted that comparative evaluation of surface roughness value of the commercially available light cure resin post exposure to various hot beverages resulted that the mean value of the surface roughness post immersion is less when compared to the mean value of the surface roughness before the immersion of the material.

Keywords: Hot beverages; innovative technology; light cure resin; surface roughness; pre and post immersion



Introduction

Smiling is the most important feature that determines the psychological and social well being of an individual. Esthetics is considered as the most important requirement in the current era. It often motivates the individual to seek dental treatment. Resin restorations play a vital role in dentist's routine practice due to increased demand of the patient's esthetic requirement (1). The continuous evolution and changes in the field of restorative dentistry led to the development of new generation resins. It should have significant strength, better handling and increased polishability for a potent optical property. Over the past three decades substantial research has been conducted to improve the performance of surface roughness and color stability. The performance of the material is being assessed under the modified United States Public Health Service Criteria (2). Surface smoothness of restoration is based on the inherent characteristics such as type of organic matrix, composition, size and distribution of filler materials also based on the exposure of the material to low pH food, mouth rinse solutions and drinks. Surface roughness of the material increases the retention of the plaque which results in superficial discolouration, gingival inflammation and secondary caries (3,4).

Resins are highly susceptible to discolouration which is caused due to extrinsic or intrinsic factors. Light cure resin consists of organic matrix and Inorganic filler (55 - 57 %) (5). Restorative materials are subjected to various conditions which lead to the changes in mechanical and physical properties such as color stability, surface roughness which affects the quality of a restorative material which leads to the replacement of the restoration (6). One of the most important mechanical properties of a restorative material is surface roughness which is the measurement of the strength of a material. Surface roughness is based on the ductility, strength, malleability and resistance to abrasion and cutting. Decrease in the value of microhardness depicts the superficial degradation of the material which leads to the change in the roughness. Surface roughness leads to the accumulation of plaque and the deposition of lactic acid which decreases the longevity of a material (7). Numerous polymerisation systems have been developed in recent days. Light cure resin is the most commonly used composite resin in recent days and the use of chemical cure composite resin has been minimised. Light cure resin is often used by dental practitioners because of its superior properties when compared to chemical cure resins (8).

The aim of the study is to evaluate the surface roughness of the light cure composite resin *in vitro*. Present study reveals the surface roughness property of the light cure resin when it is immersed in hot



beverages for 24 hours. The information obtained from this study assists to determine the surface hardness of light cure resin which helps to achieve an excellent clinical outcome (9).

Materials And Methods

Commercially available light cure resin was chosen for the present study. 10 samples were prepared using light cure resin restorative material. Ten pellets of light-cure were prepared by packing into silicone molds. Then, cured according to the manufacturer's instructions using a curing unit, for 20 seconds. Then, one surface of each specimen was finished using metal burs and stone wheel finishing burs mounted on a slow speed handpiece. Later, it was polished using poly buff brushes and polishing paste followed by a wet rag wheel with a slurry of pumice. The other surface was marked with numbers and left unfinished to distinguish the experimental surface used to measure the roughness change of the material. The surface roughness of the material before immersing in hot beverages were measured using a Stylus profilometer -Mitutoyo SJ 310, 2 μ m tip/60° angle. The device was moved physically on the surface of light cure resin disc material to obtain the values of surface roughness of the material prior to immersing the material in hot beverages. The surface roughness value after immersing the material was determined using the Stylus profilometer. The surface roughness value of light cure resin before and after immersing in hot beverages were obtained and tabulated. The mean value was obtained and the results were analysed using SPSS software version 22.0 and the results were represented graphically. Following which the pellets of light cure resin were prepared in the White lab of Saveetha Dental College and Hospital. The conduct was approved by the institutional review board.

Statistical Analysis

All data obtained were analyzed by a Paired test using MS-Excel, represented as mean $\pm$ SD. The results were computed statistically (SPSS/10 Software Package; SPSS Inc., Chicago, IL, USA) using one-way ANOVA. In all tests, the level of statistical significance was set at $p < 0.05$.

Results



Light cure resin pellets were immersed in various hot beverages i.e. tea and coffee (figure 1) and the surface roughness values were noted before and after 24 hours of immersion (figure 2,3). The mean values were calculated based on the Ra, Rq and Rz values for tea (Table 1) and coffee (Table 2). Surface roughness values post immersion was higher in the samples immersed in tea than in the sample immersed in coffee.

TABLE 1: Table represents the Ra, Rq and Rz value of pre and post immersion value of surface roughness in Tea

Samples	Surface roughness value of IPR using IPR strips			Surface roughness value of IPR using IPR burs		
	Ra	Rq	Rz	Ra	Rq	Rz
Sample 1 [Standard]	0.003	0.004	0.026	0.003	0.004	0.028
Sample 2	0.003	0.004	0.027	0.003	0.004	0.028
Sample 3	0.003	0.004	0.028	0.003	0.004	0.027
Sample 4	0.003	0.004	0.028	0.003	0.004	0.028
Sample 5	0.003	0.004	0.028	0.003	0.004	0.029
MEAN	0.003	0.004	0.027	0.003	0.004	0.028



TABLE 2: Table represents the Ra, Rq and Rz value of pre and post immersion value of surface roughness in coffee

samples	Surface roughness value before immersing			Surface roughness value after immersing		
	Ra	Rq	Rz	Ra	Rq	Rz
Sample 6 [Standard]	0.003	0.004	0.028	0.003	0.004	0.026
Sample 7	0.003	0.004	0.027	0.003	0.004	0.027
Sample 8	0.003	0.004	0.029	0.003	0.004	0.029
Sample 9	0.003	0.004	0.029	0.003	0.004	0.028
Sample 10	0.003	0.004	0.028	0.003	0.004	0.026
MEAN	0.003	0.004	0.028	0.003	0.004	0.027

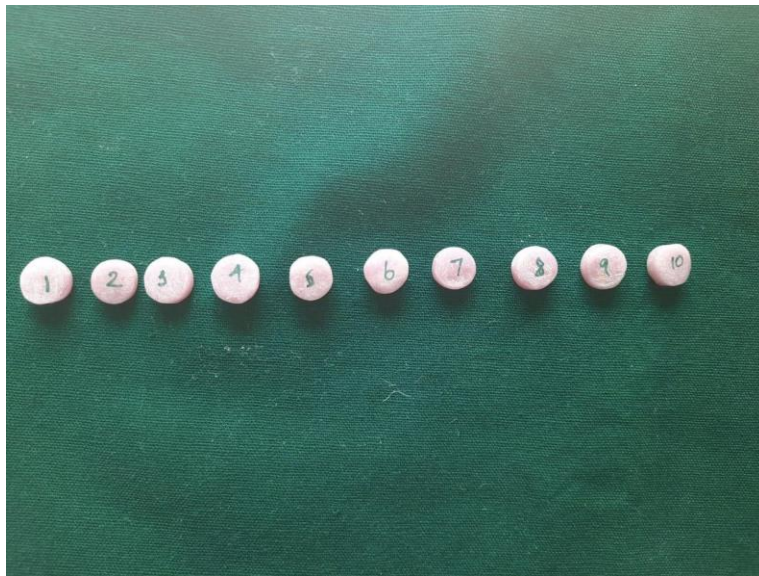


Figure 1: 10 pellets prepared from light cure restorative resin.



Figure 2: Represents the Stylus profilometer - Mitutoyo SJ 310, 2 μ m tip/60°angle, device was moved physically on the surface of the light cure resin disc material to obtain the values of surface roughness

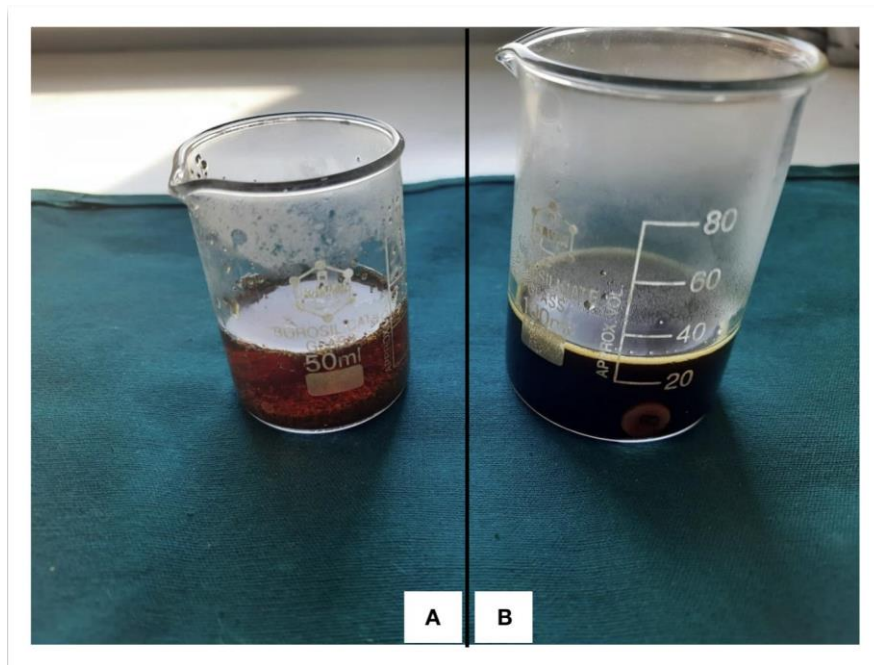
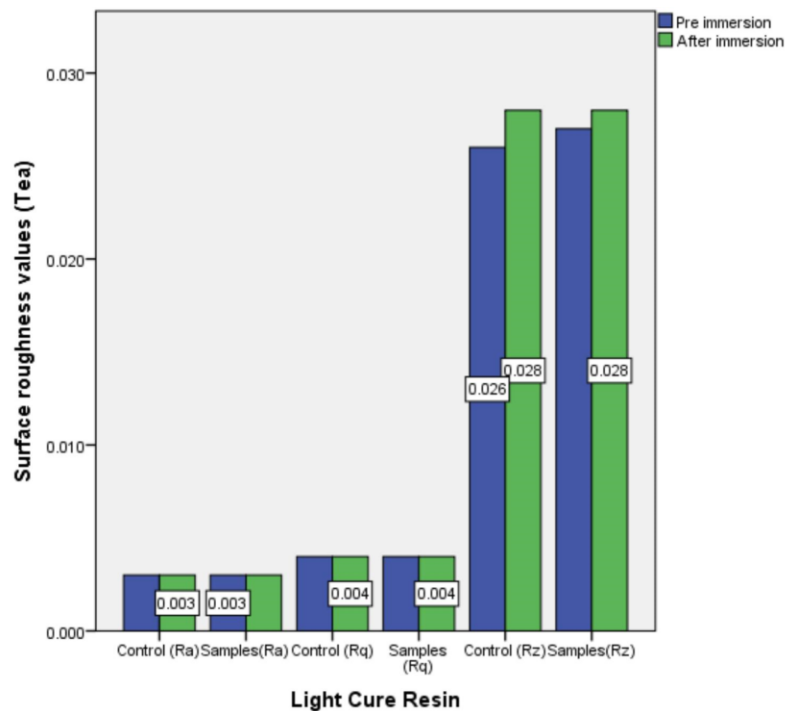
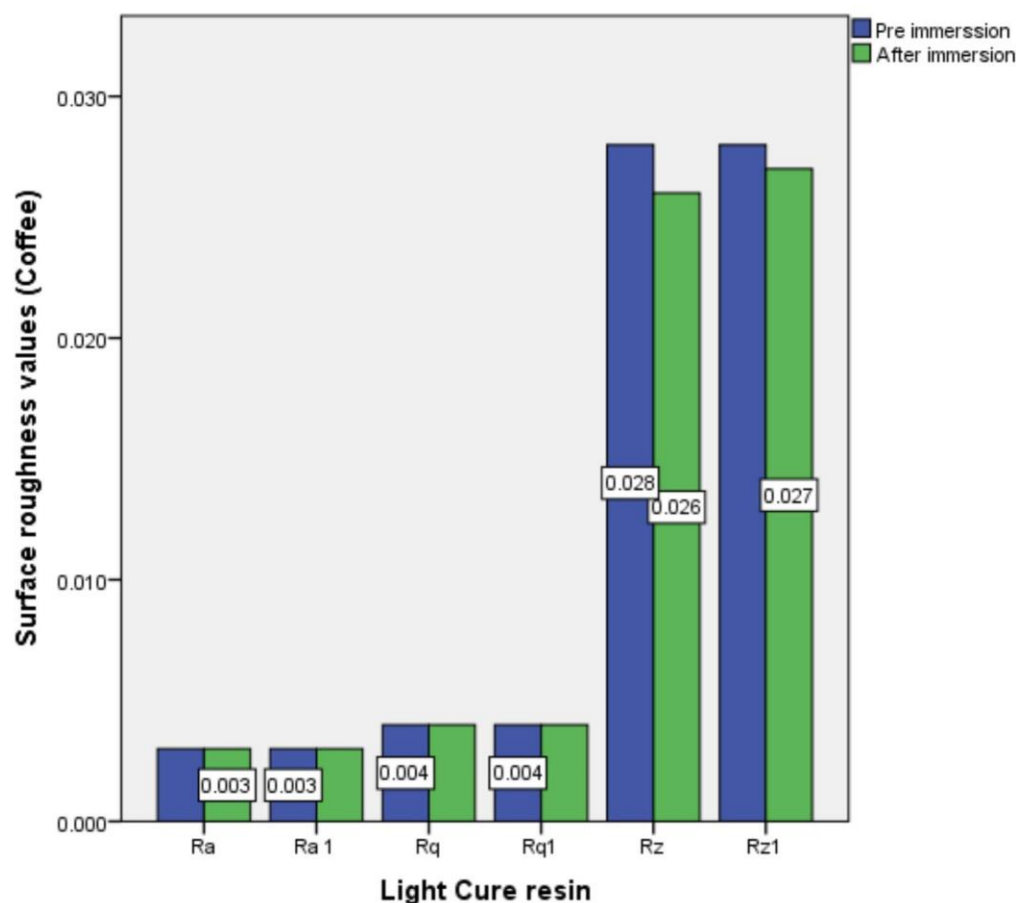


Figure 3: Figure showing light cure resin pellets immersed in tea **(A)** light cure resin pellets immersed in coffee **(B)** for 24 hours.



Graph 1: Comparative evaluation of surface roughness of light cure resin immersed in tea. X axis denotes sample and control parameters of light cure resin (Ra, Rq, Rz) and Y axis denotes surface roughness values. Blue colour denotes pre immersion values and green colour denotes post immersion values . The difference was statistically insignificant. Paired sample statistics; p value = 0.203 ($p < 0.05$). Hence statistically insignificant.



Graph 2: Comparative evaluation of surface roughness of light cure resin immersed in coffee. X axis denotes sample and control parameters of light cure resin (Ra, Rq, Rz) and Y axis denotes surface roughness values. Blue colour denotes pre immersion values and green colour denotes post immersion value. Paired sample statistics; p value = 0.203 ($p < 0.05$), Hence statistically insignificant.

Discussion

Surface roughness value of light cure resin was calculated which is immersed in tea and coffee for 24 hours in a temperature range between 69 - 71.1 degree celsius. Two pellets were immersed in distilled water which is noted to be as control. Average sampling lengths (Ra, Rq, Rz) were calculated for the pre immersion and post immersion values comparing it to the standard. It is resulted that for tea, Ra value for



the control and the sample were same (0.003) for both pre immersion and post immersion values Rq values were also observed for same level of average wavelength (0.004) for both pre immersion and post immersion values ; Rz values of post immersion value is higher than pre immersion values (0.028) (Graph 1). For coffee, Ra value for the control and the sample were same (0.003) for both pre immersion and post immersion values Rq values were also observed for same level of average wavelength (0.004) for both pre immersion and post immersion values ; Rz values of post immersion value is less than pre immersion values (0.027) (Graph 2).

Light cure resin is available in the market to satisfy the demand of various clinical conditions. Surface roughness of a material is directly proportional to the integrity of the components of composites. Microorganisms are more adhered to the rough surface. Hard brushing of teeth and acid action causes increased surface roughness and the surface gloss is decreased (10) (11). In previous studies it was reported that Ra value was assessed and the baseline value was determined and the study was done for 14 days. And only minor variations were observed in the values of surface roughness between two different brands of light cure resin (12). In previous studies done with evaluation of superficial smoothness reported that halogen lamp and light curing unit had equal level of surface roughness (13) curing unit showed similar polymerisation on top of the specimens. They also reported that tooth brushing resulted in the abrasion of the tested light cure restorative resins. Usage of fluoride toothpaste also causes increased roughness of teeth (14). The surface roughness of a restoration is associated with many factors like restorative material used, finishing and polishing instruments used and the immersion material to which they are subjected to. In previous studies they have reported that composite immersed in different solutions does not show any changes in the surface roughness. But significant changes were seen in surface roughness on usage of finishing and polishing instruments (15).

In some studies it is reported that the low pH of drinks affects surface roughness. Bacterial adhesion and plaque accumulation are caused by a rough surface wall, resulting in secondary caries. After 15 days of immersion, soft drinks have a major effect on the surface roughness of preheated nanohybrid composite resins (16). Acidic food-simulating liquids and beverages significantly increased the surface roughness and decreased surface microhardness of bulk-fill resin composites after evaluation at the end of the 28-day immersion period (17). Roughness and degradation of resin composites should be addressed when restoring damaged teeth in patients who eat acidic foods and drinks (18,19,20). Few limitations of the present study were less sample size, and the study could have included more than one light cure resin to have a better option of the commercially available products and it could have been immersed in more than



two beverages. Only surface roughness of the material was evaluated in future more parameters like tensile strength, flexural strength can also be appraised.

Conclusion

When the post immersion and pre immersion values were compared it is concluded that the surface roughness value of light cure resin pellets immersed in coffee is higher than the surface roughness value of light cure resin immersed in tea. In coffee the sample showed greater post immersion value than the control. In tea, both the control and the sample showed the same post immersion value. From this study it can be concluded that comparative evaluation of surface roughness of the commercially available light cure resin post exposure to various hot beverages resulted that the mean value of the surface roughness post immersion is less when compared to the mean value of the surface roughness before the immersion of the material.

Conflict Of Interest

The author declares that there was no conflict of interest in the present study.

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