



Original Research

Comparative Evaluation of Surface Roughness of Bulk fill Composite Resin after Simulated Brushing with Herbal and Desensitizing Toothpaste - An In vitro Study

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Abstract

Aim: The aim of the study was to evaluate and assess the resultant surface roughness of bulk-fill composite resin after duplication of daily brushing with different pastes like herbal and desensitizing formulation. **Materials and methods:** In this study two different commercially available bulk fill composite resin materials were evaluated. One brand was Swisstec and the other brand was Tetric N-ceram. 8 circular moulds were made with 10mm diameter with uniform thickness and polished with polishing burs. Eight disc designed samples were accommodated in a simulator which reproduces the brushing cycles (ZM3.8 SD Mechatronik). 4 of the samples were cleansed and brushed with the Dabur- red herbal formulation toothpaste (Group 1) and another 4 samples were cleansed and brushed with sensodyne desensitizing formulation toothpaste (Group 2). Surface roughness was checked before and after the brushing simulation using a profilometer stylus (Mitutoyo SJ 310). The Ra values, the Rq values and Rz values for the composite blocks was evaluated. **Results:** SPSS software version 23 was used and independent t-test was done for intergroup comparison analysis. Significance values for Ra, Rq and Rz are 0.356, 0.024, 0.902. Rq value was statistically significant. **Conclusion:** It was concluded that increased surface roughness was observed for bulk-fill composite resin blocks brushed with herbal based toothpaste when compared with desensitizing toothpaste. Thus, use of herbal toothpaste can affect the surface roughness properties of composite resin.

Keywords: *Brushing simulator; Composite resin; Profilometer, Surface roughness; Toothpaste; Innovative measurement.*

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INTRODUCTION

A well polished smooth and shiny surface can improve the lifecycle or the longevity of a restoration, durability and aesthetically pleasing appearance by decreasing the plaque accumulation and surface discolouration, pitting and staining, and thus mimicking the natural appearance of the tooth structure. Differences in reflection of the glossiness between a restoration and the interface of surrounding hard tissue like enamel have a clinical bearing as even the unaided human vision can easily percept and ascertain the differences in glossiness and lustre even if their individual chromas are well synched. On the other hand, high level of glossiness drastically decreases the effect of a mild chroma or value or the total color disparity as combined calorimetry of the reflected light is more overpowering than the inherent shade of the underlying elemental composite. Current composites can attain an exceptionally well polished sheen if appropriate polishing procedures are used. Glossiness is a characteristic of optical discernible actualizations that emanates from the geometrical dissemination of incident light which reflected from the surface, and is precisely altered by the surface pitting [1]. The impact of cleansing with an abrasive toothpaste on polished surface that exponential reduction in the glossiness and proportional escalation in discolouration due to pitting of restorative composites. This contraction in glossiness is the resultant of the degeneration or decadence of the restorative material due to its physicochemical interaction with the oral milieu, resulting in changes in surface glossiness and translucency and therefore deteriorated esthetics at long term [2].

Multiple evidence based studies have evaluated the resultant outcome of abrasive mechanical brushing on the restored tooth surface and evaluated the dynamics of the type of brushing manual or electric, the force executed and total time of brushing and also the most important aspect which is the relative dentin abrasivity (RDA) or the abrasive content of the toothpaste under evaluation. Dental materials in the oral milieu are exposed to an intrinsic aging process which may be a phenomenon due to nature of the diet, which can be replicated by submersion in liquid simulating human diet content [3]. The induced surface modification can harbour accumulation of biofilm and also exponentially confound the potential of the restorative surface for further breakdown. Abrading or physical and chemical degradation of the composite surface by abrasive dentifrice is hugely due to the inherent physical and chemistry of the constituents of the composites like the distribution, size, structure, shape, crystalline phase, hardness solubility [4]. Surface roughness is primarily impacted by the composition of composite matrix and filler characteristic and also by finishing and polishing protocols. The size variation of fillers in composites has been documented to be an integral constituent which leads to impacting the transmittance and reflectance of the final polished restoration. Optical properties, inclusive of color, glossiness, and surface texture of dental composites, are impacted by the surface finish achieved during finishing and polishing procedures [5]. Therefore the aim of the study was to evaluate and assess the bulk fill composite for any increase in surface pitting or change in texture after simulation of brushing with herbal formulation and desensitizing formulation.

MATERIALS AND METHODS

This in-vitro study was conducted in the White-lab - Material Research Centre, Saveetha Dental College and Hospital, Chennai, India. In this study we evaluated two different commercially available bulk fill composite resin materials. One brand was Swisstec and the other brand was Tetric N-ceram. Eight spherical moulds were made with 10mm diameter with uniform thickness and polished with polishing burs. Eight spherical disc shaped blocks were arranged in a brushing simulator (ZM3.8 SD -Mechatronik) (Figure 1). 4 block samples were cleansed and brushed with Dabur red herbal formulation (Group 1) and another 4 block samples were cleansed and brushed with Sensodyne desensitizing formulation (Group 2) (Figure 2). The bulk-fill

composite resin block samples were subjected to brushing in circular, clockwise, anticlockwise and linear x axis and y axis movements. Brushing simulation was done for 30,000 cycles which is equal to 3 years of brushing, for X axis it is 10,000 cycles, Y axis it is 10,000 cycles, clockwise it is 5000 cycles and anti clockwise it is 5000. Surface roughness was checked before and after the mechanical brushing mode simulation using a profilometer stylus- Mitutoyo SJ 310. We evaluated the Ra observations, Rq values and Rz values for the composite blocks.



Figure 1: Composite samples mounted



Figure 2: Brushing simulation

RESULTS

SPSS software version 23 was used and an independent t-test was applied for intergroup comparative analysis. Table 1 represents the significant testing between the two groups of herbal and desensitizing paste, the mean Ra, Rq and Rz values for the herbal paste group are -0.00175, -0.00200, -0.01400. The mean Ra, Rq and Rz values for the desensitizing toothpaste group are -0.00150 -,0.00175, -0.01325. Standard deviations for herbal toothpaste group are 0.000500, 0.000000, 0.006683. Standard deviations for the desensitizing toothpaste group are 0.000577, 0.000500, 0.007411. Significance values for Ra, Rq and Rz are 0.356, 0.024, 0.902. Rq value was statistically significant. (Figure 3)

Table 1: Table representing significant testing between the groups

Group	Parameter of Roughness	Mean	Standard deviation	Significance
Herbal paste	Ra	- 0.00175	0.000500	0.356
Desensitizing paste		-0.00150	0.000577	
Herbal paste	Rq	-0.00200	0.000000	0.024
Desensitizing paste		-0.00175	0.000500	
Herbal paste	Rz	-0.01400	0.006683	0.902
Desensitizing paste		-0.01325	0.007411	

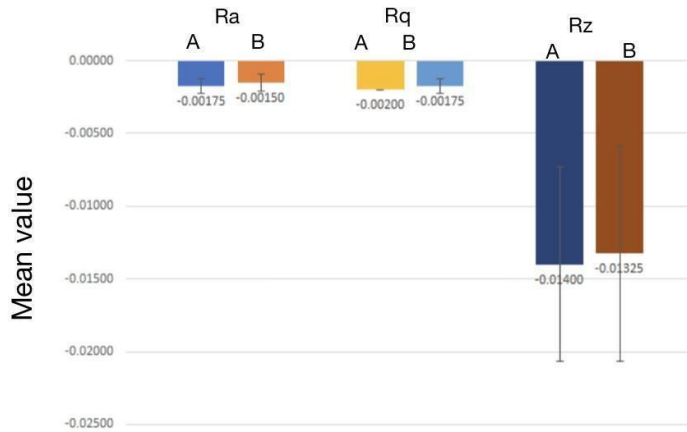


Figure 3: In the given graph A represents the herbal toothpaste and B represents the desensitizing toothpaste group. blue and orange indicate mean Ra difference index of herbal and desensitizing formulation respectively, yellow and sky blue denotes Rq mean difference rate of herbal and desensitizing toothpaste respectively, dark blue and brown indicates Rz mean difference rate of herbal and desensitizing toothpaste. Significance values for Ra, Rq and Rz are 0.356, 0.024, 0.902. Rq rate was statistically significant.

DISCUSSION

The authors have an extensive knowledge and research experience that has translated into high evidence based publications [6-25]. The size of filler particles in resin composites has been published to be an integral component which impacts and affects the transmittance and reflectance of the final polished restoration. Optical properties, which include the chroma, hue, value, translucency of the material and glossiness and texture of composites are affected finishing and polishing procedures and the armamentarium used. Thus, the integral composition of resin composites and the finishing polishing system have a far reaching impact on surface glossiness, pitting roughness or smoothness, and eventually on the resultant microhardness [26].

The dentifrice and its abrasive factor were as per studies having a significant, immense and proportional effect on the resultant surface texture and roughness. These observations are in tandem with other published data that have reiterated that abrasive dentifrices coupled with tooth brushing has resulted in an exponential increase in pitting or roughness of composite resins surface [27]. In a recent study, the authors have inferred that silica or calcium carbonate based dentifrices were minimally abrasive when compared to those dentifrices which had a greater content of sodium bicarbonate [28]. In this study there was an appreciable increased observation of surface roughness of bulk fill composite resin samples especially in the herbal toothpaste group had when compared to those of the Sensodyne group.

In the oral environment, composite materials are either exposed intermittently or continuously to variegated chemical substances found in saliva, food items and beverages [29]. As was well document in the past

literature that the abrasion of composite materials due to tooth brushing had a different outcome, dependent on the type of composite composition, characteristics of the toothpaste and also on the nature and hardness of the bristles of the toothbrush deployed. The initial wear or abrasion of resin composite material initiates with slow and irregular removal of the organic constituent which eventually results in the projection of unsupported filler particles and subsequent depilation the interfiller or matrix region which till then had a major role in the inherent wear resistance of resin composites, as the interparticle matrix region diminished the wear resistance of dental composite [30]. The quality of a constituent resin composite restoration surface primarily is dependent on two major influencing or impacting aspects i.e material components and the polishing system which was employed. Previous evidence based literature has demonstrated that the polishing system not only impacts on the concurrent surface roughness, glossiness, and colour stability but may also may impact other properties such as microhardness and microleakage and the final treatment outcome [31]. The limitations of this study were smaller sample size. However in future we can evaluate surface roughness parameters of different composite resin types with different toothpastes and scanning electron microscopic studies can be done to check surface topography and morphology changes after brushing simulation.

CONCLUSION

We can conclude that increased surface roughness was seen for bulk-fill composite block samples brushed with herbal formulation toothpaste when compared with desensitizing toothpaste. Thus, use of herbal toothpaste can affect the surface roughness properties of composite resin.

Conflict of Interests: Nil

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