Research Article

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Effect of Alcoholic and Non-Alcoholic Beverages on the Surface Roughness of Aesthetic Restorative Materials

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ABSTRACT

Background: The purpose of this study was to evaluate the changes in the surface roughness of aesthetic restorative materials (Composite and Glass ionomer cement) when exposed to commonly consumed alcoholic and non-alcoholic beverages (Nimbu Pani and Beer) by our Indian population.

Materials and method: Nanohybrid Resin Composite material A2/B2 Brilliant NG enamel (Coltene Whaledent), Conventional Glass Ionomer Cement (GC Fuji II) – type II restorative cement, Grinding machine (Buehler Metaserv, Buehler, Germany) Fine and Superfine polishing disks (Swiss flex grit – diatech premium rotary instruments)Lemon , Sugar , Salt , Chilled water , Beer (kingfisher) ,Surface profilometer (Surftest SJ-301, Mitutoyo, Japan) , Artificial saliva (Wet mouth ,IPCA). The prepared moulds were finished and polished and stored in artificial saliva subsequently, the surface roughness values were measured.

Results: Student't' test (independent) was used to find the significance of study parameters on continuous scale within each group. Statistical significance was set as $P \leq 0.05$. Differences were found to be statistically as well as clinically significant

Conclusion: Increase in surface roughness was seen when glass ionomer cement moulds and composite moulds were immersed in Nimbu Pani and Beer. Moreover, Glass Ionomer Cement showed more changes than composite.

Keywords: Beverages, surface roughness, esthetics.

INTRODUCTION

The Indian cuisine has been and is still evolving, as a result of the nation's cultural interactions with other societies. The cuisine includes various beverages also which may be alcoholic or non-alcoholic in nature. Amongst the alcoholic beverages, beer is the most commonly consumed in India. With the average age of the population decreasing and income levels on the rise, the

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popularity of beer in the country continues to increase. Amongst non-alcoholic beverages, Nimbu Pani (also known as lemon water) is commonly consumed due to its economic value, availability, acceptable flavour and most importantly its rehydrating benefits to cope up with our body's requirements in the diverse climatic conditions of India.

Unfortunately, these drinks are popular as thirst quenchers amongst the youth of today and the habit is carried over into adulthood leading to a major cause of damage to the restorations[1] if placed in their mouth. During consumption, the beverage contacts only shortly with the restoration before it are washed away by saliva [2.] Under acidic conditions, restorative materials suffer degradation over time, which can be predicted by changes in the surface roughness[3].

Roughness is an important property of the restoration surface, as a rough surface enhances accumulation of dental plaque [4] and residues, which causes gingival irritation and secondary caries risk [5]. It also diminishes the gloss of the restoration and causes more discoloration or surface degradation [6].

The outstanding development of adhesive dentistry coupled with strong esthetic demands from patients has resulted in an increasingly widespread use of resin composites in dental practice.

MATERIALS AND METHODS

Specimen preparation

A total of 60 moulds were made of out of which 30 moulds were of conventional glass ionomer cement (GC Fuji II– type II restorative cement) and remaining were of Nanohybrid Resin Composite material A2/B2 Brilliant NG enamel (Coltene Whaledent). They were later on stored in artificial saliva (ICPA health products limited, India) at room temperature to prevent its drying.

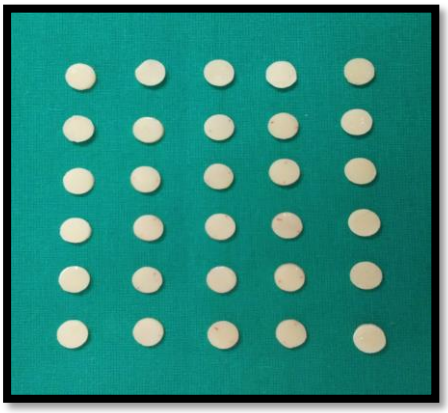


Fig 1: Composite and GIC specimens prepared.

Finishing and polishing was done for the purpose of surface standardization .The specimens were ground wet with 1000-grit silicon carbide abrasive paper for 10 seconds on a 300-rpm grinding machine (Buehler Metaserv, Buehler, Germany). The top surfaces of all specimens were then polished with fine and superfine polishing disks (Soflex, 3M, ESPE) with a low-speed handpiece. Then again all prepared specimens were stored in artificial saliva at room temperature for 24 hours for rehydration .

Beverage preparation

Nimbu Pani was prepared by mixing half a teaspoon of sugar in 25 ml of mineral water. 9-10 drops of lemon juice and a pinch of table salt were also added to the above mixture.

Beer (kingfisher)was readily available at the liquor shop.

Fig 2: Beverage Preparation

Method

These specimens were sub divided into 4 groups with 15 specimens in each group.

- Group 1 : Glass Ionomer Cement specimens dipped in 25 ml of the Nimbu Pani.
- Group 2 : Glass Ionomer Cement Specimens dipped in 25ml of Beer.
- Group 3 : Composite Cement Specimens dipped in 25ml of Nimbu Pani.
- Group 4 : Composite Cement Specimens dipped in 25 ml of Beer.

The specimens were dipped in their respective beverages for 5 minutes thrice a day (morning- 7:00 am, afternoon – 3:00 pm and night – 11:00 pm) for 7 days. As the greatest change in physical properties has been shown to occur within the first 7 days of exposure to solutions, hence the immersion protocol was carried on for 7 days. The specimens were immersed in 25 ml of artificial saliva at room temperature in-between the cycles of immersion in the selected beverages for each group.

After immersion of the specimens, the surface roughness testing was done. The average surface roughness (Ra, µm) was measured with a surface profilometer (Surftest SJ-301, Mitutoyo, Japan) using a tracing length of 1.25 mm and a cut off of 0.25 mm to maximize filtration surface waviness, and a measuring speed of 0.5 mm/s using Tools 301, Mitutoyo, Japan. Ra, was derived from these readings. The measurements were taken by rotating the specimen 90° around its centre. All test procedures were performed by only one operator.

Fig 3: Surface Profilometer

Statistical analysis

SPSS (Statistical Package For The Social Sciences) for Windows V 16.0 was used for statistical analysis .Descriptive statistics wear shown as Mean ± SD .Student ' t ' test (Independent) was used to find the significance of the study parameters on continuous scale with each group .Statistical significance was set as $P \leq 0.05$.

RESULTS

The results of the present study revealed that:

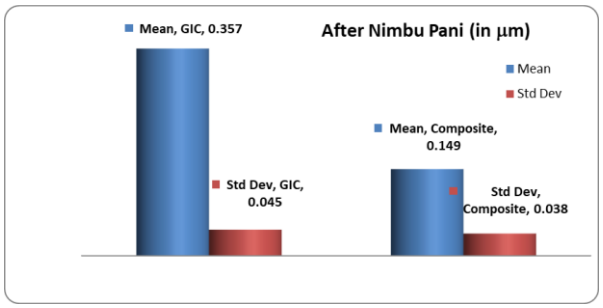
In group 1, when changes between the surface roughness was compared before (Mean =0.175 , Standard Deviation =0.060) and after (Mean = 0.357 , Standard Deviation = 0.045)immersion in Nimbu Pani, the difference within the group was found to be statistically significant (p value = 0.027)

In group 2, after comparisons between the surface roughness before Mean = 0.153, Standard deviation = 0.023) and after (Mean = 0.220, Standard deviation = 0.037) immersion in beer, the difference within the group was found to be statistically significant (p value = 0.029)

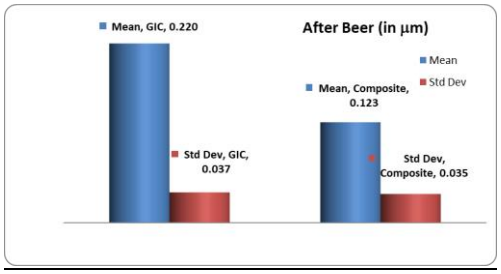
In group 3, after comparisons between the surface roughness before(Mean = 0.083, Standard deviation = 0.022) and after (Mean = 0.149, Standard deviation = 0.038) immersion in Nimbu Pani, the difference within the group was found to be statistically significant (p value = 0.018).

In Group 4, when changes between the surface roughness was compared before(Mean =0.085, Standard Deviation =0.018) and after(Mean = 0.123 , Standard Deviation = 0.035) immersion in beer the difference within the group was found to be statistically significant (p value = 0.035)

On comparing the surface roughness of the glass ionomer cement specimens and composite resin cement specimens, it was seen that the GIC specimens showed greater change in surface roughness when immersed both in Nimbu Pani and beer as compared to the composite resin cement specimens.



Graph 1: Surface Roughness: After Immersion in Nimbu pani.



Graph 2: Surface Roughness: After immersion in Beer.

DISCUSSION

India is a home to an extraordinary variety of climatic regions . Keeping in mind India's varied climatic conditions; there exist a variety of drinks to cater to the local and regional tastes. Whether it is a steaming hot cup of tea or a frosty glass of Nimbu Pani, different regions have made mouth-watering mixes infusing local herbs and spices. As the summers are extreme, one of the most common problems faced by people from all over the country is dehydration.

Amongst alcoholic drinks, beer is commonly consumed pan India and amongst non-alcoholic drinks, Nimbu Pani is most commonly used thirst quenchers pan India.

It has been established that the erosive potential of an acidic solution is related to its pH, titratable acidity and buffer capacity[7]. pH of beer is low that is ~2.5. The association of a low pH and the presence of a strong inorganic acid could have caused a more aggressive attack on the surface of restorative materials hence leading to an increase in the surface roughness.[8]

Beer is a complex sample matrix that contains numerous components including proteins, carbon dioxide, carbohydrates, inorganic anions and cations, aldehydes, organic and inorganic acids and ethanol [9]. Maupome et al [10] stated that the acidity effect of carbonated beverages is mainly due to phosphoric acid.

Drinks such as Nimbu Pani that contain citric acid have been shown to be more erosive than those containing phosphoric acid [11]. Amongst all these restorative materials, composites and conventional glass ionomer cement are commonly used amongst Indian patients and dentists[12]. The members of the Academy of Operative Dentistry (1989) were surveyed in order to assess quantitatively and qualitatively the use of glass-ionomer cements in their practices. They concluded that certain characteristics of glass-ionomer cements appeared to make them desirable dental materials and thus are most commonly used[13,14].

The use of resin-based restorative materials in dentistry has substantially increased over the past few years because of their good aesthetic appearance, improvements in formulations, ease of handling. According to studies conducted by Soderholm and Han et al [4] , they suggested that relatively higher filler loading increases the stability of resin composite surface against low pH conditions.

Glass ionomer based materials showed more surface roughness in all subgroups in comparison to composite resin based materials. It can be explained by the fact that conventional glass ionomer cement consists of glass particles in a hydrogel matrix. In acidic solutions, H+ ions of the acid diffuse into the bulk of the restoration and replace metal cations in the matrix[15]. These free cations then diffuse outward and are released from the surface. As the metal cations in the matrix decrease, more ions are extracted from the surrounding glass particles, causing them to dissolve. Consequently the material presents a rough surface with voids and protruded, undissolved glass particles. H+ ion concentration and the formation constants for soluble complexes between acid anions and metal cations in the set cement control the degree of glass-ionomer cement's erosion in organic acid solutions[16]

Although water has been a commonly employed storage medium in in vitro studies , but this study preferred artificial saliva over distilled water as the

storage medium to simulate the oral environment and provide data closer to reality and reproduce clinical situations[17,18] . Composition of the artificial saliva (ICPA health products limited) that was used: Water, glycerine, cellulose gum, sodium saccharin, parabens and flavouring agents.

CONCLUSION

Glass ionomer cement and composite resin cement are the most commonly used restorative materials in India. Any changes in the properties of these restorations due to the external environment can lead to failure of these restorations.

Within the limitations of this study, the following conclusions were drawn:

1. Increase in surface roughness was seen when glass ionomer cement moulds were immersed in Nimbu Pani and Beer. These differences were found to be statistically as well as clinically significant.

2. Increase in surface roughness was seen when composite resin cement moulds were immersed in Nimbu Pani and Beer. These differences were found to be statistically as well as clinically significant.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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