EFFECT OF ALCOHOL CONTAINING AND ALCOHOL-FREE MOUTHWASHES ON THE MICROHARDNESS OF NANO COMPOSITES-AN INVITRO STUDY

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ABSTRACT

AIM: This in-vitro study was conducted to comparatively evaluate the effect of alcohol containing and alcohol-free mouth rinses on the microhardness of Nano filled composites.

MATERIALS AND METHODOLOGY: Twenty-eight specimens of Nano filled resin-based composite specimens were prepared using a metal mold and were kept in artificial saliva for 24 hours to simulate the oral environment. The specimens were then randomly divided into 4 groups (n=7). The specimens were then immersed in respective mouth rinses (Distilled water, Hiora, Colgate Plax, Listerine) and kept under constant stirring for 24h at 37°c. The specimens were then checked for baseline and post-immersion microhardness using Vickers microhardness tester.

RESULTS: Significant reduction in the mean VHN was observed in Group 3 and Group 4 when compared to baseline values. The reduction in mean VHN are as follows: Baseline-38.167, Group1-36.083, Group 2-35.200, Group 3-27.433 and Group 4-18.317. Intergroup comparison showed a statistically significant reduction in microhardness in Group 3 and Group 4. There was no significant difference between Group 1 and Group 2 when compared with baseline.

CONCLUSION: The alcohol-containing and low ph mouth rinses were most detrimental to the surface hardness of Nano filled composite restorative materials. Listerine mouth rinse containing the highest amount of alcohol showed a maximum reduction in microhardness of nano-filled resin composite followed by Colgate Plax and Hiora.

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INTRODUCTION

Periodontal diseases and caries can be prevented and controlled to a large extent using mouth rinses (Moran, 2000)[1]. Water, antimicrobial agents, salts, preservatives and in some cases alcohol are the major constituents in mouth rinses. pH of the mouth rinses is affected by varying the concentration of these constituents (Bhatti, 1994)[2].

Resin composite materials get softened due to the alcohol which is one of the constituents in some mouthwashes (Asmussen, 1984)[3]. The amount of softening of the restorative material is directly related to the alcohol percentage (Penugonda et al., 1994)[4]. Properties such as sorption, solubility and surface degradation of resin composites is increased by the low pH content (Almeida et al.,2010)[5]. The degradation and disintegration of restorative materials due to mouth rinses also depends on the type of restorative material (Indrani et al., 2009; Diab et al., 2007; Miramda et al., 2011; Ateyah et al., 2005; Gurgan, 1997)[6-10].

Better aesthetics and mechanical properties led to the greater use of nano filled resin composites in recent times (Mozner and Klapohr, 2004; Swift, 2006; Hegde et al., 2011; Gogna et al., 2011; Lamster, 2006)[12-16]. Not much literature is available on the affect of currently available wide range of mouth rinses on restorations. Hence the aim of the study is to comparatively evaluate the effect of alcohol containing and alcohol-free mouth rinses on the microhardness of a nano filled resin composite.

MATERIALS & METHODOLOGY:

Materials:

The materials used in this study are Nano Composite resin restorative material (FiltekZ350XT), Stainless steel moulds (8mm x 3mm diameter),Composite resin visible light curing unit (Dentsply- spectrum 800),Clear matrix strips, Transparent glass slabs, Mouth rinses- (Hiora, Listerine, Colgate Plax) Distilled water, Plastic filling instrument, Artificial saliva.

Equipment:

The equipment used are Vickers microhardness tester (Wilson wolpert), Temperature controlled stirrer, Digital pH meter.

Methodology:

Seven disc shaped specimens of nano resin composite Filtek Z350XT measuring 8mm in diameter and 3mm in thickness were prepared resulting in a total of 28 samples. These were divided into 4 groups of seven specimens each:

Group 1: Distilled Water -7 specimens (CONTROL GROUP),

Group 2: Hiora -7 specimens,

Group 3: Colgate plax -7 specimens

Group 4: Listerine-7 specimens.

Standardized metal moulds were fabricated to prepare the (8mm diameter & 3mm thickness) composite specimens. The mould is placed over the transparent glass slab and matrix strip and space is filled with resin composite with incremental technique. Each increment is polymerized using a visible light curing unit for 40 seconds. Another glass slab and matrix strip are used to pack the increment of composite inside the mould and gently pressed for 30 seconds to extrude the excess material to obtain a smooth surface. Before removal of specimens, any flash of composite resin was removed from the surface of mould with sharp B.P.blade. Each specimen was cured for 40 seconds from the top and another 40 seconds from the bottom using visible light curing unit at 800 mW/cm2.

The intensity of the visible light curing unit was checked with the radiometer. All the specimens were kept in artificial saliva for 24 hours to stimulate the oral environment and the baseline microhardness value were checked using Vicker's microhardness tester after 24 hours. To simulate a year of mouth wash use of 2 minutes per day the specimens were kept under constant stirring for 24 hours at 37°C. After 24 hours the discs were removed from the vials and stored in artificial

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saliva. The specimens were checked for post immersion microhardness using the Vickers microhardness tester by applying a load of 100g for 15 seconds (Table1). Readings were subjected to statistical analysis.

pH Evaluation: The pH of five commercial mouth rinses was recorded using a digital pH meter. pH and alcohol percentages of mouthwashes were entered in (Table 2).

STATISTICAL ANALYSIS:

Wilcoxon signed rank test was used for comparing the intragroup pre and post immersion valuesKruskal-Wallis test followed by Mann-Whitney U test was used with SPSS version 16 (SPSS Inc.,Chicago) and micro soft excel version 7 (Micro soft corporation NY, USA) was used for intergroup comparison . The level of significance was set at P=0.05.

RESULTS:

Reduction of microhardness is observed in all groups. Base line showed maximum surface microhardness values when compared to other groups**.**

Significant reduction in the microhardness of resin composite was observed after immersion in Listerine and Colgate plax mouth rinses compared to

baseline values with P<0.01. Oneway ANOVA test showed significant difference in microhardness between the groups of mouth rinses with P<0.05. Group 2 Hiora showed insignificant microhardness reduction when compared to baseline values. Inter group comparison results showed that group 3 (Colgate plax) and group 4 (Listerine) exhibited maximum reduction in microhardness (Table 3).

Discussion

In recent years, the demand of aesthetic restorative materials has promoted a rapidly increasing use of composite resins to meet the cosmetic expectations of the patients. The longevity and durability of the aesthetic restorative materials in the oral environment are important factors for the proper selection of the material. The use of antimicrobial mouth rinses is an approach to limiting the accumulation of dental plaque with a primary objective of controlling the development and progression of periodontal disease and dental caries (Cavalcanti and Mitsui, 2005)[17].

The formulations of these mouthwashes are frequently used, even without professional prescription. The formulation of these mouth washes consist of water, antimicrobial agents, salts and in some cases alcohol and the different concentrations

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of these substances can affect the Ph of the

mouthwashes (Cavalcanti and Mitsui, 2005).

TABLE 1: VHN OF SPECIMENS BEFORE AND AFTER IMMERSION

S.NO	BASE LINE	DISTILLED WATER	HIORA	COLGATE PLAX	LISTERINE
1.	38.4	35.4	35.4	29.9	15.9
2.	38.6	35.3	35.8	25.9	16.2
3.	38.9	35.7	35.6	26.1	16.3
4.	37.4	36.6	34.9	27.8	17.5
5.	37.9	36.9	34.8	27.4	18.9
6.	37.8	36.8	34.7	27.5	18.4
7.	37.6	36.5	34.6	27.3	18.2

Table 2. PH and Alcohol percentage of testing mouthrinses:

Testing solutions	PH content	Alcohol percentage
Distilled water(control)	7.03	-
Colgate plax	4.25	11.6%
Listerine	3.85	21.9%
Hiora	5.79	Alcohol free

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TABLE 3: Mean values (standard deviation) of specimens of composite resin before and after immersion in mouth rinses:

	MEAN	STANDARD DEVIATION
BASE LINE	38.167	0.561
DISTILLED WATER	36.083	0.697
HIORA	35.200	0.460
COLGATE PLAX	27.433	1.439
LISTERINE	18.317	2.438

Alcohol in mouthwashes is used as solvent, taste enhancer and an antiseptic agent (Overholser et al., 1990)[18]. Concern has been expressed regarding the use of alcohol containing mouth rinses as it may softens the tooth coloured restorative materials.

The present in vitro study was designed to comparatively evaluate the effect of mouth rinses on the microhardness of nano filled resin composite FILTEK Z350XT. Listerine, colgate plax are alcohol based mouth rinses and hiora are herbal alcohol free mouth rinses. One of the most important physical properties of restorative material is surface hardness, which correlates well to compressive strength and abrasive resistance of the material.

Hardness may be defined as the resistance of a material to indentation (or) penetration. Strength, proportional limit, and ductility are related to hardness. Hardness is considered as the test parameter as it is an important property for the restorative materials to have long term durability in the oral cavity (Okada et al., 2001)[19]. So decrease in the hardness of a material may result in premature failure of a restoration requiring its replacement.

Significant reduction in the microhardness of the tested nano filled resin composite restorative material compared to base line values was observed in the present study with all the mouth rinses irrespective of the presence or absence of alcohol.

This might be due to the acidic pH of the mouth rinses which might have led to the acidic erosion of the resin composite by acid etching and leaching the principle matrix forming cations. This is in accordance with the DIAB et.al.in 2007 who reported that mouth rinses with low PH are detrimental to the hardness of resin composite (Yavuz Gomec et al., 2004)[20].

Inter group comparison showed that Listerine (Group 4) and Colgate plax (group 3) resulted in statistically more reduction in the microhardness i.e., 21.6%w/v and 11.6%w/v respectively when compared with base line value. Group 2 (Hiora) did not show statistically significant reduction in microhardness. This may be because of the lower percentage of alcohol in Hiora. This observation is in accordance with the observations by Penugonda et.al. who reported that the higher percentage of alcohol in the mouth rinses causes more reduction in the hardness of restorative material (Penugonda et al., 1994) [4]. Microhardness can be effected by the alcohol content and low pH. Softening of the composite resin surface is known to be caused by alcohol by removing monomers from the polymer structure. Diffusion of water and saliva is facilitated by the opening of the

polymer structure by alcohol that can lead to decrease in hardness, increase in material wear and change in other physical properties. BIS GMA and UDMA based polymers present in the composites are susceptible to this softening effect due to the irreversible leaching of the components. Greater surface area to volume ratio of the non-agglomerated 20nm silica filler and poor integration of these primary particles by the polymeric matrix may be attributed as the reasons for the more pronounced softening effect in nano filled resin composites.

Therefore, alcohol has a clear influence on the hardness properties. The highest reduction in the hardness of Nano filled composite restorative material was found on using with alcohol containing mouth rinses (Listerine). BISGMA based polymers are susceptible to chemical softening by alcohol in the mouth rinses (Kao, 1989)[24]. Furthermore, Listerine has low pH and high alcohol percentage so it greatly affects the hardness of resin composite (Diab et al., 2007)[7].

Dimethacrylate monomers are formed in the composition (BISGMA, UDMA and TEGDMA) due to low pH through catalysis of

ester groups and the hydrolysis of these ester groups may have formed alcohol and carboxylic acid molecules that may have accelerated the degradation of the resin composite (Gopferich,1996)[26].

Higher alcohol content and low ph may be detrimental to the nano filled resin composite used in the present study due to the regular use of alcohol-based mouth rinses like Listerine and Colgate plax. Saliva may dilute or buffer the mouth rinses in a clinical situation and hence further in vivo studies are recommended.

Conclusion

The alcohol-containing and low ph mouth rinses were most detrimental to the surface hardness of Nano filled composite restorative materials. Listerine mouth rinse containing highest amount of alcohol showed a maximum reduction in microhardness of nano-filled resin composite followed by Colgate Plax and Hiora.

Conflict of Interest Statement-

There is no conflict of interest.

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