Effect of Varying Ph of Immersion Solutions and Immersion Time on Micro Hardness of Packable Composites

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ABSTRACT

Objective:

The objective of this study was to determine effect of ph and immersion time of various immersion solutions on the microhardness values of packable composites.

Materials and methods:
Three unlike mouthwashes Colgate plax (alcohol/ ethanol free), Listerine (alcohol/ ethanol), and distilled water Clinica (Chlorhexidine Gluconate) were used as immersion solutions in this in vitro study. .Total 64 circular disc shape specimens were used. Ph of each solution was used using ph meter. The initial microhardness test was carried out before immersion for baseline measurement by Vicker,s micro hardness tester. For final microhardness testing the samples were divided into two groups. Half of them were immersed for 12 hours and other half were immersed for 24 hours.
Results:
The values obtained as base line and final Vickers hardness number for each specimen was subjected to statistical analysis. All tested mouthwashes and distilled water decreased the surface microhardness. Immersion for 24 hours affected the microhardness more then immersion for 12 hours.
Conclusion:
The results illustrated that mouthwashes containing alcohol present a higher potential to decrease the micro hardness when exposure is for longer period of time. This study will help clinicians to select a durable esthetic restorative material which shows less degradation in oral environment, and in people using mouthwashes frequently.
Keywords: Micro hardness, packable composites, immersion

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INTRODUCTION

The most important factor which should be considered while selection of esthetic restorative materials is its clinical longevity. Factors which have an impact on clinical life of a restoration may include Saliva, food components, beverages and chemicals {Carvalho, 2015 #2}. According to past researches Mouthwashes have considerable effect on salivary sorption, solubility, surface degradation (Almeida et al., 2010a , Ozer et al., 2014) and also affect color stability, surface hardness and roughness (Festuccia et al., 2012) of few restorative materials (Kramer et al., 1986, Ciancio, 1994). In case of clinical appearance of composite like restorations, its durability and lifetime improve on the basis that how much it can be withstand against the water, saliva and chemicals already present in dental plaque, beverages and many foodstuff on variable temperatures and pH. According to past literature surface of composite material easily destroy, when dipped in water and chemicals (Almeida et al., 2010a , de Moraes et al., 2014).

Hardness of material is considered as point of attention, because it is important property for the life of restorative material. Hardness is known as the resistance of a material to penetration. Strength, Flexibility and proportional limit are associated with hardness {Erdemir, 2013 #1}. When hardness is low then the restoration become weak and need replacement. Even mouth washes having alcohol or alcohol free, they causes major decrease in micro hardness of the

nanofilled resin composite material compared to standards. It's all due to acidic pH of mouth washes that leads to acid erosion of resin composite by acid etching and leaching the principle matrix forming cations. Mouth washes having low pH, damage to the hardness of resin composites. Mainly decrease pH of mouth washes can use in the polymeric matrix of the nanofilled resin composite in the study, through catalysis of ester groups from dimethacrylate monomers already present in composition (Bis GMA, Bis EMA, UDMA and TEG DMA). The hydrolysis of these ester groups formed alcohol and carboxylic acid molecules that may have enhanced the destruction of resin composite. {Jyothi,et al 2012 }
Hence the objective of present study was to determine the effect of normally available mouth washes on the surface hardness of the Nano-filled composite material.

MATERIALS AND METHODS

This experimental study was conducted in azra naheed dental college.
Study Duration: six months.
Direct resin composite microhybrid (packable) (P60,3MESPE) was used in this in vitro study.Three different mouthwashes Listerine (containing alcohol/ ethanol), Colgate plax (alcohol/ ethanol free), Clinica (Chlorhexidine Gluconate) and distilled water were used as immersion solutions in this in vitro study. Total specimens which were prepared for this experimental study was 64 circular specimens of 6mmx 2mm dimensions

Specimen Preparation:
The specimens were constructed by inserting into brass mould and light cured.The polymerized specimens were removed from the mold and their dimensions were calculated using vernier caliper. All the specimens were stored in distilled water after curing for 24 hours at 37°C to ensure complete polymerization. Distilled water was used as control. Specimens were removed from distilled water and blotted dry.
To measuring the pH, 20ml of each solution is taken into a beaker and the pH is obtained with a glass electrode 1.5cm in dia by pH meter.

pH Meter
Hardness Testing:
Hardness testing was divided into two stages initial testing and final testing. The initial testing was conducted after 24 hours of curing (before immersion) for baseline measurement (To) of microhardness by Vickers Microhardness tester.The three measurements were taken for each specimen at a distance of 1mm.
Total number of specimens was 64 which were divided into 4 subgroups i.e M1, M2,M3 and M4 M1- Colgate Plax (Alcohol/Ethanol free), M2-Listerine Cool Mint (containing Alcohol/Ethanol), M3- Clinica (Chlorhexidine Gluconate), M4- Distilled water. Each subgroups contains 16 specimens. All specimens from respective subgroups were immersed in solutions in

such a way that they were completely covered in solutions at 37°C in an incubator. Half of the specimen from each subgroup were immersed in 20 ml of treatment solution at 37°C for 12 hours, which is equivalent in time to 1 year of 2 min daily use of mouthwash and half for 24 hours, which is equivalent in time to 1 year of 4min daily use of mouthwash in different mouthwashes and distilled water.

All the specimens were removed after their immersion and incubation time, rinsed with distilled water for 120 secs and were tested for Microhardness (T1) after 12 hours and (T2) after 24 hours immersion The changes in hardness value between the baseline and after treatment measurement calculated according to the following equation. VHN = VHN (after treatment) – VHN (baseline treatment). Data analysis was done using one - way ANOVA and post-hoc tukey's t-test.P-value < 0.05 was considered as significant.

RESULTS

Before immersion

This study showed that at baseline (before immersion), the mean microhardness of microhybrid composite (P60) was 88.73±3.86

After 12 hours

After 12 hours of immersion of composites, mean microhardness of microhybrid composite (P60) in Colgate Plax mouthwash was 81.50±3.23 . In Listerine mouthwash the mean microhardness was 68.20±0.88. In Clinica mouthwash microhardness was 75.76±3.04 and mean microhardness of microhybrid composite (P60) in distilled water was 85.83±3.02

After 24 hours of immersion

after 24 hours of immersion of composites, mean microhardness of microhybrid composite in all immersion soultions was lower as compared to values after immersion for 12 hours .The values of microhardness after 12 hours of immersionwere highest for distilled water with neutral ph values and lowest for listerine mouth wash with acidic ph values.

Table1: baseline microhardness and microhardness after immersion for 12 hours

Mouthwashes	Baseline	Colgate plax	Listerine	Clinica	Distilled water
Composite	T0	T1	T1	T1	T1
Microhybrid P60	88.73±3.86	81.50±3.23	68.20±0.88	75.76±3.04	85.83±3.02
IND.SAMPL T-TEST	5.835	6.959	33.609	7.967	6.187
p-value	0.000	0.000	0.000	0.000	0.000

Table2: baseline microhardness and microhardness after immersion for 24 hours

Mouthwashes / Composites	Baseline	Colgate plax	Listerine	Clinica	Distilled Water
	T0	T2	T2	T2	T2
Microhybrid P60	88.73±3.86	78.30±3.02	59.79±1.14	69.98±1.43	83.92±3.12
IND.SAMPL T-TEST	5.835	8.186	22.302	15.763	7.490
p-value	0.000	0.000	0.000	0.000	0.000

TABLE 3:Pairwise comparison of mouthwashes after 12 hours and 24 hours of immersion

Name	Dependent variable	Mouthwash	mouthwash	Mean difference	Sig.
P60	After 12 hours	Colgate plax	Listerine cool mint	13.3000*	.000
			Clinica	5.7417*	.000
			Distilled water	-4.3250*	.002
		Listerine cool mint	Colgate plax	-13.3000*	.000
			Clinica	-7.5583*	.000
			Distilled water	-17.6250*	.000
		Clinica	Colgate plax	-5.7417*	.000
			Listerine	7.5583*	.000
			Distilled water	-10.0667*	.000
		Distilled water	Colgate plex	4.3250*	.000
			Listerine	6.0500*	.000
			Clinica	10.0667*	.000
	After 24 hours	Colgate plax	Listerine	18.5083*	.000
			Clinica	8.3167*	.000
			Distilled water	-5.7250*	.000
		Listerine cool mint	Colgate plex	-18.5083*	.000
			Clinica	-10.1917*	.000
			Distilled water	-24.1250*	.000
		clinica	Colgate plex	-8.3167*	.000
			Listerine	10.1917*	.000
			Distilled water	-13.9333*	.000
		Distilled water	Colgate Plax	5.6167*	.000
			Listerine	24.1250*	.000

			CoolMint.000		.000
			Clinica	13.9333*	.000

DISCUSSION

Hardness is an important parameter to measure the clinical longevity of a restorative material. Hardness is the resistance of a material to indentation or penetration. Strength, proportional limit and ductility are related to hardness. Hardness has also been used to predict the wear resistance of a material and its ability to abrade or be abraded by opposing dental structures and materials. So a decrease in the hardness of a material may result in premature failure of a restoration requiring its replacement(Jyothi et al 2012).0 The frequent use of mouthwash results in chemical softening of restorative material which ultimately effects performance and long term stability of restorative material (Diab et al., 2007).

A study was carried out in which the interaction of tooth-coloured dental restorative materials (a conventional glass–ionomer, two resin-modified glass–ionomers and two compomers) with acidic beverages was been studied with the aim of investigating how long-term contact affects solution pH and specimen surface hardness. The specimens were stored in sets of six in the following storage media: 0·9% NaCl (control), Coca-Cola, apple juice and orange juice. After time intervals of 1day, 1 week, 1 month, 3 months, 4 months, 6 months and 1 year, solution pH and Vickers Hardness Number were determined for each individual specimen. Differences were analysed by anova followed by Student–Newman–Keuls post hoc analysis. The conventional glass–ionomers dissolved completely in apple juice and orange juice, but survived in Coca-Cola, albeit with a significantly reduced hardness after 1 year. The other materials survived in apple juice and orange juice, but showed greater reductions in surface hardness in these beverages than in Coca-Cola. Fruit juices were thus shown to pose a greater erosive threat to tooth coloured materials than Coca-Cola, a finding which is similar to those concerning dentine and enamel towards these drinks. {Aliping-McKenzie, 2004 #29}

In the present study, all the mouth rinses irrespective of the presence or absence of alcohol resulted in significant reduction in the microhardness of both tested resin composite material compared to base line values. The pH of the tested solutions provides another possible preponderant factor for the composite resin degradation. This may be because of the acidic pH of the mouth rinses which would have caused acid erosion of the resin composite by acid etching and leaching the principle matrix forming cations. Analyzing the composition of mouthwashes in table, we observe that Listerine contains benzoic Acid with high alcohol percentage, Colgate Plax contain NaF, and Clinica contains Chlorhexidine Gluconate in its composition. The measurement of pH of these mouthwashes was 4.13,6.27 ,5.36 respectively compared to distilled water, low pH of mouthwashes may have altered the polymeric matrix of resin composite through catalysis of ester group from dimethacrylate monomers present in their composition. Hydrolysis of ester groups may have formed alcohol and carboxylic acid molecules, which

enhance the breakdown of resin composites. The same was found in the study of Dieb *et al* in 2007 in which they observed low pH mouthwashes have a harmful effect on the hardness of composite resin (Jyothi et al., 2012).

As Listerine mouthwash has low pH (4.13) because it contains benzoic Acid with high alcohol percentage, these ingredients have a strong impact on surface hardness of resin composite. Low PH accelerates biodegradation of composite resin over time which further cause composite polymer matrix to collapse, resulting in deboning of filler-polymer matrix ,release of residual monomers, wear and erosion caused by food, and by process of mastication. All these factors may depreciate the mechanical properties of the In another study researchers have quoted that the type of immersion solutions and the composition of soaked materials are important factors related to dissolution of dental composite materials which further shortens the clinical life of composite resin restorations.

CONCLUSION

Increased use of low pH mouthrinses, the restorative materials' surfaces may become rough and dull at a clinically detectable level. Surface treatment, storage solution, material type and immersion time may also influence the hardness value and all these factors should be kept in consideration while recommending any mouthrinses.

Conflict of interest

No conflict of interest

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