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An evaluation and comparison of the effect of five mouthrinses on the microhardness of esthetic hybrid composite restorative material - an in vitro study

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Abstract

Aim and Objectives: The aim of the present *in-vitro* study was to evaluate and compare the effect of five commercially available mouthrinses i.e. Listerine, Benzydamine, Rexidine, Proflo, Hiora on the microhardness of the hybrid composite restorative material.

Materials and Method: Fifty specimens were prepared withHybrid Composite Restorative Material (Te-Econom Plus) and immersed in Saleve (artificial saliva; supplied by the manufacturer) for 24hr. The baseline microhardness of specimens was recorded using Vicker's microhardness tester.The pH of mouthrinses was recorded with digital pH meter. All 50 specimens were divided into five groups of 10 samples each and immersed into20 ml of - Group I - Listerine (alcohol based) mouthrinse, Group II - Benzydamine (HCl based) mouthrinse,Group III- Rexidin (Chlorhex based) mouthrinse, Group IV-Proflo (fluoride containing) mouthrinse, and Group V -Hiora (alcohol free, herbal) mouthrinse and incubated for 24hr at 37ºC. After immersion the microhardness values of the specimens were recorded again and the data was tabulated for statistical analysis. Kruskal–Wallis test was used for inter group comparison followed by pairwise comparison of groups using Mann–Whitney U test.

Results: All mouthrinses tested showed decreased microhardness of the Te-Econom Plus (hybrid composite restorative material) ($P<0.001$). Group I-(Listerine) showed highest reduction while Group II-(Benzydamine) showed the lowest reduction in the microhardnessof the hybrid composite restorative material respectively.

Conclusion: All the five groups decreased the microhardness of the Hybrid Composite Restorative Material. The highest reduction in microhardness was found in alcohol-containing mouthrinse (Listerine).

Keywords: Microhardness, Mouthrinse, Resin composite, Vicker

Introduction

Now-a-days, the use of tooth-colored dental material is increasing very rapidly because of the esthetic needs of the patients. Composite resins are one of the best dental materials to make minimal invasive treatments as they have various properties like – easy handling, biocompatibility, adhesive, esthetic, non-thermal conduction, no mercury related side effects and adequate strength.

The oral cavity is the main entry gate of the body which is under constant varying concentration of pH and temperature cycle that alter the organic and inorganic matrix of composite resins particles. The use of mouthrinses has become very popular as they prevent and control caries, plaque, gingivitis, oral malodor and periodontal diseases. Mouthrinses contain antibacterial agents (like – fluoride, alcohol, cetylpyridinium, chloride), flavours (thymol, eucalyptol, menthol and mint oils) humectants (glycol, sorbitol, glycerol, propylene) sweetner (sodium saccharin) and colorants in an aqueous or alcoholic medium.

In previous studies, Asmussen et al (1984)[(1)] indicated that alcohol in the mouthrinses can soften the composite resin restorations. Diab et al (2007)[(2)] and Lavvaf et al (2011)[(3)] stated that alcohol containing mouthrinses decreases the hardness of the composite resins. Similarly, Shabzendedar et al (2011)[(4)]indicated that mouthrinses that contain fluoride can affect the solubility of some composite restorative materials.

Today, mouthrinses are the part of people's routine oral hygiene. They are commonly used even without professional prescription. Long term use of mouthrinses can lower the longevity of restoration and may affect the oral tissues.

Currently, a wide variety of mouth rinses are available in the market and many of them are not studied for their effect on the restorations. Hence, the aim of this study was to evaluate the effect of five commercially available mouth rinses (containing alcohol, fluoride, chlorhex, HCL and alcohol free) on the microhardness of Hybrid Composite Restorative Material.The null hypothesis was that there would be no significant difference in the microhardness value of the hybrid composite restorative material (Te-Econom Plus) after immersion in these mouthrinses-Listerine, Benzydamine, Rexidine, Proflo, Hiora.

Materials and Methods

Fifty specimens (3 mm in diameter and 3 mm in height) were prepared with Hybrid Composite Restorative Material (Te-Econom Plus) with the help of plastic mould. On a glass slide, plastic molds were placed and filled with light curing hybrid composite and covered with a matrix strip. Another glass slide was placed on matrix strip and gently pressed to obtain a smooth surface. Each specimen was cured with Blue LEX LD dental light lamp (Monitex Industrial Co. Ltd, New Taipei City, Taiwan) with a light intensity of 1000mW/cm^2 for 08 seconds on both, top and bottom side as per manufacturer's instructions. The specimens were then kept in "Saleva" (artificial saliva) for 24

hours to simulate the oral environment. After 24 hours, all the specimens were subjected to Vicker's microhardness tester (Model No. Future Tech - FM-700) to record the baseline microhardness values with a load of 200 gm for 15 seconds.

The pH of all mouthrinses was recorded by using a digital pH meter. The pH value of Listerine was 3.38, Benzydamine-pH: 5.27, Rexidin-pH: 4.43, Proflo–pH: 4.75 and Hiora-pH: 4.09. Table 1 shows the composition of Mouthrinses and Hybrid Composite Restorative material used in the study.

Table 1: Composition of Mouthrinses and Hybrid Composite Restorative material

Mouthrinses	Composition	Manufacturer
Listerine (alcohol based)	Thymol – 0.06%, Eucalyptol-0.09%,Menthol- 0.04%, alcohol-21.6%, benzoic acid and water	Johnson & Johnson Ltd, Kolhapur, India
Benzydamine (HCl based)	22.5mgbenzydamine hydrochloride, methyl Parahydroxybenzoate	U & V Cancure Pvt Ltd
Rexidin (Chlorhex based)	Chlorhexidine Gluconate - 0.2%,	Warren, Indoco Remedies Ltd, India
Proflo (fluoride containing)	Sodium Fluoride solution – 0.2%	Sandhika Pharma. Pvt Ltd
Hiora (alcohol free, herbal)	Pilu – 5mg,Bibhitaka - 10mg Nagavalli- 10mg,Ela- 0.2mg Peppermint satva– 1.6mg Yavani satva- 0.4mg	Himalaya Drug Co., Bangalore, India
Te-Econom Plus (Hybrid Composite Restorative material)	The organic part; Bis-GMA, urethane dimethacrylate and triethylene glycol dimethacrylate (18.8% by weight) and a small amount of catalyst, stabilizers and pigments (0.21% by weight). The inorganic filler (81% by weight. The filler size is (0.7ìm).	Ivoclar Vivadent, Schaan,

All 50 specimens were randomly divided into five groups of 10 samples each and immersed into 20 ml of different mouthrinses. Group I was immersed in Listerine (alcohol based) mouthrinse, Group II in Benzydamine (HCl based) mouthrinse, Group III in Rexidin (Chlorhex based) mouthrinse, Group IV in Proflo (fluoride containing) mouthrinse and Group V in Hiora (alcohol free, herbal) mouthrinse. All groups were kept in an incubator at 37°C for 24hrwhich is equivalent in time to 1 year of 4minutesdaily use of mouthrinse.

4 minute/day x 365 days = 1460 minutes, simulated by 24 hours x 60 minutes = 1440 minutes

After that, all specimens were washed thoroughly with distilled water and post immersion microhardness was checked by using same microhardness tester.

The mean values were computed to determine significant difference within the groups (Pre and post immersion). For Intergroup comparison, Kruskal Wallis Test was followed by Mann Whitney U-Test with SPSS Version 16 and MS Excel Version 7. The level of significance was set at P=0.05.

Results

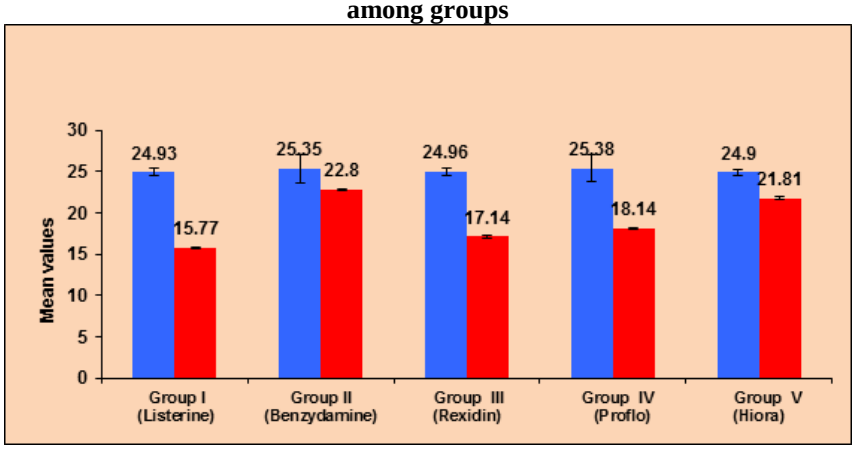
A significant reduction in the microhardness was observed in all the groups after immersion in the mouthrinses compared to baseline values with P<0.001.Therefore, null hypothesis was rejected. (Table 2, Graph 1)

Table 2: Intra (row) and Inter (column) group comparison of microhardness of Hybrid composite Restorative Material immersed in various mouthrinses

	Pre - Immersion		Post – Immersion		p value
	Mean	Std. Deviation	Mean	Std. Deviation	
Group 1 (Listerine)	24.93	0.416	15.77	0.116	<0.001*
Group 2 (Benzydamine)	25.35	1.638	22.8	0.0943	0.001*
Group 3 (Rexidin)	24.96	0.381	17.14	0.143	<0.001*
Group 4 (Proflo)	25.38	1.625	18.14	0.0966	<0.001*
Group 5 (Hiora)	24.9	0.406	21.81	0.1449	<0.001*

*p value <0.05 denotes statistically significant difference

Graph 1: Comparison of Hardness of Hybrid composite Restorative Material (Pre and Post - Immersion) among groups



Kruskal–Wallis test showed a statistically significant difference in microhardness between the five groups of mouthrinses with $P< 0.05$. Further analysis was done applying Mann–Whitney U test for pair wise comparison.

Group I (Listerine) showed highest reduction in microhardness value among all the groups and Group II (Benzydamine) showed the lowest reduction in the microhardness of the test material.

Group III (Rexidin) showed the higher reduction in microhardness value than Group II (Benzydamine), Group IV (Proflo) and Group V (Hiora) and the difference was statistically significant.

Group IV (Proflo) showed less reduction than Group I (Listerine) & Groups III(Rexidin) and more reduction than Group II (Benzydamine) & Group V (Hiora).

Group V (Hiora) showed less reduction than Group I (Listerine), Groups III (Rexidin) & Group IV (Proflo) and more reduction than Group II (Benzydamine).

Discussion

Hybrid Composite Restorative Material (Te-Econom Plus) contains Dimethacrylate and TEGDMA as resin matrix and the filler particles are Barium glass, Ytterbium trifluoride, Silicon dioxide and mixed oxide. Te-Econom Plus has an excellent physical properties, high radiopacity and long working time.[5]

Hardness is defined as the resistance of a material to indentation or penetration. It is a property of the restorative materials to have long term durability in the oral cavity. Vickers hardness tester was developed in 1924 by Smith and Sandland. In this tester a diamond tip is used to indent the test material in the form of a right pyramid with a square base and an angle of 136º between opposite faces subjected to a test force of between 1gf and 100kgf. The Vickers hardness is the quotient obtained by dividing the kgf load by the square mm area of indentation.Vickers test is easier to use than other hardness tests since the required calculations are independent of the size of the indenter, and the indenter can be used for all materials irrespective of hardness.[6,7]

In this in-vitro study, results showed that all mouthrinses decreased the microhardness of the hybrid composites restorative material. This may be because of the acidic pH of the mouthrinses which would have caused acid erosion of the hybrid composite restorative material by acid etching. This is in agreement with Penugonda et al (1994),[8] Gurgan et al (1997),[9] Cavalcanti et al (2005),[10] and Diab et al (2007),[2]who had reported that both alcohol containing and alcohol-free mouthrinses affected the hardness of the resin-composites.

Inter group comparison showed that highest reduction in the microhardness of the composite restorative material was found in Group I - Listerine mouthrinse (containing 21.6% w/v alcohol) as compared to Group II - Benzydamine and Group V - Hiora. This may be because of the lower percentage of alcohol in Benzydamine and Hiora is alcohol free. This finding was in accordance with Kao et al(1989)[11] who stated that both Bis GMA and UDMA-based polymers are susceptible to chemical softening by ethanol. Weiner et al (1997)[12] reported that composite soaked in mouthrinses containing alcohol significantly reduces hardness of composites than the ones soaked in non-alcoholic mouthrinses. Similarly, Penugonda et al (1994)[8] reported that the higher percentage of alcohol in the mouthrinses causes more reduction in the hardness of restorative materials.

Listerine has low pH (3.38) and contains benzoic acid with high percentage of alcohol which greatly affects the microhardness of the composites restorative material. Low pH increases composite biodegradation over time, deteriorate the mechanical properties and reduces the microhardness of composite restorations. The low pH of mouthrinse also changes the composite resin matrix by acting as a catalyst for the ester groups that are present in dimethacrylate monomers and causes degradation of the polymer network and reduces the microhardness of the composite resin. This was in accordance with the observations by Weiner et al (1997),[12] Yap et al (2003)[13] and Gurdal et al

(2002).[14] They reported that low pH and high percentage of alcohol in Listerine affects the hardness of resin-composite.

In the present study, Group II (Benzydamine) showed the lowest reduction in the micro hardness of the test material. This may be because Benzydamine mouthrinse contain low alcohol content and has higher pH value as compared to all other groups.

Group I (Listerine) with pH value of 3.38 showed the higher reduction in microhardness as compared to Group II (Benzydamine with pH 5.27) and Group IV (Proflo with pH 4.75). This is because the Listerine mouthrinse is more acidic than Benzydamine and Proflo mouthrinse and causes more biodegradation of composite restorative material.

Also Group IV – Proflo (containing sodium fluoride) showed higher reduction in microhardness of hybrid composite restorative material than Group II – Benzydamine and Group V – Hiora. This was in accordance with Abate et al (2000)[15] who stated that mouthrinses containing sodium fluoride as an active ingredient causes surface degradation and reduction in microhardness of composite resin.

As observed in this study, high alcohol content and low pH can have an effect on the microhardness, but these two factors may not be interdependent on each other in reducing the microhardness of the composite restorative material tested.

Though Group V - Hiora has low pH value (4.09) than Groups III- Rexidin (pH value 4.43) and Group IV –Proflo pH value 4.75), it showed less reduction in microhardness than Rexidin and Proflo. This may be because it has no alcohol in it.

Hence the long-term, regular use of alcohol based mouth rinses like Listerine with higher alcohol content (21.6% w/v) and low pH value (3.38) may be detrimental to the Hybrid Composite Restorative Material (Te-Econom Plus) used in the present study.

The results of this *in- vitro* study may not be directly related to the clinical situation as in-vitro studies do not consider certain variables such as natural saliva, food, drinks and the pH of the oral environment. Hence, further *in-vivo* studies are recommended.

Conclusion

Within the limitations of the experimental design and the test parameter, it was concluded that –

- All mouthrinses (alcohol containing, alcohol-free) decreased the microhardness of hybrid composite material (Te-Econom Plus).
- The Benzydamine mouthrinse had lowest reduction in microhardness.
- Listerine mouthrinse with low pH value and high alcohol content showed highest reduction in microhardness of light curing hybrid composite material.

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