

Effect of Different Acidic Beverages on Microhardness of Nanohybrid Composite, Giomer, and Microhybrid Composite

¹SK Somayaji, ²Arul Amalan, ³Kishore Ginjupalli

ABSTRACT

Introduction: Degradation in the oral cavity is a complex phenomenon, i.e., related to disintegration and dissolution of restorative materials in the oral cavity. Consumption of acidic food, fruit juices, and soft drinks can result in decrease in microhardness and bad esthetic appearance.

Materials and methods: Twenty-four disk-shaped specimens (10 mm in diameter and 2 mm thickness) were made from each nanohybrid composite, giomer, and microhybrid composite. The specimens were dipped in Appy fizz, Nimbooz, and Thumbs Up for 50 seconds and washed with saline. This cycle was continued for six times each day. Such hardness test was carried out in regular intervals, that is, 7, 14, and 21 days.

Results: There was reduction in hardness after 7 and 14 days but no significant difference ($p > 0.05$). There was significant difference after 21 days of experimental models for giomer, ceramic, and spectra ($p < 0.05$).

Conclusion: The microhardness of materials was reduced after 7 and 14 days, but significant difference was seen after 21 days.

Keywords: Acidic beverages, Microhardness, Nanohybrid, Soft drinks, Thumbs up.

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INTRODUCTION

There are different forms of destructive processes leading to irreversible loss of tooth structure other than caries.¹

They can be referred to as abrasion, demastication, abfraction, resorption, and erosion. Acidic soft drink causes demineralization on enamel surface. Maximum consumption of fruits, acidic drinks, and liquid medications may possibly be the etiological and aggravating causes for dental erosion. Extensively used esthetic dental biomaterials available with different properties and colors/shades, used in anterior and posterior restorations, may also be the reason for loss or change in tooth structure. Destruction and disintegration of restorative materials is related to a complex phenomenon of degradation in the oral cavity. Restorative failure can also result from exposure to various kinds of acidic foods and drinks. Researchers have reported that mechanical properties of resin composites can have a harmful effect by their exposure to low pH liquids. So a new class of dental composites called nanocomposites have been introduced lately, to overcome the shortcomings of resin composite materials.² Nanohybrid composite is a new composite material and has better physical, mechanical, and esthetic properties.² It incorporates high volume fraction of filler particles with a wide particle size distribution. Giomer is a resin composite with new innovative filler technology.³ Giomer comprises of inorganic filler that are derived from complete or partial reaction of ion-leachable fluoroaluminosilicate with polyalkenoic acids.⁴

The aim of this study was to determine the effect of Thumbs Up, Appy fizz, and Nimbooz on microhardness of nanohybrid composite, giomer, and microhybrid composites.

MATERIALS AND METHODS

Disk-shaped specimens (10 mm in diameter and 2 mm thickness) were prepared from each nanohybrid composite (Dentsply, York, PA, USA), giomer (ceram X; USA), and microhybrid composite (Spectra; Dentsply, USA). A mylar strip was placed over filled mold after which light pressure (20 N) was applied. The specimens were polymerized for 40 seconds with light-activated polymerization unit (Elipar 2500; 3M ESPE, USA).

A total of 24 samples were made for each of the composites (Giomer, Ceram, and Spectra). Six samples

¹Associate Professor, ^{2,3}Lecturer

¹Department of Conservative Dentistry and Endodontics Manipal College of Dental Sciences, Manipal University, Manipal Karnataka, India

²Department of Dental Materials, Melaka-Manipal Dental College, Manipal, Karnataka, India

³Department of Dental Materials, Manipal College of Dental Sciences, Manipal University, Manipal, Karnataka, India

Corresponding Author: Arul Amalan, Lecturer, Department of Dental Materials, Melaka-Manipal Dental College, Manipal Karnataka, India, e-mail: karikalanamalan@yahoo.co.in

(n = 6) from each composite group were immersed in four solutions, that is, Saline, Appy fizz, Nimbooz, and Thumbs Up ($6 \times 4 = 24$ samples). The specimens were dipped for 50 seconds and washed with saline. This cycle was continued for six times each day. Such hardness test was carried out in regular intervals for 7, 14, and 21 days.

The Vickers' microhardness was determined by applying a force of 100 gm with a dwell time of 15 seconds. Indentation of a static diamond tip under load into the material being tested for a certain period of time constitutes hardness test. Evaluation of microscopic impression produced from this procedure was performed after the removal of the load. Since the diamond is pyramidal in shape in Vickers' hardness test, a square-shaped impression was obtained in the material being tested. Measurements were made on both diagonals, and mean values were obtained.

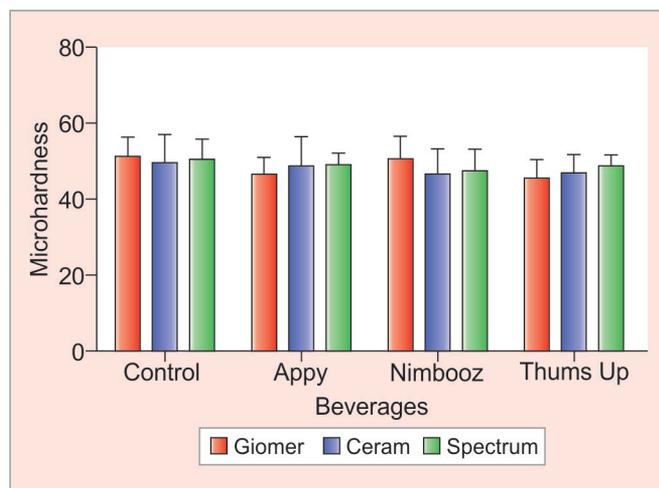
STATISTICAL ANALYSIS

Statistical analysis was by GraphPad Prism software (version 5.0, USA). Data were analyzed by one-way analysis of variance followed by Tukey's *post hoc* test.

RESULTS

The microhardness of different groups are represented by bar diagrams.

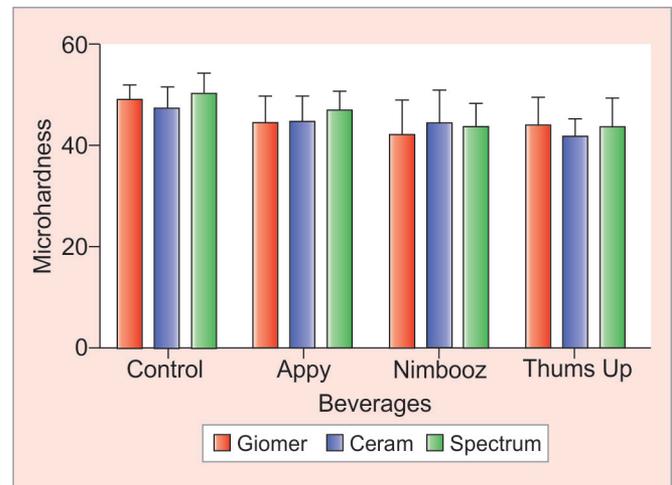
There was reduction in microhardness, but no significant difference in groups tested after 7 and 14 days ($p > 0.05$). There was significant reductions in hardness in all three composites after 21 days of immersion (Graphs 1 to 3).



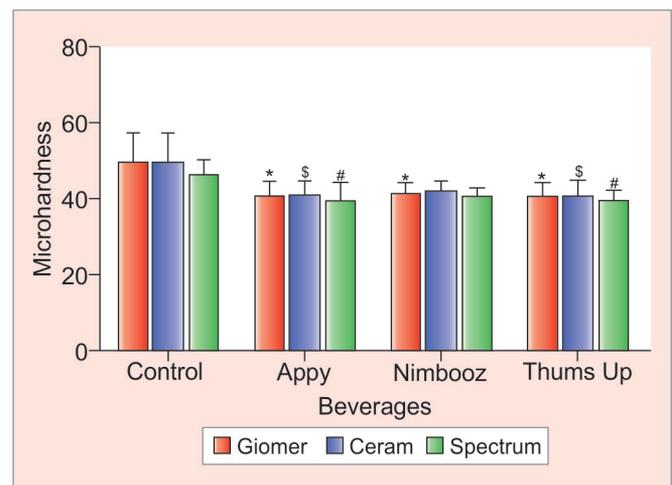
Graph 1: Tables representing microhardness values of materials when immersed in beverages for 7 days. There is no significant difference between each group

DISCUSSION

Microhardness is defined as the resistance to permanent deformation caused by indentation after load. Spectrum is microhybrid composite with nano-scaled silica. Nanohybrid composite and giomer were selected to compare with microhybrid composite (spectrum). In our study, sample size was standardized and uniform depth of cure was maintained. The restorative materials were immersed in acidic drinks for 50 seconds, then washed with saline, and the cycle was repeated for six times per day. The above time period was selected to simulate *in vivo* conditions of oral cavity, where the salivary flow dilutes the acidic concentration of beverages.



Graph 2: Tables representing microhardness values of materials when immersed in beverages for 14 days. There is no significant difference between each group



Graph 3: Tables representing microhardness values of materials when immersed in beverages for 21 days. There was significant reduction in microhardness. *Giomer vs Appy fizz, *Giomer vs Nimbooz, *Giomer vs Thumbs Up, there was significant difference after 21 days ($p < 0.05$); \$Ceram vs Appy fizz, \$Ceram vs Thumbs Up, there was significant difference after 21 days ($p < 0.05$); #Spectrum vs Appy fizz, #Spectrum vs Thumbs Up, there was significant difference after 21 days ($p < 0.05$)

In this study, no significant reduction in microhardness was seen after 7 and 14 days, but there was significant reduction after 21 days. This might be due to time taken for beverages to dissolve the composite materials. Phosphoric acid and carbonic acid present in beverages might have been responsible for reduction in microhardness.¹ Low pH induces erosive wear in composite material and decreases the microhardness.⁵

The distilled water used as control showed reduction in microhardness, due to water sorption and polymer degradation.⁶ Thumbs Up is an acidic drink with low pH that is responsible for the degradation of components.^{7,8} Appy fizz is a carbonated beverage that contains acid. The acids present in this will soften the bisphenol A-glycidyl methacrylate component.^{9,10} Nimbooz is lime juice consisting of carbonated beverage and citric acid. Immersion in Nimbooz did not affect microhardness to a greater extent, probably due to less acidity.¹¹ Acidic conditions of these drinks caused the erosion of restorative materials. Also the acids of these drinks penetrated into the resin matrix to facilitate the release of unreacted monomers which resulted in lower surface hardness values.^{12,13}

Inorganic fillers of different types may be included in the resin-based restorative materials, and fillers of zinc, barium glass, and zirconia/silica fillers are more susceptible to aqueous attack than those containing quartz fillers.¹⁴ Reduction in microhardness will also depend on water sorption of material.¹⁵ Giomer is more prone for degradation due to the water sorption than nano- and microhybrid composites.¹⁶ The bonding between the filler and resin is weaker in giomer. The life span of a restorative material may be affected by its wear and abrasion rates caused by chemical softening. Limitation of this study is that it does not simulate *in vivo* conditions. Saliva in oral cavity plays a role in reducing acidity. Further studies should be conducted that mimics clinical situation.

CONCLUSION

The microhardness of material was reduced after 7 and 14 days, but this reduction in the test groups was not significant as compared with the controls. Microhardness reduced significantly after 21 days of immersion in Appy fizz and Thumbs Up. The decrease in microhardness also depends on exposure time and chemical composition of composites and soft drinks.

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