ORIGINAL ARTICLE

Effect of carbonated beverages on flexural strength of composite restorative material

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J. Adv. Pharm. Technol. Res.

ABSTRACT

Carbonated beverages have side effects on oral health and general health. Flexural strength is a prime mechanical property of restorative material. The aim of this study is to know the effect of carbonated beverages on the flexural strength of composite restorative material. Two types of composites (Ivoclar and Restofill) were used as samples for comparative evaluation of flexural strength. The sample size is 10 where 5 of each type of composites are included. The obtained samples were immersed in carbonated beverages. One sample of each type was used as a control. After 24 h, the flexural strength of all the 10 samples was evaluated using the formula ($3FL/2bd^2$), and the values were tabulated. Average values and graphs were done using SPSS software. The results showed the changes in flexural strength of both Ivoclar and Restofill materials when immersed in carbonated beverages. The mean value of all the samples was taken, and the standard deviation was calculated. After immersion in carbonated liquids, the mean value of Ivoclar and Restofill samples is 58.9 and 35.01, respectively. $P = 0.718$ (>0.05), which was not statistically significant. After immersion in Coke, the Restofill group exhibits more flexural strength than the Ivoclar group composite; however, the strength reduces when immersed in Sprite as compared to the Ivoclar group composite.

Key words: Carbonated drinks, composite material, dental materials, flexural strength, innovative measurement

INTRODUCTION

The stress in a material just before to its yielding during a flexure test is the definition of flexural strength, a quality of a material. It is also known as bend strength or transverse strength or rupture strength.[1] The technique used is a three-point bend or flexural test technique. The maximum stress encountered within a material at its moment of yield is represented by its flexural strength, which is quantified in terms of stress.[1,2] As a result, flexural strengths for the same material are frequently higher than tensile values.[3-5]

Carbonated beverages have side effects on oral health and general health. Although the ingredients in such drinks are proven safe by the Food and Drug Administration, they have side effects, especially when consumed regularly. Awareness of the side effects of these carbonated beverages can help you make the proper diet plan and nutritional choices. The study given by Novais VR *et al*. showed that

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Submitted: 27-Apr-2022 **Accepted:** 12-Jul-2022
Published: 30-Nov-2022

Access this article online	
Quick Response Code:	Website: www.japtr.org
	DOI: 10.4103/japtr.japtr_264_22

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How to cite this article: Sushma B, Ganesh SB, Jayalakshmi S. Effect of carbonated beverages on flexural strength of composite restorative material. J Adv Pharm Technol Res 2022;13:S160-3.

carbonated drinks, when taken on a regular basis, can cause severe tooth decay.[6]

Composite resin is a material used in the restoration of teeth. It is mostly composed of Bis-GMA and other dimethacrylate monomers. Composite resins are said to be a popular alternative to silver fillings. Although they are strong enough, they may not be as hard as amalgam fillings. Some of the studies also suggest that it is harmful for the oral cavity.[7] Many of the previous articles calculated flexural strength as one of the parameters, and the present study focuses on flexural strength alone of two different composite materials. Our research and knowledge have resulted in high-quality publications from our team.[8-22] The present study aims to know the effect of carbonated beverages on the flexural strength of composite restorative material.

MATERIALS AND METHODS

The current study is an original research performed at a White Laboratory, Saveetha Dental College, Chennai. The necessary approvals were obtained from the Institutional Research Board. Two types of composites (Ivoclar and Restofill) were used as samples for comparative evaluation of flexural strength. The sample size is 10, where 5 of each type of composites are included. The obtained samples were immersed in carbonated beverages such as Coke and Sprite for 24 h [Figure 1]. One sample of each type was used as a control and not immersed in any drinks. The samples were put through a three-point bend test with a span length of 16 mm and a cross head speed of 1 mm/min on an INSTRON E3000 Universal testing machine (ElectroPuls) to determine the maximum force and maximum flexural displacement [Figure 2]. The differences between the groups were determined by paired *t*-test analysis which was analyzed in SPSS version 23.0 (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.). A bar graph was made using the mean values of respective samples.

RESULTS

All the results obtained were tabulated. Table 1 shows the flexural strength of two types of samples, i.e., Ivoclar and Restofill, before and after immersion in carbonated drinks. The Ivoclar composite has a flexural strength of 59.79 MPa before immersion, whereas the flexural strength of two Ivoclar samples was decreased to 48.69 MPa and increased to 69.12 MPa after immersion in Coke and Sprite, respectively. The Restofill composite has a flexural strength of 95.37 MPa before immersion, whereas the flexural strength of two Restofill samples was decreased to 49.02 and 21.00 MPa after immersion in Coke and Sprite, respectively. There was a decrease in flexural strength of both the Ivoclar and Restofill composites after immersion in carbonated beverages such as Coke and Sprite. Table 2 shows the significance among the groups of Ivoclar and Restofill samples. The mean and the standard deviation of the Restofill group were 17.61 ± 5.051. The

Table 1: The flexural strength of the composite resin samples

Type of sample	Flexural strength (MPa)
Ivoclar control	59.79
Ivoclar in Coke	48.69
Ivoclar in Sprite	69.12
Restofill control	95.37
Restofill in Coke	49.02
Restofill in Sprite	21.00

Table 2: Mean, standard deviation, and significance among the various groups

Group	Mean±SD	Significance
Ivoclar	0.1000±3.53262	0.718
Restofill	17.6175±5.05135	

$P<0.05$ is regarded as significant. The *t*-test for independent samples is utilized.
SD: Standard deviation

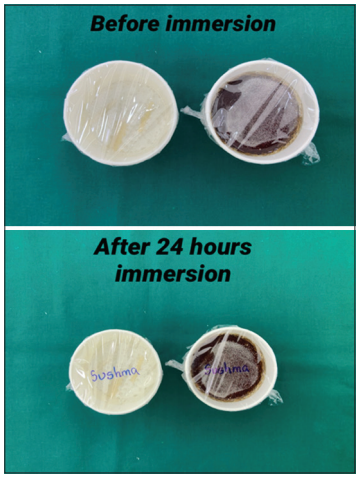

Figure 1: The above picture shows the immersion of composite resin samples of two different types in Coke and Sprite

Figure 2: Determination of maximum force with INSTRON E3000 UTM (Electroplus). UTM: Universal Testing Machine

P value (>0.05) was 0.718, which was not statistically significant [Figure 3].

DISCUSSION

The results of the present study show the effect of two types of carbonated beverages on two different brands of composite resin material, namely Ivolcar and Restofill. It shows that the Ivoclar composite can withstand the effect of carbonated drinks compared to the Restofill material, but both the materials have shown a decrease in flexural strength after immersion in the carbonated drinks. More difference is seen with the flexural strength of Restofill composite before and after immersion in carbonated drinks such as Coke and Sprite.

The three-pointbend test, which is commonly used, is a relatively simple method of producing consistent and repeatable relative strength values for dental ceramics. The only drawback of this technique is that the results obtained using this method are affected by surface flaws.[23,24] While the clinical relevance of using a highly polished or glazed surface for testing can be debated. The development of surface defects during processing, placement, and function, and the existence of a moist environment, are a clinical reality and to some degree, are likely to contribute to the degradation in strength of these materials. Previous research looked at the flexural strength of light-cured composite resins in the hopes of finding a link between the qualities of the specimens they used. Other research that has investigated how changes in material composition can affect flexural strength have demonstrated this through a series of experiments.[25-27] Hydraulic cement has an intrinsic maximum tensile strength of roughly 20 MPa, according to the few research that has investigated flexural or tensile failure. As a result, the author shows that the frequent flexural weakness of cement is caused by the big voids. Despite the huge volume of gel holes remaining in the material, removing such macrodefects resulted in flex strengths of up to 70 MPa.[28,29] Some studies have shown a decrease of the flexural strength of composite resin when immersed in various fruit juices of different concentrations.[30,31]

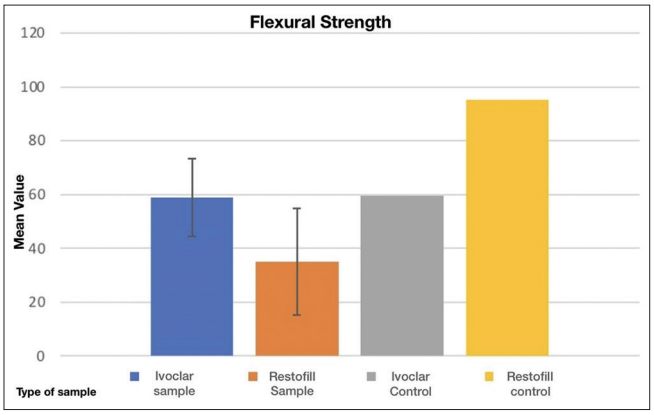

Figure 3: The above bar chart shows the correlation of mean value of flexural strength of different composite materials when immersed in carbonated drinks. X-axis denotes the type of sample. Y-axis denotes the mean value of flexural strength of different types of samples. Blue color graph denotes the Ivoclar sample, orange color graph denotes Restofill sample. Gray color and yellow color represents the control of Ivoclar and Restofill, respectively. It shows the decrease in flexural strength of both the Ivoclar and Restofill composites after immersion in carbonated beverages such as Coke and Sprite. $P = 0.718$ (>0.05) which was statistically not significant

The limitations of the study can be the smaller sample size. Hence, more criteria have to be included and to generalize the results of the current study. The future scope is stated that the determination of flexural strength will help the dentist to choose more strengthened material to provide patients with better treatment and increase the prognosis of the treatment. Different brands have to be compared in an upcoming study to determine which composite filling material stands strong over all the commercially available composite filling materials.

CONCLUSION

From the present study, it is concluded that the Restofill group shows more flexural strength when compared with the Ivoclar group composite after immersion in Coke, but the strength decreases when immersed in Sprite compared to the Ivoclar group. The overall flexural strength of both the materials when subjected to 24 h immersion in two types of carbonated beverages had decreased one-third to the original flexural strength.

Acknowledgment

We thank Saveetha Dental College for giving us the opportunity and support to conduct this study.

Financial support and sponsorship

The funds were provided by:

- Saveetha Dental College and Hospitals, Saveetha University of Medical and Technical Sciences, Saveetha University, Chennai
- Modugula Infra (Hyderabad, Telangana).

Conflicts of interest

There are no conflicts of interest.

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