

Evaluation of flexural strength of bulk-fill composite resin after immersion in fruit juices: An *in vitro* study

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ABSTRACT

Resin-based composites are increasingly employed in dental restorations due to their esthetics. Flexural strength is the characteristic feature of a substance, and it can be described as the stress present in the material just before it renders in a flexure test. The purpose of this study was to determine the flexural strength of a bulk-fill composite following immersion in fruit juices. Ten samples of bulk-fill type composite filling material were created, with four samples from Restofill (Group 1) and four samples from Ivoclar Vivadent (Group 2). Out of which, four specimens of each brand were included for immersion in fruit juices; two specimens were kept as control. The eight samples were put through a flexural strength test, with four remaining as controls, before being measured for maximum force and displacement on the Instron E3000 universal testing equipment. SPSS version 23 (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.) was used to examine the calculated flexural strength. The composite Ivoclar has a mean flexural strength of 20.52, whereas the composite Restofill has a mean flexural strength of 20.55. The *P* value for the independent sample *t*-test between the two groups, Ivoclar and Restofill, was 0.089 (>0.05), which is statistically insignificant. It is clear from this research that the bulk-fill composite resin Ivoclar has a low flexural strength when compared to the sample Restofill after immersion in fruit juices.

Key words: Composite resin, flexural strength, fruit juice, *in vitro* study, innovative measurement

INTRODUCTION

Dental cavities, more commonly referred to as tooth decay, are the corrosion of the surface of tooth enamel due to the combined activity of microorganisms, acids, plaques, and

tartar.^[1,2] It needs to be filled with restorative materials as soon as possible to prevent any complications.^[3] Resin-based composites are increasingly employed in dental restorations due to their esthetics.^[4] Between the resin-tooth interface, there involves a weak bond which accounts for its failure.^[5] The linkage between dentin-resin bonding is the vital entity for the longevity of the composite. In spite of being improved in esthetics than the amalgam restorations, few drawbacks are associated. There is still shrinkage, microleakage, subsequent caries, poor strength, fracture toughness, and wear.^[6]

The oral cavity is continuously exposed to various factors such as the occlusal/masticatory forces including tensile,

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compressive, shear, and flexural forces, microbes, and so on.^[7,8] Due to the interactions occurring between the abovementioned factors, it can lead to the degradation of the restorative materials present in that environment.^[9] Usually, the failure of those restorative materials is due to the fracture within or around the restorations. The flexural/fracture-associated aspects of restorative substances like composites are determined by the following parameters such as flexural modulus, flexural elasticity, Weibull modulus, and fracture resistance.^[10] Most of the load-bearing locations such as class 1, 2, and 4 cavities are connected with the probability of facing fractures. A lot of studies have revealed the ill effects of food substances – carbonated drinks, acidic beverages, fruit juices with natural as well as artificial sweetening agents, and high sugary items on bulk-filled restorations.^[11] Apart from this, the consequences of food-simulating agents rely on the nature of composites being placed, consisting of the hydrophilicity, solubility, porosity, chemical bonds, and corrosion resistance.

Flexural strength is the characteristic feature of a substance, and it can be described as the stress present in the material just before it renders in a flexure test.^[12] In other terms, It is also known as transverse rupture strength, bend strength, or modulus of rupture.^[13] The transverse bending test is employed to test the property of flexural strength in specimens mostly in the form of either a circular or rectangular cross section.^[14] The excessive stress accomplished with the material at the instant of relent is known as flexural strength, which is estimated in terms of stress (σ)^[15,16] Our research and knowledge have resulted in high-quality publications from our team.^[17-31] This study aims at determining the flexural strength of two commercially available bulk-fill composite resin postsubmersion in fruit juices.

MATERIALS AND METHODS

Preparation of specimens

For performing the research, two varieties of composite were tested for flexural strength. One type of resin is Restofill; the other is Ivoclar. A rubber customized mold of rectangular shape (dimensions of 2 mm × 2 mm × 25 mm) was taken for preparing the specimens. A small amount of the resin composite of each brand was taken using a carver and filled evenly in the mold. Afterward, a light-emitting diodes light curing unit was used for approximately 30–40 s. Then, the specimen was removed from the mold and smoothed up using a conical burr. Similarly, six specimens for each brand (Restofill and Ivoclar) were made. Out of which, four specimens of each brand were included for immersion in fruit juices; two specimens were kept as control which were immersed in distilled water [Figure 1].

Immersion in fruit juices

Two fruit juices were used (grape juice and lime juice) for immersion protocol [Figure 2]. The eight test groups of

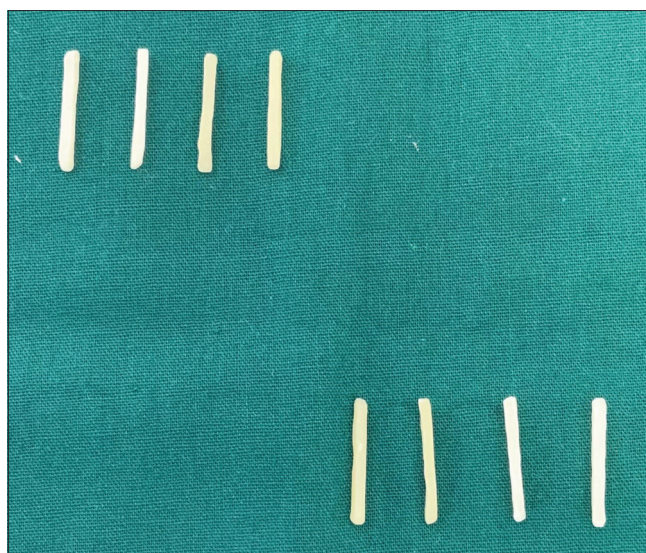


Figure 1: The composite filling materials – Restofill (Group 1) and Ivoclar (Group 2)

composite bars were separated into two set batches (4 + 4) for immersion in two juices. Each batch consisted of four specimens (two Restofill and two Ivoclar). A 1-week regimen was followed for immersion. For a day, the two sets of composites were immersed for at least 10 min, once in the morning and evening. The samples were cleaned and dried completely.

Flexural strength evaluation

A three-point bend test was performed by placing them in the Instron E3000 universal testing machine to determine their flexural strength.

RESULTS

The average value of flexural strength of the composite Restofill immersed in lime juice is 66.06, whereas that of the composite Restofill immersed in grape juice is 134.95. The average value of flexural strength of the composite Ivoclar immersed in lime juice is 63.18, whereas the average value of flexural strength of the composite Ivoclar immersed in grape juice is 139.48 [Table 1]. Independent sample *t*-test was done between the two groups: Ivoclar and Restofill and the $P = 0.089$ (>0.05) which is statistically not significant [Table 2 and Figure 3].

DISCUSSION

In our study, the flexural strength of two brands of the composite (Ivoclar and Restofill) was significantly affected by immersion in fruit juices (grape and lime). Comparatively, the flexural strength of Restofill was slightly more than that of Ivoclar. The flexural strength was low for the composite resin samples immersed in lime juice. In a study conducted by Marghalani (2020), it has reported that the flexural strength



Figure 2: The lime and grape juices in which the composite filling materials – Restofill (Group 1) and Ivoclar (Group 2) have been immersed

post immersion in solvents such as distilled water, ethanol, and hexane shows no statistical significance ($P > 0.05$), which is similar to our present study.^[32]

In a similar study, after immersion of the specimens in fruit juice and soda water and nano and microhybrid groups of different composites were selected and prepared for evaluating flexural strength. They proved that the flexural strength values and elastic modulus were significantly influenced by the fruit juice and not by milk and soda water. In our present study too, fruit juices, especially grape juice, had a huge significance on reducing the flexural strength property.^[33]

The limitations of the study can be attributed to the manual error while preparing the specimens, irregularities in the smoothing process or it can be due to the sugar content in the fruit juice that we have immersed. The presence of less sample size and criteria accounts for the limitations of the study. Future scope included in this study is that it shall aid dental practitioners worldwide to choose the better composite for restorations, which in turn leads to satisfying results for both dentists as well as patients. Furthermore, it can be extended by comparing numerous brands of composites apart from the two Ivoclar and Restofill.

CONCLUSION

From this study, it is evident that the bulk-fill composite resin Ivoclar has a low flexural strength when compared to the sample Restofill after immersion in fruit juices.

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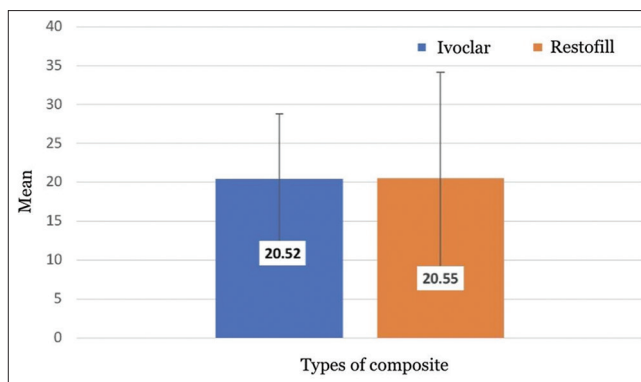


Figure 3: The mean flexural strength of composite resin samples in various immersion groups. X-axis represents the type of composite and Y-axis represents the mean value. Group 1 (blue) denotes the mean value of Ivoclar samples, whereas Group 2 (orange) denotes the mean value of Restofill samples. The flexural strength was slightly low for the composite resin sample Ivoclar

Table 1: The type of samples taken along with the assessment of flexural strength

Type of sample	Flexural strength
Ivoclar lime	63.18
Ivoclar grape	139.48
Restofill lime	66.06
Restofill grape	134.95

The mean values of flexural strength for Restofill (lime and grape) and Ivoclar (lime and grape) are shown

Table 2: Significance among the composite groups

Group	Mean	SD	Significance
Ivoclar	20.52	8.31	0.089
Restofill	20.55	13.61	0.089

The t-test for independent samples is utilized. A 0.05 P value is not statistically significant. SD: Standard deviation

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Conflicts of interest

There are no conflicts of interest.

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