

Evaluation of flexural strength of glass ionomer cement after immersion in fruit juices

B. Keerthana, S. Balaji Ganesh¹,
S. Jayalakshmi¹

Undergraduate Student, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University,
¹White Lab - Material Research Centre, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

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ABSTRACT

Glass ionomer cement (GIC) is a material used for restoration in dentistry. The stress in a material right before it yields in a flexure test is referred to as flexural strength. The aim of this study was to evaluate the flexural strength of two different glass ionomers after immersion in fruit juices. Five samples of D-Tech and Shofu GIC were prepared from each for the *in vitro* study. The eight samples were subjected to a flexural strength process and two were left as control which was followed by the determination of maximum force and displacement, then the collected data were used to determine flexural strength and analyzed using SPSS software (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp). The mean value of flexural strength of the D-Tech GIC immersed in fruit juices is 4.4375 and the mean value of Shofu GIC immersed in fruit juices was 8.4975. Paired *t*-test was done between the two groups and the *P* value was 0.00, which is considered highly statistically significant. From this study, it is evident that the GIC brand Shofu has higher flexural strength compared to D-Tech. Flexural strength was decreased for both the GIC groups when immersed in grape juice.

Key words: Flexural strength, fruit juice, glass ionomer cement, *in vitro* study, innovative measurement

INTRODUCTION

Dental caries is a microbiological disease of the teeth's hard structure that causes localized demineralization of the inorganic portion. It needs to be filled or restored with restorative materials to prevent further complications.^[1] Dental restoration is used to prevent infection and additional decay in the mouth. One of the motivating factors for dental

restoration is to improve smiles and restore confidence. The dental restorations are designed to match the color and size of the natural teeth.^[2] Glass ionomer cement (GIC) sets by an acid-base reaction.^[3,4]

During the initial setting, GIC is susceptible to water imbalance. To improve strength and reduce clinical wear, a thin layer coating over GIC with a protective agent is recommended to avoid water gain or loss.^[5] To replace varnish or petroleum jelly, a resin coating for GIC has just been introduced. During adhesive and restorative operations, rubber dam isolation is widely used.^[6] In the isolation area, the GIC dehydrates, causing microcracks in the material and causing the binding to dentin to break down. Before rubber dam isolation, coat the material with GIC to keep it from drying.^[7,8]

Address for correspondence:

Dr. S. Balaji Ganesh,
White Lab - Material Research Centre, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai - 600 077, Tamil Nadu, India.
E-mail: balajiganeshs.sdc@saveetha.com

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GIC is a two-part product that must be mixed before use. The air trapped inside the material during mixing detects porosities in the combined GIC. The more internal porosities are observed, the higher the viscosity of GIC.^[9,10] Flexural strength is a key mechanical property.^[11] The two most essential mechanical properties in the evaluation of cement are flexural strength and elasticity modulus.^[12] The flexural strength test, which is carried out using a three-point bend method, simultaneously assesses the tensile and compressive states. The flexural strength of hybrid composites was significantly higher than microfill composites. Our research and knowledge have resulted in high-quality publications from our team.^[13-27] This study aims at determining the flexural strength of two GIC materials after immersion in fruit juices.

MATERIALS AND METHODS

Preparation of specimen

For performing this study, two GICs of different brands were used. One type of GIC is Shofu and the other is D-Tech. A rubber customized mold of rectangular shape (Dimensions: 2 mm × 2 mm × 25 mm) was taken for preparing the specimens. A small amount of GIC of each brand was taken using a carver and filled evenly in the mold. Then, the specimen was removed from the mold and smoothens up using bur. Similarly, five samples for each brand (D-Tech and Shofu) were made. Out of which, four specimens of each brand were included for immersion in fruit juice, two samples were kept as control.

Immersion protocols

For comparing the flexural strength of the two types of GIC, two fruit juices (lime juice and grape juice) and distilled water were used. The eight test groups of GIC bars were separated into two set batches (4 + 4) for immersion in fruit juices. Each batch consisted of four specimens (two D-Tech and two Shofu). For the control group, two samples were immersed in distilled water. A 1-week regimen was followed for immersion. For a day, the two sets of GIC were immersed for at least 10 min, once in the morning and evening. The samples were washed and dried thoroughly after immersion [Figure 1].

Determination of flexural strength

For determining the flexural strength, a bending test was conducted by mounting them in the Instron E3000 universal testing machine [Figure 2].

RESULTS

The mean value of flexural strength of the D-Tech GIC immersed in fruit juices is found to be 4.4375 and the mean value of Shofu GIC immersed in fruit juices was 8.4975. Paired *t*-test was done between the two groups and the *P* value was 0.00, which is considered highly statistically

Table 1: The mean values of flexural strength of different glass ionomer cement groups (Shofu and D-Tech)

Samples	Mean	SD	Significance
D-Tech	4.4375	1.68941	0.000
Shofu	8.4975	4.96114	0.000

SD: Standard deviation



Figure 1: This picture depicts the lime juice, grape juice, and distilled water in which the glass ionomer cement, sample materials has been immersed

significant. Shofu type has higher flexural strength compared to D-Tech type [Table 1].

DISCUSSION

Atraumatic restorative treatment and the restoration of cervical dental lesions both require GIC. It is recommended because they are fluoride-releasing and provide a chemical attachment with little to no pretreatment. However, as compared to current resin composite materials, the significant disadvantages of GIC are their poor fracture strength. When compared to prior experiments, Singer *et al.* found that adding plant extracts at higher quantities can improve the flexural strength of glass ionomer material. A comparison of plant and fruit extracts was made in the study. In addition, the study's findings revealed that GIC's flexural strength for plant extracts is 2.61 Mpa which is significantly higher when compared to other test groups, which is similar to our present study.^[28]

Another study carried out by McKenzie MA *et al.* stated that EQUIA Forte Fil GIC is a promising restorative material with superior flexural strength and surface hardness compared to other GICs. Similarly, in our study, Shofu showed higher flexural strength when compared to D-Tech. Increased flexural strength could be a result of greater microhardness.^[29-31] Flexural strength of GIC stored in distilled water has a mean value of 25.89 Mpa, while the sample bottled in artificial saliva



Figure 2: This picture depicts the machine (INSTRON E3000 UTM) used for flexural strength assessment

has a mean value of 24.78 Mpa.^[30] When cement comes into touch with water, a chemical reaction occurs, according to a study, but the effect is minor. Natural saliva investigations, on the other hand, have proven problematic due to the fact that saliva composition varies from person to person. Studies have also supplied information on flexural strength estimation in GIC modification kinds. The mean flexural strength of coated and uncoated high powder liquid GIC was significantly lower than the resin-modified GIC. According to the findings, resin-coated GIC has high flexural strength. Resin coating increases the flexural strength of GIC under dry conditions.^[32,33]

The limitations of this study can be due to manual error while preparing the specimens, irregularities in smoothing process or it can be due to the sugar content in fruit juice that we have immersed. The presence of less sample size and criteria accounts for the major limitation in this study. The future scope included in this study is, it shall aid the dental practitioners to choose the better GIC brand for restoration, which may lead to satisfying results for both the patient and doctor. Furthermore, studies can be done on other brands of GICs except Shofu and D-Tech and also on the modified GICs.

CONCLUSION

From this study, it is evident that the GIC brand Shofu has higher flexural strength compared to D-Tech. Flexural strength was decreased for both the GIC groups when immersed in grape juice.

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Conflicts of interest

There are no conflicts of interest.

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