ORIGINAL RESEARCH

Evaluation of Flexural Strength of Glass Carbomer Cement and Conventional Glass Ionomer Cement: A comparative study

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ABSTRACT

Background: The traditional glass ionomer cement (GIC), which may chemically attach to tooth structures and release fluoride, has been recommended as a restorative material. Glass carbomer cement, a restorative material based on GIC, has just been introduced with claims of increased physical properties. In order to compare the Flexural Strength of Glass Carbomer Cement with Traditional Glass Ionomer Cement, the current investigation was carried out. **Materials & methods:** The goal of the current study was to compare the flexural strength of conventional glass ionomer cement and glass carbomer cement. Study moulds were created using silicone putty. The desired proportions of the mould were created using stainless steel scaffolding. A total of 100 specimens were processed and split into two study groups, each including 50 specimens. One group was made up of traditional GIC, and the other was made up of GCC. A universal force testing equipment was used to test the specimen's flexural strength after it had been prepared. All of the outcomes were noted, examined, and contrasted. **Results:** Mean flexural strength of GIC and GCC was 30.1 MPa and 28.7 MPa respectively. Non-significant results were obtained while comparing the mean flexural strength of GIC and GCC. **Conclusion:** Flexural strength of glass carbomer cement was similar to conventional glass ionomer cement. Hence; its use should be limited to areas of minimal stress.

Key words: Glass ionomer cement, Carbomer

INTRODUCTION

Glass ionomer cement (GIC) is a self-adhesive restorative material.[1] Chemically, it is a combination of fluoro-aluminosilicate glass powder and polyacrylic acid liquid. It is a versatile material and has a broad spectrum of uses in restorative and pediatric dentistry. It exhibits a potent anti-cariogenic action.

GIC was first described in the literature by Wilson and Kent in 1972 and has evolved gradually since then to improve its properties and broaden its uses. It is used for the cementation of fixed dental prosthesis (FDPs), orthodontic bands and brackets, and as liners or bases, as core build-up material, to restore carious and non-carious lesions, as pit and fissure sealant, and for atraumatic restorative technique (ART).[2]

GIC is both biocompatible and bioactive. Although the pH of freshly mixed GIC ranges between 0.9-1.6 still, the pulp response to GIC is considered mild.[3]

Glass carbomer cement represents a new generation of dental material, which mineralizes gradually into fluorapatite.[4]

Hence; the present study was conducted for comparing the Flexural Strength of Glass Carbomer Cement and Conventional Glass Ionomer Cement.

MATERIALS & METHODS

The goal of the current study was to compare the flexural strength of conventional glass ionomer cement and glass carbomer cement. Study moulds were created using silicone putty. The desired proportions of the mould were created using stainless steel scaffolding.

The GIC was chemically healed. With mild pressure, the material was moulded to the mold's surface. To ensure optimum material adaptation, compression firming was carried out manually using a plastic tool. The material was taken out of the mould once it had set. The samples were then visually checked for flaws.

A GCC that had undergone light curing was offered in capsule form. GCC gloss was applied to the mold's interior surface. A powerful Carbo LED curing light was used to cure the entire sample for 60 s. Once the material had dried, a metal tool was used to delicately remove it from the silicone mould. The samples were then checked for flaws as usual.

A total of 100 specimens were processed and split into two study groups, each including 50 specimens. One group was made up of traditional GIC, and the other was made up of GCC. A universal force testing equipment was used to test the specimen's flexural strength after it had been prepared. All of the outcomes were noted, examined, and contrasted.

RESULTS

Mean flexural strength of GIC and GCC was 30.1 MPa and 28.7 MPa respectively. Non-significant results were obtained while comparing the mean flexural strength of GIC and GCC.

Table 1: Comparison of flexural strength (MPa)

Study group	Mean	SD	p-value
GIC	30.1	10.2	0.136
GCC	28.7	8.4	

DISCUSSION

Glass ionomer cement (GIC), an acid-base cement, is formed by the reaction of weak polymeric acids with inorganic glass powder.[5] GIC has multiple advantages: First, it adheres specifically to the teeth to prevent corrosion or leakage. Second, there is slow release of fluoride ion over time to maintain dental health. Third, its color is very similar to that of human teeth.[6,7] Despite the advantages of GIC, further improvement is required in terms of its mechanical characteristics. In order to improve the mechanical strength of GIC, the resin-modified glass ionomer (RMGI) was developed; it has an additional monomer compared to GIC and improved mechanical strength through photopolymerization and acid-base reaction.[8,9] RMGI obtained by resin curing has improved physical properties, but the amount of the released fluoride ion, which is important in preventing dental caries, is low. Studies have reported on the manufacture of GIC using macromonomer and viscosity dilution materials to exclude the effects of water and the production of a material known as a compomer.[10]

Further improvement in the material has led to the development of glass carbomer cement (GCP) which incorporates nanosize particles with fluorapatite being added as a secondary filler.[11] The use of nanosize particles helps to increase the surface area for reaction of the cement leading to a better reactive process, while the inclusion of fluorapatite converts the glass ionomer into a fluorapatite-like material, as shown by Van Duinen et al.[12] A biocompatible carbon-based additive has been used to sup plement the cement, with the objective of improving the strength and transparency of the material.[13] Moreover, the fine structure of the cement gives it a smooth and highly polished surface similar to resin composite restorative materials.

Hence; the present study was conducted for comparing the Flexural Strength of Glass Carbomer Cement and Conventional Glass Ionomer Cement.

In this study, the mean flexural strength of GIC and GCC was 30.1 MPa and 28.7 MPa respectively. Non-significant results were obtained while comparing the mean flexural strength of GIC and GCC.

Faridi MA et al[14] evaluated flexural strength of a conventional GIC (Fuji IX) against a newly developed glass carbomer cement (GCP). For Fuji IX and GCP, a total of 80 blocks were prepared and divided into 16 groups ($n = 5$). These groups were further categorized according to the storage medium (artificial saliva and Vaseline) and time intervals (24 h and 1, 2, and 4 weeks). A 3-point bending test was carried out, and statistical analysis was done using ANOVA and Tukey post hoc tests. Fuji IX showed a mean flexural strength of 25.14 ± 13.02 versus 24.27 ± 12.57 MPa for GCP. There was no significant statistical difference between both materials when compared under storage media. Both materials showed the highest value for flexural strength at 2 weeks of storage and lowest at 4 weeks. The storage media do not affect the flexural strength of the specimens with reference to time.

Flexural strength was chosen for evaluation because it is more sensitive to small changes in a material's structure than the compressive strength and allows the clinical loading situation to be mimicked by giving an appropriate estimate of the tensile strength of a material.[15] However, it is difficult to prepare the beam specimens required for the test without flaws or cracks.[16]

Flexural strength was measured according to ISO 9917-2. The test was performed after 24 h of storage, as a GIC's final setting and strength are achieved after 24 h, and they usually present lower strength values during the first hours.[17] The values demonstrated in the present study were comparable to the results presented by Kutuz et al.[18] in 2019 and Sajjad et al. in 2019.[19] The results showed that the plant extract enhanced the flexural strength of the GIC, with the 2:1 group ($M = 26.1$ MPa) having the highest median flexural strength, which was statistically different from the control ($M = 11.8$ MPa), CHX-GIC (15.3 MPa), and 1:2 groups (11.5 MPa). Moreover, his effect was found to be concentration-dependent, whereby the 2:1 group yielded the highest flexural strength value, followed by the 1:1 group ($M = 19.6$ MPa); both were significantly different from the control, CHX-GIC, and 1:2 (lowest extract concentration) groups.

CONCLUSION

Flexural strength of glass carbomer cement was similar to conventional glass ionomer cement. Hence; its use should be limited to areas of minimal stress.

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