RESEARCH
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COMPARISON OF COMPRESSIVE STRENGTH OF ZIRCONOMER AND GLASS IONOMER CEMENT AFTER IMMERSION IN FIZZY BEVERAGES - AN INVITRO STUDY

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Abstract
Introduction: The glass ionomer has high fluoride release and chemical bonding to the tooth structure make them the cement of choice for several restorative and luting functions. A high-strength restorative material, which has been reinforced with zirconia fillers known as zirconomer, has been a recent substitute to glass ionomer cement in dentistry. Compressive strength is considered to be a critical indicator of success in restorative dentistry because a high compressive strength is necessary to resist masticatory and parafunctional forces. The aim of the study is to compare the compressive strength of zirconomer and glass ionomer cement after immersion in fizzy beverages.
Materials and Methods: An in-vitro study was carried out to find the compressive strength of zirconomer and glass ionomer cement post immersion in fizzy drinks. Samples were made from shofu brand glass ionomer cement and shofu brand zirconomer. Total of 10 samples were made, 5 were prepared from zirconomer and the other 5 were prepared from glass ionomer cement. They were immersed respectively in fizzy beverages (pepsi and miranda) for 24 hours and distilled water was used as control. Then they were mounted in the Instron E 3000 universal testing machine to check for the compressive strength. A statistical analysis was performed by chi square test using SPSS version 21.
Results: On comparing all the 3 groups, zirconomer has more compressive strength than glass ionomer cement. P value of the chi square test is 0.000 which is statistically significant.
Conclusion: The comparative evaluation of the compressive strength of zirconomer and glass ionomer cement after immersion in fizzy beverages have shown that zirconomer has superior compressive strength than the glass ionomer cement. Hence, zirconomer can be used as a promising posterior tooth restorative material.
Keywords: Zirconomer, Glass ionomer cement, Compressive strength, Fizzy beverages.
Running Title: Compressive strength of zirconomer and GIC after immersion in fizzy beverages.
Type of Study: Original in vitro study.

INTRODUCTION

A glass ionomer cement (GIC) is a dental restorative material used in dentistry as a filling material and luting cement, including for orthodontic bracket attachment. Glass-ionomer cements are based on the reaction of silicate glass-powder and polyacrylic acid, an ionomer. Glass ionomers contribute directly to remineralisation of carious dentine, provided that good seal is achieved with intimate contact between the GIC and partly demineralised dentine. Glass ionomer cements were first developed by Wilson and Kent in the 1960s. Their high fluoride release and chemical bonding to the tooth structure make them the cement of choice for several restorative and luting functions. However, their high solubility and relatively low compressive strength have meant that since the 1980s, researchers have sought to improve the strength of glass ionomers(1). The earliest attempts on creating reinforced cements focused on combining the glass powder with readily available materials such as silver alloy from dental amalgam. However, this was soon replaced with the sintering of specific metal alloys from manufacturers. The advent of nanotechnology at the turn of the 21st century brought about new scope for the reinforcement of glass ionomer cements(2).

Over the past decade, glass ionomer powder was reinforced with different nanoparticles, ranging from amorphous materials such as hydroxyapatite to metals. The chemical structure of the glass ionomer is based on the formation of a gel matrix. To this extent, it has been hypothesized that the addition of fibrous materials would reinforce this structure (3). A high-strength restorative material, which has been reinforced with zirconia fillers known as zirconomer (white amalgam), has been a recent substitute to glass ionomer cement in dentistry. Zirconia (ZrO2) is a white crystalline oxide of zirconium. It is a polycrystalline ceramic

without a glassy phase and exists in several forms. The name “zirconium” comes from the Arabic word “Zargon" which means “golden in color.

Zirconia is one of the tooth-colored materials with good dimensional stability and excellent strength and toughness, coupled with a Young’s modulus in the same order of magnitude of stainless steel alloy and is the origin of the interest in using ZrO2 as a filler(4). Zirconomer as per manufacturer’s claims are strong and safe replacements imbibing the strength of amalgam and the various advantages of glass ionomers. The structural integrity has been attributed to the inclusion of zirconia fillers in the glass component thereby imparting better strength(5). Zirconomer is a reliable and durable self-adhesive tooth coloured zirconia reinforced posterior bulk fill restorative material that comprises nano-sized zirconia fillers to enhance aesthetic properties and superior handling characteristics(6). The compressive strength of a material is an important factor to be considered in relation to masticatory forces. This property is the resistance exhibited by a restorative material against intraoral compressive and tensile forces which are produced both in function and para function. It is the amount of stress required to distort the material in an arbitrary amount(7). This study aimed to compare the compressive strength of zirconomer and glass ionomer cement after immersion in fizzy beverages.

MATERIALS AND METHODS

An in vitro study was carried out to find the compressive strength of glass ionomer cement and zirconomer post immersion in fizzy drinks. Samples were made from shofu brand glass ionomer cement and shofu brand zirconomer. Each sample was made of standard dimension, measuring 10mm x 2mm x 2mm was made using a template. Total of 10 samples were made, 5 were prepared from Zirconomer (Figure 1) and the other 5 were prepared from Glass ionomer cement (Figure 2). They were immersed respectively in fizzy beverages (pepsi and miranda) for 24 hours and distilled water was used as control. (Figure 3)

Then they were mounted in the Instron E 3000 universal testing machine to check for the compressive strength.(Figure 4) The compressive force was applied with a crosshead speed of 1.0 mm/min and the values were obtained for the samples in N/m. The collected data was then tabulated and imported to the software SPSS version 21.

Figure 1: Zirconomer samples

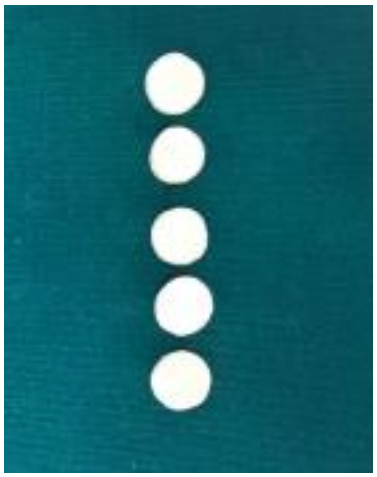

Figure 2: GIC samples

Figure 3: Samples are immersed in fizzy drinks(orange colour-miranda; brownish red colour-pepsi) and distilled water (transparent) which are contained in a glass beaker

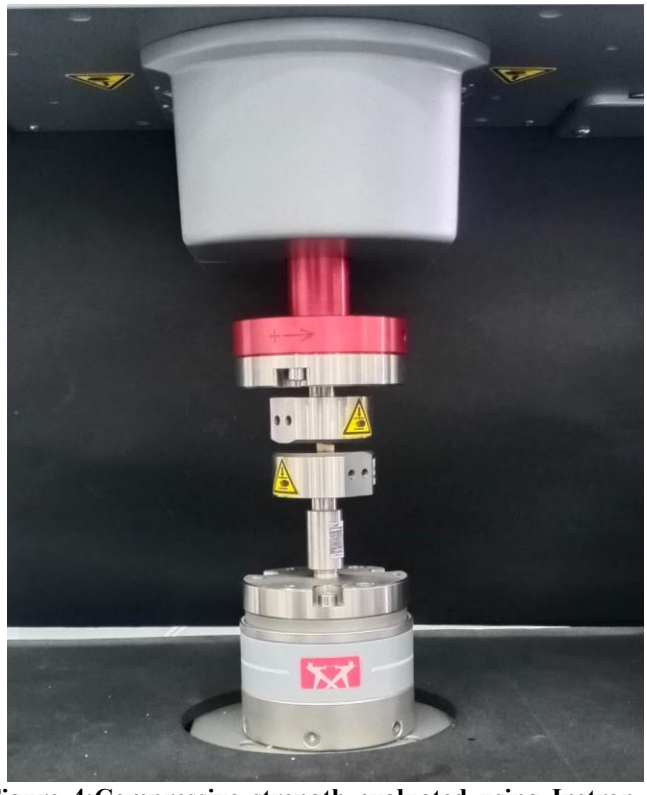

Figure 4:Compressive strength evaluated using Instron E 3000 universal testing machine

RESULTS

TABLE 1: Compressive strength value of each sample after immersion in fizzy beverages (miranda and pepsi) and distilled water (control) .

No.	Sample	Compressive strength (N)
1.	control - zirconomer	356.15
2.	control- GIC	188.23
3.	miranda zirconomer (1)	199.35
4.	miranda zirconomer (2)	49.55
5.	miranda GIC (1)	578.88
6.	miranda GIC (2)	708.78
7.	pepsi GIC (1)	169.21
8.	pepsi GIC (2)	203.15
9.	pepsi zirconomer(1)	983.65
10.	pepsi zirconomer (2)	549.51

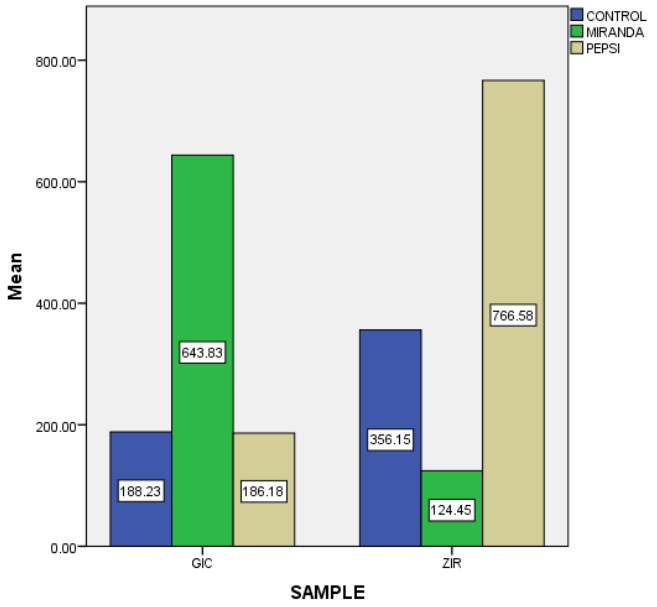

Figure 5: The bar graph depicts the compressive strength values of GIC and zirconomer after immersion in miranda, pepsi and distilled water. X axis denotes the samples and the y axis denotes the mean compressive strength values. Blue denotes control , green denotes miranda and brown denotes pepsi group. Compressive strength of the zirconomer was higher than the GIC. P value of the chi square test is 0.000 which is statistically significant.

The present study has compared the values of zirconomer and GIC samples in fizzy drinks like pepsi and miranda. The study compared the samples in miranda, pepsi and distilled water. 2 samples of zirconomer and 2 samples of GIC were immersed in each drink (miranda and pepsi) which are contained in glass beakers. 1 sample of zirconomer and 1 sample of GIC were immersed in distilled water. The samples immersed in distilled water are used as control. The mean value for the pepsi group and miranda group is found. The mean value of zirconomer was more in Pepsi group when compared to Miranda and control.The mean values of GIC was more in Miranda group when compared to pepsi and control group. On comparing all the 3 groups, zirconomer has more compressive strength than GIC. P value of the chi square test is 0.000 which is statistically significant. (Figure 5 and table 1) In the study the zirconomer immersed in distilled water has the compressive strength of 356.15 and compressive strength for the zirconomer immersed in Miranda group sample 1 was 199.35 and sample 2 was 49.55. Compressive strength for the zirconomer immersed in pepsi group sample 1 was 983.65 and sample 2 was 549.51. GIC immersed in distilled water had the compressive strength of 188.23 and the compressive strength GIC immersed in miranda group sample 1 was 578.88 and sample 2 was 708.78. Compressive strength of GIC immersed in pepsi group sample 1 was 169.21 and sample 2 was 203.15.

DISCUSSION

Compressive strength is considered to be a critical indicator of success in restorative dentistry because a high compressive strength is necessary to resist masticatory and parafunctional forces. On comparing the products, GIC has more compressive strength in Miranda than zirconomer and control and zirconomer has more compressive strength in pepsi than GIC and control. From the previous study, compressive Strength of Ketac Molar, Zirconomer, and Zirconomer Improved was compared. Highest compressive strength was exhibited by Zirconomer (321.92 MPa) followed by Zirconomer Improved (302.23 MPa) and Ketac Molar (261.53 MPa). The results analyzed were statistically significant with a p-value of <0.001. All the tested restorative materials exhibited sufficient compressive strengths with Zirconomer exhibiting significantly higher compressive strength(8).Our team has extensive knowledge and research experience that has translated into high quality publications (9–17)(18–21)(22–26)(27).

Compressive strength and diametral tensile strength of zirconomer, GIC and amalgam were compared in a study. They found that addition of zirconia to the GIC has improved its mechanical properties as amalgam. Hence, zirconomer can be used as posterior restorative material(28). Solubility and compressive strength of three different glass ionomer cements in artificial saliva was analysed in a study. They found that zirconomer had the highest compressive strength when compared to miracle mix and glass ionomer cement type IX-Extra. Thus, Zirconia-reinforced glass ionomer cement is a promising dental material and can be used as a restoration in stress-bearing areas due to its high strength and low solubility and sorption rate. It may be a substitute for silver-reinforced glass ionomer cement due to the added advantage of esthetics(29).

The compressive strength of conventional glass ionomer cement under the influence of dietary fluids was investigated in a study. They found that immersion in orange juices showed a reduction in the GIC compressive strength.(30) The limitations of the study will be the smaller sample size and only 2 types of beverages we have used. Furthermore studies will be conducted on using different types of beverages and knowing their influence on the mechanical properties of zirconomer and glass ionomer cement.

CONCLUSION

The comparative evaluation of the compressive strength of zirconomer and glass ionomer cement after immersion in fizzy beverages have shown that zirconomer has superior compressive strength than the glass ionomer cement. Hence, zirconomer can be used as a promising posterior tooth restorative material.

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Conflict of Interest:
Nil.

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