RESEARCH
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COMPARISON OF COLOUR STABILITY OF ZIRCONOMER AND GLASS IONOMER CEMENT BEFORE AND AFTER IMMERSION IN FIZZY DRINKS - AN IN VITRO STUDY.

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Abstract
INTRODUCTION: Glass ionomer cements have 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 (white amalgam), has been a recent substitute to glass ionomer cement in dentistry. Colour stability is the ability of a light source to maintain its color properties over time. The aim of the study was to compare the colour stability of zirconomer and glass ionomer cement before and after immersion in fizzy drinks.
MATERIALS AND METHODS: An in-vitro study was carried out to find the colour stability 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 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. The samples were analyzed using VITA easy shade spectrophotometer to determine the colour stability.
RESULTS: The mean delta E value of the zirconomer is the same in the pepsi group and in the control group. The mean delta E value of the zirconomer is high in the Miranda group when compared to its pepsi group. While the GIC has a higher mean delta E value than the zirconomer in both the fizzy drinks (Miranda and Pepsi). Thus, the colour stability of the GIC is lower than the zirconomer. The P value is 0.695 (>0.05), hence statistically insignificant.
CONCLUSION: Based on the findings and within the scope of the analysis, Zirconomer had higher colour stability than glass ionomer cement post immersion in the fizzy drinks after evaluating with a spectrophotometer.
KEYWORDS: Glass ionomer cement, Zirconomer, Colour stability, Fizzy drinks, Spectrophotometer

Running title: Comparison of colour stability of zirconomer and glass ionomer cement before and after immersion in fizzy drinks.

INTRODUCTION:

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(1). 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(2). The earliest attempts on creating reinforced cements focused on combining the glass powder with readily available materials such as silver alloy from dental amalgam. (3,4)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.(5)

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.(6) To this extent, it has been hypothesized that the addition of fibrous materials would reinforce this structure, Carbon nanotubes are available in the form of fibers and have been shown to greatly improve the structure and nature of gel matrices. The glass ionomers lack the esthetic effects of composites, they are often used as an esthetic restorative material, especially in primary teeth.(6,7) It has been shown that the use of additives reduces the color stability of glass ionomers.

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.(8) 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.(9) Zirconomer as per manufacturer’s claims are strong and safe replacements imbibing the strength of amalgam and the various advantages of glass ionomer.(10) The structural integrity has been attributed to the inclusion of zirconia fillers in the glass component thereby imparting better strength. 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.(11)

Colour stability is the ability of a light source to maintain its color properties over time. Color changes can occur due to various etiologic factors; extrinsic discoloration can occur due to staining in the superficial layer of resin composite, water absorption, surface roughness, smoking, and diet. In oral conditions, restorative materials are exposed to different fizzy drinks such as pepsi, miranda which might result in absorption and adsorption of colorants in those drinks into the restorative surface and consequently undesirable color change may happen. Therefore the aim of the study was to compare the colour stability of zirconomer and glass ionomer cement before and after immersion in fizzy drinks.

MATERIALS AND METHODS:

Sample preparation for the in vitro study:

An in-vitro study was carried out to find the colour stability of glass ionomer cement and zirconomer post immersion in fizzy drinks. The study was done at White lab - Material Research Centre, Saveetha Dental College, Chennai. 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).

Color stability analysis:

The samples were analyzed using VITA easy shade spectrophotometer to determine the colour stability. The data collected was used to determine colour stability

The magnitude of the color difference (ΔL*) perceived between two objects is thus calculated. The calculation of ΔL* (color difference before and after immersion) was done using the following formula: ΔE (L * a * b*) = ([ΔL*]2+ [Δa*]2+ [Δb*]2) 1/2

In which ΔL* is the difference between the L* values

Δa* is difference between the a* values

Δb* is difference between the b* values. Each specimen was assessed for color measurements, and the average was recorded. The difference between Glass ionomer cement and Zirconomer was determined by chi-square analysis which was analyzed in SPSS version 23.0

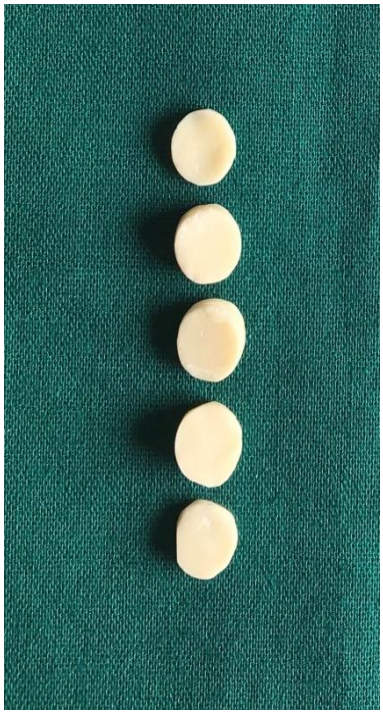

Figure 1: pre-immersion samples of zirconomer

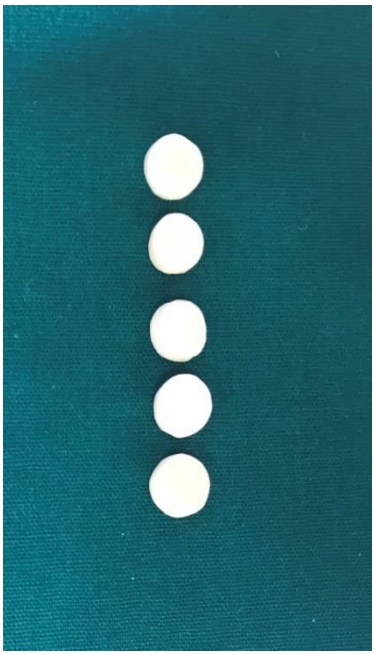

Figure 2: pre-immersion samples of GIC

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.

RESULTS:

In our study we have compared the pre and post immersion delta values of zirconomer and GIC samples in fizzy drinks like pepsi and miranda. We have 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 pre and post immersion L,a,b values are found and converted into delta E value. Then the mean value for the pepsi group and miranda group is found.

The Zirconomer samples are indicated as Z1, Z2, Z3, Z4 and Z5. The Z1 and Z2 are the samples which were immersed in Miranda for 24 hours. The Z3 and Z4 are the samples which were immersed in pepsi. Z5 is a control sample. Z5 was immersed in distilled water. The delta E values of the zirconomer samples were tabulated. (Table 1) The GIC samples are indicated as G1,G2,G3,G4 and G5. The G1 and G2 are the samples which were immersed in Miranda for 24 hours. The G3 and G4 are the samples which were immersed in pepsi. G5 is a control sample. G5 was immersed in distilled water. The delta E values of the GIC samples were tabulated.(Table 2) The mean Delta E value of GIC was more in pepsi group when compared to miranda and control. The mean Delta values of Zirconomer was more in Miranda group when compared to pepsi and control group. On comparing all the 3 groups, Zirconomer has lower mean delta value when compared to GIC. Hence, zirconomer has got more colour stability when compared to GIC. The P value of association is 0.695 (>0.05). Hence, it is not statistically significant.(Figure 4).

TABLE 1: This table represents the delta E value of the zirconomer samples.

Samples	delta E value
Z1	17.492.
Z2	17.8746
Z3	17.9204.
Z4	14.1071
Z5	16.3061

TABLE 2: This table represents the delta E value of the GIC samples

Samples	Delta E value
G1	16.2564.
G2	21.934
G3	20.8552.
G4	25.8523
G5	19.1891.

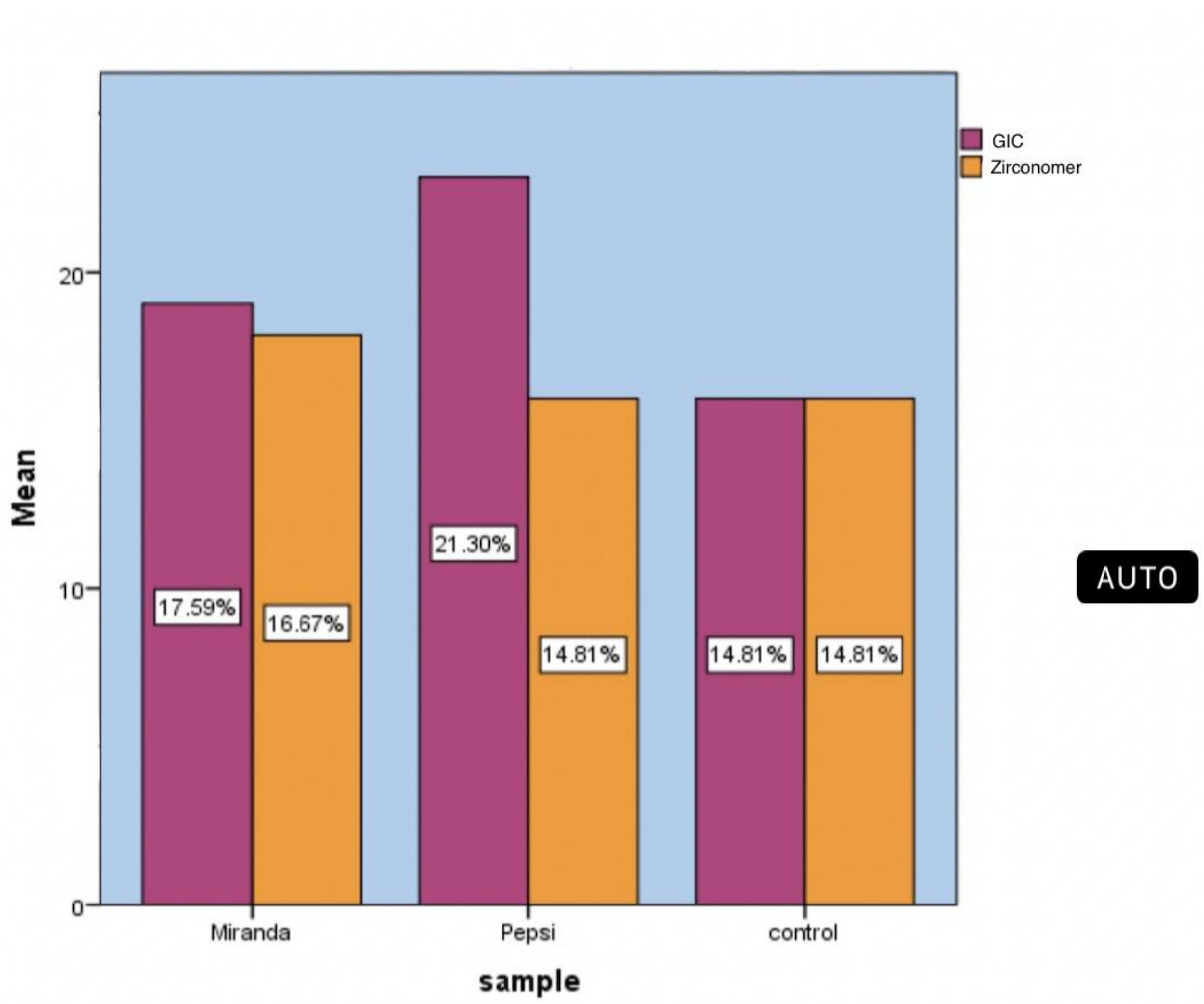

Figure 4: This bar graph indicates the association between the samples prepared and the mean delta E value. The mean delta E value of the zirconomer is the same in the pepsi group and in the control group. The mean delta E value of the zirconomer is high in Miranda group when compared to its pepsi group. While the GIC has a higher mean delta E value than the zirconomer in both the fizzy drinks (miranda and Pepsi). Thus, the colour stability of the GIC is lower than the zirconomer. The P value is 0.695 (>0.05). Hence, it is not statistically significant.

DISCUSSION:

Color stability of dental restorative materials is a crucial property. In a previous study done by Pani SC et al , the colour stability of the GIC after reinforcement with 2 different nanoparticles was compared. The results of that study indicated that carbon nanotube reinforced specimens exhibited less color stability when compared to controlled glass ionomer cement specimens; however, both samples had significantly greater color stability than silver nanoparticle reinforced glass ionomer samples.(13) In a previous study done by Kale YJ, et al, the effect of different pediatric drug formulations on color stability of composite, zirconia-reinforced glass ionomer cement, and glass ionomer cement were compared. The results obtained in that study revealed that Δ E* (color difference) elevation was significantly low with GIC ($P < 0.001$) and high with composite for all five groups. Amoxicillin along with clavulanic acid and metronidazole group showed highest color sustainability among all groups.(14)

In a previous study done by Prabhakar AR and Pattanshetti K, the color and fluoride ion release of conventional and resin-modified GICs in combination with 1.25 and 2.5% chlorhexidine diacetate were evaluated and calculated. Resin-modified GIC groups showed less color stability and better fluoride release at the end of the study compared to conventional GIC groups.There was no significant change in color and fluoride release between 1.25 and 2.5% conventional GIC and also between 1.25 and 2.5% resin-modified.(15) This is similar to the results of the present study where GIC was less color stable. The clinical performance of zirconia (ZrO_2) infused glass ionomer cement (GIC) was compared to conventional GIC in another study where the results showed that ZrO2infused GIC has better color stability than the conventional GIC, but Conventional GIC was much better in surface texture and marginal adaptation.(16)

In the present study, the specimens were immersed in fizzy drinks, and then their colour stability was tested. Also, intentionally, no protective coating was applied to the specimens. Colour stability studies are very colour sensitive and any irregularities (cracks, porosities) in the specimens could result in different results. Therefore, even though the data in this study may not correspond to values published in the scientific literature, it is still useful for providing new information about the colour stability of Glass ionomer cement and Zirconomer. Limitation of the present study is that the smaller sample size and the specimens were not subjected to thermocycling, which is done to simulate clinical conditions. Future studies can be conducted to examine the effects of drugs on the color stability of zirconomer material.

CONCLUSION:

Based on the findings and within the scope of the analysis, Zirconomer had higher colour stability than glass ionomer cement in post immersion in the fizzy drinks after evaluating with a spectrophotometer. As a result, Zirconomer may be seen as an alternative to standard Glass ionomer cement for clinical use in dentistry, but further long term clinical trials are needed to prove its effectiveness in a clinical environment.

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