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COMPARISON OF COLOUR STABILITY OF ZIRCONOMER AND GLASS IONOMER CEMENT BEFORE AND AFTER IMMERSION IN FRUIT JUICES - AN IN VITRO STUDY

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ABSTRACT

INTRODUCTION: Glass ionomer cement is the most commonly used dental restorative material. Recently, Zirconia reinforced restorative material, a safe alternative to glass ionomer cement was developed. Color sustainability of restorative materials is imperative for the success of the treatment. Many studies have evaluated the effects of cola on the color stability of restorative materials; however, the effects of lemon and grape juice have not been reported. The aim of the present study was to analysecolour stability of zirconomer and GIC before and after immersion in fruit juices such as grape and lemon juice

MATERIALS AND METHODS: Each sample was made of standard dimension, measuring diameter 10mm and thickness 2mm was made using a template. 10 samples were made, 5 were prepared from Glass ionomer cement (Shofu brand d) and the other 5 were prepared from Zirconomer (Shofu brand). Samples were immersed in fruit juices such as lemon and grape juices for 24 hrs. Distilled water was used as a control group. Colour stability (delta E) values were obtained using VITA easy shade spectrophotometer and analysed statistically using SPSS software version 23.0.

RESULT: The colour stability difference between GIC and Zirconomer was tabulated. Delta E value was less for Zirconomer when compared with GIC post immersion in fruit juices. Chi-Square Test results showed p-value = 0.928, which was statistically not significant.

CONCLUSION: Based on the results of the present study, it can be concluded that Zirconomer seems most resistant to discoloration compared to GIC. Zirconomershowed better performance in terms of color stability compared to GIC after immersion in fruit juices like grape and lemon juices.

KEYWORDS: Glass ionomer cement, Zirconomer, Colourstability, Fruit juices

INTRODUCTION:

Esthetic appearance is considered as a prime factor for social acceptance as well as professional success (1).In dentistry, a number of esthetic restorative materials such as composite resins, glass ionomers, compomers, and zirconia- reinforced glass ionomer cements (GICs) are used with comparable results. These materials are used for restoring decayed posterior zones and esthetic zones of anterior teeth, helping improve disfigure teeth. However, longevity and acceptability of such restorations are directly proportional to the color stability of the restorative materials used. Glass-ionomer cement (GIC) are often viewed as basic filling materials; they are long established, economical, and straightforward to use. They are usually applied in bulk without an adhesive, are self-curing, and don't require complicated dental equipment (2).

Recently, a tooth-colored, basic filling material for direct restorations, Zirconomer has gained importance in restorative dentistry. it's self-curing with optional additional light-curing. The Zirconomer thus redefines the essential filling, combining bulk placement, ion release, and sturdiness during a dual-curing, esthetic product satisfying the stress of both dentists and patients. Zirconomer has been suggested to possess strength like amalgam (3)(4).

Glass ionomer cement additionally recognized as condensable or packable and excessive viscous glass ionomer cement, possesses greater strength, higher put on resistance, and flexural energy as in contrast to traditional glass ionomer cement(5). Another hindrance of GIC consists of excessive microleakage in sandwich restorations; the phosphoric acid etching of GIC prior to the placement of composite resin does not enhance the sealing capability of sandwich restorations(6)(7). Recently, a novel biomaterial referred to as zirconia-reinforced GIC used to be created to tackle the dangers of traditionally used tooth-color restorative substances whilst incorporating and maintaining the advantages of each amalgam and ordinary Glass ionomer cement. To overcome the drawbacks of GIC, a restorative material strengthened with ceramic and zirconia fillers (zirconia-reinforced GIC) has been lately utilized in dentistry(8).

On the other hand, various extrinsic and intrinsic stains cause discoloration of restorations rendering high failure rate. Extrinsic discolorations can be attributed to insufficient polymerization, frequent consumption of food and beverages as well as drug formulations containing coloring agents/additives(9). Staining of oral tissues and restorations is known to be affected by dietary factors. Consumption of soft drinks is known to have increased in recent years, and is especially high among younger individuals (10). Other drinks frequently consumed include fruit juices like lemon, grape juice which may include aromatic substances and flavorings added to encourage consumption. Spectrophotometry and colorimetry have both been used to measure color change in dental materials(11). Many studies have evaluated the effects of cola on the color stability of restorative materials; however, the effects of lemon and grape juice have not been reported. Therefore, the aim of the present study was to evaluate the color stability of zirconomer and GIC before and after exposure to various fruit juices such as lemon and grape juice

MATERIALS AND METHODS

The study was conducted at White lab-Material Research Centre, Saveetha Dental College, Chennai. Each sample was made of standard dimension, measuring diameter 10mm and thickness 2mm was made using a template.10 samples were made, 5 were prepared from Glass ionomer cement (Shofu brand d) and the other 5 were prepared from Zirconomer (Shofu brand). For immersion we used acidic (lemon juice) and non acidic (grape juice). Distilled water was used as control. Required quantities of grape juice, lemon juice and distilled water were weighed and taken in a beaker. The zirconomer, GIC and control samples were immersed respectively for 24 hours (figure 1). We observed colour stability of the samples before and after immersion in the respective medium. The colour stability was checked using a vita easy shade spectrophotometer and the L,a,b values were obtained. Then, we calculated Delta E values for the comparison between pre-immersion and post-immersion in fruit juices.

Color assessment:

Color evaluation was performed with color parameters. Before the measurements, the spectrophotometer was calibrated with its own special calibration tool and positioned in the center of each specimen. The color of specimens was assessed according to the Commission International deL'Eclairage L*a*b* (CIELAB) color space using digital image analysis method. The CIELAB system is a chromatic value color space that measures chroma and value in three coordinates:

•L* represents brightness or lightness (value)

•a * and b * serve as numeric correlates both for hue and chroma

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

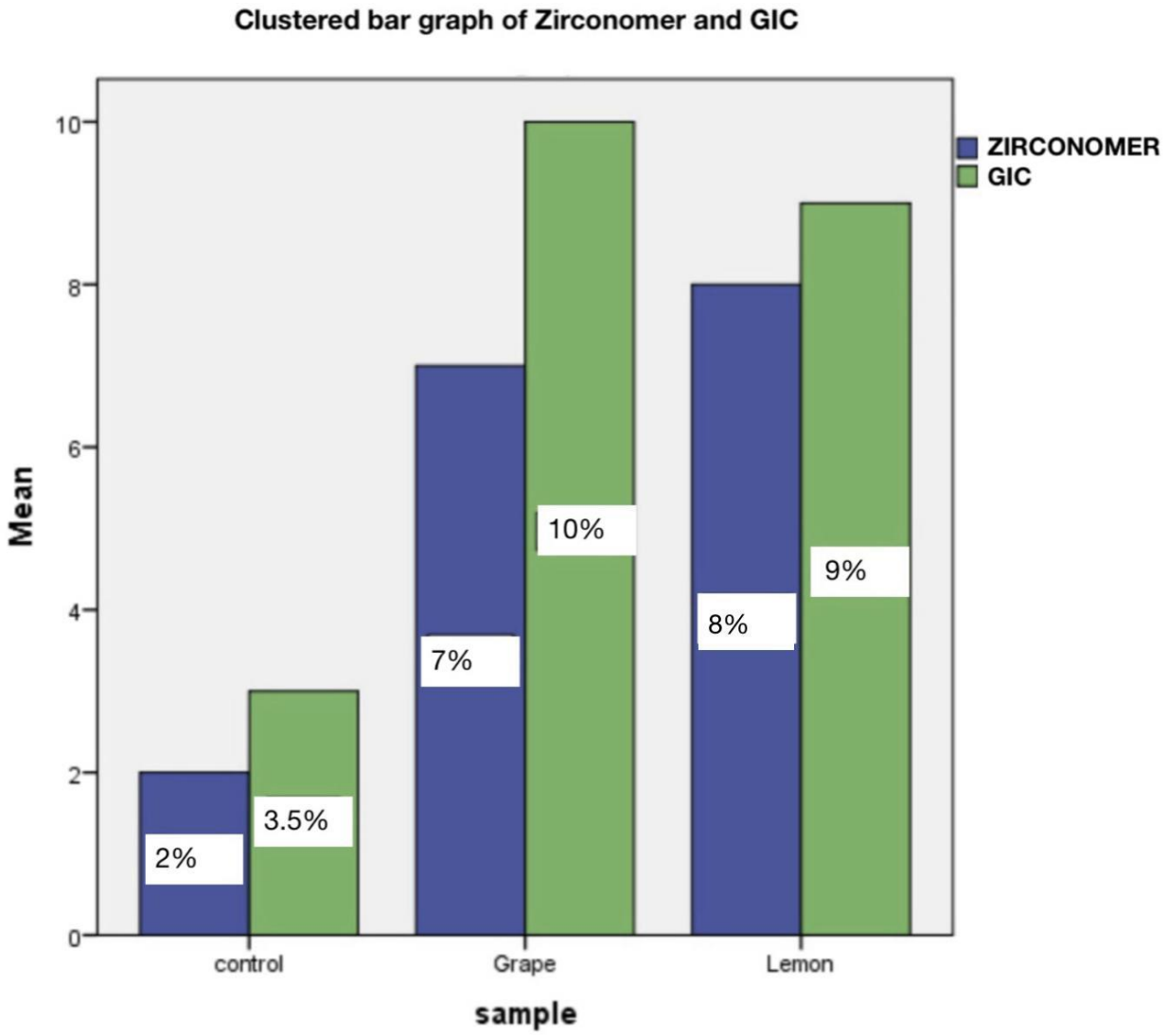
Figure 1: This image depicts the immersion of GIC and Zirconomer in fruit juices (lemon and grape) and in distilled water

RESULTS:

The use of the CIELAB for the evaluation of tooth-colored restorative materials is considered a universally accepted technique. The results after 24 hours showed significant differences between the three groups.

The use of the L*a*b color axes for the measurement of color change is universally accepted as a better method than using more subjective shade guides. From the above figures, it can be seen that GIC samples immersed in fruit juices were more stained than Zirconomer samples. The descending order in which Zirconomer was stained in immersing solutions is as follows: lemon>grape>control. In the grape juice solution, the ΔE value of Zirconomer was 7 and the ΔE value of GIC was 10, In the lemon juice solution ΔE value of zirconomer was 8 and the ΔE value of GIC was 9, In the control group, the ΔE value in zirconomer was 2 and the ΔE value of GIC was 3.5 (Table 1). The ΔE value of the GIC in the test solution was higher than Zirconomer.

A bar graph was plotted against the sample and mean ΔE values. It was found that GIC has more mean ΔE values than Zirconomer which indicates GIC is less color stable than Zirconomer (Graph 1). A paired sample t-test was done to find out the p-value. p= 0.928 >0.05 which is statistically not significant (Table 2).



Graph 1: The graph depicts the association between samples and mean delta E value, where blue color denotes 'Mean ΔE value of Zirconomer, green denotes ''Mean ΔE value of GIC'. The x-axis represents the samples and the y-axis represents the Mean ΔE value. On comparing the above three, Mean ΔE values of GIC were higher than Zirconomer, which indicates colour stability was found to be more in Zirconomer than GIC after immersion in fruit juices. A paired

sample t-test was done to find the p values and was found to be statistically not significant (p= 0.928).

Table1: The delta e values of colour stability of glass ionomer cement and Zirconomer

SPECIMEN LABEL	DELTA E
GRAPE -ZIRCONOMER	7
LEMON -ZIRCONOMER	8
CONTROL-ZIRCONOMER	2
CONTROL-GIC	3.5
GRAPE -GIC	10
LEMON -GIC	9

Table 2: The table represents the p-value obtained by paired sample test. p= 0.928 (> 0.05), which is statistically not significant.

	Zirconomer group
P-value	**0.928**

DISCUSSION:

Dental restorations are constantly exposed to multiple oral environmental challenges such as variations in temperature and pH. This results in a series of extrinsic and intrinsic changes at surface or within the body of the material that alter their physical, mechanical, chemical as

well as esthetic properties (12). One of which is color stability influencing the longevity and durability of the restorations. Discoloration due to intrinsic and extrinsic factors includes adsorption of coloring agents on the surface and absorption within the subsurface layer making it prone for replacement, consuming money and time of patients as well as dental practitioners (13–15). The color stability of restorative material is accredited to multiple factors including type of matrix of restorative material, particle size, filler content and type, polymerization depth, mode of polymerization as well as contact with coloring agents. It is also directly related to the hydrophilic property of the material(16,17). On the other hand, Bagheri et al. in 2005 stated that higher water content of conventional GIC allows lesser water absorption making it less susceptible to color changes(12).

In this present study, we aimed to evaluate the effect of 2 different fruit juices formulations i.e., acidic and non-acidic on the color stability of zirconomer and GIC. For this study, the CIE L*a*b*. The system was chosen to measure differences because of its ability to detect small differences in color. Extensive search of literature has revealed that very few studies have been conducted on color stability of GIC and zirconomer. To avoid subjective bias associated with color sensitivity in human investigators, we used a spectrophotometer, which has several other advantages such as repeatability, sensitivity, and objectivity.

Chan et al., investigated the staining potential of orange, grape, lemon on two different resin composites and reported that staining after 1 week of immersion differed significantly from all succeeding weeks, and the greatest amount of discoloration occurred during the first week, which is in agreement to the results obtained in the present study(18). In the present study, the duration of immersion of acidic juices like grape juice shows an increase in colour stability of zirconomer when compared with GIC, because of less deltaE value in zirconomer groups. Zirconomer was found to be more resistant to staining than GIC. This clearly demonstrates that Zirconomer is more resistant to fruit juices than GIC because the average colour stability value is lower for zirconomer than it is for GIC after being immersed in fruit juices. This finding was in agreement with the study done by Tüzüner et al. in 2017 which reported that the composite exhibits significant discoloration values when exposed to commonly used fruit juices (19). Probable reason behind discoloration of composite resin can be water absorption induced. As a result, it can be stated that GIC with a high amount of resin matrix, low concentration, and larger size filler particles have more tendency toward discoloration and zirconomer was found to

be more resistant to color changes. Prabhakar et al. in 2015, reported that conventional GIC was much better as compared to ZrO2 infused GIC in terms of better color stability, color match, surface texture, and marginal adaptation(20). Our team has extensive knowledge and research experience that has translated into high quality publications(21–30),(31–34),(35–39),(40). At present, very limited literature is available related to color stability of zirconomer restorative material. Zirconia-reinforced GIC was introduced to enhance the mechanical properties of conventional GIC as well as to overcome drawbacks of previously used tooth-colored esthetic restorative materials. Though the color stability of zirconomer in a variety of immersing solutions has won interest amongst the researchers, the staining impact on the use of fruit juices has not been pronounced much. Hence, the current study has shown the impact of color stability of zirconomer when immersed in fruit juices like grape and lemon juices. Limitations of the present study include less sample size and we could have immersed for a longer time period with multiple fruit juices. Further research has to be done by comparing the colour stability of zirconomer with other restorative materials such as composite resin material.

CONCLUSION:

Color sustainability of restorative materials is imperative for the success of the treatment. The selection of the appropriate restorative material is important which should meet adequate inherent characteristics such as dimensional stability and color stability. Based on the results of the present study, it can be concluded that Zirconomer seems most resistant to discoloration compared to GIC. Zirconomer showed better performance in terms of color stability compared to GIC after immersion in fruit juices like grape and lemon juices.

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CONFLICT OF INTEREST:

The authors declare that there was no conflict of interest

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