ORIGINAL RESEARCH PAPER

Dental Science

DOES ZIRCONIA IN GIC PREVENT THE FAILURE OF A RESTORATION?

KEY WORDS: Glass ionomer, Zirconia, Marginal leakage

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ABSTRACT

Aim: - To compare and evaluate the marginal leakage of zirconia infused glass ionomer cement with conventional glass ionomer cement. **Methods: -** 12 non-carious therapeutically extracted premolars were selected and randomly divided into 2 groups (Group I– Conventional GIC and Group II – Zirconomer)of 6 each and class V cavities of standard dimensions were prepared buccally and lingually on each tooth which were then restored with test materials..The whole surface of the teeth was coated with nail varnish except 1mm around the restoration and was allowed to dry. Later these samples were immersed in Rhodamine B (0.5%) solution and left for 24 hours. Coronal portions of the teeth were then sectioned buccolingually and 22 samples were examined under stereo microscope to assess the marginal leakage. Scoring was done according to Michal Staninec and Mark Holts scoring system. **Results: -** The results showed a 'p' value of 0.029 which is statistically significant ($p<0.05$) where in the Group II samples showed lesser marginal leakage than group I samples. **Conclusion: -** Marginal leakage was reduced with respect to Zirconia infused GIC compared to conventional GIC.

INTRODUCTION:

The pivotal role of a restorative material is to substitute the properties of enamel and dentin in a healthy tooth with respect to their biology, function and esthetic appearance (1). Of the many essential elements for the success of a restoration, the critical one remains to be its ability to prevent the marginal leakage as it is a major contributing factor for secondary caries and pulpal irritation and ultimately failure of the restoration (2,3).This is achieved by proper adherence of the restorative material to the cavity walls (2).The lack of a restoration to accomplish a complete marginal seal with the tooth leads to microfissures, seepage of ions, fluids, bacteria and thus hypersensitivity of restored teeth, tooth discoloration, recurrent caries, pulpal injury and accelerated deterioration of the restoration (2,4).

It is these detrimental effects of marginal leakage that push us to come up with a better dental restorative. This endless yearning for newer materials and techniques along with changing professional perceptions as well as the patient's demands has led to the introduction of various restorative materials from time to time (5).

One such material is Zirconomer (Shofu.Inc) which is a Zirconia infused GIC and is commercially advertised as "WHITE AMALGAM". Zirconia has found its way in dentistry with the fabrication of Zirconia crowns and bridges which can also be veneered with feldspathic porcelain for aesthetic reasons. Zirconia which was introduced by Martin Klaproth in 1789 is alluring due to its good mechanical properties, aesthetics and low plaque accumulation. This material is a non-cytotoxic white crystalline metal oxide of Zirconium which is insoluble in water and has no potential for bacterial adhesion. In addition, it has radiopaque properties and exhibits low corrosion (6,7).

These scientifically proven positive attributes of Zirconia poked our curiosity if Zirconia in GIC can prevent marginal leakage and so, it led to the projection of the present in vitro study wherein we compared the marginal leakage of Zirconia infused GIC with Conventional GIC.

MATERIALS AND METHODS:

The ethical clearance for this study was obtained from the Institutional Review Board of Bapuji Dental College and Hospital. This was an experimental, in vitro inter-group study between two materials including –

- **Group I (Control):** Conventional Type II Glass ionomer cement (Shofu.Inc..Kyoto, JAPAN).
- **Group II (Experimental):** Zirconia-reinforced glass ionomer (ZIRCONOMER Shofu.Inc.Kyoto, JAPAN)

Evaluation Of Marginal Leakage:

a) Sample preparation: 12 non-carious therapeutically extracted premolars were cleaned off their debris with an ultra-sonic scaler and stored in 0.1% Thymol solution until the experiment. Standardized class V cavities of dimensions 3 x 2 x 1.5 mm were prepared on buccal and lingual surfaces of each tooth using a no. 9 straight fissure bur (8).

The test materials were then manipulated according to manufacturer's instructions and placed into the cavities in such a way that the buccal surface was restored with the control group and lingual surface with the test group. Immediately, after the restoration of the cavity, a mylar strip was placed over the restoration to ensure a smooth surface All the teeth were subjected to thermocycling regimen of 500 cycles between 5C and 55C with a dwell time of 1 min and 3 sec transfer time between the baths to simulate oral conditions (8).

The teeth were dried after thermocycling and the whole surface of each tooth was coated with an acid resistant nail varnish except for 1 mm around the restoration and was allowed to dry. During the placement of the nail varnish, moist cotton was placed over the restoration to prevent dehydration of the cement (8).

These specimens were then immersed in 0.5 % Rhodamine B dye solution at 37C under vacuum. The apical foramens of all the specimens were sealed with modelling wax to prevent dye penetration through the apices (8).

After removal of the specimens from the dye solution, the coronal portion of the tooth was sectioned buccolingually through the centre of the restoration. 24 samples were obtained from sectioning which were examined under stereo microscope to assess the marginal leakage (Figure I & II) (9).

B) Evaluation Procedure: The scoring was done according to Michal Staninec and Mark Holts scoring system (Table I) (10).

RESULTS:

The results were subjected to Mann Whitney U test for inter group comparison of Marginal leakage. Group I had one sample with score 1, one sample with score 2 and twenty-two samples with score 3 whereas Group II had four samples with score 0, three samples with score 2, one sample with score 1 and sixteen samples with score 3.

The average mean of Group I samples was 2.875 with the median value being 3 and Group II samples had an average mean of 2.29 with a median value of 3 (Table II). The results obtained showed a 'p' value of 0.029 which is statistically significant ($p<0.05$, Figure III).

DISCUSSION:

The Glass ionomer cement has been a time-honoured restorative material which has been tried and tested with various modifications. And now that we have reached an era of aestheticism, the strongest dental material with best aesthetics i.e. Zirconia was also not spared from being added to the trail of modifications of GIC. Although the ultimate evidence of clinical performance of any restoration is provided by clinical trials, a preparatory groundwork on the properties and assurance of the material in vitro is mandatory (11). And hence they have conducted few studies on this alteration of adding Zirconia to GIC. But, they did not cover all the facets of GIC. Evidence of marginal leakage of Zirconia infused GIC being compared to modified glass ionomer cements like Resin modified glass ionomer cement, composite, Ketac molar, Giomer, Ceram-X by various authors showed diversified results and there is no significant evidence with conventional GIC which pretty much justifies the intention behind this study (12,13).

Poor marginal seal is a major drawback for the longevity of the restoration. Control of marginal leakage due to dimensional changes and lack of adaptation of the material to the cavity walls is a major goal in restorative dentistry. These gaps lead to recurrent or secondary caries and pulpal pathosis (9). Gupta et al studied marginal leakage in various glass ionomers and they concluded that none of the GICs were free from microleakage (8).

There are various methods to evaluate marginal leakage but, the dye leakage method is simple, inexpensive and fast and does not require the use of any complex laboratory equipment. Several dye penetration studies have been performed using methylene blue, India ink, basic fuschin, crystal violet, as well as fluorescin (14). Rhodamine-B dye was used in this study since its molecular size is as low as 1 nm which is smaller than the diameter of a dentinal tubule and can thus penetrate through even the smallest of gaps between the restoration tooth interfaces (15,16). It is an organic dye compounded by a red-violet powder, classified as a xanthene dye, and presents greater diffusion on human dentin than methylene blue (15). In the present study, thermocycling was also done prior to immersion of samples in the dye, because it is a widely used method in dental research to simulate temperature changes that take place in the oral environment (17).

According to the observations of the current study, conventional glass ionomer samples had a significant increased marginal leakage values compared to the Zirconia reinforced glass ionomer samples. The reason for these characteristic findings is unknown.

CONCLUSION:

Within the limitations of this study, marginal leakage was found to be less with respect to Zirconia infused GIC restoration than Conventional GIC. But, the scope for Zirconia infused GIC is still open to rule out any probabilities and limitations in this study. Further research is needed with a larger sample size for more accurate results to make an opinion on the characteristic features of Zirconia infused GIC.

Figures

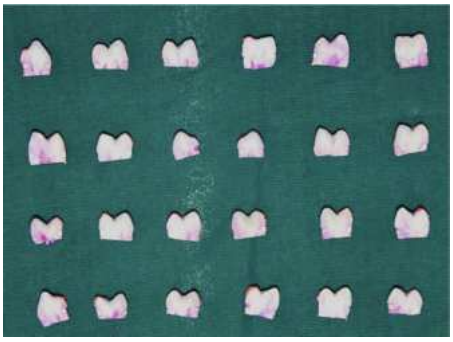

Fig 1: Buccolingual hemisectioned samples

Fig 2: Marginal Leakage in GIC restoration on the right side and Zirconia infused GIC on the left side

Fig 3: Graph Representing the mean marginal leakage scores between Group I and Group II

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