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Comparative Evaluation of Microleakage of Type IX GIC, Chlorhexidine Incorporated GIC and Triclosan Incorporated GIC: An in Vitro Study

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ABSTRACT

Aims: To evaluate & compare the microleakage of type IX GIC, Chlorhexidine Incorporated GIC and Triclosan Incorporated GIC.

Method and Materials: Forty-five extracted molars were taken for the study. The samples were divided into three groups with equal number of teeth in each group. Class V cavities were prepared on the buccal surfaces of each tooth. Group I was restored with type IX GIC, Group II with Chlorhexidine Incorporated GIC and Group III with Triclosan Incorporated GIC. After finishing and polishing the samples were thermocycled to simulate the oral conditions and immersed in dye for twenty-four hours. The microleakage evaluation was done for all the samples. Data obtained was statistically evaluated.

Statistical analysis: Data was statistically analyzed using kruskal-wallis non-parametric analysis and mann-whitney U test.

Result: There was statistically significant difference between Triclosan incorporated GIC and Chlorhexidine incorporated GIC but there was non-significant difference between Type IX GIC and Triclosan incorporated GIC.

Conclusion: The microleakage of 0.5% Triclosan incorporated GIC are comparable to that of Type IX GIC, discernibly signifying that it can be considered as viable options for use in pediatric dentistry.

Keywords: Microleakage, Type IX GIC, Triclosan incorporated GIC, Chlorhexidine incorporated GIC.

INTRODUCTION

Dental caries is defined as a progressive, irreversible, microbial disease affecting the hard parts of the tooth exposed to the oral environment, resulting in demineralization of the inorganic constituents and dissolution of the organic constituents thereby leading to cavity formation[1]. Once caries occurs, restoring the carious lesion becomes mandatory. The most widely used material for restoring the deciduous teeth in GIC. Conventional GICs were introduced to the dental professional in 1970s by Wilson and Kent and have shown to be a very useful adjunct to restorative dentistry due to their unique ability to release fluoride, which is mainly responsible for their cariostatic action. Moreover, glass ionomer cement bonds chemically to enamel and dentin, thereby reducing the need for a retentive cavity preparation thus, preserving the sound tooth structure too

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following the principle of conservative for prevention[2]. Because of these properties, Glass ionomer cement is the material of choice in Atraumatic restorative treatment (ART) also. As ART is practiced using hand instruments only, there is a possibility of insufficient caries removal, therefore such kind of cavities require a restorative material with good antibacterial efficacy[2]. Thus therapeutic benefits may be gained by reinforcing glass ionomer cements with additional antibacterial agents. Such agents should not affect the physic-mechanical properties of Glass ionomer cement as then only they would add to the benefits of glass ionomer cement as a restorative material.

In 1970, it was reported that a safe antimicrobial agent called chlorhexidine, which had been widely used in medical field & it could effectively reduce plaque formation.- Different salts of chlorhexidine have been evaluated for their antimicrobial efficacy, which is present irrespective of the salt added to the dental restorative material[3]. Among the antiseptics Triclosan has proven to be safe and effective antimicrobial agent. It is a broad spectrum antimicrobial agent which has been extensively used in the mouth washes and dentifrices[4]. At specific concentrations, Triclosan appears bacteriostatic and is seen to target bacteria mainly by inhibiting fatty acid synthesis. It has proved to provide effective antimicrobial action when added to glass ionomer cement[5].

Efficient adhesion between cavity walls and restorative material is desired, producing well sealed and long durable restorations. The inability of the restorative material to adapt or adhere tightly to dental hard tissues is what creates the gaps allowing microleakage to occur. Therefore for longevity of a restoration, it is utmost necessary that the restorative material should have adequate strength and minimal microleakage[6].

An antibacterial when added to GIC is considered a successful alternative if it does not affect the physical properties of the cement. Since there are not many studies to assess microleakage of antibacterial agents supplemented to GIC. This study was planned to comparatively evaluate microleakage of Triclosan incorporated glass ionomer cement and Chlorhexidine incorporated glass ionomer cement with the Type IX glass ionomer cement.

MATERIALS AND METHODS

The material used for the study included GIC Type IX and 0.5% Triclosan incorporated GIC and 0.5% Chlorhexidine incorporated GIC

Sample selection: A total of forty-five permanent human extracted molars were collected for the study after ethical approval. Debris was removed, teeth were cleaned using ultrasonic scaler, autoclaved and stored in distilled water at room temperature until used for the experiment.

PREPARATION OF RESTORATIVE MATERIALS

Preparation of 0.5% Triclosan incorporated GIC 0.045 gm of Triclosan powder was added to 2.925 gm of glass ionomer powder to obtain 0.5% formulation of Triclosan incorporated GIC.

Preparation of 0.5% Chlorohexidine incorporated GIC 0.015 gm of Chlorhexidine powder was added to 2.925 gm of glass ionomer powder to obtain 0.5% formulation of Chlorhexidine incorporated GIC.

Sample preparation: Class V cavities (4 mm wide ×2 mm high ×1.5 mm deep) were prepared on the buccal surfaces of teeth, with no retentive features incorporated in the cavity design, using burs with high-speed air rotor handpiece with water coolant. New burs were used after every five preparations. All cavosurface angles were kept at right angles with no bevels. Dimensions were standardized using vernier caliper. The prepared cavity was rinsed thoroughly with air/water spray and dried.

Division of samples: Samples were divided into three groups of fifteen samples each according to the restorative materials used. Then the samples of Group I- (Red) Type IX GIC, Group II- (Blue) Chlorhexidine incorporated GIC and Group III- (Green) Triclosan incorporated GIC.

METHODOLOGY

After the preparation of class V cavities the samples of Group I, Group II and Group III were restored with type IX GIC, Chlorhexidine-modified

GIC and Triclosan-modified GIC respectively. The storage medium for the entire study was distilled water. The prepared samples were subjected to thermocycling in waterbaths for 250 times between 5 and 55 degrees with a dwell time of 15 seconds in each bath and a transfer time of 10 seconds to simulate the oral conditions. After thermocycling the apices of teeth were sealed with sticky wax.

For microleakage evaluation

All tooth surfaces were triple coated with finger nail varnish, with the exception of a 0.5-1.0 mm window around the sealant margins. The teeth were immersed in 10% methylene blue for 24 hours, after which they were rinsed with water and air dried. All the samples were longitudinally sectioned in a bucco-lingual direction using a diamond disc at slow speed in a micromotor straight hand piece. The microleakage was assessed by viewing all the treatment groups under stereomicroscope at a magnification of 40X. The scoring criteria for the microleakage assessment were followed according to Wilder et al (2000)[7].(Figure 1)

The extent of microleakage was noted according to the following criteria:

Score 0: no dye penetration

Score 1: up-to 1/3rd cavity depth

Score 2: 1/3rd to 2/3rd cavity depth

Score 3: >2/3rd cavity depth

Score 4: involving the axial wall

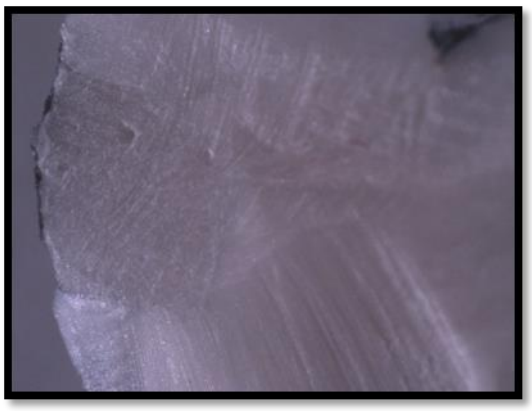


Fig 1: Score 0.

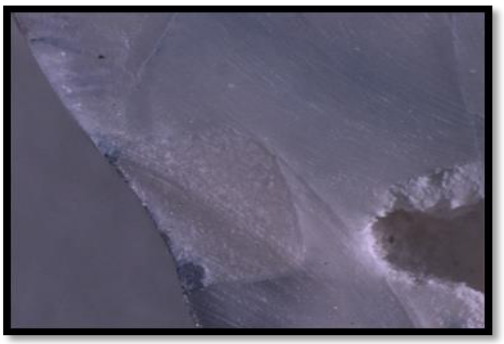


Fig 2: Score 1.

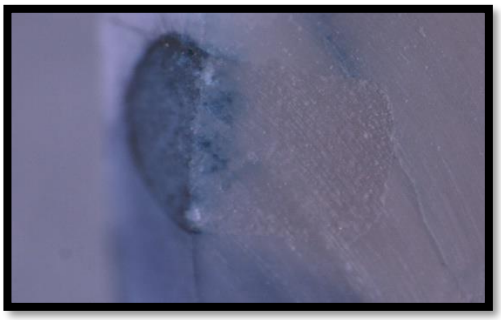


Fig 3: Score 2.

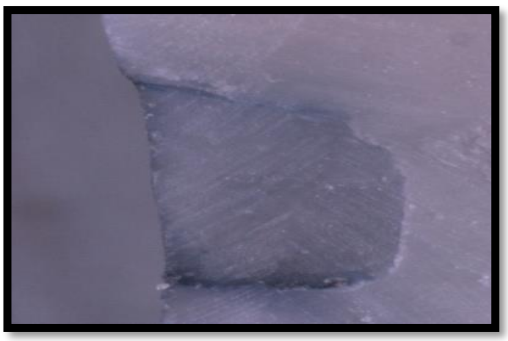


Fig 4: Score 3.

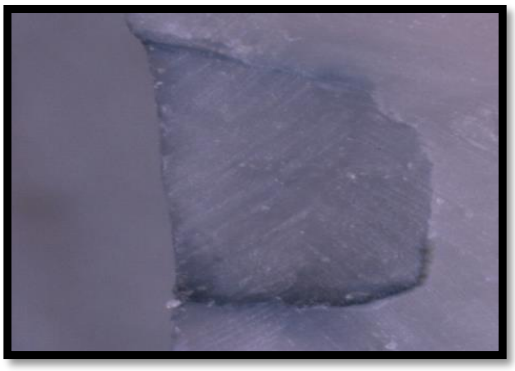


Fig 5: Score 4.

Table 1: Mean rank scores between Group I, Group II and Group III.

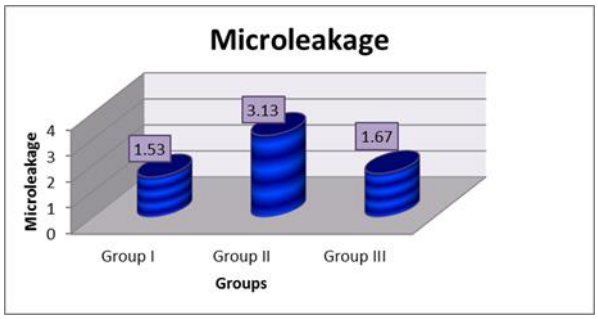
Groups*	N	Mean	Std. Deviation	Median	Std. Error of Mean
I	15	1.53	1.187	2.00	0.307
II	15	3.13	.990	3.00	0.256
III	15	1.67	1.291	2.00	0.333

* Group I- Type IX GIC
* Group II-CHX incorporated GIC
* Group III-Triclosan incorporated GIC
** Significant (p<0. 05)
*** Non – significant (p> 0. 05)

Table 2: Intergroup comparison of the mean rank of microleakage in a group I, Group II and group III

Groups	**N**	Mean Rank	Mann- Whitney U	p Value
I	**15**	**10.37**	**35.500**	**0.001****
II	**15**	**20.63**		
I	**15**	**14.97**	**104.500**	**0.731*****
III	**15**	**16.03**		
II	**15**	**20.17**	**42.500**	**0.003****
III	**15**	**10.83**		

* Group I- Type IX GIC
* Group II-CHX incorporated GIC
* Group III-Triclosan incorporated GIC
** Significant (p<0. 05)
*** Non- significant (p>0. 05)



Graph 1: Graphical representation of mean of microleakage among all the groups.

Group I- Type IX GIC, Group II-CHX incorporated GIC, Group III-Triclosan incorporated GIC

The scores were tabulated, interpreted and the resultant findings were statistically evaluated

RESULTS

The data was subjected to statistical analysis using SPSS version 19. The p-value less than 0.05 is considered as significant and kruskal-wallis non-parametric analysis and mann-whitney U test was applied to compare the various groups.

The mean value of microleakage in group I was 1.53±1.187, for group II, 3.13±0.990 and for group III 1.67±1.291. It was noted that microleakage value was the highest in group II (CHX incorporated GIC) followed by group III (Triclosan incorporated GIC) and least in group I (Type IX GIC). (Table 1, Graph 1)

When intercomparison between various groups was done, significant difference was found between group I and group II and between group II and group III with a p value of 0.001 and 0.003 respectively. Non significant difference was found between group I and group III with a p value of 0.731. (Table 2)

DISCUSSION

Dental caries is still the most common dental disorder. Although not life threatening, they can cause discomfort, pain or even be responsible for loss of teeth. Preventive strategies continue to be the most effective measures for controlling dental caries. However, teeth still get cavitated as no preventive regime is efficient enough to cause complete eradication of caries. GIC was introduced by Smith in the late 1960s, resulting from the

replacement of phosphoric acid in zinc phosphate cements. It is the most widely used restorative material in the pediatric dentistry. Though it is widely considered that fluoride release from the restorative materials, glass ionomer in particular, has a caries preventive effect. But the fluoride released from glass ionomer cement is maximum for first 24 hours after that it decreases exponentially in further days. Thus, various attempts have been made to improve the antibacterial property of GICs by the inclusion of specific antimicrobial compounds[8,9].

In the present study, Chlorhexidine (0.5%) & Triclosan (0.5%) were incorporated into type IX GIC to evaluate their marginal sealing ability. In the studies carried out by Turkun et al (2008) and Marti et al (2014) the addition of 0.5% chlorhexidine-diacetate is optimal to give appropriate antibacterial, physical and bonding properties to Fuji IX[3,10]. In the present study Type IX GIC showed the least microleakage when compared to Chlorhexidine incorporated GIC (0.5%) and Triclosan incorporated GIC (0.5%). An *in-vitro* comparative study on strength characteristics and marginal sealing ability of Chlorhexidine modified GIC and Type IX GIC was done by Ahluwalia et al (2012), they concluded that the Chlorhexidine incorporated GIC showed higher microleakage than Type IX GIC[2].

Fuji IX is a high strength posterior restorative material which sets faster and is of higher viscosity because of finer glass particles, anhydrous polyacrylic acids of higher molecular weight and a high powder to liquid ratio. These properties may be responsible for Fuji IX exhibiting a good marginal seal[11,12].

In the present study 0.5% Chlorhexidine incorporated GIC showed maximum microleakage followed by 0.5% Triclosan incorporated GIC and least microleakage was shown by the Type IX GIC. An in vivo comparative study on evaluation of microleakage of 1% chlorhexidine modified GIC and Type IX GIC was done by Mathew et al (2013), they concluded that the 1% Chlorhexidine modified GIC showed higher microleakage then Type IX GIC[12]. Moreover, the physical properties of Chlorhexidine incorporated GIC can be attributed to the fact that this powder has a low solubility in water. Therefore cationic salts hamper the setting reaction of the polyacrylic acid glasses, thereby extending the setting time, due to interfered proton attack and leaching of ions from the glasses[3,13].

The microleakage of 0.5% Triclosan incorporated GIC was lower than that of Chlorhexidine incorporated GIC but slightly higher when compared to Type IX GIC &the results showed were non-significant. An *in-vitro* study on evaluation of microleakage in conventional GIC and Triclosan incorporated GIC was done by Somani R, Jaidka S, Jawa D, Mishra S (2014), and they concluded that the addition of Triclosan to GIC has no statistical difference in terms of microleakage[14].

The intergroup comparison showed non significant difference in microleakage scores of Type IX GIC and 0.5% Triclosan incorporated GIC, which vindicates that these may be considered as viable options for use in pediatric dentistry with good marginal sealing ability.

Since in vitro studies do not reflect all variables present in the mouth, the results of this in vitro study may not be extrapolated to the clinical situation unless adequate clinical trials are conducted to test the in vivo efficacy of the material.

CONCLUSION

The marginal sealing ability of Triclosan-incorporated glass ionomer cement was comparable to those of glass ionomer cement (Fuji IX). So, Triclosan incorporated glass ionomer cement can be considered as a substitute for glass ionomer cements, especially in pediatric dentistry with an added advantage of antibacterial property.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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