Comparative evaluation of microleakage in conventional glass ionomer cements and triclosan incorporated glass ionomer cements

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Abstract

Aim and Objective: The aim of the following study is to comparatively evaluate the microleakage of triclosan incorporated GIC with conventional restorative GIC. **Materials and Methods:** Triclosan in powder form was added to conventional GIC to formulate a concentration of 2.5%. Class five cavities were prepared in non-carious extracted molars and were respectively restored with conventional restorative GIC and triclosan incorporated GIC. Samples were kept in 10% methylene blue dye. Ground sections were obtained and were observed under a binocular microscope for dye penetration. **Result:** No significant difference was found in the microleakage of two groups. **Conclusion:** Triclosan incorporated GIC can be considered as an alternative to GIC with enhanced antibacterial property.

Keywords: Conventional type II glass ionomer cements, microleakage, triclosan incorporated glass ionomer cements

Introduction

Microleakage and the lack of marginal integrity of restorations has been implicated in dentinal sensitivity, secondary caries formation, corrosion or dissolution of dental materials, discoloration of dental materials and surrounding tooth structure and percolation of fluid. The fact that restorations exhibit leakage at marginal interfaces with tooth structure comes as no surprise to practicing dentists. It is described as the movement of oral fluids between the tooth and restoration interface. That fluid may contain bacteria and other noxious substances that may affect the tooth/pulp biologic unit.

Since the introduction of glass ionomer cements (GIC) in 1972, they have been widely used as restorative materials, luting cements and base materials. These materials have widened the armamentarium of tooth-colored restorative materials and in particular, they have been successfully used for restoration of primary teeth. Their main advantages are relative ease of use, bonding potential to enamel and dentin and fluoride ion release. However, the disadvantage is the microleakage present with the GIC. Therefore reinforcing the conventional GIC with additional antibacterial agents may be an effective measure.[1]

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.[2] It is a white crystalline powder with a faint aromatic smell. At in-use concentrations, triclosan acts as a biocide, with multiple cytoplasmic and membrane targets. At lower concentrations, however, 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 GIC.[3]

An antibacterial when added to GIC is considered a successful alternative if it does not effect the physical properties of the cement. Thus, this study comparatively evaluates microleakage of triclosan incorporated GIC with the conventional GIC.

Materials and Methods

The material used for the study included GIC type II and 2.5% triclosan incorporated GIC type II.

Sample selection

A total of 20 permanent human extracted molars were collected for the study after ethical approval. These teeth were selected according to following inclusion and exclusion criteria.

Inclusion criteria

1. Non-carious molars
2. Molars extracted due to periodontal pathologies or due to traumatic injuries.

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Exclusion criteria

1. Carious teeth
2. Crown of the tooth fractured during extraction
3. Hypoplastic or hypomineralized teeth
4. Teeth with any kind of developmental anomaly.

These teeth underwent thorough scaling and were autoclaved. These were stored in saturated aqueous solution at 4°C to reduce deterioration in storage. All the selected teeth were used within 3 months of extraction, as per recommendations of occupational safety and health.

Division of samples

Samples were divided into two groups according to the restorative materials used. Each group consisted of 10 teeth.

Group I (control group)

Teeth restored with conventional type II GIC.

Group II (experimental group)

Teeth restored with 2.5% triclosan incorporated.

Preparation of 2.5% triclosan incorporated GIC

A total of 0.075 g of triclosan powder was added to 2.925 g of glass ionomer powder to obtain 2.5% formulation of triclosan incorporated GIC.[2]

Sample preparation

Standardized class V cavities were prepared on the buccal surface of the tooth 1 mm above the cementoenamel junction. The cavities were prepared using high speed air-rotor handpiece with a straight fissure bur no. 9. The cavities were measured with a Williams probe and Vernier calipers at 3 mm length 2 mm width and 1.5 mm depth.

These cavities were rinsed thoroughly with air water syringe and dried. Then the cavities were restored with GIC and triclosan incorporated GIC, respectively according to manufacturer's instructions. After restoration, the teeth were stored in distilled water at 37°C for 24 h and then subjected to thermocycling at 5°C and 60°C with 20 s of dwell time in each bath.

All the surfaces except the restoration and a 1 mm zone adjacent to the margins were covered with two coats of varnish. The root apices, if any were sealed with sticky wax. The coated teeth were then immersed in 10% methylene blue dye for 4 h. After 4 h the samples were removed from the dye washed and sectioned into two halves from between the restoration. Ground sections were then obtained from these samples. These sections were viewed under a binocular microscope at ×40 magnification for the depth of dye penetration. The extent of microleakage was noted according to the following criteria [Figures 1-4].[4]

Score 0: No dye penetration
Score 1: Upto 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.

The scores were tabulated, interpreted and the resultant findings were statistically evaluated by Mann–Whitney test.

Results

The results were based on the grading of the dye penetration in the tooth and restoration interface. The results revealed that one sample from group I and no samples from group II had score 0. Five samples from each group showed a dye penetration with score 1. Two samples from group I and three samples from group II presented score 2. One sample from each groupprevealed a microleakage score of 3 and 4 [Table 1].

The statistical analysis of the scores of microleakage revealed that there was no significant difference between the microleakage scores of GIC and triclosan incorporated GIC as the *P* value was 0.495 which is more than 0.05 [Table 2].

Discussion

The potential limitation of atraumatic restorative treatment is difficulty in removal of the entire carious lesion using only hand instruments with the likelihood of residual caries in the cavity. This necessitates complete removal of the cariogenic lesion as a prerequisite for control of caries progression.

Though it is widely considered that fluoride release from the restorative materials, glass ionomer in particular, has a caries preventive effect, many studies have confirmed the contrary. It has been established that secondary caries is one of the most common reason for failure of GIC.[2] Mjör IA found in his preliminary report that secondary (recurrent) caries, was the most common reason for replacement of GIC, amalgam and composite. Hara *et al*. studied the influence

Table 1: Comparison of microleakage observed with glass ionomer cement and chlorhexidine modified glass ionomer cement

Scores	Group I	Group II
0	1	0
1	5	5
2	2	3
3	1	1
4	1	1

Table 2: Statistical analysis by Mann-whitney test

Group	*N*	Mean rank	Sum of rank	Significance
Group I	10	19.20	384.00	*P*=0.495
Group II	10	21.80	436.00	

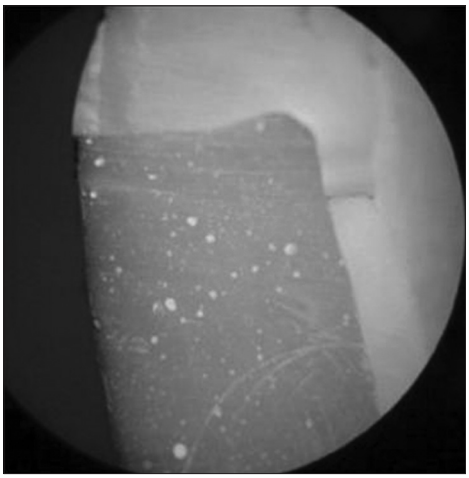

Figure1: Grade 0 of dye penetration

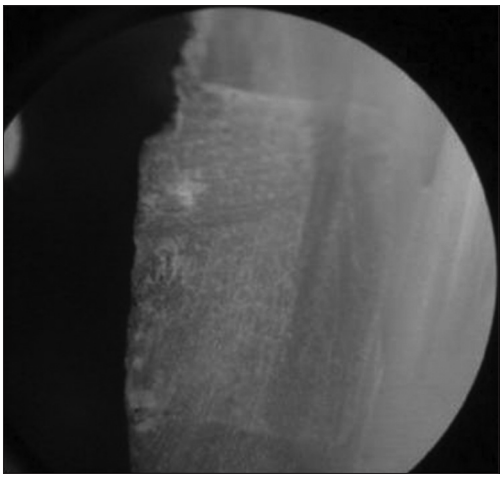

Figure 2: Grade 1 of dye penetration

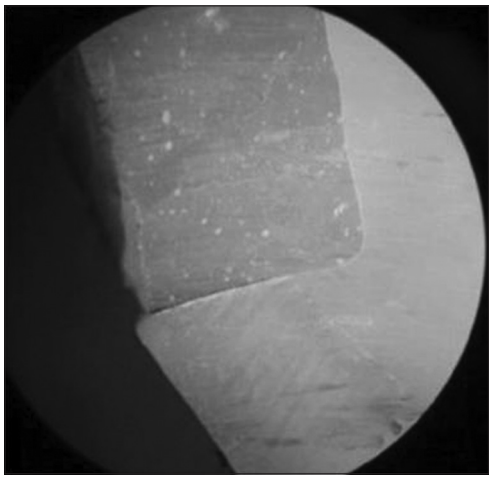

Figure 3: Grade 2 of dye penetration

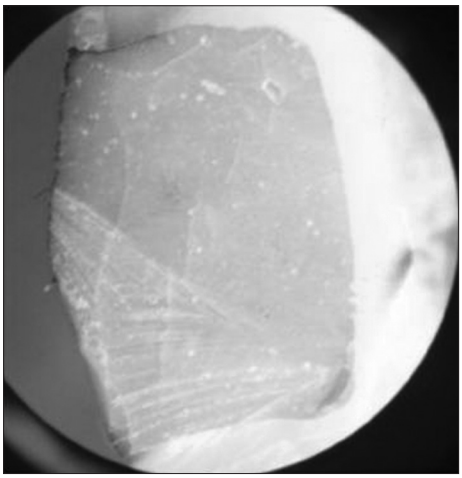

Figure 4: Grade 3 of dye penetration

of fluoride releasing restorative materials on the secondary caries and concluded that under the cariogenic and fluoride dentifrice exposure conditions of the study, the glass-ionomer restoration, either aged or unaged, did not provide additional protection against secondary root caries.

The addition of antibacterial agents is gaining popularity with the aim of suppressing the growth of bacteria under restoration to minimize the risk of recurrent caries. Various antibacterial agents such as chlorhexidine hydrochloride, cetylpyridinium chloride, cetrimide and benzalkonium chloride have been incorporated in GIC to increase the antimicrobial efficacy of GIC.[4] However, these antibacterial agents affect the clinical performance of the material.[5] They were found to reduce compressive strength,[5,6] surface hardness,[6,7] bond strength[8] and slightly increases the setting time.[9] These effects were due to the cationic nature of these materials. So, triclosan was selected which is anionic by nature.[2,3]

Triclosan is an antibacterial and antifungal agent. It is a polychloro phenoxy phenol. This organic compound is a white powdered solid with a slight aromatic/phenolic odor. It is a chlorinated aromatic compound that has functional groups representative of both ethers and phenols. Phenols show antibacterial properties. Triclosan is only slightly soluble in water, but soluble in ethanol, methanol, diethyl ether and strongly basic solutions such as a 1 M sodium hydroxide solution. Sainulabdeen *et al*. studied the antibacterial effect of triclosan incorporated GIC and concluded that 2.5% concentration of triclosan incorporated GIC provides an optimum amount of antibacterial effect.[2]

Bonding of restoration to the tooth is an important property responsible for success of restoration. Microleakage is a measure to this property. It is basically passage of bacteria, fluids, molecules or ions between a cavity wall and restoration applied to it. It is a very important property of any material for success of restoration.

In the present study microleakage of 2.5% triclosan incorporated GIC was compared with conventional type II GIC and the results revealed that the microleakage was similar to that of the conventional GIC. There is no

documented evidence of the microleakage of triclosan incorporated GIC.

Conclusion

The addition of triclosan to GIC has no effect on the microleakage of the cement. This study suggests that triclosan incorporated GIC can be successfully used in pediatric dentistry with an added advantage of antibacterial property. Further research is required to test other physical properties of triclosan incorporated GIC on a wide scale.

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