Effect of pH cycling on the marginal integrity of Glass Ionomer Cement - An invitro study

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Abstract:

Background: Marginal adaptation is the interfacial distance among the restoration and the tooth structure. The better sealing for the margin the lesser microleakage occurs furthermore secondary caries and postoperative sensitivity will be reduced. Glass ionomer based materials are clinically popular in several areas of restorative dentistry, but restoration of cervical lesions has proven particularly successful.

Aim: To assess the effect of ph cycling on the marginal integration of GIC.

Methods: Freshly extracted caries free maxillary premolars were selected for the study from the Oral Surgery department. On the buccal surfaces of each tooth, standardised rectangular class V conventional cavities with 90 degrees cavosurface angles were prepared. The selected teeth were assigned randomly into two main groups. The specimens of each group were dehydrated, mounted on aluminum stubs, and then gold sputter coated. Scanning electron microscopy was then used to assess the marginal adaptation.

Conclusion: Based on the results of this in-vitro study and within its limits, it can be concluded that the type 2 vs type 7 GIC shows comparable marginal integrity as classical component. The marginal quality of class V restorations of type 2 was found to be better when compared to the of type 7 GIC.

Keywords: Marginal adaptation, GIC, microleakage, cervical lesions, secondary caries.

1.Introduction:

Non-carious cervical lesion is one of a challenging dental problem that requires professional attention. Their prevalence has increased due to the implementation of preventive dentistry and caries control, and patient complaints have started to be more and more related to this kind of lesions (1). The incidence of non-carious cervical lesions increases with age and are associated with middle-aged patients. Composite resin and glass ionomer cements (GICs) have commonly been indicated as the restorative materials of choice for these cases. GICs however have a wider range of clinical applications in non-carious cervical lesions (1).

Marginal adaptation is the interfacial distance among the restoration and the tooth structure.The better sealing for the margin the lesser microleakage occurs furthermore secondary caries and postoperative sensitivity will be reduced.(2) Using fluoride-releasing materials and good bonding agent enhances good marginal adaptation due to the crystalline deposits resulting from the fluoride-releasing materials and the formed crystals shape.(3) Clinically Microleakage is the major cause for the failure of dental restorations, especially in Class V cavities, as margins of such restorations are generally located in dentin/cementum. Dental restorations attempt to restore the shape, function, and esthetics caused by the loss of dental tissue. (4)To choose the most adequate restorative material, the clinician must take into account factors such as biological, optical, mechanical, and manipulative properties.

Currently the materials performance take up the main concern regarding the marginal sealing integrity and their durability, especially in the cavities that involve the cementum region, where clinical problems are aggravated.(5) Over the past few years a great progress occurred in esthetic dentistry, which resulted in the evolution of a lot of restorative materials with magnificent improvement. Glass ionomer (GI) is known to offer reasonable esthetics and durability, chemical bonding, fluoride release, and caries inhibiting potentials without extensive sound tooth structure preparation(6). Glass ionomer based materials are clinically popular in several areas of restorative dentistry, but restoration of cervical lesions has proven particularly successful.(7) Various etiologies, conformations, locations and structural characteristics make non-carious cervical lesions more challenging to adhesive restorative procedures and marginal seal in the long run (8,9). Due to their characteristics, glass ionomer cements (GICs) have precise indication for these cases. Hence this study was conducted to assess the effect of ph cycling on the marginal integration of GIC.

2.Materials and methods:

2.1Teeth selection: Freshly extracted maxillary premolars were selected for this study from the Oral Surgery department. All the teeth were examined microscopically under stereomicroscope (20× magnification) to rule out the presence of external defects. Soft tissue remnants were removed using a hand scaler, then teeth were disinfected with hydrogen peroxide solution, and subsequently kept for 24 hours at 37°C distilled water in an incubator.

2.2Cavity preparation: On the buccal surfaces of each tooth, standardised rectangular class V conventional cavities with 90 degrees cavosurface angles were prepared using carbide burs No. 245 with a high speed handpiece. The depth of the cavity was checked using a periodontal probe.

2.3Restorative procedure and studygroups: The selected teeth were assigned randomly into two main groups.Group one was restored with GIC type II, and group two was restored with GIC type VII according to the manufacturer's instruction.

2.4 pH cycling: Samples were subjected to Ph cycling according to featherstone pH cycling regimen(1986).It is recommended 16 hours of remineralisation and 6 hours of demineralisation with 2 hours of handling period.

2.5 Sectioning: Samples are mounted in acrylic resin blocks and sectioned in buccolingual plane through the centre of the restoration using Isomet 1000 precision saw and the marginal adaptation is evaluated by Scanning Electron Microscopy.

2.6Marginal Adaptation Evaluation by Scanning Electron Microscope: The specimens of each group were dehydrated, mounted on aluminium stubs, and then platinum sputter coated and visualised under Scanning Electron Microscopy at ___magnification.

According to Featherstone pH cycling regimen (1986), it is recommended 16 hours of remineralisation and hours of demineralisation with 2hrs of handling period.

Demineralizing solution	
Calcium	2.0 mmol/L
Phosphate	2.0 mmol/L

Acetic acid	75.0 mmol/l
Remineralizing solution	
Calcium	1.5 mmol/L
Phosphate	0.9 mmol/L
KCl	130.0 mmol/L
Sodium cacodylate	20.0 mmol/L

Table 1: Composition and measured values of the demineralizing and remineralizing solutions used in the study.

3. Results:

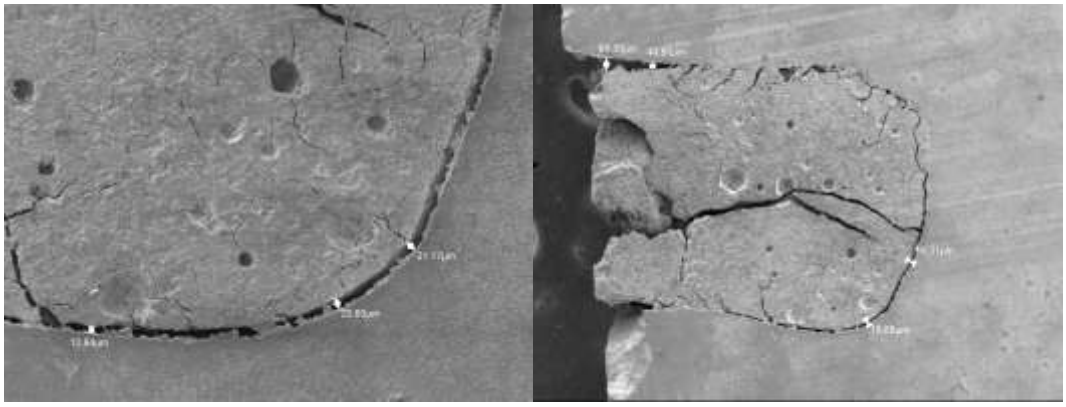

Figure 1: Photomicrography obtained showing the presence of gap in the dentinal margin of a restoration performed with type 2 GIC.

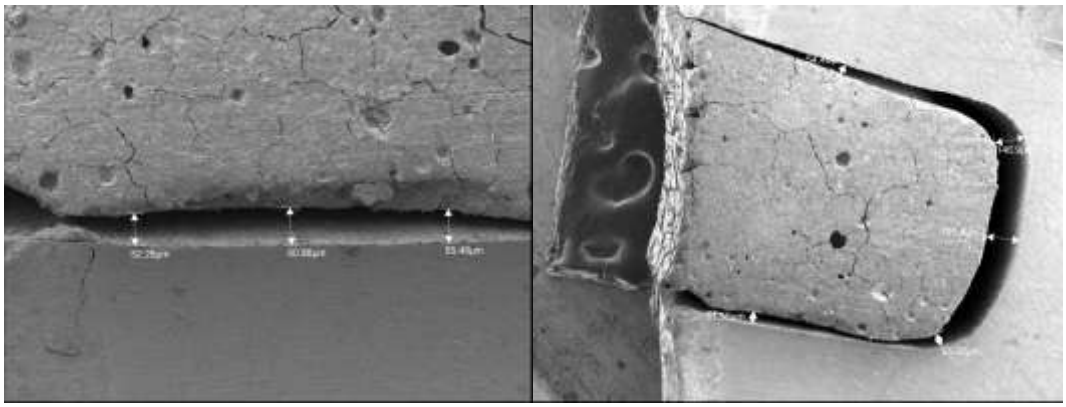

Figure 2: Photomicrography obtained showing the presence of gap in the dentinal margin of a restoration performed with type 7 GIC.

The results of the gap measurements for the adhesive and substrate factors are displayed in Figure 1 and Figure 2. The type 7 GIC presented higher values of gap widths than the type 2 GIC when the margin of restoration was located in the dentin.

	Location of margin	**Gap in dentinal margin**	**Mean value**
Type 2 GIC	Dentin	21.17um 20.60um 14.31um 18.66um	18.68um
Type 7 GIC	Dentin	52.28um 55.48um 54.46um 61.55um	55.94um

Table 2: Comparison of marginal gap measurements between Type 7 GIC and Type 2 GIC restorations based on adhesive and substrate factors. Higher gap width values were observed in Type 7 GIC compared to Type 2 GIC when the restoration margins were located in dentin. Values are expressed as mean gap width measurements under the tested conditions.

Discussion:

A proper marginal sealing is essential to improve the longevity of GIC restoration. Class V cavities were chosen in this study because they remain a challenge for restorative procedures. Thus, most of the clinical studies evaluating the performance of an adhesive system use class V cavities. The C-factor of these cavities impairs the flow during polymerization shrinkage, intcreasing the stress over the bonding interface. Moreover, these cavities frequently present gingival margins in the dentin, consisting of an additional challenge to obtain a proper marginal sealing.

In a previous study conducted, it was found that GICs are very durable in cervical restorations and compete with the composites, particularly where bonding to cervical dentin is required. Sclerosed dentin remains the greatest obstacle in obtaining good bonding with dentinal bonding agents and failure at the cervical margin, as a result of microleakage, is not always easily detected. (10)

It was found that removal of the outer surface layer of the sclerotic dentin by roughening with a diamond bur did not improve retention for RMGICs, as shown in previous studies(11) . Special characteristics of these lesions are the presence of dentin or cementum in the gingival margins, and restorations that are more susceptible to microleakage and postoperative sensitivity because the available dentin is not favorable to adhesive systems, due to its higher mineral concentration.(12)

Results of the present study are in agreement with the previous studies, that strong chemical and micromechanical bonding to the tooth structure and application of the coating material for GIC and RMGI have filled any gaps at the tooth restoration interface also increase the sealing properties of GIC as a result of the heat generated during its polymerization leading to increase in the molecular kinetic energy and rearrangement that may facilitate better adhesion. In addition, the flowability of the restorations allows better wetting along the cavity walls, thus improving adaptation of dental restorations to the walls of the cavity (13).

Conclusion:

Based on the results of this in-vitro study and within its limits, it can be concluded that the type 2 vs type 7 GIC shows comparable marginal integrity as classical component.

The marginal quality of class V restorations of type 2 was found to be better when compared to the of type 7 GIC.

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