Study the effect of surface sealant on microleakage in class V cavities filled by different restorative materials

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Abstract:

The aim of this study was to evaluate the effect of unfilled resin sealant coating on marginal leakage in decreasing microleakage in class v cavities using PROMEDICA light cure Nano-ceramic composite and nono glass ionomer filling material (EQUIA system). Twenty extracted sound human upper premolars has been selected, Standardized class v cavity with butt-joint marginal configuration were prepared in the middle third of the buccal and palatal surfaces of the tooth. The teeth were randomly divided into four groups of five teeth. Cavities of group 1 were restored with nano composite only , group 2 were restored with nano composite coated with unfilled resin sealant,group3 were restored with light curing nano glass ionomer filing only, and group4 were restored with light curing nonoglass ionomer filing . After rinsing and drying one thin coat of unfilled resin sealant was applied and were light polymerized for 15 seconds. The procedures for dye penetration using Methylene Blue dye were followed and examined under stereomicroscope for evaluation. The data collected were analyzed statistically using paired t test. Nanocomposite recorded less microleakage than nanoglass ionomer cement at occlusal and cervical margins. Results showed that restorations were coated with resin sealant showed significantly less dye penetration in comparison with uncoated surfaces. For nanocomposite filling material p value= 0.002 while for nano glass ionomer filling material p value=0.0047. Though the coating of unfilled resin sealant did not completely eliminated microleakage, unfilled resin sealant was effective in reducing microleakage of the esthetic restorations in class V restorations.

Keywords: Microleakage, Nanocomposite, Nano glassionomers and unfilled resin sealant surface coating.

Introduction

The ingress of acids, ions, enzymes and their products through gaps at the tooth restorative interface has been termed microleakage [1]. This phenomenon may predispose a tooth to discoloration at cavity margins, recurrent decay and pulpal inflammation [2,3]. Post-operative sensitivity has also been reported as a result of microleakage [4,5]. Class V cavities can be restored with glass ionomer cement, resin reinforced glass ionomer and, resin composite materials. Micro gap formation at the restoration tooth interface, particularly at the cervical region, occurs due to loss of marginal integrity caused by several factors, including material characteristics, polymerization shrinkage, cavity margin location, morphological and histological constituents of enamel and dentin, patient's occlusion components, insertion technique and operator compliance with manufacturer's instructions [6].

Microleakage tests can provide much useful information about the performance of restorative materials. A variety of different technique for assessing microleakage have been developed and utilized. Most modern techniques utilize different principles involving biological, chemical, electrical, physical or radioactive components. These include the use of dyes, radioactive isotopes, air pressure, bacteria, neutron activation analysis, artificial caries, scanning electron microscopy (SEM), calcium hydroxide and other methods [7, 8].

In an attempt to overcome microleakage problem, using layer of low viscosity resin sealant over composite restoration has been investigated. This resin should penetrate into interfacial microgaps, especially in dentin cementum margins, thus promoting better marginal sealing. In addition material would fill the structural micro defects formed during the insertion technique and finishing and polishing procedures, thus increasing the wear resistance of the restoration [9-11]. All efforts till date have failed to completely eliminate the marginal contraction gap and prevent microleakage in class V restorations especially with gingival margins on dentin and cementum [12].

The purpose of this in vitro study was to evaluate the microleakage of nano composite and nano glassionomer restorative materials when used with and without unfilled resin surface sealant.

Materials and method:

Twenty extracted sound human upper and lower premolars has been selected and stored in %50 ethanol at room temperature. The selected teeth were placed in a physiological saline solution until use.

Standardized class v cavity with butt-joint marginal configuration were prepared in the middle third of the buccal and palatal surfaces of the tooth (2mm high, 3mmwide, 2mmdepth). using ahigh speed hand piece which was adapted to the horizontal arm of a surveyor in such a way that the long axis of the bur will be perpendicular to that of the tooth, using a medium grain diamond bur, under water coolant. For standardization and accurate positioning of the two cavities, two vertical lines were drawn from the tips of the buccal and palatal cusps to the lowest points of the cervical lines, the mid distance of these lines represent the center of each cavity, this guidance will aid in perfect sectioning through the two opposite cavities. The outline of the cavity was drawn on the tooth surface with a 0.5 mechanical pencil using a matrix band with a pre-cut hole of 2×3 mm which was fixed on the tooth with a retainer. The cavities per tooth were not inter related, and the data were analyzed as if they were independent replica cavities for each of the restoration.

The samples of twenty teeth were divided into four groups of five teeth randomly:

Group 1: (10) cavities were filled with Nano ceramic composite without using surface sealant.

Group 2: (10) cavities were filled with Nano ceramic composite using surface sealant.

Group 3: (10) cavities were filled with Nanoglass ionomer filling without using surface sealant.

Group 4: (10) cavities were filled with Nanoglass ionomer filling using surface sealant.

The nano ceramic composite (Promedica, Germany) was applied to 20 cavities in bulk technique and hand condensed with small plastic instrument specially at margins and the excess removed from the peripheries then mylar

celluloid strip was applied and the restorations were light cured for 40 second by light emitting diode curing device. The other 20 cavities were restored with light curing nanoglass ionomer (Equia system, gcamerica) by injection the filling material to the prepared cavities, the excess removed and the restorations were light cured for 40 second by light emitting diode curing device.

After cavity filling one thin coat of unfilled surface sealant was applied to restoration/tooth interfaces and was light polymerized for 15 seconds. All the specimens were thermally stressed (1000 cycles) between 15°c and 45°c ± 2°c, with dwell time of 30 second in each bath and transfer time of 3 seconds. Before dye penetration with methylene blue the apical portion of the teeth were sealed by coating with sticky wax while all other surfaces were coated with two nail varnish coats avoiding the restoration and their margins by about (1-1.5mm) which were to be subjected to dye solution when the varnish were dry, the teeth were immersed in2% aqueous methylene blue solution and stored for 24 hours at 37C in the incubator. In order to have equal and uniform sections the tooth with the two restorations were sectioned under continuous drop of water to avoid over heating and chipping through the bucco-palatal cusp tips downwards toward the restorations with a diamond disc. The sections were kept ready for evaluation.

The degree of dye penetration was evaluated using standardized scoring system using stereomicroscope as 0-3 (figure 1 and 2):

Score (0) no dye penetration

Score (1) dye penetration involving enamel/restoration interface only.

Score (2) dye penetration involving whole enamel and dentin/restoration interface only

Score (3) dye penetration involving enamel, dentin including axial wall/restoration interface only

Figure 1: (A) dye penetration for group 1: Nano ceramic composite, (B) group2 Nano ceramic composite with using surface sealant.

Figure 2: (A) dye penetration for group 3: Nano: Nanoglass ionomer, (B) group 4 Nanoglass ionomer with using surface sealant.

Results:

For each group score of dye penetration, mean and standard deviation were calculated. Statistical analysis for comparison of micro leakage between the two groups was done by paired t-test test.

Table (1) depict the comparison of dye penetration between Nano ceramic composite without surface sealant (group1) and Nano ceramic composite (group 2) with using surface sealant along occlusal and cervical margins. On unsealed Nano ceramic composite specimens showed significantly more leakage when compared to sealed Nano ceramic composite specimens along occlusal and cervical margins.

Table (1): comparison of dye penetration between(group 1) Nano ceramic composite without surface sealant and (group 2) Nano ceramic composite with using surface sealant.

Group	N	MEAN	Std.Deviation	Minimum score	Maximum score	Paired ttest
I	10	2.4	0.91	0	3	0.002
II	10	0.7	0.82	0	2	
Paired t test < 0.05= significant						

Table (2) depict the comparison of dye penetration between Nanoglass ionomer without surface sealant (group3) and Nanoglass ionomer (group 4) with using surface sealant along occlusal and cervical margins. On unsealed Nanoglass ionomer specimens showed significantly more leakage when compared to sealed Nanoglass ionomer specimens along occlusal and cervical margins.

Table (2): comparison of dye penetration between(group 3) Nanoglass ionomer without surface sealant and (group 4) Nanoglass ionomer with using surface sealant.

Group	N	MEAN	Std.Deviation	Minimum score	Maximum score	Paired ttest
III	10	2.5	0.5	2	3	0.0047
IV	10	1.2	0.74	0	2	
Paired t test < 0.05= significant						

Discussion

To overcome the polymerization shrinkage and provide good sealing effect, in this study two newly aesthetic restorative, light cured Nano glass ionomer cement and Nano ceramic composites, which are product of Nanotechnology, were used for cervical class V restoration. They supposed to have excellent aesthetics, superb polish, and high wear resistance according to manufacturers. Light cured Nano glass ionomer cement has an added advantage of fluoride release [21].

Several methods have been suggested to reduce these destructive factors such as the use of rebonding agents, retention grooves, acid etch, enamel bevel, incremental placement of filling material, application of glass ionomers, flowable composite and self-cure composites under light-cure composites, indirect resin inlay, dentin bonding agents, suitable polishing techniques and slow polymerization speed. It has been shown that none of these methods could completely eliminate microleakage [13]. Attempt to seal the contraction gap by coating the polymerized composite resin and resin

modified glass ionomer cement with bonding agent or resin sealants have been reported [14- 15]. Penetration of the unfilled resin by capillary action would seal the marginal gaps, reducing the microleakage. Capillary action is directly related to the viscosity and wetability of the material [16]. Also, these materials must have coefficient of thermal expansion and contraction similar to tooth structure, and they must be compatible with the respective restorative material [17, 18]. Some of the studies showed no effect of unfilled resin sealant on the marginal leakage of class v restoration [19, 20]. The results of this study indicate that Nano ceramic composites restoration with using surface sealant are superior to Nano glass ionomer cements with using surface sealant in preventing microleakage. This result is in agreement with study conducted by Sharath etal [21]. The Study also confirms that unfilled resin sealant coated on finished Nano ceramic composite and Nanoglass ionomer restorations, reduces microleakage of these class v restorations. But it could not prevent microleakage completely. The probable explanations for these results are that unfilled surface sealant will fill the structural microdefects and microfissures that are formed on the composite and resin modified glass ionomer cement. The ability to penetrate deeply in to the interfacial microgaps, provide marginal sealing.

Conclusion

Results of this study revealed that:

Within the limitations of this study, it can be concluded that, the using of unfilled resin sealant did not completely eliminated microleakage, unfilled resin sealant effective in reducing microleakage of Nano ceramic composite and Nano glassionomers, in class V restorations.

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