

Microleakage of Different Pit and Fissure Sealants

Research Article

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Abstract

Background/Aim: Sealing pits and fissures is considered to be an effective way of preventing caries initiation. The present *in vitro* study was carried out to evaluate the microleakage and sealing ability of Helioseal F, Seal-it and GCP Glass seal and compared sealing ability of GCP Glass seal with resin fissure sealants.

Materials and Method: 80 extracted premolars free of caries, cracks or morphogenic diversity were collected and distributed equally in four groups (20 in each). Group-I (Helioseal F), Group-II (Seal-it), Group-III (GCP Glass seal) and Group-IV (GCP Glass seal without etching). Samples were cleaned with pumice slurry and etched with phosphoric acid etchant except Group-IV without etching. Air and water sprays were used for washing and drying, the teeth were treated with sealants followed by thermocycling and immersion in methylene blue dye for 48 hours. The samples were sectioned and examined under a stereomicroscope at x15 magnification then the score was given for microleakage. The sections were photographed to show a score of "0", "1", "2" or "3" microleakage and the data was statistically analyzed with Chi-Square test.

Results: Seal-it material was the best sealant material as it was showing significantly least microleakage as compare to Helioseal F and GCP Glass seal and the microleakage was found to be the highest for the GCP Glass seal with etching.

Conclusion: According to the results, the Seal-it material was found to be an excellent dental material for pits and fissures and GCP glass seal should be used without etchant.

Keywords: Pit and Fissure Sealants; Stereomicroscope; Microleakage.

Introduction

In spite of numerous prevention methods, dental caries is still a highly prevalent disease in the world [1]. Effects of caries preventive measures are greater on smooth surfaces, while occlusal caries remains a problem. It has been shown that a carious lesion most frequently occurs in pits and fissures of occlusal surfaces, primarily due to their specific anatomy, which is considered to be an ideal site for bacteria and food remnants retention [2, 3].

Sealing pits and fissures is considered to be an effective way of preventing caries initiation. A fissure sealant is defined as a material that is placed in pits and fissures of teeth in order to prevent or arrest the development of dental caries [4].

Microleakage or marginal leakage may be defined as the ingress of

oral fluid into the space between the tooth and restorative material. So, the ability of a sealant to prevent microleakage is important [5].

Microleakage is considered as the main problem with direct restorative procedures and one of the main reasons for restoration failure. A dental sealant is successful only if it firmly adheres to the enamel surface, and protects pits and fissures from the oral environment [6].

Many studies have examined microleakage of sealants placed by the conventional method of acid etching of the enamel. All show some microleakage but results vary [7-9].

The present study represents an attempt to detect and compare the microleakage of three dental fissure sealants.

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Aim of The Work

The present study was undertaken to evaluate the microleakage and sealing ability of Helioseal F, Seal-it and GCP Glass seal and Compare the sealing ability of GCP Glass seal with resin fissure sealants.

Materials and Methods

The present study was carried out in the Department of Preventive Dentistry, Umm Alqura University, Makkah, Saudi Arabia. This was an *in-vitro* experimental study.

Eighty extracted maxillary and mandibular Premolars with intact occlusal surfaces were used for the study. The teeth were free of cracks, caries and restorations. Prior to the study, the occlusal surfaces of teeth were cleaned with pumice slurry using brushes at low-speed handpiece.

The Eighty premolars were randomly assigned into four groups of twenty teeth each, according to the material used as pit and fissure sealant. Group-I: Helioseal-F (Ivoclar Vivadent AG, Schaan / Liechtenstein), Group-II: Seal-it (Spident, Incheon, South Korea), Group-III: GCP Glass seal and Group-IV: GCP Glass seal without etching (GCP, Ridderkerk, Netherlands).

Fissure Sealant Application

The teeth were etched with 37% phosphoric acid etchant gel for sixty seconds, except group IV without etching, to provide more surface area with micro porosities which allow making materials flow in those areas which will enhance the bonding between material and tooth interface. Oil free air and water sprays were used for twenty seconds to completely rinse the acid and dry the teeth. The sealant was placed over the pit and fissure area respectively. The sealants were cured under the light cure for thirty seconds.

Microleakage Assessment

To simulate oral conditions, the sealed teeth were immersed in ready-made artificial saliva in plastic containers for one week in an

incubator at 37°C. Prior to testing, the teeth were thermocycled 500 times at $5 \pm 2^\circ\text{C}$ to $55 \pm 2^\circ\text{C}$, with a dwell time for thirty seconds.

The surfaces of specimens were coated with two layers of nail polish except for one millimeter around the sealant. The apices of the teeth were sealed with sticky wax. The specimens were stored in 5% methylene blue for 48 hours, then were rinsed with tap water and sectioned bucco-lingually in the mesial and distal surfaces of each tooth with an Isomet low-speed saw (TECHCUT 4TM\ Rancho Dominguez, California). Three sections made of each specimen to assess dye penetration under x15 magnification of a stereomicroscope (Meiji Techno\ San Jose, California). The sections were photographed to show scores of microleakage.

The degrees of microleakage were scored by a single observer depending upon leakage level using criteria by Colley et al., [8] as the following:

- 0 = No dye penetration.
- 1 = Dye penetration restricted to the outer half of the sealant.
- 2 = Dye penetration to the inner half of the sealant.
- 3 = Dye penetration into the underlying fissure.

Statistical Analysis

Data were collected, tabulated and subjected to analysis using SPSS program version 22.0. The comparison between groups carried out using chi-square test. The level of significance was considered at P value ≤ 0.05 .

Results

The present study was conducted to evaluate microleakage of different sealant materials. A total number of 240 sectioned surfaced of teeth (60 sections in each group) were examined under stereomicroscope, to evaluate sealant microleakage (Figure 1).

(Table 1) and (Graph 1) shows the distribution of microleakage scores among different sealant materials. There was statistically significant difference among the different sealant materials (chi-square test) and P-value ≤ 0.05 .

Figure 1. Digital images explaining sealant microleakage.

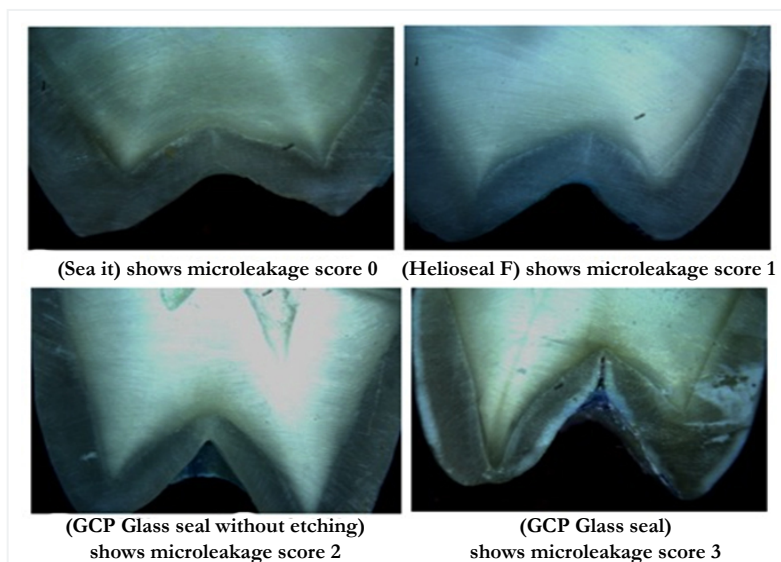


Table 1. Frequency distribution of microleakage scores.

Microleakage score	Group I	Group II	Group III	Group IV	Total	P-value
	No.(%)	No. (%)	No.(%)	No.(%)		
0	9 (15°/o)	23 (38.3%)	0 (0%)	3 (5%)	35	0.000
I	27 (45°/o)	27 (45%)	9 (15%)	18 (30%)	81	
2	23 (38.4%)	10 (16.7%)	31 (51.7°/o)	31(51.7°/o)	95	
3	1(1.6%)	0 (0°/o)	20 (33.3%)	8 (13.3°/o)	29	
Total	60	60	60	60	240	

No= Number, Group I= Helioseal, Group II= Seal it, Group III= Glass seal with etchant, Group IV= Glass seal without etchant. Comparison done by chi-square test and P-value ≤ 0.05 was considered to be statistically significant.

Graph 1. Shows comparisons among microleakage scores for different groups.

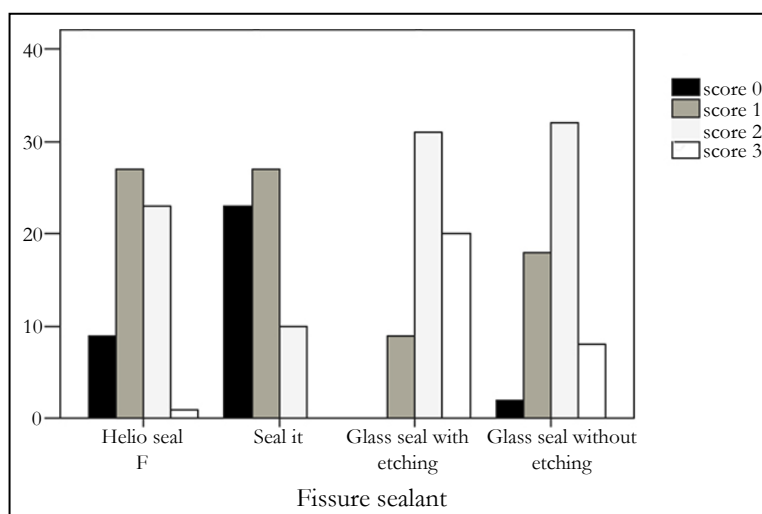


Table 2. p values for Comparison between different groups.

Groups Compared	p-value
I -II	.007
I -III	.000
I -IV	.004
II -III	.000
II -IV	.000
III -IV	.017

Group-I: (Helioseal F), Group-II: (Seal-it), Group-III: (GCP Glass seal) and Group- IV: (GCP Glass seal without etching).

(Table 2) shows the comparison among different sealant materials. Sealant materials of all groups were found to be comparable as the degree of microleakage between them were highly significant (p=0.000). On comparison between group I and group-II it showed statistically significant difference (p=0.007).

Comparison between Group-I and group-III showed highly significant difference (p=0.000). Also, when group- I was compared with group-IV it showed statistically significant difference (p=.004). Comparison between Group-II vs group-III and group-IV showed the same statistically significant differences (p=.000). Comparison between group-III vs group-IV showed the least statistically significant difference (p=.017). All comparisons were done by chi-square test.

Discussion

Pit-and-fissure sealants have been considered an outstanding adjunct to oral health care preventive strategies in the decrease of occlusal caries onset and/or progression [10]. The properties of an ideal sealing material include biocompatibility, retention, resistance to abrasion and wear [11]. Sealant bonding to enamel is also important because microleakage at the tooth-material interface can lead to treatment failure. The relative effectiveness of different types of sealants has yet to be established. There is rapid raise in the development of restorative materials and techniques in determining the capability of each new material to adapt to the tooth without microleakage.

In the present study, the *in vitro* microleakage of three materials used as pit-and-fissure sealants were evaluated. All materials were applied without enameloplasty in order to observe the behavior of these materials without removal of tooth substance. The specimens were thermocycled to reproduce the different temperatures to which the teeth are subjected during eating and drinking under clinical conditions.

In vitro microleakage tests carried out with dye penetration technique are stricter than those performed in the oral cavity [12]. This is most likely due to several factors such as the dye being more easily diffused than bacteria and their by-products and the fact that buildup of proteins in the marginal opening/gap may improve the seal. On this basis, they are likely to respond even better on a clinical level [13].

The use of pumice prophylaxis followed by acid etching in all group except group IV was chosen in the present study because it is adopted by most dentists for application of sealants and is also recommended by the manufacturer [14].

Because scarcity of studies has been done to evaluate microleakage of glass carbomer sealant, the present study was performed to evaluate the microleakage of this material in comparison with Helioclear F and Seal-it *in Vitro*. The study results showed significant differences in the sealant penetration among the groups of sealant materials. Seal-it material was found better for sealing ability as it was showing significantly least microleakage as compare to Helioclear F, and GCP Glass seal. On other hands, the microleakage was found to be highest for the GCP Glass seal with etching.

Within the recognized limitation of an *in vitro* study, the above results are viewed as the theoretical level of leakage which may or may not occur *in vivo* but may be accepted as an aid for selection of a good sealant material before placement of a pit & fissure sealant.

The sealing ability of resin fissure sealant is depending on the penetration of resin into a morphologically porous enamel layer created by phosphoric acid etching. The high sealing ability of Seal-it may be due to its high flowability which allows with better penetration of etched enamel and formation of resin tags better than Helioclear F. Although phosphoric acid etching effectively increases the bond between the enamel and sealant, it presents problems because of its bad taste and time-consuming procedure. To overcome these problems glass ionomers based compounds were developed to use as fissure sealant [15]. Recently nano-particles developed glass ionomers sealant (GCP Glass seal) used in the present study to improve sealing ability and avoid using of etching. It gives reasonable results compared with Helioclear F and Seal-it but its sealing ability less than them.

The difference was statistically significant. The decreased sealing ability of GCP Glass seal in the present study may be due to complete dryness of the teeth during application of sealant as glass ionomers hydrophilic and wet surface help its retention. Another cause for the decreased sealing ability may be due to thermocycling as glass ionomer more affected by heat than resin [16].

According to manufacturer instructions glass seal should be used without acid etching but in the present study it was used with

etching in a separate group to evaluate the effectiveness of etching on sealing ability. The results show statically significant highest leakage in Glass seal with etchant group compared with other groups. The explanation of that may be the flow of glass seal on a smooth surface and chemical bonding with enamel is better than on the rough surface, also, micro-tags and low flowability of glass seal may lead to entrapment of air bubbles which lead to increased microleakage. Another factor may be a formation of minerals or salts due to the reaction between acid and enamel hydroxyapatite which prevent intimate contact between sealant and enamel.

Increased marginal microleakage was observed for group III (GCP Glass seal with etching) compared with group IV (GCP Glass seal without etching), these findings disagreed with that reported by Birkenfeld LH and Schulman A [17]. They reported that etching were significantly reduced microleakage in teeth sealed with a GI bond fissure sealant.

The direction of research will have to be involved in simulating *in vitro* studies on microleakage with *in vivo* studies. There is a poor correlation between the extent of microleakage found *in vitro* & *in vivo* studies. *In vitro* studies definitely give a path to compare the sealing abilities of the materials. This elusive ability to prevent microleakage demands controlled clinical studies, which will draw the conclusion about the micromechanical bond and its strength between the fissure sealant and tooth structure [18].

Conclusions

The results observed in the present study suggested that Seal-it was the best material amongst three different materials in terms of least microleakage. Helioclear F gave the promising results where as GCP Glass Seal was the least successful pit and fissure sealant material.

Recommendations

1. The use of glass seal should be according to manufacturer instructions and no need for acid etching before its application.
2. Further studies are needed to evaluate the sealing ability of different sealing materials *in vivo*.

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