Comparison of Micro Leakage of Two Pit and Fissure Sealants under Four Different Conditions (In Vitro Study)

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Dedication

This work is humbly dedicated to all my valuable treasures in life:

My beloved father, *the one Allah has covered him with prestige and dignity, I carry his name proudly, his words are stiff shining such as stars to guide me today, tomorrow, and in the future.*

My beloved mother, *the meaning of love and tenderness, the smile of life, the secret behind my success, the most, the most beloved among off all love.*

My brother and sister, *those who supported, encouraged and eased the difficulties of my study through their words and feelings.*

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List of Abbreviations

Abbreviation	Abbreviation for
RBS	Resin based sealant
GIC	Glass ionomer cement
RM-GIC	Resin modified-glass ionomer
RB	Resin Based
Ca	Calcium
P	Phosphorus
G V Black	Greene Vardiman Black
DD instrument	DIAGNODent instrument
FOTI	Fiber-optic trans-illumination
DIFOTI	Digital imaging fiber-optic trans- illumination
QLF	Quantitative light-induced fluorescence
OCT	Optical coherence tomography
ADA	American Dental Association
AAPD	American Academy of Pediatric Dentistry
BIS-GMA	Bisphenol Glycidymethacylate
UDMA	Urethane Di-methacrylate
CAs	Cyanoacrylates
hrs	Hours
nm	nano-meter
Fig	Figure
PMRC	Poly- acid modified resin composite
CPP-ACP	Casein phospho peptides-amorphous calcium phosphate
ACP	Amorphous calcium phosphate

Abbreviation	Abbreviation for
BPA	Bis-phenol A
min	Minute
s	Second
Mm	Millimeter
GI	Glass ionomer
FDC	Fuji Triage under dry condition
FWD	Fuji Triage under water contamination condition
FSD	Fuji Triage under saliva contamination with air – drying condition
N	Number
FSC	Fuji Triage under saliva contamination
IDC	Ionoseal under dry condition
IWD	Ionoseal under water contamination condition
ISC	Ionoseal under saliva contamination condition
ISD	Ionoseal under saliva contamination with air –drying condition
SD	Standard Deviation
Er:YAG laser	Erbium-doped yttrium aluminium garnet laser
HR	High Risk
LR	Low Risk
n	Number
ISO	International Organization for Standardization
FS	Fissure Sealant
^{0}C	Celsius
USA	United States of America

Introduction

Dental caries is a major oral health problem in most arab league countries, and it is affecting deciduous teeth more than permanent teeth. Tooth surfaces with pits and fissures are particularly vulnerable to caries development [1,2].

The susceptibility of these surfaces can be explained by the presence of deep pits and fissures, which are difficult to clean by routine tooth brushing leading to plaque accumulation to the extent that the enamel does not receive the same level of caries protection from fluoride as does smooth surface [3].

Pit and fissure sealing is commonly used measure to prevent occlusal caries, since it is a safe, viable, and effective method. The role of school-linked fissure sealant delivery programmes at reducing caries in pits and fissures of children's teeth was reported in many studies [4,5].

There are many types of materials used as pit and fissure sealants. The most commonly used material is the resin based sealant (RBS). The development and improvement of glass ionomer cements (GIC), many authors have proposed its use as pit and fissure sealant. GIC obtains further preventive effect due to the presence of fluoride inside their composition [6-8].

Different types of fissure sealants have been investigated and it is a clear fact that the clinical retention of sealants was found to be the factor of highest impact on caries prevention. The key for success of the sealant retention is depended upon achieving a good isolation.

Resin based sealants application is particular sensitive to moisture. The use of glass ionomer sealant has been advocated for situations in which moisture control may be difficult [9-11].

Many studies have suggested that the use of adhesive systems could be improving the effectiveness of sealants placed in fissures after different contamination circumstances**;** however this will add more clinical steps which are inconvenient particularly with children [12-15].

Considering the difficulty of obtaining isolation in young children, several advancements in dental materials chemistry and adhesion have potential for sealant success. Many of these materials are new enough that a little clinical data, others have proven benefits [9].

We conducted our study to compare between the resin modified glass ionomer cement (Fuji Triage) and the resin reinforced glass ionomer cement (Ionoseal) under four different conditions (dry condition, water contamination, saliva contamination and saliva contamination with air drying).

Review of literature

Dental caries remains as one of the most widespread disease of humankind. It is the most common chronic childhood disease. Caries in children begins shortly after eruption of the deciduous teeth. It progresses rapidly and has lasting detrimental impact on the dentition [16].

Considering the fact that occlusal surfaces contributed only 12% of the total number of tooth surfaces, it means that the pit and fissures are approximately eight times as vulnerable as the smooth caries. At present, the maintenance of an oral hygiene in conjunction with the fluoride therapy and prudent use of pit and fissure sealants seems to be the best preventive strategy [16].

Dental caries:

Dental caries is a multifactorial disease. The four main factors associated with dental caries are microorganism, substrate (diet), host (tooth) and time (duration). Beside the main factors there are many factors that influence the outcome of the disease such as biological factors (the composition and flow rate of saliva and the availability of protective substances as fluoride), personal and behavioral factors (oral hygiene , poor habits, poverty, social status and education) [17,18].

The disease occurs in the crown (coronal caries) and the root (root caries) portions of primary and permanent teeth. The susceptibility of host/tooth structure to dental caries can be divided into [19,20]:

1) **Morphological characteristics:** deep, narrow occlusal fissures, buccal pits of mandibular molars and palatal pits of maxillary

incisors and molars tend to trap food debris and bacteria, which can cause caries. As teeth get attrition, caries declines. The smooth surface caries less favorable site for plaque attachment. Plaque usually attaches on the smooth surfaces that are near the gingiva or under proximal contact.

Occlusal fissures are classified into five types U, V, Y, I, IK based on fissure morphology. The shallow wide V and U shaped fissures are wide, self-cleansing, and somewhat caries resistant. The deep narrow Y, IK and I shaped fissures are more susceptible to caries [(21)]. (fig. 1)

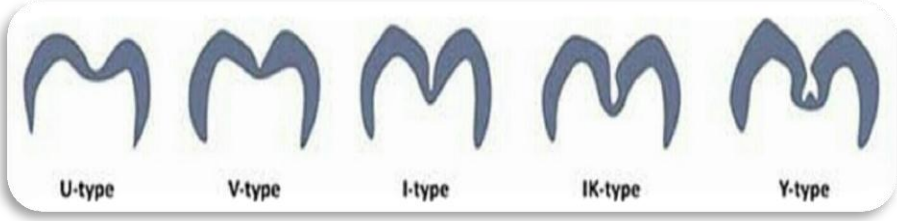

Figure (1): *Diagram showing different shapes of occlusal fissure* [(21)].

2) **Position:** Posterior teeth are more susceptible to dental caries compare to anterior. Malalignment teeth (crowding and abnormal spacing) increase the susceptibility to caries.

3) **Composition**: deficiency of calcium (Ca), phosphorus (P), fluorine, zinc, lead and iron content of enamel increase the occurrence of dental caries.

Many researchers concluded that highest risk of caries development is during the first five years after tooth eruption as this tooth has no antagonist contact, easy plaque accumulation due to

difficult access for cleaning procedures especially in molars and incomplete maturation of enamel [22].

Diagnosis of dental caries:

Caries diagnosis is an important process and can be considered as a three-step procedure; first detection of the lesion, second assessment of the severity of the lesion and third assessment of the cavity of the lesion [23].

The first trial to diagnose pit-fissure caries came from G.V. Black, who was the first described in detail methods of visual and tactile detection of dental caries as part of an oral examination. This includes cleaning with drying of teeth and the use of explorer. Black's diagnostic methods laid the ground work for the future criteria for the detection caries [24].

Investigators have reported that the use of an explorer (probe) does not enhance the added validity or reliability. The explorer use can result in false positive diagnosis of caries in narrow and deep fissures. In addition to vigorous use of it can lead to fracture of relatively intact surface zone of enamel, produce cavitation and inhibit remeneralization [25,26].

The conventional visual and tactile examination using mirror and prope cannot detect incipient demineralization and subsurface caries so it should be supported with dental radiograph. Dental radiograph can detect subsurface caries, but it found to have minimal diagnostic value in pits and fissures because of large amounts of surrounding enamel [27].