

A Comparison of Conventional Resin Sealants and Self Etching Fissure sealant in terms of Micro leakage and Clinical Durability

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BY

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Summary:

New Advances in restorative materials which are continuous resulted in the evolution of a new self adhering flowable composite that was claimed to have the ability of bonding to enamel and dentin skipping the technique sensitive steps of bonding for composite restorations. Our study was designed to compare this self adhering flowable composite, with the conventional total etch technique for pits and fissure sealing.

The current study was composed of two corresponding, in vivo and in vitro studies. In the In Vivo study, a total of twenty patients between the ages of 6-10 were selected from the clinic of Pediatric Dentistry Department, Faculty of Dentistry, Ain shams University. All the children included in the study showed co-operation and had two sound contra-lateral lower 1st permanent molars following the inclusion criteria adopted by the study.

Using split mouth design in a child's mouth, each segment received one of the fissure sealants to be compared, i.e. 40 molars were divided into two groups each received a different type of fissure sealant. Follow up appointments, were given 24 hours, 3 and 6 month later for each patient, to evaluate the sealants. . Clinical performance was assessed by the method followed by Pereira et al.²⁹

Statistical analysis of the tabulated scores was performed, revealing the superiority of the conventional fissure sealant in comparison to self adhering fissure sealant in retention. A sudden steep deterioration in clinical performance of the self adhering fissure sealant was noticed at 3 and 6 month, where partial and total loss of fissure sealant showed up in five patients out of twenty patients.

In the in vitro study, a total of Forty two sound human premolars that were extracted for orthodontic reasons were collected from the Department of Maxillo-Facial and Oral surgery, Faculty of Dentistry, Ain shams University to be utilized in this study. The teeth were divided into two main groups (21 each) according to the type of fissure sealant used. Each of the above two main groups was sub-divided into three sub-groups (7 teeth each) according to the storage period. In each sub-group, 5 teeth were used to assess the micro leakage while the other 2 teeth

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Introduction

The term pit and fissure sealant is used to describe a material that is introduced into the occlusal pits and fissures of caries-susceptible teeth, thus forming a micromechanically-bonded protective layer cutting access of caries-producing bacteria from their source of nutrients.¹

Flowable composite is one of the materials of choice as fissure sealants because it has the ability to wet and fill the minor irregularities of the occlusal surface, pits and fissures.¹

Recently, self adhesive flowable composites were introduced into the dental market aiming to reduce bonding procedures to minimum. The use of direct, resin-based composite materials in pediatric dentistry as fissure sealants or restorations will significantly enhance the practice regarding time consumption and the ease of child management as the procedure duration will remarkably be reduced.

This therefore will increase its use in our practice, if it was proven that these types of self-adhering flowable composites will provide us with accepted bond strength and microleakage to withstand deterioration and degradation in clinical service.

Review of literature

Dental caries is a chronic infectious disease that produces lesions experienced by more than two thirds of all children. Teeth surfaces with pits and fissures are particularly vulnerable to caries development.² Ripa observed that although the occlusal surfaces represented only 12.5% of the total surfaces of the permanent dentition, they accounted for almost 50% of the caries in school children.³ This is due to the morphological complexity of these surfaces which favors plaque accumulation to the extent that the enamel does not receive the same level of caries protection from fluoride as does the smooth surfaces.⁴

The plaque accumulation and caries susceptibility are greatest during the eruption of molars as proven by Carvalho et al. in 1989.⁵ It was also shown by Brown et al. in 1996⁶ and Kaste et al. in 1996⁷ that in fluoridated communities 90% of dental caries is exclusively pit and fissure caries. Pit and fissure sealants were first introduced in 1971 as a result of Buonocore's work; a material that is introduced into the occlusal pits and fissures of susceptible teeth, thus forming a micro mechanically-bonded, protective layer cutting access of caries-producing bacteria from their source nutrients.⁸ Pits and fissure sealants were utilized heavily in 1980s, both in community programs and in private practice because it showed effectiveness in dental caries prevention.⁹

There are different types of materials used as fissure sealants available in the market, the most frequently used are the Resin- based sealant (RBS), they are considered the material of choice as they have high retention rates and a proven cariostatic effect.¹⁰ RBS is made of an organic matrix Bis-GMA(Bisphenol A glycidyl methacrylate) resin and UDMA(Urethane Dimethacrylate) and may contain inorganic filler such as glass, quartz differing in amount and quality of this filler in the overall material composition. Clinical studies have reported that the ability of resin sealants to control the initiation of occlusal caries is limited to the formation of a physical barrier. This barrier prevents the metabolic exchange between the fissure cariogenic microorganisms and the oral environment.¹ Placement of resin based fissure sealants is technique sensitive, therefore it is not indicated in situations where moisture isolation cannot be performed which may result in sealant failure. Different types of resin sealants were introduced, according to filler content, fluoride release, and mode of polymerization.

Penetration of RBS was found to be inversely proportional to the viscosity of the sealant which depends on its filler content, thus it could be reasoned that an unfilled resin will penetrate deeper into fissure systems, than filled resin and therefore perhaps be better retained.⁸ Regarding fluoride releasing sealants some studies found that it couldn't act as a reservoir for fluoride it just gives a burst effect for few days.¹¹ Other studies mentioned that fluoride releasing sealants may affect the retention rates¹² while others denied that retention could be affected due to fluoride release.¹¹ Different polymerization modes found not to affect the retention rates.¹³

Glass ionomers (GIC) have been used as pits and fissure sealants due to their biocompatibility to dental tissues and anticariogenic properties due to its fluoride release action. Clinically GIC's revealed lower retention rates when applied as occlusal sealants.¹⁴⁻¹⁵ Lower retention rates shown by conventional GIC was explained by the fact that this material shows low resistance to surface wearing when subjected to occlusal forces. However GIC still showed caries prevention effect in the sealed first molars, due to the material remaining in the deepest parts of the fissure, even when the sealant was visually lost.¹⁶ The cariostatic effect has been attributed to the continuous release of fluoride by the ionomeric materials used as occlusal sealants.¹⁷

Resin- modified glass ionomer (RMGI)cements presented better properties due to the incorporated resin matrix, and increasing the working time, some studies show better retention rates than conventional ionomers,¹⁸ while other studies show poor retention.¹⁵

Poly-acid modified resin-based composites, (PMRC, Compomers) have been used as pit and fissure sealants, combining some of the best properties of composites and glass ionomers. When compared to conventional GIC, they showed better adhesion to enamel, lower solubility and lower dehydration susceptibility. The greatest disadvantage is that the material showed significantly lower fluoride release.¹⁹

It was clearly stated in many studies that the effectiveness of pit and fissure sealants depends heavily on the retention. Retention of pit and fissure sealants is affected by many different factors like, type of material, method of adhesion, etching time, isolation, type of bond and occlusal surface treatment. Long-term retention of pit and fissure sealants is essential for their success.²⁰ It is generally believed that, if the adhesion property of the sealant material is

high, the retention of sealants is secured. If the length of retention is considered as the outcome variable for the success of sealants, there is no doubt that resin-based materials score the highest of the materials that have been used to seal pits and fissure.²¹

Resin based fissure sealants showed better retention rates, but their application is technique sensitive. Years of research have been dedicated to improve the bonding strength and clinical retention periods.

I) Clinical Performance of fissure sealants

It was clearly revealed in a 5 year study performed by Horowitz et al.²² that the longer the pits and fissure sealant is retained, the more it is effective in preventing caries in sealed tooth surfaces. Factors that may affect the clinical retention period of fissure sealants were predicted to be the type of materials, bonding technique, etching time, and different enamel surface treatments which have been investigated by a number of studies.

Weerheijm et al. in 1996 compared the retentive qualities of two glass ionomers, it was found that a glass ionomer cement restorative material is more retentive than that the glass ionomer cement sealant material and there was hardly any caries reduction after two years from application of glass ionomer sealants.²³

A review of the literature on glass ionomer fissure sealants which was presented by Simonsen R. in 1996 revealed that resin based fissure sealants showed better retention rates than glass ionomers but still Caries prevention benefit from the use of glass ionomer sealants or resin sealant is equivocal.²⁴

There is a clear evidence of the reduction of caries incidence with satisfactory placement of resin based fissure sealants.²⁵ Beiruti et al.²¹ mentioned in a study of one hundred and three school children that the relative risk of caries with Glass Ionomer cements (GIC) compared with Resin based sealants (RBS) was slightly higher, it was also found that the longer retention of fissure sealants results in better protection from caries therefore resin based fissure sealants showed better results.

Polyacid-modified resin composite material (PMRC), (Dyract, Dentsply) performance in minimally invasive occlusal cavities and its neighboring fissures were evaluated in a clinical study for three years long. One hundred and sixteen restorations of the material investigated were placed by a single operator in a group of selected children under controlled conditions. Isolation of the restorations was accomplished with the use of cotton rolls and aspiration. The primer used was Dyract PSA primer (Dentsply, Konstanz, Germany), no etchant was used. The restorations were reviewed clinically within 1 week of placement to obtain baseline data, and thereafter at 6 months, 1, 2 and 3 years. In this clinical study, the tension rate of the tested PMRC material was good, although a marked occlusal wear was evident. The marginal adaptation of the PMRC at the enamel site would probably have been better by the use of enamel-etching. Provided that marginal adaptation and wear resistance of the material is further improved, clinical use of PMRCs in minimally invasive occlusal cavities can be advocated.²⁶

De Luca-Fraga LR et al. in 2001 evaluated the clinical performance of glass-ionomer /resin-based hybrid materials used as pit and fissure sealants. Hundred children received two types of sealants, each randomly assigned to either left or right side of the mouth, polyacid-modified resin composite and resin-modified glass-ionomer sealant. It was found that the hybrid materials were able to control occlusal caries. Polyacid-resin modified composites showed better retention rates than resin-modified glass ionomer sealants.²⁷

Autio-Gold JT evaluated clinical performance of a medium-filled flowable restorative material as a pit and fissure sealant. Thirty two children with fully erupted, caries free first and second permanent molars were included in the study. Medium filled flowable restorative material did not perform better in terms of retention rate or caries increment compared with unfilled conventional sealants.²⁸

Pereira Ac et al.²⁹ conducted a three year clinical study of glass ionomer cements used as fissure sealants. A total number of hundred children with 400 permanent first molars received conventional glass ionomer sealants and resin-modified glass ionomer sealants. The resin-modified glass ionomer sealants showed higher retention rates accompanied with lower caries incidence than the conventional glass ionomer sealants.

A two year clinical follow-up to compare two fissure sealants was performed by Yildiz E et al. in 2004, based on the results of this study, the application of fissure sealants has shown to be highly effective in preventing caries in a young adult population, and reduction of caries development is more related to the quality of sealant retention than to the content of the material.³⁰

Poly-acid modified resin composite-based fissure sealants were compared to conventional sealants by Gungor et al in 2004³¹, there was no statistical significance neither in retention rates nor in caries development. It was concluded that the use of Poly-acid modified composites on permanent molars was clinically comparable to conventional resin based fissure sealants for the 24 month evaluation period.

A one year randomized, controlled trial comparing the retention of a flowable composite system with a conventional sealant was performed by Corona et al.³² Forty children with 160 sound caries-free, fully erupted first or second primary molars and first permanent molars with deep and retentive pits and fissures were included in the study. A split mouth design was performed. It was concluded that flowable restorative system yielded optimal retention for both primary and permanent molars and its retention rate was significantly higher than that of the conventional pit and fissure sealant on primary teeth.

Pardi V. and Pereira AC. evaluated the clinical performance of three different materials used as pit and fissure sealant in a 24 months long study. One hundred and thirteen school children with 356 permanent molars with no previous filling, sealant or evidence of caries were included in the study. Each child received one of the fissure sealant, Vitremer (3M ESPE), Revolution (Kerr) or Dyract flow (Dentsply International). The retention rate was evaluated after 6 12 and 24 month. It was found that all the three materials were effective in preventing occlusal caries but the flowable composite showed the most satisfactory retention throughout the period of the study.³³

A study was performed in 2007 to assess clinical efficiency of composite materials and glass-ionomer cements as pit and fissure sealants in caries prevention. The study compromised 50 patients (141 teeth), both genders, 6-7 years old with at least two erupted non carious first

permanent molars. Materials tested in this study were two composite materials (Heliobond and Heliobond-Trans- parent) and two glass ionomers (Fissurit and Fuji VII). The obtained results showed no statistically significant differences among materials in respect to retention, marginal adaptation, discoloration and secondary caries. The difference was significant in respect to surface roughness between Fuji VII and Fissurit and Fuji VII and Heliobond-Opak. It was concluded that sealant Heliobond-Opak and glass-ionomer Fuji VII showed better clinical results in respect to all tested parameters compared to Heliobond- Transparent and Fissurit.³⁴

Retention of three fissure sealants and a dentin bonding system was evaluated for 12 months in a study conducted by Pilar B et al.³⁵ A Comparison in terms of retention between the three fissure sealants (Delton®, Delton Plus® and Concise®) and a filled dentin bonding system (Optibond Solo®). Fifty-six children aged 7-8 years received fissure sealants either in the four permanent first molars, in the four deciduous second molars, or in all eight of these teeth. Every child received a different sealing material in each quadrant on a random basis. Clinical evaluation at 12 months was performed by a single blind examiner, and the retention was classified as either a success (total retention) or a failure (partial retention or not present). Results revealed no statistically significant differences among the four materials in permanent maxillary molars or deciduous molars. In permanent mandibular molars, Optibond Solo® showed lower retention rates which were significantly different to that of Delton, Delton Plus and Concise. It was concluded that One bottle dentin bonding system used as a sealant does not improve the retention of conventional fissure sealants.

A study evaluated the retention of glass ionomer used as a fissure sealant when compared to a self-cure resin-based sealant. One hundred and seven children between the ages of 6-9 years, with all four newly erupted permanent first molars were selected. Two permanent first molars on one side of the mouth were sealed with Delton, a resin-based sealant, and the contralateral two permanent first molars were sealed with Fuji VII glass ionomer cement. Evaluation of sealant retention was performed at regular intervals over 12 months, using Simonsen's criteria. At the end of the study period, the retention of the resin sealant was seen to be superior to that of the glass ionomer sealant.³⁶