Evaluation of Dyad Flow as a Pit and Fissure Sealant: An In-Vitro Pilot Study

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ABSTRACT

Aims and objectives: The aim of this *in vitro* study was to evaluate self-adhering composite Dyad flow (Kerr, USA) as a pit and fissure sealant. The objectives were to assess the degree of microleakage with self-adhering composite Dyad flow and that with Fissurit F as pit and fissure sealants and, to compare the same between these two materials. **Materials and Methods:** 20 premolars extracted for orthodontic purpose with intact occlusal surfaces were selected for the study. These were divided randomly into two groups, group A and group B, of 10 teeth each where Fissurit F and Dyad flow were used respectively as pit and fissure sealants. After enameloplasty was carried out, respective sealants were applied to the teeth of both the groups according to the manufacturers' instructions. The teeth were then thermocycled and subjected to 1% methylene blue dye penetration for 24 hours, and sectioned mesio-distally. Microleakage was evaluated by observing degree of dye penetration under a stereomicroscope, and data was subjected to statistical analysis, using Mann-Whitney U test. **Results:** The results showed that the difference in scores of microleakage between Fissurit F and Dyad flow was not statistically significant. **Conclusion:** The conclusion of this in vitro pilot study was that both, Fissurit F and Dyad flow performed similarly as a pit and fissure sealant when evaluated in terms of microleakage. Thus, Dyad flow could be further evaluated in terms of clinical parameters as a pit and fissure sealant.

KEYWORDS: Fissurit F, Dyad Flow, Microleakage, Pit And Fissure Sealant, Self-Adhering Composite

INTRODUCTION

The occurrence of dental caries, especially along the pits and fissures on occlusal surfaces of primary and permanent teeth, has been a major cause for concern. The preventive strategies that have been implemented over the years to combat this, involved methods such as blocking off the susceptible fissures with zinc phosphate cement[1], mechanical fissure eradication[2], prophylactic odontodomy[3] and chemical treatment with silver nitrate.[4] Ingenuity in this effort against fissure caries continues, with new materials and technologies being tested each year. When Buonocore in 1955[5] described acid etch bonding to enamel as a new technology, it was employed in the form of resin sealants for the first time in the prevention of pit and fissure caries.

Simonsen has described pit and fissure sealant as 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.[6]

The caries-preventive effect of pit and fissure sealants was demonstrated in the 1970s and 80s by conducting randomized clinical trials where parallel groups or split-mouth designs were used. In these studies[7,8,9], tested materials in treatment groups were ultraviolet-activated, auto-polymerized or light-cured resin-based sealants (RBS) while control groups did not receive any sealant. Compared to glass ionomer cement (GIC) sealants which were introduced as an alternative[10], resin based sealants had better caries-preventive effect in the long term because of their higher retention rate. [11, 12] GIC has therapeutic advantages of releasing fluoride. It can exert a cariostatic effect and for this reason, GIC is more of a fluoride vehicle rather than traditional fissure sealant.[13]

Numerous clinical studies have documented the efficacy of pit and fissure sealants in caries prevention, with sealants' retention being the primary factor in the continued efficacy (Rock and Bradnock 1981). [13] Similarly, the marginal sealing ability of pit and fissure sealants is also critical for effective treatment outcomes. Improper marginal sealing causes marginal leakage, allowing the passage of bacteria, fluids, and ions at the interface of the tooth and the sealant, thus resulting in occurrence of dental caries underneath the sealant. [14] Thus, the success of pit and fissure sealants largely depends upon the long-term retention and tight micromechanical adhesion to enamel surfaces.

Flowable composites are resin composites that have less filler loading and/or a greater proportion of diluent monomers in the composite formulation. They are

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purported to offer higher flow, better adaptation to the internal cavity wall, easier insertion, and greater elasticity.[15] Fissurit F is one such flowable composite that has conventionally been used as a pit and fissure sealant.[16]

Dyad flow is a self-adhering flowable composite manufactured by Kerr, USA, which combines the resin technology of composites and adhesives into one by incorporating the bonding agent i.e. acidic adhesive monomer into the flowable composite itself. It is claimed to rely on the chemical and micromechanical interaction between material and tooth structure or other substances.[17] Owing to the novelty of this material, the present study was undertaken with the aim of evaluating Dyad flow as a pit and fissure sealant.

The objectives of this study were to assess the microleakage using Fissurit F and Dyad flow as pit and fissure sealants in vitro and to compare the same.

MATERIALS AND METHODS

The sample of 20 premolar teeth was obtained from among the patients requiring extractions of these while undergoing orthodontic treatment. After extraction, these teeth were selected for the study based on the following inclusion and exclusion criteria:

- **Inclusion Criteria:**
  - ✓ Teeth with intact occlusal surface

- **Exclusion Criteria:**
  - ✓ Teeth with developmental defects
  - ✓ Teeth with occlusal surface involving caries
  - ✓ Teeth with extensive loss of crown structure due to caries or trauma

Twenty premolars selected for the study were assigned to two groups, A and B by simple random sampling, with each group consisting of 10 teeth. Fissurit F (VOCO, Germany) was applied to teeth in group A, and Dyad flow (Kerr, Sybron dental specialties, USA) was applied to teeth in group B, as pit and fissure sealants, according to the manufacturers' instructions.

This collected sample of 20 extracted premolar teeth was first cleaned with an ultra-sonic scaler to remove local factors, disinfected with 10% formosaline for 10 minutes and then stored in distilled water until required for the next step of the study. The apical end of the teeth was sealed with nail varnish to prevent dye penetration apically.

Enameloplasty was carried out using a No.2 tapered fissure bur (Mani, India).[18] The etchant (37% phosphoric acid) was applied for 20 seconds to the prepared fissure[19] and was rinsed away thoroughly with water. The surface was air-dried for 5 seconds. Fissurit F was applied to the teeth in group A, and Dyad flow was applied to the teeth in group B directly from the syringe supplied by the manufacturer. Excess material was removed using the brush provided by the manufacturer. The material was cured using the UV light for 20 seconds. The samples were subjected to thermocycling (500 cycles, dwell time: 15 seconds, 5°C and 55°C) using Thermocycling unit LG Model 051SA [Figures 1a and 1b].

Figure 1a: Thermocycling unit. LG Model: 051SA

Figure 1b: Tooth samples in the Thermocycling unit

The teeth were then placed in 1% methylene blue dye for 24 hours at 37°C. After they were removed from the dye solution, the teeth were cleaned and sectioned mesiodistally through the sealed fissures using a diamond disc mounted on a straight handpiece.

The sections were then observed under the stereomicroscope with a magnification of 10 X (model number: XTL 3400E) [Figure 2] to check for the presence and degree of microleakage.

The degree of marginal leakage was determined as per the criteria described by Al-Jobair A (2010) which is as described in the given diagram [Figure 3].[20] As shown in the diagram of buccolingual section of a premolar tooth, illustrating the degree of microleakage in a sealed fissure (S= sealant), the scores are as follows

- 0= no dye penetration visible
- 1= dye penetration up to the half of the fissure
- 2= dye penetration more than half of the fissure

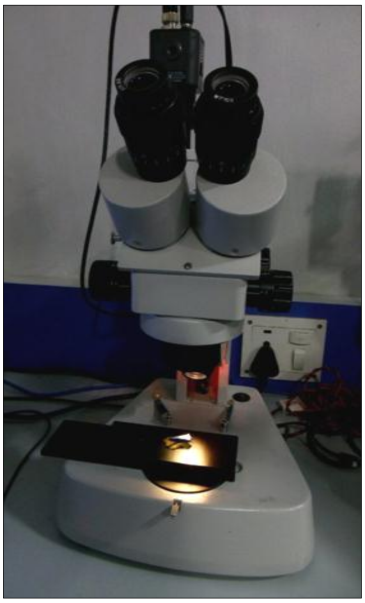


Figure 2: Stereomicroscope Model: XTL 3400E

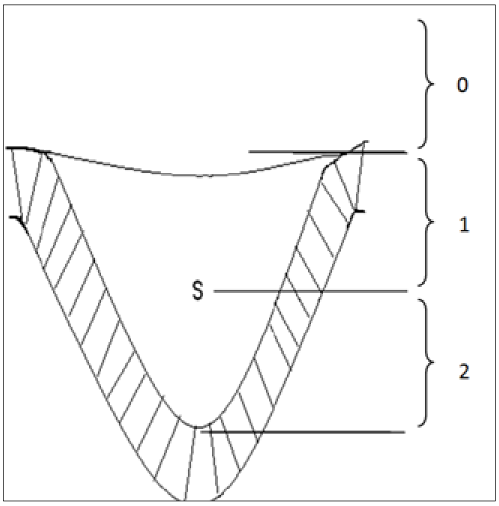


Figure 3: Degree of marginal leakage as per the criteria described by Al-Jobair A

The sections observed under the stereomicroscope to check for the presence and degree of microleakage, were then scored using an Image Analysis system (Chroma Systems Pvt. Ltd., India Model: MVIG2005 [Figure 4].

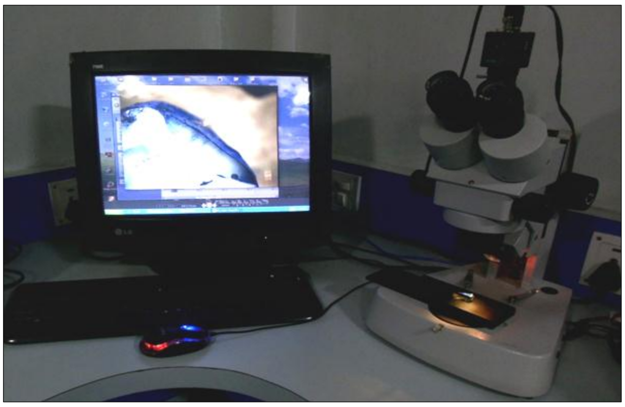


Figure 4: Image Analysis system Make: Chroma Systems Pvt. Ltd., India. Model: MVIG2005

RESULTS

The number of samples from each of the groups A and B, showing scores of 0 [Figure 5a], 1 [Figure 5b] and 2 [Figure 5c] for the degree of dye penetration were counted and tabulated as shown in Table 1. The microleakage scores for each sample from both the groups A and B is depicted in graph 1.

Figure 5a: Score 0: no dye penetration visible

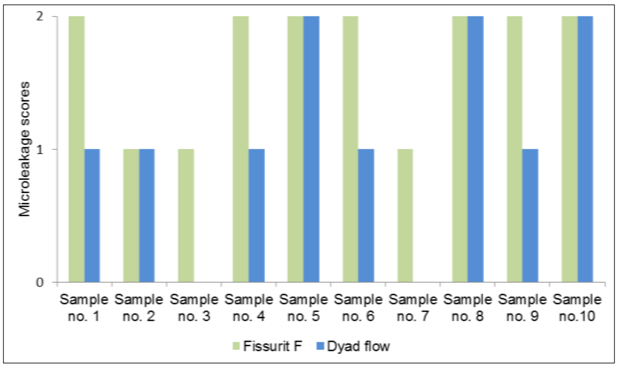
Figure 5b: Score 1: dye penetration up to the half of the fissures

Figure 5c: Score 1: dye penetration more than half of the fissures

Based on these results, 20% of the samples where Dyad flow was used as a sealant showed a score of ‘0’, i.e.,

Score	Dye penetration	Group A (Fissurit F)	Group B (Dyad flow)
0	no dye penetration visible	0	2
1	dye penetration up to the half of the fissure	3	5
2	dye penetration more than half of the fissure	7	3

Table 1: Number of samples in each group having particular score



Graph 1: Individual sample microleakage scores for both groups

there was no dye penetration indicating no microleakage. Scores of '1'indicating dye penetration up to the half of the fissure were seen in 30% and 50% samples which received Fissurit F and Dyad flow respectively. Maximum microleakage, with dye penetration up to more than half of the fissure, was seen with 70% of samples sealed with Fissurit F while only 30% of ones with Dyad flow showed such scores.

The results appeared to show better performance, i.e., lesser microleakage/dye penetration scores with Dyad flow. However, the difference in cumulative dye penetration scores of Dyad flow and Fissurit F was not statistically significant.

Statistical analysis of the tabulated data was done using SPSS. Scores were analyzed using Mann- Whitney U test. The probability value was set as, $P < 0.05$ as significant. P value was calculated as 0.089 i.e. < 0.05 as not statistically significant.

DISCUSSION

Pit and fissure sealants are an important adjunct to the prevention of dental caries. The ideal requisites of a pit and fissure sealant include biocompatibility, retention, and resistance to abrasion and wear. [14] Optimal bonding of the sealant with enamel is also very important since microleakage at the tooth-material interface can lead to treatment failure.[14] The effectiveness of a sealant as a caries prevention measure depends on its retention rate in the oral environment, which in turn, depends on its bonding to the tooth structure.[21]

In the present exploratory study, the microleakage using Fissurit F and Dyad flow as pit and fissure sealants (in vitro) was evaluated and compared with each other.

Fissurit F has been studied as a pit and fissure sealant and found to be effective in comparison with Conventional pit and fissure sealants.[22] It bonds micromechanically to the tooth structure and has shown good retention rate.[22]

Dyad Flow, which is a relatively new material introduced by Kerr, USA was evaluated as a sealant, as there are no studies reporting its performance as one. According to the Technical Bulletin Kerr/35104 (2010), Dyad Flow has GPDM (Glycerol Phosphate Dimethacrylate) adhesive monomer. It has an acidic phosphate group and two methacrylate functional groups for copolymerization with other methacrylate monomers to provide increased crosslinking density and enhanced mechanical strength for the polymerized adhesive.

The type, proportion, and size of each filler particles are carefully chosen for optimized wetting, mechanical strength, and polishability. Dyad Flow consists of four filler types: a prepolymerized filler, a 1- micron barium glass filler, a nanosized colloidal silica, and a nanosized Ytterbium fluoride. The average particle size of Dyad Flow is 1 micron. The pre-polymerized filler (PPF) enhances the handling characteristics of the material, making it smooth and easy to manipulate, thus allowing better flow along pits and fissures.

It was recognized early in the development of the acid etch technique that isolation was a very critical element for the successful application of a pit and fissure sealant. There is significant reduction in bond strength if the enamel, contaminated with saliva, is not washed off thoroughly. [23] Saliva produces an organic film that can penetrate into the enamel microporosities created by acid etching and, thereby interfering with the bonding of the sealant material into the etched enamel. [24] Their clinical limitation is in the difficulty of handling the resin sealant in a moist environment. Even when stringent moisture control procedures are attempted during clinical sealant application, contamination can occur, and these contaminations are the likely cause of the sealant failure. Saliva contamination of etched enamel surface before sealant placement is cited as the most common reason for sealant failure.

In the present study, the Fissurit F and Dyad flow, however, were compared only with respect to marginal leakage under different contamination conditions. However, to study the effectiveness of a sealant, other parameters such as long-term retention, shear bond strength and its integrity must be considered when comparing both materials. Nevertheless, despite its limitations, this study provides some data to support further research into the use of Dyad flow as a pit and fissure sealant in pediatric dentistry.

After etching, conventionally, a bonding agent is used, with the aim of improved micromechanical retention, and less or no microleakage. However, use of a bonding agent adds one procedural step which increases time and also increases the chances of contamination, especially in pediatric patients where patient co-operation is a critical factor.

The advantage of using Dyad flow, like Fissurit F, is that it does not require any bonding agent. According to the Technical Bulletin Kerr/35104 (2010), Dyad Flow has GPDM (Glycerol Phosphate Dimethacrylate) adhesive monomer. It consists of a phosphate functional group that creates a chemical bond with the calcium ions of the tooth. GPDM monomers ensure a tenacious bond to both enamel and dentin, evidenced by the strength known to all generations of the OptiBond adhesive family. A GPDM adhesive monomer acts as a coupling agent. On one hand, it has an acidic phosphate group for etching the tooth structure and also for chemically bonding to the calcium ions within the tooth structure. These properties are probably responsible for few samples showing absolutely no dye penetration (microleakage score: 0) with Dyad flow.

The findings in the present study disclosed that there was no statistically significant difference between microleakage of Fissurit F and Dyad flow when used as a pit and fissure sealant. Both the materials performed similarly in terms of bonding to the tooth structure. It can be speculated that Dyad flow (Kerr, USA) which is a self-adhering composite can prove as an effective alternative to conventional pit and fissure sealants.

CONCLUSION

In the present study, microleakage scores of Fissurit F and Dyad flow were found to be similar. Thus, both the materials performed similarly when used as a pit and fissure sealant in terms of bonding to the tooth structure.

Thus, Dyad flow (Kerr, USA) which is a relatively newly introduced self-adhering composite could be used in place of the conventional pit and fissure sealants. Further research with a larger sample size and in vivo studies need to be carried out to further confirm the effectiveness of Dyad flow as a pit and fissure sealant.

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