A Comparative Analysis of Penetration and Adaptation of Two Types of Light Cure Pit and Fissure Sealants: An In-vitro Study

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This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Pit and fissure sealants are well-known for their ability to prevent occlusal caries. Given the difficulties of maintaining complete isolation for longer periods of time when treating young patients, a streamlined sealant application process is needed. As a result, the goal of the present study is to compare the penetration and adaption of 2 types of light cure sealants.

Objectives:
1. To evaluate the adaptation and penetration of Conseal f ‘pit and fissure sealant’.
2. To evaluate the adaptation and penetration of PF seal SE ‘pit and fissure sealant’.
3. To evaluate comparison of adaptation and penetration between two types of light cure sealants.

Methodology: This will be an in-vitro comparative study, which will consist of 2 categories - Group I (acid-etch fissure sealant, Conseal f) and Group II (self-etch fissure sealant, PF seal SE). A total of 20 extracted permanent teeth will then be classified into 2 groups of 10 teeth respectively and stereomicroscope will be used to compare the penetration and adaptation between two types of light cure pit and fissure sealants.

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**Expected Results:** The study will evaluate the penetration and adaptation of two types of light cure sealants on the tooth surface which will provide the efficacy of the sealant.

**Conclusion:** The study will determine the sealing and penetration and adaption capacity of the sealant by the light cure method. And the sealants are beneficial and biocompatible in preventing, stopping the advancement of non-cavitated carious lesions. Additional study is needed to determine the relative advantages of the various categories of sealant material. In practice, the benefits of sealing should be examined locally, and practitioners should follow specific standards.

**Keywords:** Pit and fissure sealants; caries; penetration; adaptation; Conseal f; PF seal SE.

### 1. INTRODUCTION

“Dental caries is defined as a multifactorial microbial infectious disease characterized by demineralization of inorganic and destruction of the organic substance of the tooth.” (Shafer) Pits and fissures are ideal sites for food lodgment and bacterial retention which makes the area inaccessible to clean. According to Nagano (1961), occlusal fissures are divided into five types based upon morphology – IK, inverted Y, V, U, and I. These caries susceptible sites should be sealed for the prevention of caries [1-3].

The effectiveness of 'pit and fissure sealants' in the prevention of caries, especially in people at more risk for caries, is time-proven and well-supported by the literature. The sealant's rate of success, however, depends primarily on the capability to avoid buildup, as well as the acidic products. For the operation to be a good one, the sealant's adhesion to the surface of the tooth is therefore very necessary. The traditional and common technique used over time to help resin sealants stick securely to the expected pits and fissures is the etching of the tooth enamel with phosphoric acid [1]. The inadequacy of fissure sealants is mostly caused by insufficient isolation and saliva contamination of the etched enamel [4-6].

Etching is a very important step in achieving a successful bond during any adhesive operation. The strength of the bond between enamel and resin depends on the pattern of etching, which promotes the creation of resin tags. Salivary contamination after enamel etching reduces the etchable area because of the development of a coating on the surface, causing the process of etching to be redone [7].

By providing reliable bonding to both enamel and dentin, the advent of the “all-in-one” solution has made dentistry using adhesives easy and effective. Interestingly, the use of the "all-in-one" adhesive method also revealed that the overall length of care was halved [8].

**Conseal f** – conseal f is a fluoride-releasing sealant. Fluoride promotes the prevention of caries, inhibition of demineralization of enamel, and remineralization. Conseal f has an optimum less viscosity, allowing it to flow quicker and deeply into ‘pits and fissures’. It's 7 percent packed with 0.04 micron, submicron filler to prevent wear of surface.

**PF seal SE** – PF seal SE is a self-etching, light-curing 'pit and fissure sealant' reinforced with active hydroxyapatite that can remineralize. The optimal balance of wear resistance and flow opacity is provided by the nano-filled material.

**Composition** – Urethane Dimethacrylate, Triethylene Glycol Dimethacrylate, acidic phosphate monomer, Silanated Barium Glass Powder Amorphous Fumed Silica, coloring agents, Curing Agents and Stabilizer.

The present study is therefore conducted to compare and evaluate the adaptation and penetration of 2 types of light cure 'pit and fissure sealant' on the tooth surface.

#### 1.1 Background/Rationale

The aim of the present study is to evaluate the adaptation and penetration of 2 types of light cure ‘pit and fissure sealants’.

#### 1.2 Objectives

1. To evaluate the adaptation and penetration of Conseal f ‘pit and fissure sealant’.
2. To evaluate the adaptation and penetration of PF seal SE ‘pit and fissure sealant’.
3. To evaluate the comparison of adaptation and penetration between two types of light cure sealants.
2. METHODS

2.1 Study Setting

The present study will be conducted in Sharad Pawar Dental College, Sawangi, Wardha. Extracted teeth will be taken from the Oral and Maxillofacial Surgery Department based on inclusion and exclusion criteria.

The crown surfaces of the chosen teeth will be cleansed with a slurry of water with fine pumice and a gently rotating rubber cup. A total of 20 extracted permanent molars and premolars will then be fairly and randomly categorized into 2 groups of 10 teeth respectively after thorough rinsing and air-drying and a stereomicroscope will be used to compare the penetration and adaptation between two types of light cure pit and fissure sealants.

Group 1 – (acid etch fissure sealant) 10 teeth will be selected and the whole area of the fissure will be etched for 30 sec with 37 percent H₃PO₄ etching gel. This will be followed by a 20-second water rinse and drying with compressed air without oil. According to the manufacturer’s instructions, a fissure sealant (Conseal f) will then be applied. The sealant material applied to teeth will be permitted to enter the fissure for 20 seconds before being polymerized with a visible light cure device for another 20 seconds.

Group 2 – (self-etch fissure sealant) 10 teeth will be selected and the sealant (PF seal SE) will be administered as per the manufacturer’s recommendations, penetrating the fissure for 20 seconds before being polymerized for 40 seconds with a visible light cure device.

2.2 Evaluation of Sealant Penetration and Adaptation

The sample teeth (10 samples in each group) will be immersed for 6 hours in a 30% nitric acid solution to dissolve and only get the sealants. The fissure will be replicated using the base of the sealant that has been obtained. The ‘replicas’ will be washed and placed on a slide using deionized water.

To check sealant penetration and adaptation properties, the stereomicroscopic analysis will be performed viz:

1. Fissure with bubbles at the bottom.
2. Fissure with debris.
3. Tags at slopes of the cusps and fissure’s entrance.
4. Tags at the fissure’s bottom.

2.3 Eligibility Criteria

Inclusion criteria - The research will be performed on 20 extracted, permanent and non-carious teeth with deep pits and fissures (molars and premolars).

Exclusion criteria - Deciduous teeth, Carious teeth, fractured teeth, attrited teeth, and restored teeth.

2.4 Variables

To check sealant penetration and adaptation properties, the stereomicroscopic analysis will be performed viz:

1. Fissure with bubbles at the bottom.
2. Fissure with debris.
3. Tags at slopes of the cusps and fissure’s entrance.
4. Tags at the fissure’s bottom.

Bias: All the potential sources of bias have been removed.

2.5 Sample Size

20 extracted teeth. 10 in each group.

2.6 Estimation of Sample Size

The given formula is used to calculate sample size:

\[ \sqrt{n} = \frac{z_{\alpha/2} \times \sigma}{E} \]

where,
- \( \sigma \) = previous expected values = 13
- \( E \) = desired Margin of error = 5
- \( z_{\alpha/2} \), confidence interval of 90%, \( z = 1.65 \)
- \( n \) = sample size

Substituting the values in the formula:

\[ (1.65)^2 \times (13)^2 \]

\[ \frac{(13)^2}{(5)^2} \]

With the above-mentioned calculation, sample size determination is 18 in number and considering dropouts, the sample size has been estimated 20. In Total 20 samples. Each group will have 10 samples.
2.7 Quantitative Variables: Based On

To check sealant penetration and adaptation properties, the stereomicroscopic analysis will be performed viz:

1. Fissure with bubbles at the bottom.
2. Fissure with debris.
3. Tags at slopes of the cusps and fissure’s entrance.
4. Tags at the fissure’s bottom.

2.8 Statistical Methods

Statistical The penetration and adaptation will be evaluated on the basis of bubbles, debris, and tags in the fissures which will be compared between the two groups using the Chi-square test adjusted by Fishers Exact. Kruskal Wallis Anova will be performed for assessing all four parameters. Intergroup comparison will be done based on Mann Whitney U test.

3. EXPECTED OUTCOMES/RESULTS

The study will evaluate the penetration and adaptation of two types of light cure sealants on the tooth surface which will provide the efficacy of the sealant.

4. DISCUSSION

Sealant retention is mostly determined by perfect isolation and exact procedure. In pediatric dentistry, quick sealant application procedures with minimum stages are preferred due to patient behavior and cooperation.

In vitro study in 2019 was conducted by Dhruv Garg et al on a comparison of scanning electron microscopic and stereomicroscopic examination of the adaptation and penetration and sealing ability of a self-etching pit and fissure sealant. This was a comparative in vitro intergroup analysis consisting of two categories: Group I (Clinpro traditional acid-etching sealant) and Group II (Self-etch sealant, Prevent Seal). Of the 32 teeth chosen, microleakage was studied using 16 teeth, using the Övrebö and Raadal parameters for dye penetration tests. To test sealant adaptation and penetration viz

1. Fissure with bubbles at the bottom.
2. Fissure with debris.
3. Tags at slopes of the cusps and fissure’s entrance.

remaining 16 were used. The relation between the groups of tested properties was performed using the Chi-square test. There was no statistical considerable difference between the 2 classes (’p=0.63 and p= 0.131, 0.131, 0.302, 0.106’ respectively) when comparing sealant adaptation/penetration and microleakage properties. While etching patterns between the groups were compared, no definitive results could be withdrawn Like traditional acid etch sealant, the study concluded that microleakage and sealant adaptation and penetration qualities were found to be identical in Prevent seal [9].

The factors, such as saliva, which affects the adaptive quality of sealants, are not included in our study because we are aiming to achieve complete isolation so that the properties of the sealants should not be decreased.

A comparative study in 2017 was conducted by Shirin Malek et al. Their aim was to evaluate the in vitro marginal integrity of RMGIC to that of resin sealant. A 1/4 round carbide bur was used to create 40 artificial pit and fissure cavities on the occlusal surfaces of extracted premolar teeth. Cavities were packed with synthetic organic waste, cleaned with a prophylactic pumice brush and paste, and then divided into 2 treatment groups. 15 fissure cavities in Group A were sealed with resin sealant, whereas 15 fissure cavities in Group B were sealed with RMGI sealant. Thermo-cycling and dye penetration tests were performed on these samples. The SEM was used to examine the remaining five cavities of each category for debris score. The microleakage test revealed that samples sealed with RMGIC sealant had better effectiveness in preventing microleakage than specimens sealed with a resin sealant. However, no apparent alterations were discovered. The study indicated that using an RMGIC sealer to fill pits and fissures is a suitable option [10].

In this study, we will comparatively evaluate the penetration and adaptation of Conseal f and PF seal SE pit and fissure sealant.

Future research on the retention and efficacy of ‘pit and fissure sealants’ in the prevention of caries in vivo is advised.

Generalizability: The study has good external and internal validity.
5. OUTCOMES

Both light cure sealants are most widely used as a preventive measure from caries, hence this study will compare the penetration and adaptation of two types of light cure sealant on the tooth surface which will provide the information of the sealant with better efficacy.

6. CONCLUSION

The study will determine the sealing and penetration and adaption capacity of the sealant by the light cure method. And the sealants are beneficial and biocompatible in preventing, stopping the advancement of non-cavitated carious lesions. Additional study is needed to determine the relative advantages of the various categories of sealant material. In practice, the benefits of sealing should be examined locally, and practitioners should follow specific standards.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline Patient's consent and ethical approval will be collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


