Clinical Aspects of Pit and Fissure Sealant - An Update

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Pit and fissure sealing is a well-established method for prevention of occlusal caries. Clinical trials reported 80-96% effectiveness in reducing occlusal caries in the first year after application, and about 60% effectiveness in the following 7-10 years (1-4). The objectives of this article are to highlight two major issues related to the use of pit and fissure sealants: clinical considerations in selecting the teeth for treatment and performing the pit and fissure sealant, and to describe a method for occlusal restoration using fissure sealant instead of 'extension for prevention'.

SELECTION OF TEETH

To maximize the benefit to the patient, it is essential to treat only those teeth at risk. Thus, careful selection of patients, teeth and materials is mandatory (5-9). Patients who are handicapped, mentally retarded, physically or socially disadvantaged, and children who have had occlusal caries in the deciduous dentition should have their permanent molars sealed.

The annual DMFS increment of occlusal caries in children 6-15 years old in non-fluoridated and fluoridated communities in the U.S. is about 0.6 and 0.5, respectively (10). Thus, in order to increase the effectiveness of the pit and fissure sealant in preventing occlusal caries, teeth requiring sealing should be treated within 4 years after eruption (5). Nevertheless, if sealants are applied later than 4 years after eruption, it may still be helpful.

Indeed, it was found that the occlusal caries rate of children aged 6.5-10 were similar to that of 13-16 years old (4, 11,12). If one first permanent molar has occlusal caries, the other three and the second molars should also be sealed (13). In general, primary molars should be sealed according to the same criteria as the permanent molars. It is clear that the presence of a proximal caries should preclude sealant placement. Premolars should be evaluated separately as the occlusal caries incidence in premolars is relatively low (4,13).

Close follow-up of occlusal caries is necessary in caries-free young individuals. A study of 120 caries-free 17-24 year old naval recruits (14) showed that during 4 years of the study, caries was detected among 37% of the individuals. Of all lesions, 90% involved the occlusal surface, of which the majority were on second molars. This study emphasized the importance of monitoring caries-free individuals, and may support the application of fissure sealants in young adults.

SEALANT APPLICATION

Fissure sealant is a technique sensitive procedure. Adherence to manufacture's-instructions is imperative. The first stages of pit and fissure sealant placement are cleaning, etching, washing and drying (15).

Ripa (16) clearly stated that pumice and water should be used for plaque and pellicle removal. Cleaning the enamel surface with pumice and water is supported by in vitro studies (17,18). Ferreria (19) and Taylor and Gwinnett (20) have shown that after cleaning, pumice particles were impacted in the fissures and could be incorporated into the sealant resin. Donnan and Ball (21) found no advantage in performing this cleaning before etching. However, it should be emphasized that the authors etched the enamel for 60 sec. The omission of the cleaning using slurry of pumice with reduced etching time of 20 sec still requires validation. When used, prophylaxis paste containing oil and/or fluoride should be avoided (22).

Following cleaning, it is recommended to dredge the fissure with a blunt probe to remove debris, thus, enabling the etching solution to penetrate the fissure (23). This procedure may be important mainly following the wear or partial loss of the sealant (23). When there is suspicion of caries in the fissure site, it is recommended to clean the site mechanically by using the smallest conventional burs, which allows direct exploration of the fissure. If there is no caries and the suspected site is restricted to enamel, the operator may continue to the etching stage. Shapira and Eidelman (24) have found that mechanical cleaning of the teeth in the fissure area resulted in a significantly higher retention rate of sealants placed on maxillary molar teeth.

It has been established that the enamel surface should be etched as reported by Buonocore (25), and confirmed

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by others (26-28). The recommended concentration of phosphoric acid to be used is 37%. Several authors have shown that the use of an etchant in gel form was as effective as liquid etching (29-31), and that there was no difference in the penetration into occlusal pits and fissures when either the liquid or gel phosphoric acid etchants were used. The inability of acid to penetrate a fissure was not dependent on the form of the acid, but on the presence of debris within the grooves (31).

The effect of etching time was studied clinically (32-34). These studies showed that the accepted etching time of 60 sec was disputable and that a 20 sec period may be adequate (34).

It is essential to dry the teeth before placing the sealant. If accidental salivary contamination occurs during the procedure, minimal re-etching (10 sec), washing and drying is necessary (35).

The retention of self-polymerized sealant was found to be significantly greater than that of light-cured sealant, one year after application (36). The reason for this difference is not completely clear. One possibility is that when placing light cured sealant, there is not enough time for the material to penetrate into the etched pores. Indeed, Chosack and Eidelman (37) found a correlation between the lapse of time from the application of the sealant until the exposure to the visible light and the tag length. Following a 20 sec lapse, the length of tags was 15.53m, as compared with a self- polymerized sealant which showed a mean tag length of 23.95 m.

SEALANT AND DENTAL CARIES

Sealed occlusal caries is a particularly difficult problem. When sealants were first used, some controversies were raised regarding the outcome of caries sealed in situ. The maxim of the 1960's was 'when in doubt, fill'. This shifted in the 1970's to 'when in doubt, watch' and later it was changed to ' when in doubt, seal' (13).

There is now ample evidence to suggest that if any material is placed over active caries, it inhibits or stops the spread of the caries (38-44). However, if there is leakage around or through the sealant, then recurrent caries is likely. This is probably the main reason for the current suggestion: 'when in doubt, do mechanical cleaning and seal'. When a small occlusal lesion is found, it is recommended to perform 'preventive resin restoration', as will be described below (45). Sealing caries in moderate or deep cavities cannot be considered a viable alternative to a cavity preparation and restoration (46).

OCCLUSAL RESTORATION USING FISSURE SEALANT INSTEAD OF 'EXTENSION FOR PREVENTION'

In traditional dental practice, cavity preparation extends into neighboring pits and fissures, including those which are not carious (47). Although extension is performed to reduce the probability of recurrent decay, sound tooth structure is usually sacrificed. Several investigators (45,48) have studied what they termed 'preventive resin restoration' (PRR) on occlusal surfaces. This is a variant of fissure sealing. In this technique, caries is removed as necessary, but no attempt is made to extend the cavity to include fissures that are not carious. The cavity is then etched and filled with composite material. Sealant is used to seal the adjacent pits and fissures. This technique has been practiced with excellent results (49-53).

The details of the technique are as follows: the toothsurface is cleaned with a rubber cup, and the carious lesion is removed with an 330 high- speed bur and round low-speed burs (when required, local anesthetic is given). The preparation consists of caries removal only. Grossly undermined or soft demineralized enamel is removed, but there is no attempt to extend into sound pits and fissure or to eliminate slightly undermined enamel. Following caries removal, calcium hydroxide base is placed over the exposed dentin, and the tooth surface is etched for 20 sec. The surface is washed and dried. Bonding agent should be used and a composite resin material, preferably light-cured, is then carefully pushed into the preparation, filling the cavity but avoiding excess. In general, the newer composites designated for posterior restorations are more wear-resistant. The sealant should then be applied according to the manufacturer's instructions. After the sealant is polymerized, it should be tested by attempting to pry it off with an explorer (54). Occasionally the sealant may be dislodged, and it should then be reapplied following re-etching of the tooth for at least 10 sec.

Caries lesions do not reoccur unless there is sealant loss exposing a susceptible pit or fissure. Resealing should therefore be performed if a partial sealant loss is detected during recall examinations. If a carious lesion develops on the proximal tooth surface, it should be treated with as little involvement of the occlusal surface as possible. Preliminary evidence indicated that there will be little, if any leakage at these amalgam/sealant interface if amalgam is used to restore the proximal lesion and the occlusal composite resin sealant is left intact (55-56). Hosada and Fusayama (57) have reported considerable success with this method. Only 4 out of 94 restorations were associated with secondary caries after 5-6 years. Walls et al. (58) have compared the efficacy of an occlusal amalgam restoration with minimal composite restoration and fissure sealant in the management of occlusal caries in young patients. After 24 months, 5 out of 72 pairs of restorations have failed, three amalgam and two composite.

This technique increases the diagnostic capability in cases of suspected occlusal caries and conserves valuable tooth structure. It is particularly recommended when occlusal carious lesions have not yet involved all pits and fissures. Unlike the traditional methods, caries-free surfaces may be preserved resulting in a stronger restored tooth.

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