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Paediatric Dentistry

PIT AND FISSURE SEALANT APPLICATION USING SELF- ETCH BONDING AGENT; A LITERATURE REVIEW

KEY WORDS: Bonding agents, self- etch, pit and fissure sealants, sealant evaluation.

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ABSTRACT

Self-etch adhesive systems may be an alternative for occlusal sealant especially in young children, where simplifications in the clinical procedures are warranted. This paper describes self- etch adhesive systems and their role in the retention of pit and fissure sealant.

INTRODUCTION

Pit and fissure sealants have been effective in reducing occlusal caries, but their effectiveness may be precluded by technique problems during application, such as salivary contamination and tissue management.[1]

The benefit of adding a dentin bonding agent between the etched enamel and sealant as a way of optimizing bond strength in the phase of moisture and salivary contamination was first reported by Hitt and Feigal in 1992.[2] In 1994, Borem and Feigal showed the use of bonding agent under sealants on contaminated enamel increases bond strength, reduces microleakage and enhances flow of resins into fissures.[3]

Self- etch Bonding agents with pit and fissure sealants

The placement of adhesive system prior to sealant application has been suggested to improve the sealant retention due to their hydrophilic characteristics.[4]

Mechanical adhesion is the main mechanism of adhesion used in fissure sealant therapy. Polymerization shrinkage of resin-based composite materials has a deleterious effect on composite adhesion and can induce gaps in adhesion. Sealant materials contain high levels of resins; thus, polymerization shrinkage has a more deleterious effect on fissure sealant retention. Also, considering the configuration factor (C-factor) in sealant therapy, the deep pits and fissures may act like a class I cavity. So, sealants will have a high level of c-factor and that the fissure sealant may experience a high level of stress owing to shrinkage. In this case, a low-elastic modulus material, such as an adhesive system, may help by acting as a stress breaker for the fissure sealant material.[5]

The adhesive technique of fissure sealing became more acceptable among Pediatric dentists when self-etching adhesive systems were introduced in the early 2000's. One of the main disadvantages of this type of system is that it uses a mix of hydrophilic and hydrophobic components in 1 bottle, making the components susceptible to the phase separation and formation of droplets within their adhesive layers.[6]

These new, one-step systems simplify the clinical bonding procedure not only by eliminating the separate etching and rinsing steps but also accomplishing the priming and the bonding of the dental surfaces simultaneously. The main advantage of self-etching adhesive systems is that they reduce the chair time and this is of great importance for treating young patients. Based on this, self-etch adhesive systems may be an alternative for occlusal sealant especially in young children, where simplifications in the clinical procedures are warranted.[7]

They have been made available since 2005.So far, a number of shortcomings of the seventh-generation adhesives have been documented but to the complex nature of the mixed solutions, they have attained consistently lower bond strengths than the fourth- and fifth generation adhesives.[8]

Self-etch adhesives can be further subdivided into 'Strong' (pH<1), 'Intermediary strong' (pH=1-2), 'Mild' (pH≈2) and 'Ultra -mild' (pH>2.5) self-etch adhesives.[8]

According to evidence-based recommendation for pit and fissure sealants,[9] utility of self- etch adhesives for sealant application and retention of light cured fissures sealants have been identified as a potential research area for generation of more evidence. There are few comparisons on the effect of etch-and-rinse and self-etch systems on clinical performance of occlusal sealants, and the results are unclear.

Table 1: In Vivo Studies That Investigated Effectiveness Of Self- Etch Adhesive Systems In The Retention Of Pit And Fissure Sealant

Study	Feigal, Quelhas22	Burbridge et al.23	Karaman et al.24	Maher et al.46	Aman et al.8	Mohammed Et al47	Unverdi et al48	Nirwan et al.49
Year	2003	2007	2013	2013	2015	2016	2016	2017
Country	USA	Scotland	Turkey	Egypt	Pakistan	India	Turkey	India
Self-etch system	Prompt L-Pop (3M ESPE, St. Paul, MN, USA)- sixth generation	Xeno III (Dentsply, Germany) sixth generation	Futurabond NR (Voco, Cuxhaven, Germany)	Adper Prompt L-Pop sixth generation	Adper Easy One (3M ESPE, St. Paul, MN, USA) Seventh generation	NA Seventh generation	Clearfil SE Bond sixth generation	Optibond Seventh generation
Control group	Phosphoric acid gel	37% phosphoric acid	Phosphoric acid gel + Solobond M	35% phosphoric acid	37% phosphoric acid + Adper	35% phosphoric acid	conventional acid-etch	without bonding agent,

		+ Prime and Bond (Dentsply, Germany)	(Voco, Cuxhaven, Germany)	(Scotchbond Etchant, 3M ESPE, St. Paul MN, USA)	Single Bond 2 (3M ESPE, St. Paul, MN, USA)		sealant, prior enamel etch + ER adhesive, prior enamel etch + SE adhesive	sixth generation bonding agent (ADPER PROMT), eighth generation (FUTURA BOND DUAL CURE)
Study design	Split mouth	Split mouth	Split mouth	Split mouth	Split mouth	Split mouth	Split mouth	Split mouth
n (molars in one group)	18	50	64	45	91	30	57	37
Mean age	7–13 years (mean 10.5)	5–13 years (mean 9.15)	18–21 years (mean 20)	4–6 years (mean 5.18 ± 0.83)	6–16 years (mean 12.7 ± 2.9)	7-13 years (mean 9.3 years)	mean age = 8.1 ± 0.7 years	6-11 years
Dentition	Permanent	Permanent	Permanent	Primary	Permanent	Permanent	Permanent	Permanent
Isolation	Cotton roll and saliva ejector	Cotton roll and saliva ejector	Cotton roll and saliva ejector	Cotton roll and saliva ejector	Cotton roll and saliva ejector	Cotton roll	rubber dam isolation	rubber dam isolation
Manufa-cturer's instructions	Sealant and adhesive were light-cured together in the experimental group	Followed manufacturer's instructions	Followed manufacturer's instructions	Sealant and adhesive were light-cured together in the experimental group	Followed manufacturer's instructions	Followed manufacturer's instructions	Followed manufacturer's instructions	Followed manufacturer's instructions
Examiner (Number, Blinded)	Two/blinded (3 in case of disagreements)	One/blinded	2calibrated/ blinded (different of operators)	One	Two/blinded	One/blinded	Two/blinded	One
Analysis instrument	Photographic images of each tooth	Visual inspection	Dental explorer and a mirror	Visual inspection - only the mirror (probe in case of doubt)	Visual inspection (opaque sealant)	Visual inspection	Dental explorer and a mirror	magnifying glass and under ambient light
Evaluation criteria	Failure (total/partial loss) or success	Color Coverage Caries Sealant Evaluation System	Completely retained, partial loss, total loss	Color Coverage Caries Sealant Evaluation System	Complete retention; partial retention; complete failure	Color Coverage Caries Sealant Evaluation System	modified United States Public Health Service (USPHS) clinical rating system	Simonsen's criteria
Follow-up	24 months	12 months	12 months	12 months	6 months	6 months	24 months	6 months
Results	Retention rates % Success: total retention SE – 61% TE-61% Failure: total or partial loss SE – 39% TE-39%	Retention rates % Success: total retention SE – 0% TE-26.3% Failure: total or partial loss SE – 100% TE-73.7%	Retention rates % Success: total retention SE – 17.2% TE-87.5% Failure: total or partial loss SE – 82.8% TE-12.5%	Retention rates % Success: total retention SE – 51% TE-64% Failure: total or partial loss SE – 49% TE-36%	Retention rates % Success: total retention SE-28.6% TE-58.2% Failure: total or partial loss SE-71.4% TE-41.8%	Retention rates % Success: total retention SE-66.7% TE-66.7% Failure: total or partial loss SE-16.7% TE-10%	Retention rates % Success: total retention SE-35% TE-88% Failure: total or partial loss SE-65% TE-12%	Retention rates % Success: total retention SE-70.27% Failure: total or partial loss SE-29.72%

SE, self-etch adhesive system, TE, total etch – conventional approach.

According to Nirwan et al.,[10] Baca et al.[11] retention of sealant was less when using self-etch compared to etching with phosphoric acid. This might be attributed to the improper enamel tags formed as conventional etching technique is not used. All-in-one self-etch systems are not as acidic as the

phosphoric acid used with the etch-and-rinse adhesives. This characteristic has raised concerns about the performance of all-in-one self-etch systems on intact enamel.[12]

Grinding the enamel during a bevel or cavity preparation, for instance, makes the substrate more receptive for bonding with all-in-one self-etch systems. As the smear layer might not be totally removed by these systems, the partially demineralized smear layer becomes incorporated into a hybrid layer. Thus, self-etching primer produces a thinner hybrid layer than systems using etchants such as phosphoric acid. Two-step self-etch adhesives may not bond as well to intact enamel.[13]

A systematic review by Botton et al.[7] was able to summarize the clinical data on different bonding approaches used for occlusal sealant application and showed that the retention of occlusal fissure sealants is higher when applied after prior phosphoric acid etching. The higher failure rates when using self-etch systems prior sealants may be related to the pH aggressiveness of these materials, because mild or ultra-mild self-etch primers may insufficiently etch the enamel, resulting in deficient resin penetration into enamel. The acidity of self-etch systems is lower than that of phosphoric acid, so these materials do not etch the enamel as effectively as phosphoric acid, especially sound enamel. For strong self-etch systems (pH approximately 1), etching depth and depth of penetration of adhesive are identical, and there were no differences in sealant retention using self-etch adhesive or a conventional phosphoric acid etching technique. This may be the basis of conflicting reports in literature.

According to systematic review and meta-analysis by Bhagerian et al.[5]the poor sealant retention in self-etching adhesives compared with etch-and-rinse adhesives can be attributed to the lesser ability of self-etching adhesives to penetrate the enamel surface, which may result in lower bond strengths. The use of adhesive systems beneath fissure sealants can increase the retention of fissure sealants. Also, when adhesive systems are used with fissure sealants, etch-and rinse systems are preferable.

CONCLUSION

Considering the global analysis, however, it can be evidenced that self-etch system could not be the ideal approach prior to pit and fissure sealants. There is no study available in the literature that had evaluated the combined effect of enamel surface pretreatment on retention of pit and fissure sealant placed with self- etch adhesive system. Despite the increased popularity of self-etch adhesives, etching with phosphoric acid is still considered the golden standard against which new materials are tested.

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