Dental Sealants Part 3: Which material? Efficiency and effectiveness

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ABSTRACT

Determining the best choice between the different sealant materials might be complicated. The products that dentists can choose have different properties, such as caries' preventive effect, fluoride release and retention rate. According to the literature, fissure sealant materials fall into two main categories: resin-based sealants and glass ionomer sealants. Even if the "fluoride-releasing resin sealants" are better than "glass ionomer", with regards to retention of the material, the literature shows that their effectiveness in preventing fissure caries in permanent molars does not differ significantly over 24 months.

Keywords *Dental sealants; Glass ionomer sealant; Resin-based sealant.*

In clinical practice, when dentists have to decide which dental sealant material to use, there are some critical points to take into account.

1. Will the sealant have the appropriate preventive effect on caries?
2. How easy is it to use/apply?
3. How long will it last?
4. Is it safe?

While for the last point a separate section will be dedicated, for the others, we should examine the different dental sealants to verify whether they meet these requirements.

According to the "Evidence-based clinical practice guideline for the use of pit-and-fissure sealants" [2016], fissure sealants fall into two broad categories: resin-based sealants and glass ionomer sealants. These two main categories can be further divided into four subclasses:

1. resin-based sealants;
2. glass ionomer sealants;
3. resin-modified GI sealants;
4. polyacid-modified resin sealants.

Resin-Based Sealants

Resin-based sealants (RBS) can be classified according to their method of polymerisation (Table 1), viscosity (Reddy et al., 2015) (Table 2) and translucency [Simonsen et al., 2002] (Table 3).

First generation

The material starts polymerisation when UV rays take action on the initiator inside the sealant; this process, however, is no longer used [Dean et al., 2016].

Manufacturers' instructions for effective placement and long-term retention of resin-based sealants typically include cleaning pits and fissures, appropriate acid etching of the surfaces and maintaining a dry field until the sealant is placed and cured [Beauchamp et al., 2008].

Furthermore, the literature suggests supplemental techniques, which include the use of bonding agents

1st generation	The material starts polymerisation when UV rays take action on the initiator inside the sealant; this process, however, is no longer used [Dean et al., 2016].
2nd generation	Autopolymerising resin-based sealants or chemically-cured sealants; the activator, a tertiary amine, is added to one component and mixed with another one. The reaction between these two components produces free radicals that initiate the polymerisation of the resin sealant material (1 to 2 min setting time).
3rd generation	Visible light-polymerising resin-based sealants; photoinitiators sensitive to visible light in the wavelength of around d470 nm (blue) are present in the sealant material and they are activated by the visible light (10-20 sec setting time)
4th generation	Fluoride-releasing resin-based sealants; fluoride-releasing particles are added to the previous material generation, in an attempt to inhibit caries [Simonsen et al., 2002]

TABLE 1 Resin-based sealants classified by the method of polymerisation.

Filled	The addition of filler particles to the fissure sealant material seems to have only a small effect on clinical outcomes. In addition, filled sealants have a higher wear resistance and their ability to penetrate into fissures is low. Moreover, the filled sealants usually require occlusal adjustments, which lengthens the procedure
Unfilled	The unfilled resin sealants have a lower viscosity, which offers a better penetration into fissures. Also, it allows a better retention and lower microleakage rates. Occlusal adjustments are not necessary (this procedure requires less time and lower costs)

TABLE 2 Resin-based sealants classified by viscosity.

rather than the use of various forms of mechanical enamel preparation, such as air abrasion and modification with a bur (enameloplasty) [Ferrazzano et al., 2017].

Lastly, sealant retention should always be checked with a probe after polymerisation to ensure that all the fissures are completely sealed; if any material is worn the sealant should be reapplied after re-cleaning, when necessary.

Glass Ionomer Sealants

Conventional glass-ionomer sealants (GI) present several advantages. Firstly, they are generally easier to place than resin-based sealants. They bond the enamel and dentin through a chemical reaction and do not need pretreatment of the the tooth before application [AAPD, 2016]. Secondly, GI are moisture-friendly, hence they are not vulnerable to moisture in contrast to the hydrophobic resin-based sealants.

Thirdly, another great advantage of GIs is the continuous release of fluoride (until the material remains on the tooth), which may contribute to caries prevention. However, the clinical effect of fluoride release from glass ionomer cement is not well-established.

On the other hand, this material has also an important disadvantage: retention. Eight out of fifteen studies contained in "Sealants for preventing dental decay in the permanent teeth, 2013" (Cochrane database of systematic reviews) comparing resin-based sealant with glass ionomer clearly report better retention rates for resin-based sealants compared to glass ionomers [Forss 1998; Karlzén-Reuterving, 1995; Kervanto-Seppälä, 2008; Poulsen, 2001; Rock, 1996; Sipahier, 1995; Songpaisan, 1995; Williams, 1996]. For instance, at 36–48-month follow-up, the average retention rate for the resin-based sealants was 76%, while, for the glass ionomers it was only 8% (based on five studies with these follow-up times).

Considered the above, GI may be used as an interim preventive agent when there are indications for placing a resin-based sealant but concerns about moisture control may compromise such placement (e.g. partially erupted permanent teeth, teeth difficult to isolate due to a child's uncooperative behavior, etc. [Dean et al., 2016].

Opaque	White opaque fissure sealants are easier to see during application and easier to detect clinically during examination
Transparent	Transparent sealants can be clear, pink, or amber

TABLE 3 Resin-based sealants classified by translucency.

Resin-Modified Glass Ionomer Sealants

When resin is incorporated with glass ionomer, we have a material called resin-modified glass ionomer, which can be defined as a hybrid material that sets by means of an acid base reaction and partly via a photo-chemical polymerisation reaction. Its resin component improves its physical characteristics, compared to conventional GI [Pinkham et al., 2005]; in fact, when compared to conventional GI, the modified type shows less sensitivity to water and a longer working time [AAPD, 2016].

Polyacid-Modified Resin Sealants

Polyacid-modified resin sealants, also referred to as compomers, combine resin-based material in traditional resin-based sealants with the fluoride-release and adhesive properties of GI sealants. As resin-based, they do not contain water, are hydrophobic and can be polymerised after positioning the bonding agents; similarly to the GIs they release fluoride, but in much smaller amounts.

Determining the best choice between the different sealant materials might be complicated.

Several studies [Amin et al., 2008; Antonson et al., 2012; Guler et al., 2013] have found no statistically significant difference in the preventive effect of resin-based sealants and GIs at 24, 36, and 48-month follow up periods. As far as retention, glass ionomer sealants may have a five times greater risk of experiencing loss of retention compared with resin-based sealants after 2 to 3 years of follow-up. Nevertheless, in a recent update, the American Dental Association, in collaboration with the American Academy of Pediatric Dentistry, could not draw any conclusion about which of the two sealants is better because of the low quality of the available evidence. The AAPD, "determined the overall quality of the evidence for this comparison as very low owing

Sealant Materials	Summary of Findings	Level of Significance	Quality of Evidence
GI vs. RBS	Sound occlusal surface: GI reduces caries incidence by 37%	Non-significant	Very low
	Non-cavitated occlusal carious lesion: GI Very low increases incidence of caries by 53%	Non-significant	
	Risk of retention loss: GI has a 5 times greater risk of loss	Significant	
GI vs. RMGI	Sound occlusal surface: GI increases caries incidence by 41%	Non-significant	Very low
	Risk of retention loss: GI has a 3 times greater risk of loss	Significant	
RMGI vs. Polyacidmodified resin sealant	Sound occlusal surface: RMGI reduces caries incidence by 56%	Non-significant	Very low
	Risk of retention loss: RMGI has an increased risk of loss of 17%	Non-significant	
Polyacid-modified resin sealant vs. RBS	Sound occlusal surface: Poly-acid modified resin sealant increases caries incidence by 1%	Non-significant	Very low
	Risk of retention loss: Poly-acid modified resin sealant has a decreased risk of loss of 13%	Non-significant	

TABLE 4 Summary of evidence-based findings when comparing different sealant materials [Naaman et al., 2017].

to serious issues of risk of bias, inconsistency and imprecision" [AAPD, 2016].

Table 4, extracted from a recent review [Naaman et al., 2017], summarises the findings from the comparison of different sealants.

In conclusion, even if retention of fluoride-releasing sealants is better than that of glass ionomers, the literature shows that their effectiveness in preventing fissure caries in permanent molars does not differ significantly over 24 months. For this reason, glass ionomer sealant can be also a valid alternative where and when resin sealant placement is not possible.

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