https://doi.org/10.5272/jimab.2022281.4186

Journal of IMAB
ISSN: 1312-773X
https://www.journal-imab-bg.org

Journal of IMAB - *Annual Proceeding (Scientific Papers).* 2022 Jan-Mar;28(1)

Review article

TYPES OF PIT AND FISSURE SEALANTS. INDICATIONS AND CONTRAINDICATIONS FOR SILANIZATION. REVIEW.

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SUMMARY

Background: Dental sealants have been used to reduce the incidence and severity of dental caries in the pits and fissures of teeth for over 40 years. Since that time, numerous scientific discoveries have led to the development of multiple generations of new sealant materials.

Aim: The aim of this paper is to summarize the findings of reviews regarding the types of pit and fissure sealants, indications and contraindications for their use.

Methods and materials: Previous systematic reviews on this topic were used as the basis for the current review. Cochrane, MEDLINE, Embase, and a few other bibliographic databases were searched for English and Bulgarian-language articles. The year of publication of the searched articles was limited from 2000 to 2020. Only articles in English and Bulgarian languages were read in full.

Results: A total of 114 articles were identified by the literature search, the title and abstract of the articles were examined. Twenty-four original research studies met the inclusion criteria. They were read in full, and evidence was extracted for types of pit and fissure sealants, as well as indications and contraindications for their use.

Conclusion: Evidence derived from the literature led to the conclusion that sealants are effective in preventing pit and fissure occlusal carious. The selection of the material used for silanization is made depending on a few factors that should be considered, such as patient's and tooth age, child's behavior and ability to isolate the surfaces which are going to be sealed. Regular examinations are required to be able to determine the need for reapplication of sealants and to maximize the effectiveness and results of the treatment.

Keywords: pit and fissure sealants, types of sealants, indications for silanization, contraindications for silanization.

BACKGROUND

Dental sealants have been used to reduce the incidence and severity of dental caries in the pits and fissures of teeth for over 40 years. It is widely known that occlusal surfaces are highly predisposed to dental caries development due to the retentiveness of pits and fissures [1]. There was an observation made by Ripa, where it is concluded that although occlusal surfaces are 12,5% of the total surfaces of permanent dentition, 50% of dental caries in schoolchildren is affecting them. There are a few caries preventive measures that were taken, such as control of the plaque, fluoridation of community water, control of the intake of carbohydrates, local application of fluoride agents. However, they effect- caries reduction is mainly on the smooth tooth surfaces. More effective measures are necessary to reduce the risk of occlusal caries, and these include pit and fissure sealants [2]. Due to EAPD: "a fissure sealant is a material that is placed in the pits and fissures of teeth in order to prevent or arrest the development of dental caries" [1]. Different materials and techniques have been used for the silanization of pits and fissures during the years. Since the time of the invention of pit and fissure sealants, numerous scientific discoveries have led to the development of multiple generations of new sealant materials.

AIM

The aim of this paper is to summarize the findings of reviews regarding the types of pit and fissure sealants, indications and contraindications for their use.

MATERIALS AND METHODS

Databases such as: Cochrane, MEDLINE, Embase, Scopus and several others were searched for relevant articles. The year of publication of the searched articles was limited from 2000 to 2020. Only articles in English and Bulgarian languages were read in full.

The subject heading "pit fissure sealant" was combined with several keyword terms: dental prevention, types of sealants, dental caries, occlusal caries, primary prevention, etc.

RESULTS

Initially, a total of 114 articles and their abstracts were reviewed. Twenty-four original research studies met the inclusion criteria. They were read in full, and evidence was extracted for types of pit and fissure sealants, as well as indications and contraindications for their use. Pit and fissure sealants can be used effectively to prevent occlusal caries as part of the population based or individual based programs for populations at risk. Sealants are placed to prevent caries initiation and to arrest caries progression by

providing a physical barrier that inhibits microorganisms and food particles from collecting in pits and fissures [3].

Types of pit and fissure sealants

Sealant materials can be divided into two main groups: resin-based sealants and glass ionomer cement-based sealants [2,8].

Resin-Based Sealant Materials (RBSs)

Resin-Based Sealant Materials (RBSs) are classified into four generations, determined by the method of polymerization.

First generation RBS

First generation RBS was polymerized by the action of ultraviolet rays. Nuva-Seal was the first successful commercial sealant to be placed on the market in 1972. This type, however, is no longer used [4].

Second generation RBS

The second generation was the auto-polymerizing resin-based sealants (ARBS) or chemical-curing sealants [5].

Third generation RBS

Visible light-polymerizing resin-based sealants (LRBS). In this type of sealant, the visible light activates photoinitiators that are present in the sealant material and are sensitive to visible light in the wavelength region of around 470 nm (blue region) [6].

The mixing step is eliminated, thus fewer air bubbles are incorporated with the sealant application [7].

Fourth generation RBS

The fourth generation is the fluoride-releasing resin-based sealants (FRBS). Fluoride ions are added to inhibit caries, however, FRSB could not provide fluoride release for a long period of time, so there is no additional benefit to LRBS [8,9].

Determined by the addition of filler, RBS can be classified into filled and unfilled.

Filled sealants have a higher viscosity and a higher wear resistance, while unfilled sealants have a lower viscosity and lower wear resistance. Thanks to their better penetration, unfilled sealants provide better retention [8,10].

Determined by their translucency, RBS can be classified into opaque and transparent.

Opaque sealants are tooth-colored or white. Their application and visual examination are easier during recall visits due to their easier detection. Transparent sealants are clear, amber or pink [5]. Their visual examination is harder to perform. The choice of the sealant material is a matter of the personal preference of the clinician [2].

Glass Ionomer Sealant Materials

Conventional glass ionomer (GI) material bonds chemically to enamel and dentin and has also been used as pit and fissure sealants[11]. GI sealants can be classified into high and low viscosity types [12].

Resin-modified glass ionomer (RMGI)

Resin-modified glass ionomer a resin incorporated with glass ionomer. Resin-modified glass ionomer has improved physical characteristics compared to conventional glass ionomer: longer working time and more water tolerance [11].

Polyacid-modified resin sealants (Compomers)

Compomers are a combination between resin-based and glass ionomer-based sealants. Compared to conventional glass ionomers, they are less water soluble and more technique-sensitive [11,15].

Indications and contraindications for silanization

Dental sealants were introduced to the market in the mid-1970s. Since then, they were advocated only for the prevention of dental caries. Controversial was the use of pit and fissure sealant over questionable carious lesions [16]. Since then, various researches have been conducted. Some of them support sealant application on pits and fissures with caries lesions, where the lesion is confined to the enamel. If the lesion extends to the dentin, it should be prepared and then restored. Sealing early carious lesions isolates the carious lesion from the surface biofilm and thus prevents further progression of caries. Most importantly, after their application, sealants should be regularly monitored and repaired if needed [2,11,14,17].

The recommendations given by EAPD for the use of pit and fissure sealants suggest that caries risk assessment is crucial for determining who receives sealants [1].

The selection of people and teeth should be based on the following:

- Children with acute caries activity: all predisposed pits and fissures should be sealed, including the buccal fissures of permanent molars.
- Children with impairments- physical, medical or intellectual. Primary teeth should also be considered for silanization.
- Children with deep and retentive fissures- potentially susceptible to dental caries should be considered for sealing [1,18].

DISCUSSION

There are factors that may influence the decisions whether to seal or not, as well as what type of sealant is most suitable for the clinical situation.

Resin-based fissure sealants (FS) are bonded to the underlying enamel through micro-mechanical connection, using the acid-etch technique. They establish a tight seal, which prevents leakage of microorganisms and nutrients to the deeper parts of the pits andfissures[1].Òhe better retention of the sealant is mainly dependent on the salivary isolation. In terms of retention and the need to reassess sealants within a year after placement, it is very important to adequately isolate the teeth. Salivary contamination is the major cause of the loss of sealants in the first year. Various

materials could be used for sealanization. Five studies [19, 20, 21, 22, 23, 24] compared RB and GIC sealants. It was concluded that resin-based sealants provide the greatest retention rates, 2%–80% better than the GIC sealants, which is the main problem with glass ionomer sealants.

The guideline panel of the FDA suggests that the choice of the proper sealant material should be made while taking into consideration the particular clinical case and the specifics of the patient. For instance, when the tooth has not fully erupted, and the appropriate isolation is impossible to be achieved, glass ionomer sealant is the material of choice. However, if the tooth can be isolated and dry field and long-term retention are possible to be achieved, then the preferable material for silanization is a resin-based sealant [11].

Generally speaking, glass ionomer sealants are able to perform continuous fluoride release, as well as have recharging ability. They are also less-technique sensitive and more moisture-friendly compared to the hydrophobic resin-based sealants [17]. Glass ionomer sealants have a preventive effect due to the retention of particles in the deepest parts of the fissures even after the visible loss of the sealant material. Glass ionomer sealants are considered as transitional sealants, which are to be replaced with a resin-based one after proper isolation of the tooth is possible [5,14].

More specific guidelines for fissure sealant application include [16]:

1. The application of sealant material should be performed right after the eruption of the posterior teeth when they have the greatest probability of dental caries development. The first two to four years after the eruption are the most appropriate time for silanization. This is the time when the enamel is not fully mineralized yet and is most prone to decay. However, sealant application could be indicated later on as well in cases of changes in health status (e.g. xerostomia) or changes in oral hygiene status (e.g. compromised hygiene secondary to orthodontic appliances).

2. Only teeth with occlusal surfaces, which were not previously restored, could be sealed.

3. Teeth with dental caries extending to the dentin cannot be sealed but should be restored.

4. Pits and fissures of the teeth that are going to be sealed should be susceptible to caries. Narrow and deep pits and fissures are more retentive and more difficult to be cleaned properly and thus more susceptible to decay. This retentive anatomy of the occlusal surface is typical for permanent molars, while primary molars usually don't have retentive pits and fissures.

5. An operculum can cause poor retention of the sealant. That is why, in this case, glass ionomoer sealants are the material of choice until the full eruption of the tooth. Later on, when proper isolation is achievable, they are replaced by resin-based sealants.

5. Ideally, fluoride prevention should be performed on patients who are going to receive sealants to reduce the risk of smooth surface caries [16].

The success of the sealants depends on other factors as well:

Considerations for premature sealant failure suggested by some authors are: occlusalparafunctional habits which could lead to wear of sealant, patients with behavioral issues, structural defects of the enamel (amelogenesisimperfecta, dentinogenesis imperfect) [25].

CONCLUSION

Evidence derived from the literature led to the conclusion that pit and fissure sealants can be used effectively to prevent occlusal caries as part of the population based or individual based programs for populations at risk. Sealants are placed to prevent caries initiation and to arrest caries progression by providing a physical barrier that inhibits microorganisms and food particles from collecting in pits and fissures. The selection of the material used for silanization is made depending on a few factors that should be considered, such as patient's and tooth age, child's behavior and ability to isolate the surfaces which are going to be sealed. Regular visits to the dental office and examinations are required to be able to determine the need for reapplication of sealants and to maximize the effectiveness and results of the treatment.

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Please cite this article as: Shtereva L, Kondeva V, Dimitrova M. Types of pit and fissure sealants. Indications and contraindications for silanization. Review. *J of IMAB.* 2022 Jan-Mar;28(1):4186-4189.
DOI: https://doi.org/10.5272/jimab.2022281.4186

Received: 19/05/2021; Published online: 06/01/2022

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