

Pit and Fissure Sealants: A Review of Systematic Reviews

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Abstract

Background and objectives: Pit and fissure sealants have been long suggested as the method of preventing dental caries. The aim of the study was to provide an overview of the latest evidence on clinical effectiveness of pit and fissure sealants in prevention of dental caries. **Materials and methods:** Literature survey was carried out from 2010 to 2020 in electronic databases such as PubMed, Google Scholar and Virtual Health Library database using key words such as “Pit and fissure sealants” and “systematic reviews.” The searches revealed 457 articles out of which 5 were selected after reading the full text articles. **Results:** The review of 5 articles revealed that high viscosity GIC and resin-based sealants have similar caries-preventive efficacy in permanent molar teeth after 48 months. The evidence for a potential superiority of high viscosity GIC over resin-based sealants after 60 months is still low. Sealants alone had a 2- to 3-fold higher risk of arresting or reversing lesions (moderate certainty for all comparisons) as compared to no treatment. In comparison to no therapy, the combination of sealants and 5% NaF varnish was the most effective in arresting or reversing lesions. When compared to varnish, Fissure sealants had limited superiority in minimizing occlusal caries. **Conclusions:** The evidence suggests that sealing pit and fissures are effective in prevention of dental caries however it is hampered by high risk of bias. Hence, future studies with high quality should be conducted assessing the effectiveness of different types of sealants.

Keywords: Pit and fissure sealants, systematic reviews, caries prevention, resin-based sealants.

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INTRODUCTION

Dental caries is a major public health problem that has far-reaching consequences around the world. Untreated caries in children can result in disrupted eating and sleeping habits, hospitalization, stunted development, and low weight gain, putting their overall health and quality of life at risk.

Caries in pits and fissures accounts for about 90% of caries in permanent posterior teeth and 44% of caries in primary teeth in children and adolescents [1]. The widespread adoption of caries-prevention strategies such as community water fluoridation, topical fluoride treatment, plaque management, and dietary sugar restriction has been attributed to the overall decline in caries prevalence.

Pit and fissure sealants have long been suggested as a method of avoiding pit and fissure caries in permanent molars. They act as a physical barrier between enamel and the oral environment, preventing

food debris and plaque from accumulating. Sealants have been introduced to treat active teeth as the popularity of minimal intervention dentistry has grown [2].

The most widely used sealing materials are resin-based sealants and glass ionomer sealants. Glass ionomer sealants are made up of fluoroaluminosilicate glass powder and an aqueous-based polyacrylic acid solution, while resin-based sealants are made up of urethane dimethacrylate (UDMA) or bisphenol A-glycidyl methacrylate (bis-GMA) monomers. The most obvious benefit of resin-based products is that they are cost-effective [3].

However, resin-based sealants and glass ionomer sealants both have drawbacks. One downside of resin-based materials for sealing is polymerization shrinkage, which can lead to microleakage, allowing saliva and bacteria to penetrate the occlusal barrier [4]. Also, glass ionomer cements have less ability to withstand occlusal forces leading to fractures [5]. The

adherence to the hard substance of the tooth is the most important consideration when placing sealing materials [6].

Systematic evaluations have exploded in popularity in the last decade as one of the most important resources for supporting evidence-based health care and as a high-level, low-cost form of study. However, some have discovered that reporting quality was generally low as a result of reporting and technical flaws. There is evidence that intact sealants can stop the development of caries in the permanent dentition or both primary and permanent dentitions, regardless of the severity of the caries [7]. However, more research into the efficacy of sealants in preventing or arresting non-cavitated caries lesions in primary molars is required as there are insufficient well-controlled randomised controlled clinical trials to assess if sealants can help prevent or stop non-cavitated occlusal caries [8]. Hence, this review aims to evaluate the evidence on clinical aspects of pit and fissure sealant, as well as the most recent publications that support an evidence-based clinical application technique.

METHODOLOGY

Search strategy

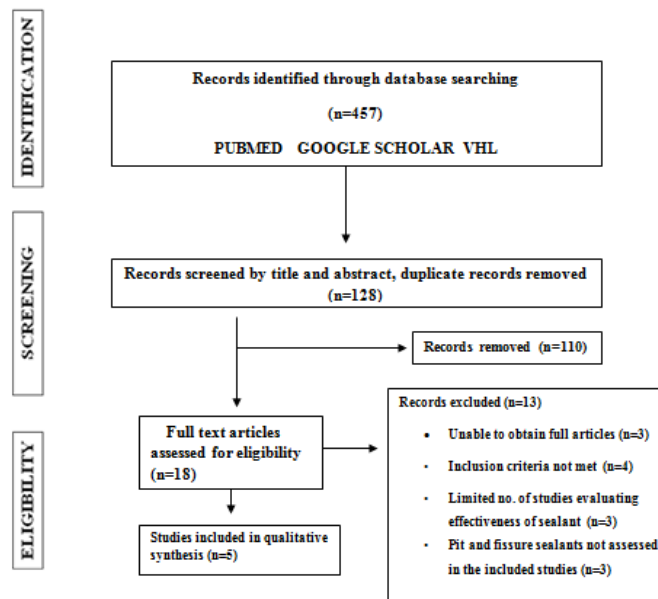
A literature search was carried out in various electronic data bases to identify the systematic reviews fulfilling the objectives of this study. MeSH terms/keywords used were “Pit and fissure sealants” and “systematic reviews,” in the electronic data bases such as PubMed, Google Scholar and Virtual Health Library database and hand search was also done using the cross references. Articles published in English language from 2010 to 2020 which fulfilled the objectives of the study were included.

Inclusion Criteria

1. Systematic reviews
2. Studies assessing effectiveness of pit and fissure sealants on prevention of dental caries

Exclusion Criteria

1. Animal based studies
2. Narrative reviews on pit and fissure sealants.
3. Studies evaluating the retentivity of pit and fissure sealants
4. Studies assessing effect of sealant on orthodontically induced white-spot lesions



Author, year, Country	Data of search	Databases searched	Number of studies included Type of study	Outcome	Risk of bias tool used
Steffen Mickenautsch <i>et al.</i> , 2015, Canada[9]	Not specified	CENTRAL accessed via Cochrane Library, MEDLINE accessed via PubMed; Biomed Central, Database of Open Access Journals (DOAJ); Regional databases: Africa: Sabinet, India: IndMed; Grey-Literature	6 STUDIES INCLUDED 1. Clinical trials 2. Controlled trials 3. Trial focus relevant to review question 4. Prospective trials (retrospective trials not included); 5. Full trial reports (abstracts without full reports not included); 6. Follow-up period	No statistically significant differences after up to 48 months and borderline significant differences in favour of high viscosity GIC sealants after 60 months (RR 0.29; 95% CI: 0.09–0.95; p = 0.04 / RD -0.07; 95% CI: -0.14, -0.01)	Verbatim quotes relevant to selection-, performance- and detection bias risk

		sources: OpenSIGLE, Google Scholar.	minimum 24 months; 7. Treatment on fully erupted caries-free molar teeth in the permanent dentition; 8. High-viscosity glass- ionomers as test intervention; 9. Resin-based materials as control intervention.		
O. Urquhart <i>et al</i> , 2019, USA[10]	1946- 2017	OVID Medline, Embase and the Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews	Forty-four trials included Parallel and split-mouth randomized controlled trials	When opposed to no care, sealants alone had a 2- to 3-fold higher risk of arresting or reversing lesions (moderate certainty for all comparisons). In comparison to no therapy, the combination of sealants and 5% NaF varnish was the most effective in arresting or reversing lesions (RR, 3.35; 95 percent CI, 2.42 to 4.64; moderate certainty)	Cochrane Risk of Bias Tool
Isauremi Vieira de Assunção <i>et al</i> , 2014, Brazil[11]	Till November 2013	Medline/PubMed, LILACS, SciELO and Scopus	5 studies included Clinical trials	The fissure sealing technique can be used as an alternative to invasive restorative procedures. in treatment of non- cavitated occlusal carious lesions in dentin in deciduous and permanent molars	Not evaluated
Feifei L <i>et al</i> , 2020, China[12]	1948 to 2018	(CENTRAL; 2018), MEDLINE (via OVID, 1948 to February 2018), PUBMED (1960 to February 2018), Embase (1984 to February 2018), and CNKI (2018)	8 studies included Clinical trial	The overall relative ratio (RR) of Caries incidence for Fissure sealants to Fluoride varnish was was 1.12 without statistical significance (95% CIs: 0.60 to 2.09; p=0.72).	The Cochrane “risk of bias” instrument
PHOEBE P.Y. LAM <i>et al</i> , 2019, China[13]	Not specified	(Cochrane Central Register of Controlled Trials [CENTRAL]; Ovid Embase; Ovid MEDLINE; Web of Science)	7 studies included Randomized or quasi- randomized controlled trials of at least 6-months follow-ups, with either parallel or split-mouth designs	No significant difference in the caries incidence and progression when evaluated over 24 months between (1) resin-based sealant (RBS) and glass ionomer sealants (GIS) or resin- modified GIS; (2) conventional and newly developed RBS; (3) autopolymerized and light-polymerized RBS; (4) RBS with topical fluoride application and topical fluoride alone; and (5) RBS with topical fluoride application and resin infiltration with topical fluoride application.	Cochrane risk of bias tool for randomized trials

Steffen Mickenautsch *et al.*, 2015 in their systematic review reported that after 60 months, a borderline significance in caries prevention in favour of high viscosity GIC over resin based sealants was identified (RR 0.29, 95 percent CI: 0.09–0.95; $p = 0.04$). This means the teeth sealed with HVGIC have a 71% lower risk of decay. It revealed that 4 out of 100 HVGIC-sealed teeth were carious, compared to 13 out of 100 resin composite-sealed teeth. Evidence suggested that HVGIC-based fissure sealants were equally successful in protecting against dental caries lesions in patients with completely erupted permanent molar teeth. Furthermore, the high risk of selection, performance/detection, and attrition bias raises doubts about the validity of the currently available data. Due to imprecision, the evidence for a potential superiority of HVGIC over resin-based sealants after 60 months is low (even if the high bias risk is ignored) and needs future studies to corroborate [9].

O. Urquhart *et al.* 2019 stated that sealants alone had a 2- to 3-fold higher risk of arresting or reversing lesions (moderate certainty for all comparisons). In comparison to no therapy, the combination of sealants and 5% NaF varnish was the most effective in arresting or reversing lesions (RR, 3.35; 95 percent CI, 2.42 to 4.64; moderate certainty). The certainty for the outcome of arrest or reversal varies from very low to very high across all surfaces of teeth, forms of lesions, and dentition due to severe issues of bias and imprecision [10].

Isauremi Vieira de Assunção *et al.* 2014, evaluated the effectiveness in arresting the progression of non-cavitated occlusal carious lesions in dentin. They reviewed five studies, three out of which reported a significantly less caries progression by pit and fissure sealant both clinical and radiographically with one study reporting significant reduction only radiographically and one study stating no significant difference between sealant and control group. Thus concluding that fissure sealing treatment is effective in halting caries progression in deciduous and permanent molars as compared to invasive intervention [11].

Feifei L *et al.* 2020, evaluated the studies based on three outcomes: caries incidence, caries incidence of first permanent molars and incidence of caries on their occlusion surfaces by fissure sealant compared to fluoride varnish. Overall relative ratio (RR) of Caries incidence for pit and fissure sealants to fluoride varnish was 1.12 without statistical significance (95% CIs: 0.60 to 2.09; $p=0.72$). There was lack of statistical significance to show superiority between FV and FS (RR: 1.29; 95% CIs: 0.95 to 1.75; $p=0.10$) in caries incidence of first permanent molars. When compared to varnish, Fissure sealants had limited superiority in minimizing occlusal caries incidence (RR: 1.33). However, statistical significance was not achieved (95 percent CIs: 0.83 to 2.11, $p=0.23$) [12].

Phoebe P.Y. lam *et al.* 2019 reviewed 7 studies based on Resin-Based Sealant Versus No Use of Sealants, Glass ionomer sealant/resin-modified glass ionomer sealant versus no use of sealant, New Types of Fissure Sealants Versus No Use of Sealant, Resin-Based Sealant Versus Other New Sealants, Auto polymerized Resin-Based Sealant Versus Light-Curing Resin-Based Sealant, Fissure Sealants With Topical Fluoride Application Versus Topical Fluoride Application Alone and Fissure Sealants Compared With Other Types of Caries Preventive and Caries Arrest Measures. No study was found comparing the use of RBS with no sealant in caries increment in primary teeth. No significant difference in a number of carious occlusal surfaces between the Glass ionomer sealant/resin-modified glass ionomer sealant versus no use of sealant (odds ratio [OR], 0.79; 95% confidence interval [CI], 0.50-1.25, $P = 0.310$). At 6 months, the GIS/RMGIS group had a slightly lower caries incidence rate (OR, 3.90; 95 percent CI, 1.06-14.4, $p = 0.041$), but at 18 months, there was no disparity between the two groups (OR, 3.90; 95 percent CI, 1.06-14.4, $p = 0.041$). (OR, 1.92; 95 percent CI, 0.68-5.40; $p = 0.216$). However, because of bias resulting from the randomization process, missing outcome results, and bias in the measurement, the overall risk of bias in this study was very high. No statistically significant difference was found between RBS and F-RBS regarding caries incidence (OR, 12.2; 95% CI, 0.65-226.97, $P = 0.093$). 43 No caries developed at 24 months in both the groups comparing RBS with ACP-RBS and F-RBS with ACP-RBS. No significant difference in caries incidence was reported between the autopolymerized Resin-Based Sealant and light-Curing Resin-based sealants (OR, 0.58; 95% CI, 0.13-2.55, $P = 0.466$). There were no data provided regarding the effects of sealants on caries progression. Although no significant difference in caries incidence between fissure Sealants With Topical Fluoride application and Topical Fluoride Application alone was found at 2 years (OR, 0.54; 95% CI, 0.23-12.78; $P = 0.702$), 42,48 the small sample size included (25 teeth) had placed the precision of the estimate uncertain. When comparing the sealants plus fluoride varnish group to the resin infiltration with fluoride varnish group, no difference in overall caries prevention and arrest was observed (OR, 1.35; 95 percent CI, 0.46-4.00; $P = 0.584$) [13].

DISCUSSION

Pit and fissure sealants have been evaluated extensively in a variety of systematic reviews, but mostly on first permanent molars. The results of these reviews suggested that high viscosity GIC and resin-based sealants tend to have similar caries-preventive efficacy in permanent molar teeth after 48 months, but this is hampered by high bias risk. The evidence for a potential superiority of high viscosity GIC over resin-based sealants after 60 months is still low. Sealants alone had a 2- to 3-fold higher risk of arresting or reversing lesions (moderate certainty for all

comparisons) as compared to no treatment. In comparison to no therapy, the combination of sealants and 5% NaF varnish was the most effective in arresting or reversing lesions (RR, 3.35; 95 percent CI, 2.42 to 4.64; moderate certainty). When compared to varnish, Fissure sealants had limited superiority in minimizing occlusal caries. If a resin-based fissure sealant is used, noninvasive therapeutic fissure sealing is useful for the management of non-cavitated occlusal carious lesions in dentin. No significant difference in the overall caries incidence and progression was reported over 24 months between resin-based sealant (RBS) and glass ionomer sealants (GIS) or resin-modified GIS; conventional and newly developed RBS; autopolymerized and light-polymerized RBS; RBS with topical fluoride application and topical fluoride alone; and RBS with topical fluoride application and resin infiltration with topical fluoride application. There have been a variety of inconsistencies in treatment conditions, treatment methods, applied sealant products, tooth selection criteria, and trial evaluation. These discrepancies, such as the presence of fluoride in certain resin-based sealant products but not in others, or differences in applied sealant brands, may theoretically have led to some degree of heterogeneity. There have been no studies comparing new sealants, such as amorphous calcium phosphate (ACP)-containing resin-based sealant (ACP-RBS) and fluoride-containing sealants (F-RBS), to controls with no sealant so no outcome could be evaluated. Other confounders that may have affected the magnitude of the preventive and arrest fraction of sealants, such as local fluoridation, dietary patterns, baseline caries experience, and oral hygiene status of individual participants, may affect overall caries risk and the effectiveness of sealants in caries prevention and arrest, were not clearly established. No new diagnostic tools such as laser fluorescence, transillumination, electrical current, or ultrasound were used to detect the progression of occlusal caries were used in any of the study. Majority of reviews did not assess publication bias due to the small number of studies included per tooth surface/lesion form.

CONCLUSION

As a result of the limited quantity and quality of relevant studies available, the level of evidence available for data synthesis is severely constrained. As a result, the weight of the evidence was reduced since there is a high risk of overall bias and imprecision.

Hence, future trials should strive to improve the overall quality of their research by presenting a more comprehensive report of their procedures and lowering the likelihood of bias by using appropriate allocation concealment and randomization methods.

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