

Pit and fissure sealants – an update

Abstract

Purpose: To evaluate evidence on pit and fissure sealants available since the publication: Pit and fissure Sealants: Evidence-based guidance on the use of sealants for the prevention and management of pit and fissure caries (2010) and assess whether there is a need to adapt current practice, considering the Covid-19 pandemic.

Process: Search Strategy: PubMed, Cochrane Library, Guideline International Network and Medline through PubMed databases were searched from January 2010 to June 2020. The guidelines that were used as a basis for the original guideline were also searched for updates. Ninety-six relevant papers were identified. *In-vitro* studies and review papers were excluded, and the 35 remaining studies were critically appraised, with results from relevant studies tabulated including the strength of the evidence.

Results

1. Pit and fissure sealants are effective and should be placed on first and second permanent molars.
2. Non-operative cleaning of fissures using a toothbrush or bristle brush is recommended. Mechanical preparation of fissures is not recommended.
3. Patients should be recalled at six-month intervals, or more frequently based on caries risk level.
4. Fluoride application can be considered when pit and fissure sealants cannot be satisfactorily placed and patients recalled within three to six months depending on caries risk level.

Further research is required to establish:

5. The use of self-etching agents.
6. The use of a bonding agent when placing sealants.

Conclusions: Processes should be put in place to ensure regular updating of guidelines.

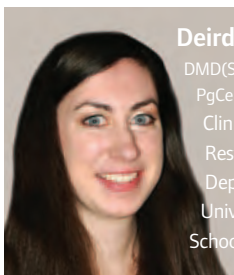
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Introduction

The pits and fissures of teeth are susceptible to dental caries.¹⁻⁶ It is well known that sealing these surfaces with a resin or glass ionomer sealant can reduce the amount of caries an individual will experience. This decrease in incidence is due to reducing fissure depth allowing easier mechanical cleansing and the physical reduction of the surface area of the tooth that is exposed directly to demineralisation. Ideally, each tooth should be sealed “as soon as sufficiently erupted” to allow a genuine prevention of caries formation. If patients are seen when a tooth is insufficiently erupted, a sealant may not adequately bond due

to the presence of crevicular fluid causing moisture contamination from the surrounding gingiva; however, if patients are seen long after tooth eruption the caries risk increases.⁷

A suite of evidence-based guidelines⁸ were published jointly by the Oral Health Services Research Centre (OHSRC) University College Cork (UCC), the Health Service Executive (HSE) and funded by the Health Research Board (HRB) (Grant No. S/A013) – Pit and Fissure Sealants: Evidence-based guidance on the use of sealants for the prevention and management of pit and fissure caries (2010), from here on referred to as “the Guideline”.

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Evidence-based guidelines are systematically developed statements designed to help administrators, practitioners and patients make decisions about appropriate healthcare for specific circumstances.⁹ The Guidelines published were a landmark, as this was the first time that there was strong evidence-based guidance for dentists in terms of dental public health policies in the Republic of Ireland.

The pit and fissure sealants Guideline⁸ was developed using the ADAPTE process,¹⁰ which provides a method of adapting clinical practice guidelines from one organisation or context to another. For the update of the guideline, similar search terms were used in a literature review of relevant material. In addition, the guidelines which were used in the formulation of the Irish Guideline (2010) were consulted.

At the time of publication, it was recommended that an update should be carried out in 2013. As such there is a need to identify the existence of any new evidence since 2010.

For the revision on pit and fissure sealants Guideline, the updated document 'Evidence-based clinical practice guideline for the use of pit and fissure sealants: A report of the American Dental Association and the American Academy of Pediatric Dentistry'¹¹ was also included.

Process

A literature search was conducted searching the following databases: Medline through PubMed and Cochrane Library databases. The following guideline databases were also searched for any relevant guidance or publications: Guidelines International Network site;¹² and, European Academy of Paediatric Dentistry site.¹³ Search terms including "resin sealants, dental sealants, fissure sealants, glass-ionomer sealants, pit and fissure sealants, and occlusal caries prevention" were used. Searching also involved combinations of the search terms using "AND" and "OR" Boolean operators. Lastly, "snowballing" was used to find more papers, meaning that the references of relevant papers were examined for additional evidence. The time limits were set from the previous Guideline in January 2010 to June 2020.

The 2008 ADA guidelines,² which were used as a satellite for the current Irish Guideline were themselves updated in 2009 and most recently again in 2016.¹¹ Additionally, the Cochrane collaboration also published an update in 2013¹ and 2017¹⁴ on the use of sealants in the prevention of dental decay. A total of 95 papers were identified. Inclusion and exclusion criteria were then applied. *In-vitro* and non-clinical studies were excluded, while current guidelines, studies on sealants, and randomised controlled trial clinical studies were included. Papers were then critically appraised using the critical appraisal skills programme checklists.¹⁵ This process resulted in 35 papers that were selected and appraised, and the summary of each paper recorded in an evidence table.

This method permitted an overview of all the new evidence relating to each particular section in the Guideline. All of the identified papers were read in duplicate with relevant information collated into an evidence table.

Finally, the reviewers' conclusions of the study were recorded. This organisation of the studies indicated whether new research was available and if it affected the existing recommendation. The papers are discussed under the original headings used in the Guideline:

1. How effective are sealants?
2. Should fissures be prepared before placing sealants?

3. What is the best way to achieve moisture control?
4. Is self-etch better than etch-and-rinse?
5. Should I place a bonding agent before placing a fissure sealant?
6. When should I apply topical fluoride?
7. When should I use glass-ionomer fissure sealants?

Results

How effective are fissure sealants?

A full-mouth, randomised control clinical trial was carried out by Hilgert *et al.*¹⁶ in a school-based environment, with a sample size of 242 children. They found that, for high-risk individuals, placement of resin sealants resulted in a similar caries experience rate as low-risk individuals without any sealants (91% vs 92%). However, they also found that supervised tooth brushing resulted in a similar caries experience for both high-risk and low-risk groups. The effectiveness of the sealants depends on why the individual has been placed in a high-risk category. If the reason for the high-risk is deep plaque retentive fissures, then sealants are going to be significantly effective. In this study, the patients were deemed high-risk based solely on fissure depth. Kumaran,¹⁷ Chen and Liu¹⁸ and Prathiba *et al.*¹⁹ each carried out split mouth randomised clinical trials on retention rates between resin sealants and glass-ionomer (sample sizes 40, 57 and 120, respectively). Results indicated the resin sealants were significantly better retained than glass-ionomer. Despite this, glass-ionomer materials were shown to have more of a caries preventive effect than their low retention rate would suggest. This is likely due to some glass ionomer material persisting in the fissures and possibly having a positive effect due to fluoride release.

Key point to learning: sealants are effective in preventing pit and fissure caries and should be placed in high caries-risk individuals. In the American Academy of Pediatric Dentistry Recommendations: Best Practices manual, it explains that caries risk assessment should be a routine part of the dental examination, and may be completed using various questionnaires such as the Caries-Risk Assessment Tool (CAT).²⁰ The manual advocates that the dental clinician must have a pragmatic approach to placing a sealant material, which they deem appropriate for the level of isolation which can be achieved.

Should fissures be prepared before placing sealants?

It is important to remember that the aim of placing a sealant is not to retain the sealant but for the prevention and management of pit and fissure caries. Dhar and Chen²¹ showed that while retention rates were higher in teeth that had mechanical preparation of enamel carried out, the caries rate was also higher. This is due to the removal of a sound layer of enamel resulting in a shorter path for caries to affect dentine.

Key point to learning: non-operative cleaning of fissures prior to sealing using a toothbrush or hand piece-driven bristle brush is recommended. Drilling of fissure prior to placement of sealant is not recommended.

What is the best way to achieve moisture control?

There is no new research to consider for the recommendation regarding the optimum method to achieve moisture control for placement of sealants. Any method that results in a dry field when placing the sealant can be used, giving consideration to ease of placement, patient co-operation, and operator preference.

Is self-etch better than etch and rinse?

Small sample size studies carried out by Nogourani *et al.*²² and Karaman *et al.*²³ give a slight indication that etch and rinse sealants have a higher retention than self-etch adhesive sealants; however, the authors of the respective studies agree further research is needed to confirm this.

Key point to learning: etch and rinse using 37% phosphoric acid is still the gold standard for achieving resin sealant retention.

Should I place a bonding agent before placing a fissure sealant?

McCafferty and O'Connell,²⁴ in a full-mouth, randomised clinical trial of 103 patients, showed that there was some benefit to using a bonding agent; however, they concluded that the effect was only noticeable in the palatal fissure of upper FPMs and no difference was achieved in the lower FPMs. An investigation was carried out by Moreira *et al.*²⁵ to observe the effect an intermediary layer may have on caries risk and sealant retention. Their study compared retention results of teeth sealed with different sealants with or without an adhesive layer, and with or without fluoride application at different levels of tooth eruption. They found the teeth with the most successful retention of sealant were those that were fully erupted, regardless of the method of sealant application. A study by Rishika *et al.*²⁶ suggests that there is enhanced retention of pit and fissure sealants following enamel deproteinisation and intermediary bond layer; however, the study duration was one year.

Key point to learning: due to a lack of robust evidence, the use of a bonding agent cannot be suggested at this time when placing sealants.

When should I apply topical fluoride?

There are often difficulties in maintaining adequate moisture control in children. This is especially true for younger children, anxious children, children with challenging behaviour, and children with special needs. In these cases, other preventive strategies should be available, such as fluoride varnish application. Fluoride varnishes aid remineralisation of early enamel lesions and can help slow the rate of progression of caries that has extended into dentine but not yet cavitated (Marinho *et al.*²⁷).

Chestnutt *et al.*²⁸ proposed that a six-monthly application of fluoride varnish is comparable to the caries preventive rate of fissure sealants. They randomly allocated 1,016 children into two groups: one that received resin sealants (Delton FS); and, one that had topical fluoride varnishes (Duraphat 22,600ppm (Colgate-Palmolive)). Both groups were examined every six months, the resin sealants were reapplied if necessary, and fluoride varnishes were also reapplied every six months. They found that over 36 months dentine caries had developed in 19.6% of resin-sealed teeth and 17.5% of teeth that had fluoride varnish applied to them.

Tagliaferro *et al.*²⁹ in a randomised controlled trial of 268 children, randomly allocated three groups, with both high caries-risk and low caries-risk children separated within each group. The three interventions were: oral hygiene instruction (OHI) alone (control group); OHI with fluoride varnish; and, OHI with glass-ionomer sealant. They showed that for high caries-risk children, biannual fluoride varnish application on occlusal surfaces of FPMs resulted in a 0.29 decayed missing filled (DMF) increment after two years (compared to 0.39 DMF increment for the control). However, a glass-ionomer sealant was the most effective at reducing caries with only a 0.06 DMF increment.

Key point to learning: fluoride varnish applied biannually is an effective preventive measure, but must be followed up with recalls.

When should I use glass-ionomer fissure sealants?

While glass-ionomer sealants are not retained as well as resin sealants, their real advantage is seen when their caries preventive effect is compared to resin sealants. Antonson *et al.*³⁰ in a 24-month clinical trial of children aged five to nine years with partially erupted first permanent molars showed that there was less marginal staining around glass-ionomer sealants, compared to resin sealants in teeth sealed with up to half of the occlusal surface covered by operculum. This study did not however state if these children were high or low caries risk and had quite a small sample size of 39.

Liu *et al.*³¹ looked at teeth with deep fissures and/or teeth that had incipient caries visible even when the tooth surface was wet. They attempted to show a difference between resin and glass-ionomer sealants when it was known that the carious process was established in pits and fissures. The results showed that after two years, 4% of resin sealants had dentine caries compared to 7% for glass-ionomer sealants. The glass-ionomer sealants were placed using polyacrylic acid conditioning and a "finger-press technique". The study is of relatively high quality and assessed a sufficiently large sample size (n=280). Zhang *et al.*³² carried out a study with a large sample size (n=405) with a 10% drop out after four years. The study included high caries-risk children only with a DMF score of ≥ 2 . There was block randomisation carried out by a statistician who was not involved in interpretation of the results. Selection of patients, placement of sealant and assessment of sealant were carried out by different individuals. Portable equipment was used on site in five different primary schools. Resin sealants were placed with conventional methods (37% phosphoric acid etch and rinse), while glass-ionomer sealants were placed using polyacrylic acid conditioning and an atraumatic restorative treatment (ART) technique. The glass-ionomer sealants were light cured for 60 seconds after placement. Their results showed 98% teeth with no dentine caries for glass-ionomer sealants and 96.4% for resin sealants. The authors attribute the poorer performance of resin sealants due to the field setting that the sealants were placed in.

Key point to learning: glass-ionomer sealants may be used in circumstances such as: when there is insufficient moisture control; or, where the tooth is partially erupted. The caries preventive effect of glass-ionomer sealants is higher than their retention rate would suggest.

Discussion and conclusions

Since publication of the Irish Guideline, new studies have occurred that relate to the recommendations within the Guideline. After searching and appraising the literature, some recommendations remain unchanged; however, as the world adjusts to the global impact of Covid-19, dentistry as we know it must adapt accordingly. The virus SARS-Cov-2 or Covid-19 is a novel infectious respiratory disease, which ranges in presentation and severity of symptoms. As some patients may be asymptomatic on presentation for dental treatment, the risk of spreading of the virus is increased through close interactions of unknown carriers.³³ During usage of certain dental equipment such as the three-in-one syringe, there is a risk of transmissible droplets being transferred through the air to susceptible staff or other patients through aerosol generating procedures (AGPs).³⁴ At this time of the Covid-19 pandemic, it is important to recall the definition of evidence-based guidelines. Evidence-based guidelines are systematically developed statements designed to help administrators, practitioners and patients make decisions about appropriate healthcare for specific circumstances.⁹ Given the specific circumstances of the

Table 1: Recommendations for pit and fissure sealants.

1. Pit and fissure sealants are effective and should be placed on first and second permanent molars. Sealant material of choice should be appropriate for the level of isolation which can be achieved.
2. Non-operative cleaning of fissures using a toothbrush or bristle brush is recommended. Mechanical preparation of fissures is not recommended.
3. Patients should be recalled at six-monthly intervals, or more frequently based on caries risk level.
4. Fluoride application can be considered when pit and fissure sealants cannot be satisfactorily placed and patients recalled within three to six months depending on caries risk level.

Covid-19 pandemic, glass-ionomer sealants and their ability to bond to the tooth surface without etching, should be given greater consideration as they may offer us a safer option at present. It should however, not be overlooked that sealants placed must be reviewed for retention and maintenance.¹

As a summary for general practitioners, the recommendations that remain unchanged are listed in **Table 1**. While there is some evidence that the use of self-etching agents and intermediate bonding agents can be beneficial, the findings were limited to four high-quality studies and consequently, further research is needed.

Ideally, a means of convening a guideline development group would be put in place, so that a timeline of an update for the Guideline can be agreed upon. This ensures that resources are available to the practitioner with the most up-to-date information, and that findings from new research can be implemented efficiently.

References

1. Ahovuo-Saloranta, A., Forss, H., Walsh, T., *et al.* Sealants for preventing dental decay in the permanent teeth. *Cochrane Database Syst Rev* 2013.
2. Beauchamp, J., Caufield, P.W., Crall, J.J., *et al.* Evidence-based clinical recommendations for the use of pit and fissure sealants: a report of the American Dental Association Council on Scientific Affairs. *J Am Dent Assoc* 2008; 139(3): 257-268.
3. Gooch, B.F., Griffin, S.O., Gray, S.K., *et al.* Preventing dental caries through school-based sealant programs: updated recommendations and reviews of evidence. *J Am Dent Assoc* 2009; 140(11): 1,356-1,365.
4. American Academy of Pediatric Dentistry. Periodicity of Examination, Preventive Dental Services, Anticipatory Guidance/Counseling, and Oral Treatment for Infants, Children, and Adolescents. *The Reference Manual of Pediatric Dentistry* 2019-2020/P. 209-219.
5. American Academy of Pediatric Dentistry. Caries-risk Assessment and Management for Infants, Children, and Adolescents. *The Reference Manual of Pediatric Dentistry* 2019/P. 220-224.
6. Welbury, R., Raadal, M., Lygidakis, N.A. EAPD guidelines for the use of pit and fissure sealants. *Eur J Paediatr Dent* 2004; 5(3): 179-184.
7. Reddy, V.R., Chowdhary, N., Mukunda, K.S., Kiran, N.K., Kavyarani, B.S., Pradeep, M.C. Retention of resin-based filled and unfilled pit and fissure sealants: A comparative clinical study. *Contemp Clin Dent* 2015; 6(Suppl 1): S18-23.
8. Irish Oral Health Services Guideline Initiative. Pit and Fissure Sealants: Evidence based guidance on the use of sealants for the prevention and management of pit and fissure caries. 2010. Available at: <https://www.ucc.ie/en/ohsrc/publications-guidelines/>. Accessed June 2018.
9. Lim, W., Arnold, D.M., Bachanova, V., *et al.* Evidence-based guidelines—an introduction. *Hematology Am Soc Hematol Educ Program* 2008: 26-30.
10. The ADAPTE Process: Resource Toolkit for Guideline Adaptation Version 2.0. 2009. Available at: <http://www.g-i-n.net>. Accessed June 2018.
11. Wright, J.T., Crall, J.J., Fontana, M., *et al.* Evidence-based clinical practice guideline for the use of pit and fissure sealants: A report of the American Dental Association and the American Academy of Pediatric Dentistry. *J Am Dent Assoc* 2016; 147(8): 672-682.e612.
12. Guidelines International Network. Available at: <http://www.g-i-n.net>. Accessed June 2018.
13. European Academy of Paediatric Dentistry. Available at: <http://www.eapd.gr>. Accessed June 2018.
14. Ahovuo Saloranta, A.F.H., Walsh, T., Nordblad, A., Mäkelä, M., Worthington, H.V. Pit and fissure sealants for preventing dental decay in permanent teeth. *Cochrane Database Syst Rev* Cochrane Review; 2017.
15. CASP. CASP Checklists. Available at: <http://www.casp-uk.net/casp-tools-checklists>. Accessed June 2018.
16. Hilgert, L.A., Leal, S.C., Mulder, J., Creugers, N.H., Frencken, J.E. Caries-preventive Effect of Supervised Toothbrushing and Sealants. *J Dent Res* 2015; 94(9): 1,218-1,224.
17. Kumaran, P. Clinical evaluation of the retention of different pit and fissure sealants: a 1-year study. *Int J Clin Pediatr Dent* 2013; 6(3): 183-187.
18. Chen, X., Liu, X. Clinical comparison of Fuji VII and a resin sealant in children at high and low risk of caries. *Dent Mater J* 2013; 32(3): 512-518.
19. Prathiba, B., Reddy, P., Anjum, M., Monica, M., Praveen, B. Sealants Revisited: An Efficacy Battle Between the Two Major Types of Sealants - A Randomized Controlled Clinical Trial. *Dent Res J* 2019; 16(1): 36-41.
20. American Academy of Pediatric Dentistry. Caries-risk Assessment and Management for Infants, Children, and Adolescents. *American Academy of Pediatric Dentistry Journal* 2017; 39(6): 197-204.
21. Dhar, V., Chen, H. Evaluation of resin based and glass ionomer based sealants placed with or without tooth preparation—a two year clinical trial. *Pediatr Dent* 2012; 34(1): 46-50.
22. Nogourani, M.K., Janghorbani, M., Khadem, P., Jadidi, Z., Jalali, S. A 12-month clinical evaluation of pit and fissure sealants placed with and without etch-and-rinse and self-etch adhesive systems in newly-erupted teeth. *J Appl Oral Sci* 2012; 20(3): 352-356.
23. Karaman, E., Yazici, A.R., Tuncer, D., First, E., Unluer, S., Baseren, M. A 48-month clinical evaluation of fissure sealants placed with different adhesive systems. *Oper Dent* 2013; 38(4): 369-375.
24. McCafferty, J., O'Connell, A.C. A randomised clinical trial on the use of intermediate bonding on the retention of fissure sealants in children. *Int J Paediatr Dent* 2016; 26(2): 110-5.
25. Moreira, K., Kantovitz, K., Pedrini Dias Aguiar, J., Flavia Sanches Borges, A., Pascon F., Puppini Rontani, R. Impact of the intermediary layer on sealant retention: a randomised 24-month clinical trial. *Clinical Oral Invest* 2017; 21: 1,435-1,443.
26. Rishika, N., Mayall, S., Pathivada, L., Yeluri, R. Combined Effect of Enamel Deproteinization and Intermediate Bonding in the Retention of Pit and Fissure Sealants in Children: A Randomized Clinical Trial. *J Clin Pediatr Dent* 2018. 42(6): 427-433.

27. **Marinho, V.C., Worthington, H.V., Walsh, T., Clarkson, J.E.** Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2013(7): Cd002279.
28. **Chestnutt, I.G., Playle, R., Hutchings, S., et al.** Fissure Seal or Fluoride Varnish? A Randomized Trial of Relative Effectiveness. *J Dent Res* 2017; 22034517702094.
29. **Tagliaferro, E.P., Pardi, V., Ambrosano, G.M., Meneghim Mde, C., da Silva, S.R., Pereira, A.C.** Occlusal caries prevention in high and low risk schoolchildren: A clinical trial. *Am J Dent* 2011; 24(2): 109-114.
30. **Antonson, S.A., Antonson, D.E., Brener, S., et al.** Twenty-four month clinical evaluation of fissure sealants on partially erupted permanent first molars: glass ionomer versus resin-based sealant. *J Am Dent Assoc* 2012; 143(2): 115-122.
31. **Liu, B.Y., Xiao, Y., Chu, C.H., Lo, E.C.M.** Glass ionomer ART sealant and fluoride-releasing resin sealant in fissure caries prevention – results from a randomized clinical trial. *BMC Oral Health* 2014; 14(1): 54.
32. **Zhang, W., Chen, X., Fan, M.W., Mulder, J., Huysmans, M.C., Frencken, J.E.** Do light cured ART conventional high-viscosity glass-ionomer sealants perform better than resin-composite sealants: a 4-year randomized clinical trial. *Dent Mater* 2014; 30(5): 487-492.
33. **Health Protection Surveillance Centre.** COVID-19 Guidance on Managing Infection Related Risks in Dental Service v1.1 15/05/2020 – updated March 5, 2021. HSE Available at: <https://www.hpsc.ie/a-z/respiratory/coronavirus/novelcoronavirus/guidance/infectionpreventionandcontro> Iguidance/dentalservices/Guidance%20for%20Dental%20Services.pdf. Accessed June 22, 2020.
34. Recommendations for the re-opening of dental services: a rapid review of international sources. COVID-19 Dental Services Evidence Review (CoDER) Working Group Version 1.2 – updated May 13, 2020. Available at: https://oralhealth.cochrane.org/sites/oralhealth.cochrane.org/files/public/uploads/covid19_dental_reopening_rapid_review_13052020.pdf. Accessed June 2020.

CPD questions

To claim CPD points, go to the MEMBERS' SECTION of www.dentist.ie and answer the following questions:



CPD

1. Recommendation for best practice includes the following measure directly prior to placing fissure sealants:

- ☐ A: Mechanical shaping of fissures with a diamond bur
- ☐ B: Placement of rubber dam isolation
- ☐ C: Cleaning of occlusal surface with bristle brush and pumice
- ☐ D: Use of bond as an intermediary layer

2. Pit and fissure sealants are an effective preventive measure for the following patients:

- ☐ A: Children aged six to nine years with high caries risk
- ☐ B: Adults with immunocompromised status
- ☐ C: Adolescents with poor oral hygiene
- ☐ D: All individuals who are assessed as being high caries risk

3. When is the best time to place fissure sealants?

- ☐ A: When the child is six years old
- ☐ B: When the tooth is sufficiently erupted to be isolated
- ☐ C: When there are one or more permanent first molars partially erupted in the mouth
- ☐ D: When there is an early enamel lesion in the occlusal fissure