JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S11

Dental Sealants: A Comprehensive Overview for Caries Prevention

Ashwag Moohmaed Alahmari[1], Sarah Hamed Almutairi[2], Alwah Muhammad Alshmrani[3], Nouf Ibrahim Almkezem[4], Naif Ahmed Alrumayyan[5], Ghada Alshtaahrani[6], Munarh Abdullh Alanazi[7], Maher Alabdulkarim[8], Anwar Yahya Mashi[9], Hussam Alshamrani[10]

1. *Dental assistant, Dental clinic complex west of Riyadh, Saudi Arabia, Ashwag140753@gmail.com*
2. *Dental hygienist, Dental clinic complex west of Riyadh, Saudi Arabia, Sarah-hamed@hotmail.com*
3. *Dental assistant, Dental clinic complex west of Riyadh, Saudi Arabia, lwlhalshmrany4@gmail.com*
4. *Dentist, Druma General Hospital (C3), Saudi Arabia.*
5. *Dentist, Druma General Hospital (C3), Saudi Arabia.*
6. *Dental assistant, Dental clinic complex west of Riyadh, Saudi Arabia, Ghabalshahrani@moh.gov.sa*
7. *Dental assistant, Al Yamamah hospital, Saudi Arabia, Malanazi221@moh.gov.sa*
8. *Periodontics, Dental clinic complex west of Riyadh, Saudi Arabia, dr.alabdulkarim@gmail.com*
9. *Dental Assistant, Al Yamamah Hospital, Saudi Arabia, Anmashi@moh.gov.sa*
10. *Family dentistry specialist, Security forces hospital program Riyadh, Saudi Arabia, dr.hos@live.com*

Abstract

Dental caries is a highly prevalent and destructive oral disease impacting physical health, quality of life, and overall well-being. Effective preventive strategies like dental sealants are crucial for maintaining oral health. This comprehensive review provides an in-depth understanding of dental sealants' classification, mechanisms, effectiveness in caries prevention and arrest, clinical indications, longevity, and factors influencing success.

Dental sealants are classified into resin sealants, glass ionomer sealants, and hybrid sealants based on their material composition. They prevent caries by creating a physical barrier, facilitating oral hygiene, and releasing remineralizing ions. Numerous studies demonstrate their effectiveness, with resin sealants reaching up to 92% preventive fraction at 6 months and 61% at 60 months.

Dental sealants are recommended for patients with high caries risk, both primary and permanent teeth, sound tooth surfaces, and non-cavitated caries lesions. Their application on occlusal fissures, smooth surfaces, fully/partially erupted molars, and teeth with fluorosis is supported by evidence. Adequate moisture control, proper surface preparation with pumice cleaning and acid etching, and judicious use of dental adhesives optimize sealant longevity.

While resin sealants generally exhibit superior retention, the choice of material should consider caries risk, eruption status, and fluorosis presence. Ongoing research and advancements in dental materials will further enhance sealants' efficacy and longevity, solidifying their role in modern preventive dentistry as part of a comprehensive caries management approach.

Introduction:

Dental caries, commonly known as tooth decay, is a highly prevalent oral disease worldwide, affecting billions of people across all age groups (Global Burden of Disease Collaborative Network, 2019; Pitts et al., 2017). It is a progressive and destructive process that can lead to pain, infection, and ultimately tooth loss if left untreated (Passarelli et al., 2020). The consequences of dental caries extend beyond physical health, impacting quality of life, self-esteem, and overall well-being (Bukhari, 2020; Kaur et al., 2017; Kastenbom et al., 2019). Given the significant burden of dental caries, effective preventive strategies are crucial for maintaining oral health and reducing the associated costs and complications.

One of the most effective and widely recognized preventive measures for dental caries is the application of dental sealants. Dental sealants are protective coatings that are applied to the pits and fissures of tooth surfaces, providing a physical barrier against the

accumulation of plaque and the entry of cariogenic bacteria and food debris (Yu et al., 2021). By sealing these vulnerable areas, dental sealants can significantly reduce the risk of caries development and progression.

The concept of dental sealants dates back to the early 20th century, with pioneers like Hyatt and Buonocore exploring different approaches to eliminate fissures and prevent caries (Hyatt, 1923; Buonocore, 1955, 1970). Over the years, dental sealants have evolved, incorporating various materials and advanced technologies, and their application has been recognized and endorsed by professional organizations such as the American Dental Association (Council on Dental Materials Devices and Council on Dental Therapeutics, 1971).

This comprehensive review aims to provide an in-depth understanding of dental sealants, their classification, mechanisms of action, effectiveness in caries prevention and arrest, clinical indications, longevity, and factors influencing their success. By synthesizing the latest research and evidence-based practices, this review seeks to inform clinicians, researchers, and policymakers about the critical role of dental sealants in contemporary caries management strategies.

Classification of Dental Sealants:

Dental sealants can be broadly classified into three categories based on their material composition: resin sealants, glass ionomer sealants, and hybrid sealants (Gizani, 2018; Ng et al., 2023).

1. Resin Sealants:
   Resin sealants are the most commonly used type of dental sealants. They contain an organic resin-based oligomer matrix, typically composed of monomers such as Bisphenol A-glycidyl methacrylate (Bis-GMA), Urethane-dimethacrylate (UDMA), or Triethylene glycol dimethacrylate (TEGDMA) (Pratap et al., 2019; Sanders, 2016). Resin sealants may also contain fillers, fluoride particles, or photoinitiators to enhance their properties and performance.

Resin sealants can be further categorized based on their polymerization mechanism:

a. Auto-cure resin sealants: These sealants undergo auto-polymerization, initiated by chemical reactions between tertiary amines and benzoyl peroxide, without the need for an external light source (Sanders, 2016).

b. Light-cure resin sealants: These sealants require an external light source, typically visible light, to initiate the polymerization process through the dissociation of photoinitiators into free radicals (Kowalska et al., 2021; Worzakowska, 2021).

Additionally, resin sealants can be classified based on their ability to release fluoride ions:

a. Fluoride-releasing resin sealants: These sealants contain fluoride particles or fluoride-releasing glass fillers, providing an additional mechanism for caries prevention through the release of fluoride ions (Poggio et al., 2016).

b. Non-fluoride-releasing resin sealants: These sealants do not contain fluoride and rely solely on their physical barrier properties for caries prevention.

Furthermore, resin sealants can be categorized as filled or unfilled, depending on the presence of filler particles, which can influence their wear resistance and viscosity (Faria et al., 2021; Reddy et al., 2015).

2. Glass Ionomer Sealants:
   Glass ionomer sealants are another important category of dental sealants. They are composed of fluoroaluminosilicate glass powder and polyacrylic acid liquid (Nicholson, 2016; Shahid & Duminis, 2019). Glass ionomer sealants can be further divided into two types:

a. Conventional glass ionomer sealants: These sealants set through an acid-base reaction between the glass powder and polyacrylic acid liquid (Nicholson, 2016).

b. Resin-modified glass ionomer sealants: These sealants incorporate resin-based monomers, such as 2-hydroxyethylmethacrylate (HEMA) or UDMA, into the

conventional glass ionomer formulation, setting through a combination of acid-base reactions and resin polymerization (Ana & Anggraeni, 2021; Kim et al., 2015; Shen et al., 2022).

Glass ionomer sealants are known for their ability to release fluoride ions, which can promote remineralization and inhibit cariogenic bacterial growth (Ramamurthy et al., 2018).

3. Hybrid Sealants:
   Hybrid sealants represent a relatively new category that combines properties of both resin and glass ionomer materials. These include:

a. Compomer sealants: Also known as polyacid-modified composite resins, compomer sealants contain non-reactive inorganic filler particles, reactive silicate glass particles, a polyacid-modified monomer, and a photoinitiator (Shen et al., 2022).

b. Giomer sealants: Giomer sealants are composed of pre-reacted glass ionomer (PRG) filler particles and a resin-based monomer matrix, providing both fluoride release and improved physical properties (Rusnac et al., 2019).

Dental sealants can also be classified based on their color, with clear, white, and pink being the most common options. Clear sealants allow for better monitoring of underlying lesions, while colored sealants may be easier to visualize during follow-up examinations (Fontana et al., 2014).

Mechanisms of Dental Sealants in Caries Prevention and Arrest:

Dental sealants employ several mechanisms to prevent and arrest dental caries, including the creation of a physical barrier, facilitation of oral hygiene practices, and the release of ions that promote remineralization (Ng et al., 2023).

1. Physical Barrier:
   By sealing the pits and fissures of tooth surfaces, dental sealants create a physical barrier that prevents the accumulation of plaque biofilm and the entry of cariogenic bacteria and food debris (Ng et al., 2023; Yu et al., 2021). This barrier disrupts the caries process by depriving the bacteria of the necessary environment and nutrients for their growth and acid production.
2. Ease of Cleaning:
   Dental sealants can improve oral hygiene practices by transforming the complex, plaque-retentive fissure system into a smoother, easier-to-clean surface (Balian et al., 2022; Ng et al., 2023). With the fissures sealed, it becomes easier for patients to effectively remove plaque and debris during routine brushing and flossing, further reducing the risk of caries development.
3. Ion Release:
   Several types of dental sealants, including glass ionomer sealants, hybrid sealants, and some resin sealants, are capable of releasing ions that can inhibit demineralization and promote remineralization of tooth structures (Alsabek et al., 2019; Cagetti et al., 2014; Kaga et al., 2014; Ogawa et al., 2022).

a. Fluoride release: Fluoride ions released from fluoride-containing sealants can reduce demineralization, promote remineralization, and inhibit the growth of cariogenic bacteria (Johnston & Strobel, 2020; Philip, 2019).

b. Antimicrobial ion release: Some giomer sealants release antimicrobial ions, such as borate and strontium, which can inhibit bacterial growth and serve as buffers against lactic acid produced by cariogenic bacteria (Kaga et al., 2014; Ogawa et al., 2022).

The combination of these mechanisms provides a multifaceted approach to caries prevention and arrest, making dental sealants a highly effective and valuable tool in contemporary caries management strategies.

Effectiveness of Dental Sealants in Caries Prevention and Arrest:

Numerous studies have demonstrated the effectiveness of dental sealants in preventing and arresting dental caries, particularly in the past decade (2012-2022). Notably, the preventive fraction of resin sealants can reach up to 92% at 6 months (Gonçalves et al.,

2016), 88% at 18 months (Uzel et al., 2022), and 61% at 60 months (Liu et al., 2018). Similarly, glass ionomer sealants have demonstrated preventive fractions of 92% at 6 months (Gonçalves et al., 2016) and 88% at 18 months (Uzel et al., 2022). However, the evidence on hybrid sealants is more limited.

In addition to caries prevention, dental sealants have also shown promising results in arresting non-cavitated caries lesions. Several studies have reported the successful arrest of non-cavitated caries, including dentinal caries, through the application of resin or glass ionomer sealants (Alsabek et al., 2019; Borges et al., 2012; Hesse et al., 2014; Jaafar et al., 2020). However, the effectiveness of dental sealants in arresting cavitated caries remains controversial, with some studies reporting positive outcomes (Kasemkhun et al., 2021; Muñoz-Sandoval et al., 2019) and others suggesting limited effectiveness (Beresescu et al., 2022).

Longevity of Dental Sealants:

The longevity and retention of dental sealants are crucial factors influencing their effectiveness in caries prevention and arrest. For resin sealants, retention rates range from 11% to 89% at 6 months (Alsabek et al., 2019; Gonçalves et al., 2016; Mohapatra et al., 2020), 18% to 88% at 12 months (Askarizadeh et al., 2017; Bhatia et al., 2012; Kumaran, 2013; Khatri et al., 2015; Mathew et al., 2019; Ntaoutidou et al., 2018; Prathibha et al., 2019; Reddy et al., 2015; Ulusu et al., 2012), 24% to 70% at 18 months (Al-Jobair et al., 2017; Uzel et al., 2022), and 21% to 80% at 24 months (Antonson et al., 2012; Chen & Liu, 2013; Haricharan et al., 2022; Özgür et al., 2022; Reic et al., 2022; Ulusu et al., 2012).

For glass ionomer sealants, retention rates range from 49% to 63% at 6 months (Alsabek et al., 2019; Gonçalves et al., 2016; Mohapatra et al., 2020), 21% to 78% at 12 months (Bhat et al., 2013; Mathew et al., 2019; Prathibha et al., 2019; Ulusu et al., 2012), and 14% to 44% at 24 months (Antonson et al., 2012; Chen & Liu, 2013; Haricharan et al., 2022; Özgür et al., 2022; Reic et al., 2022; Ulusu et al., 2012).

For hybrid sealants, limited data is available, with retention rates ranging from 8% to 26% at 12 months (Özgür et al., 2022; Siripokkapat et al., 2018).

While these retention rates vary across studies and follow-up periods, it is evident that regular monitoring and potential reapplication of dental sealants may be necessary to maintain their protective effects over time.

Indications for Dental Sealant Placement:

Based on the available evidence, dental sealants are recommended for a wide range of clinical scenarios and patient populations. The following factors should be considered when determining the indications for dental sealant placement (Ng et al., 2023):

1. Caries Risk of the Patient:
   Dental sealants are particularly beneficial for patients with a high caries risk, as they have been shown to be more effective and cost-effective in this population (Akinlotan et al., 2018; Griffin et al., 2016). Patients with high caries risk should be prioritized for dental sealant application.
2. Types of Dentition:
   Dental sealants are recommended for both primary and permanent teeth. Systematic reviews and meta-analyses have demonstrated the effectiveness of resin sealants in preventing caries in permanent molars for up to 4 years (Ahovuo-Saloranta et al., 2017; Lam et al., 2021; Wright et al., 2016). Additionally, dental sealants have been found to be effective in preventing caries in primary teeth, with evidence supporting their use as a cost-effective approach (Ramamurthy et al., 2018, 2022).
3. Caries Status of the Tooth:
   Dental sealants are highly effective in preventing caries on sound tooth surfaces. Numerous studies have reported significantly lower caries incidence rates on

sealed sound surfaces compared to unsealed surfaces (Ahovuo-Saloranta et al., 2017; Godhi et al., 2021; Lam et al., 2021; Wright et al., 2016).

Furthermore, dental sealants have demonstrated the ability to arrest non-cavitated caries lesions (Alsabek et al., 2019; Borges et al., 2012; Urquhart et al., 2019). Several studies have shown that the chance of arresting or reversing non-cavitated occlusal caries is 2-3 times higher with dental sealants compared to no treatment (Fontana et al., 2014; Urquhart et al., 2019). However, the effectiveness of dental sealants in arresting cavitated caries remains controversial, with some studies reporting positive outcomes (Kasemkhun et al., 2021; Muñoz-Sandoval et al., 2019) and others suggesting limited effectiveness (Beresescu et al., 2022).

4. Types of Tooth Surfaces:
   Dental sealants are commonly applied to occlusal fissure surfaces, where they have demonstrated significant effectiveness in caries prevention (Ahovuo-Saloranta et al., 2017; Lam et al., 2021). However, recent studies have also supported the application of dental sealants on axial smooth surfaces, including proximal surfaces, to prevent and arrest non-cavitated and micro-cavitated caries lesions (Basili et al., 2017; Chen et al., 2021; Lindquist & Emilson, 2020; Soto-Rojas et al., 2012).
5. Eruption Status of the Tooth:
   Dental sealants can be applied to both fully erupted and partially erupted molars. However, it is important to note that the retention rate of sealants in partially erupted molars may be lower due to challenges in achieving adequate moisture control and the difficulty in accessing these surfaces (Antonson et al., 2012; Moreira et al., 2017). In cases where partially erupted molars are to be sealed, glass ionomer sealants may be a better choice than resin sealants due to their improved moisture tolerance.
6. Presence of Dental Fluorosis:
   Dental sealants can be applied to teeth affected by dental fluorosis. In these cases, the choice of seal

ant material becomes crucial, with studies suggesting that resin sealants exhibit higher retention rates compared to glass ionomer sealants on fluorotic permanent molars (Hasanuddin et al., 2014).

Operative Factors Affecting Sealant Longevity:

The longevity and effectiveness of dental sealants are influenced by several operative factors, including moisture control, tooth surface preparation, and the application of dental adhesives (Ng et al., 2023).

1. Moisture Control:
   Achieving adequate moisture control is critical for successful sealant placement and retention. Saliva contamination has been shown to significantly increase microleakage and reduce the shear bond strength of dental sealants (Bao et al., 2022; Memarpour et al., 2018, 2021; Paryab, 2013). Several studies have compared different isolation methods, such as rubber dams, cotton rolls, and dental isolation systems, and found no significant differences in sealant retention rates among these techniques (Bandi et al., 2021; Lyman et al., 2013; Mattar et al., 2023). However, patient preference and chair time may influence the choice of isolation method (Mattar et al., 2021).
2. Tooth Surface Preparation:
   Proper tooth surface preparation is essential for optimal sealant adhesion and penetration. The following techniques have been explored:

a. Surface Cleaning: Cleaning the tooth surface with pumice slurry has been shown to significantly improve sealant retention compared to no treatment or dry brushing alone (Hegde & Coutinho, 2016; Sridhar et al., 2016). Air polishing has also been suggested as

a superior method for surface cleaning (Ansari et al., 2022), but caution should be exercised due to the potential risk of subcutaneous emphysema (Alonso et al., 2017).
b. Mechanical Preparation with Dental Burs: Mechanical preparation with burs before sealant placement is generally not recommended, as studies have found no significant difference in retention rates between teeth prepared with or without burs (Nahid et al., 2012).
c. Mechanical Preparation with Lasers: The use of lasers, such as Er,Cr:YSGG or Er:YAG, for surface preparation has shown inconsistent results in terms of improving sealant retention or shear bond strength compared to conventional acid etching (Ciucchi et al., 2015; Durmus et al., 2017; Karaman et al., 2013; Rattanacharoenthum et al., 2019; Yilmaz & Keles, 2020; Zhang et al., 2019).
d. Mechanical Preparation with Air Abrasion: Current evidence suggests that air abrasion prior to sealant placement does not significantly improve retention rates or penetrability compared to acid etching alone (Bhushan & Goswami, 2017; Cho et al., 2015; Fumes et al., 2017; Reddy et al., 2014).
e. Chemical Preparation with Acid Etching: Acid etching with 37% phosphoric acid for 30 seconds remains the standard of care for enamel pretreatment before resin sealant application (Bagherian & Sarraf Shirazi, 2016; Lo et al., 2020; Markovic et al., 2019).
f. Fluoride Varnish Pre-treatment: The use of fluoride varnish prior to sealant placement is not recommended, as studies have shown no improvement in caries prevention or sealant retention, and potential adverse effects on shear bond strength and microleakage (Frazer et al., 2017; Germán-Cecilia et al., 2018; Lakshmi et al., 2018).

3. Application of Dental Adhesives:
   The use of dental adhesives prior to sealant placement has been explored, with mixed results. While some studies have reported increased bond strength and reduced microleakage with the use of adhesives (Attar et al., 2021; Bagherian et al., 2016; Bao et al., 2022), others have found no significant improvement in sealant retention (Bandi et al., 2020; Nazar et al., 2012). Among adhesive systems, etch-and-rinse adhesives have generally shown better performance than self-etch adhesives in improving sealant bond strength (Bagherian et al., 2016; Botton et al., 2016; Martignon & Zarta, 2017).

Conclusion:

Dental sealants represent a highly effective and valuable strategy for caries prevention and management in contemporary dentistry. This comprehensive review has highlighted the diverse classifications of dental sealants, their mechanisms of action, clinical effectiveness, indications for use, longevity, and factors influencing their success.
The available evidence strongly supports the use of dental sealants, particularly resin and glass ionomer sealants, for preventing and arresting non-cavitated caries lesions in both primary and permanent dentitions. Their ability to create a physical barrier, facilitate oral hygiene practices, and release remineralizing ions contributes to their protective effects against caries development and progression.
While resin sealants generally demonstrate superior retention rates, the choice of sealant material should be guided by factors such as caries risk, eruption status, and the presence of dental fluorosis. Proper operative techniques, including adequate moisture control, surface preparation, and the judicious use of dental adhesives, play a crucial role in optimizing sealant longevity and effectiveness.
As dental caries remains a significant public health concern worldwide, the implementation of effective preventive strategies like dental sealants is essential. By incorporating the latest evidence and best practices, dental professionals can maximize the benefits of dental sealants and contribute to improved oral health outcomes for patients across all age groups.

It is important to note that dental sealants should be part of a comprehensive caries management approach that includes regular oral hygiene practices, dietary modifications, and periodic professional evaluations. Ongoing research and advancements in dental materials and techniques will further enhance the efficacy and longevity of dental sealants, solidifying their role as a cornerstone in modern preventive dentistry.

References:

Ahovuo-Saloranta, A., Forss, H., Walsh, T., Nordblad, A., Mäkelä, M., & Worthington, H. V. (2017). Pit and fissure sealants for preventing dental decay in permanent teeth. Cochrane Database of Systematic Reviews, 7(7), CD001830. https://doi.org/10.1002/14651858.CD001830.pub5

Akinlotan, M., Chen, B., Fontanilla, T. M., Chen, A., & Fan, V. Y. (2018). Economic evaluation of dental sealants: A systematic literature review. Community Dentistry and Oral Epidemiology, 46(1), 38-46. https://doi.org/10.1111/cdoe.12326

Alonso, V., García-Caballero, L., Couto, I., Diniz, M., Diz, P., & Limeres, J. (2017). Subcutaneous emphysema related to air-powder tooth polishing: A report of three cases. Australian Dental Journal, 62(4), 510-515. https://doi.org/10.1111/adj.12537

Alsabek, L., Al-Nerabieah, Z., Bshara, N., & Comisi, J. C. (2019). Retention and remineralization effect of moisture tolerant resin-based sealant and glass ionomer sealant on non-cavitated pit and fissure caries: Randomized controlled clinical trial. Journal of Dentistry, 86, 69-74. https://doi.org/10.1016/j.jdent.2019.05.027

Ana, I. D., & Anggraeni, R. (2021). Development of bioactive resin modified glass ionomer cement for dental biomedical applications. Heliyon, 7(4), e06944. https://doi.org/10.1016/j.heliyon.2021.e06944

Ansari, M. T., Verma, M. K., & Abdullah, A. (2022). A comparative evaluation of different methods of cleaning and preparing occlusal fissures, before placement of pit and fissure sealant: A stereomicroscopic study. University Journal of Dentistry Sciences, 8(3), 10-15. https://doi.org/10.21276/ujds.2022.8.3.3

Antonson, S. A., Antonson, D. E., Brener, S., Crutchfield, J., Larumbe, J., Michaud, C., & Yazici, A. R. (2012). Twenty-four month clinical evaluation of fissure sealants on partially erupted permanent first molars: Glass ionomer versus resin-based sealant. Journal of the American Dental Association, 143(2), 115-122. https://doi.org/10.14219/jada.archive.2012.0121

Askarizadeh, N., Heshmat, H., & Zangeneh, N. (2017). One-year clinical success of embrace hydrophilic and helioseal-F hydrophobic sealants in permanent first molars: A clinical trial. Journal of Dentistry (Tehran, Iran), 14(2), 92-99.

Attar, M. H., Abdallah, M. A., Alharthy, H. A., & El Meligy, O. A. (2021). Effect of bonding agent on retention of different sealants: An in vitro study. Journal of Clinical Pediatric Dentistry, 45(3), 177-185. https://doi.org/10.17796/1053-4625-45.3.6

Bagherian, A., & Sarraf Shirazi, A. (2016). Preparation before acid etching in fissure sealant therapy: Yes or no? A systematic review and meta-analysis. Journal of the American Dental Association, 147(12), 943-951. https://doi.org/10.1016/j.adaj.2016.08.003

Bagherian, A., Shirazi, A. S., & Sadeghi, R. (2016). Adhesive systems under fissure sealants: Yes or no? A systematic review and meta-analysis. Journal of the American Dental Association, 147(6), 446-456. https://doi.org/10.1016/j.adaj.2016.01.014

Balian, A., Campus, G., Bontà, G., Esteves-Oliveira, M., Salerno, C., Cirio, S., ... & Abate, A. (2022). Long-term caries prevention of dental sealants and fluoride varnish in children with autism spectrum disorders: A retrospective cohort study. Scientific Reports, 12(1), 8478. https://doi.org/10.1038/s41598-022-12176-7

Bandi, M., Mallineni, S. K., & Nuvvula, S. (2021). Influence of isolation methods on retention of pit and fissure sealants in young permanent teeth based on Simonsen's criteria: A randomised clinical trial. Journal of Clinical and Diagnostic Research, 15(6), ZC06-ZC09. https://doi.org/10.7860/JCDR/2021/44929.14734

Bandi, M., Mallineni, S., & Nuvvula, S. (2020). Retention and effectiveness of pit and fissure sealants placed with or without bonding agent in young permanent teeth: A randomized clinical trial with a year follow-up. Indian Journal of Dental Research, 31(6), 877-882. https://doi.org/10.4103/ijdr.IJDR_779_19

Bao, Z., Sun, H., Fan, D., Wang, X., & Wang, Q. (2022). Shear bond strength and microleakage of pit and fissure sealants placed after saliva-contaminated etched enamel. Coatings, 12(4), 441. https://doi.org/10.3390/coatings12040441

Basili, C. P., Emilson, C. G., Corvalan, G. C., Moran, M. P., Torres, C., Quiroz, M. D., & Arredondo, M. E. (2017). Preventive and therapeutic proximal sealing: A 3.5-year randomized controlled clinical trial follow-up. Caries Research, 51(4), 387-393. https://doi.org/10.1159/000470851

Beresescu, L., Păcurar, M., Bica, C. I., Vlasa, A., Stoica, O. E., Dako, T., & Petrică, B. (2022). The assessment of sealants' effectiveness in arresting non-cavitated caries lesion—A 24-month follow-up. Healthcare, 10(9), 1651. https://doi.org/10.3390/healthcare10091651

Bhat, P. K., Konde, S., Raj, S. N., & Kumar, N. C. (2013). Moisture-tolerant resin-based sealant: A boon. Contemporary Clinical Dentistry, 4(3), 343-348. https://doi.org/10.4103/0976-237X.118394

Bhatia, M. R., Patel, A. R., & Shirol, D. D. (2012). Evaluation of two resin based fissure sealants: A comparative clinical study. Journal of the Indian Society of Pedodontics and Preventive Dentistry, 30(4), 227-230. https://doi.org/10.4103/0970-4388.105015

Bhushan, U., & Goswami, M. (2017). Evaluation of retention of pit and fissure sealants placed with and without air abrasion pretreatment in 6-8 year old children–an in vivo study. Journal of Clinical and Experimental Dentistry, 9(2), e211-e215. https://doi.org/10.4317/jced.53259

Borges, B. C. D., de Souza Borges, J., Braz, R., Montes, M. A. J. R., & de Assunção Pinheiro, I. V. (2012). Arrest of non-cavitated dentinal occlusal caries by sealing pits and fissures: A 36-month, randomised controlled clinical trial. International Dental Journal, 62(5), 251-255. https://doi.org/10.1111/j.1875-595X.2012.00117.x

Botton, G., Morgental, C. S., Scherer, M. M., Lenzi, T. L., Montagner, A. F., & Rocha, R. O. (2016). Are self-etch adhesive systems effective in the retention of occlusal sealants? A systematic review and meta-analysis. International Journal of Paediatric Dentistry, 26(6), 402-411. https://doi.org/10.1111/ipd.12214

Bukhari, O. M. (2020). Dental caries experience and oral health related quality of life in working adults. The Saudi Dental Journal, 32(8), 382-389. https://doi.org/10.1016/j.sdentj.2019.11.003

Buonocore, M. G. (1955). A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. Journal of Dental Research, 34(6), 849-853. https://doi.org/10.1177/00220345550340060801

Buonocore, M. (1970). Adhesive sealing of pits and fissures for caries prevention, with use of ultraviolet light. The Journal of the American Dental Association, 80(2), 324-328. https://doi.org/10.14219/jada.archive.1970.0061

Cagetti, M. G., Carta, G., Cocco, F., Sale, S., Congiu, G., Mura, A., ... & Campus, G. (2014). Effect of fluoridated sealants on adjacent tooth surfaces: A 30-mo randomized clinical trial. Journal of Dental Research, 93(7_suppl), 59S-65S. https://doi.org/10.1177/0022034514535808

Chen, Y., Chen, D., & Lin, H. (2021). Infiltration and sealing for managing non-cavitated proximal lesions: A systematic review and meta-analysis. BMC Oral Health, 21(1), 13. https://doi.org/10.1186/s12903-020-01364-4

Chen, X. X., & Liu, X. G. (2013). Clinical comparison of Fuji VII and a resin sealant in children at high and low risk of caries. Dental Materials Journal, 32(4), 512-518. https://doi.org/10.4012/dmj.2012-300

Cho, J. S., Covey, D., Abdelmegid, F., & Salama, F. (2015). Effects of the preparation technique and type of material on the penetrability of sealants. General Dentistry, 63(6), e18-e22.
Ciucchi, P., Neuhaus, K. W., Emerich, M., Peutzfeldt, A., & Lussi, A. (2015). Evaluation of different types of enamel conditioning before application of a fissure sealant. Lasers in Medical Science, 30(1), 1-9. https://doi.org/10.1007/s10103-013-1333-2
Council on Dental Materials Devices, & Council on Dental Therapeutics. (1971). Pit and fissure sealants. The Journal of the American Dental Association, 82(5), 1101-1103. https://doi.org/10.14219/jada.archive.1971.0194
Durmus, B., Giray, F., Peker, S., & Kargul, B. (2017). Clinical evaluation of a fissure sealant placed by acid etching or Er: YAG laser combined with acid etching. Oral Health & Preventive Dentistry, 15(2), 157-162. https://doi.org/10.3290/j.ohpd.a37927
Faria, M., Guedes, A., Rompante, P., Carvalho, O., Silva, F., Henriques, B., ... & Almeida, B. (2021). Wear pathways of tooth occlusal fissure sealants: An integrative review. Biotribology, 27, 100190. https://doi.org/10.1016/j.biotri.2021.100190
Fontana, M., Platt, J. A., Eckert, G. J., González-Cabezas, C., Yoder, K., Zero, D. T., ... & Ando, M. (2014). Monitoring of sound and carious surfaces under sealants over 44 months. Journal of Dental Research, 93(10), 1070-1075. https://doi.org/10.1177/0022034514551753
Frazer, R. A., Platt, J. A., Sanders, B. J., Yepes, J. F., & Jones, J. E. (2017). The effect of fluoride varnish on enamel shear bond strength of pit and fissure sealants. Pediatric Dentistry, 39(2), 155-158.
Fumes, A. C., Longo, D. L., De Rossi, A., Fidalgo, T. K., de Paula e Silva, F. W. G., & Borsatto, M. C. (2017). Microleakage of sealants after phosphoric acid, Er: YAG laser and air abrasion enamel conditioning: Systematic review and meta-analysis. The Journal of Clinical Pediatric Dentistry, 41(3), 167-172. https://doi.org/10.17796/1053-4628-41.3.167
Germán-Cecilia, C., Reyes, S. M. G., Silva, A. P., Muñoz, C. S., & Ortiz-Ruiz, A. J. (2018). Microleakage of conventional light-cure resin-based fissure sealant and resin-modified glass ionomer sealant after application of a fluoride varnish on demineralized enamel. PLoS ONE, 13(12), e0208856. https://doi.org/10.1371/journal.pone.0208856
Gizani, S. (2018). Pit and fiss
ure sealants. In K. Bekes (Ed.), Pit and fissure sealants (pp. 23-34). Springer International Publishing.
Global Burden of Disease Collaborative Network. (2019). Global Burden of Disease Study 2019 (GBD 2019) Results. Institute for Health Metrics and Evaluation (IHME).
Godhi, B., Shanbhog, R., Nandlal, B., Rashmi, S., & Gopi, A. (2021). Retention and caries preventive effect of GC fuji VII sealant on the first permanent molars among high-risk residential school children-A three year follow up study. Journal of Natural Science, Biology and Medicine, 12(1), 155-160. https://doi.org/10.4103/jnsbm.JNSBM_154_20
Gonçalves, P. S. P., Kobayashi, T. Y., de Oliveira, T. M., Honório, H. M., Rios, D., & da Silva, S. M. B. (2016). Pit and fissure sealants with different materials: Resin based x glass ionomer cement—results after six months. Pesquisa Brasileira em Odontopediatria e Clinica Integrada, 16(1), 15-23. https://doi.org/10.4034/PBOCI.2016.161.02
Griffin, S. O., Wei, L., Gooch, B. F., Weno, K., & Espinoza, L. (2016). Vital signs: Dental sealant use and untreated tooth decay among U.S. school-aged children. Morbidity and Mortality Weekly Report, 65(41), 1141-1145. https://doi.org/10.15585/mmwr.mm6541e1
Haricharan, P. B., Voruganti, S., Kotha, A., Shivanna, M. M., Gandhi, B., & Suresh, N. (2022). An efficacy study between high viscosity glass ionomers and resin sealants in fissure caries prevention: A 2-year split mouth randomized controlled trial. European Journal of Dentistry, 16(1), 137-144. https://doi.org/10.1055/s-0041-1731925
Hasanuddin, S., Reddy, E. R., Manjula, M., Srilaxmi, N., Rani, S. T., & Rajesh, A. (2014). Retention of fissure sealants in young permanent molars affected by dental fluorosis: A

12-month clinical study. European Archives of Paediatric Dentistry, 15(5), 309-315. https://doi.org/10.1007/s40368-014-0116-1

Hegde, R. J., & Coutinho, R. C. (2016). Comparison of different methods of cleaning and preparing occlusal fissure surface before placement of pit and fissure sealants: An in vivo study. Journal of the Indian Society of Pedodontics and Preventive Dentistry, 34(2), 111-115. https://doi.org/10.4103/0970-4388.180403

Hesse, D., Bonifácio, C. C., Mendes, F. M., Braga, M. M., Imparato, J. C. P., & Raggio, D. P. (2014). Sealing versus partial caries removal in primary molars: A randomized clinical trial. BMC Oral Health, 14(1), 58. https://doi.org/10.1186/1472-6831-14-58

Hyatt, T. P. (1923). Prophylactic odontotomy: The cutting into the tooth for the prevention of disease. Dental Register, 77, 196-228.

Jaafar, N., Ragab, H., Abedrahman, A., & Osman, E. (2020). Performance of fissure sealants on fully erupted permanent molars with incipient carious lesions: A glass-ionomer-based versus a resin-based sealant. Journal of Dental Research, Dental Clinics, Dental Prospects, 14(1), 61-67. https://doi.org/10.34172/joddd.2020.009

Johnston, N. R., & Strobel, S. A. (2020). Principles of fluoride toxicity and the cellular response: A review. Archives of Toxicology, 94(4), 1051-1069. https://doi.org/10.1007/s00204-020-02687-5

Kaga, M., Kakuda, S., Ida, Y., Toshima, H., Hashimoto, M., Endo, K., & Tsuchitani, Y. (2014). Inhibition of enamel demineralization by buffering effect of S-PRG filler-containing dental sealant. European Journal of Oral Sciences, 122(1), 78-83. https://doi.org/10.1111/eos.12107

Karaman, E., Yazici, A. R., Baseren, M., & Gorucu, J. (2013). Comparison of acid versus laser etching on the clinical performance of a fissure sealant: 24-month results. Operative Dentistry, 38(2), 151-158. https://doi.org/10.2341/11-435-C

Kasemkhun, P., Nakornchai, S., Phonghanyudh, A., & Srimaneekarn, N. (2021). The efficacy of dental sealant used with bonding agent on occlusal caries (ICDAS 2-4): A 24-month randomized clinical trial. International Journal of Paediatric Dentistry, 31(6), 760-766. https://doi.org/10.1111/ipd.12758

Kaur, P., Singh, S., Mathur, A., Makkar, D. K., Aggarwal, V. P., Batra, M., ... & Sharma, A. (2017). Impact of dental disorders and its influence on self esteem levels among adolescents. Journal of Clinical and Diagnostic Research, 11(5), ZC05-ZC08. https://doi.org/10.7860/JCDR/2017/23362.9515

Kastenbom, L., Falsen, A., Larsson, P., Sunnegardh-Gronberg, K., & Davidson, T. (2019). Costs and health-related quality of life in relation to caries. BMC Oral Health, 19(1), 187. https://doi.org/10.1186/s12903-019-0874-6

Khatri, S. G., Samuel, S. R., Acharya, S., Patil, S., & Madan, K. (2015). Retention of moisture-tolerant and conventional resin-based sealant in six- to nine-year-old children. Pediatric Dentistry, 37(4), 366-370.

Kim, Y. K., Kim, K. H., & Kwon, T. Y. (2015). Setting reaction of dental resin-modified glass ionomer restoratives as a function of curing depth and postirradiation time. Journal of Spectroscopy, 2015, 1-8. https://doi.org/10.1155/2015/732624

Kowalska, A., Sokolowski, J., & Bociong, K. (2021). The photoinitiators used in resin based dental composite—A review and future perspectives. Polymers, 13(3), 470. https://doi.org/10.3390/polym13030470

Kumaran, P. (2013). Clinical evaluation of the retention of different pit and fissure sealants: A 1-year study. International Journal of Clinical Pediatric Dentistry, 6(3), 183-187. https://doi.org/10.5005/jp-journals-10005-1215

Lakshmi, M. S., Srilatha, K. T., Nandlal, B., & Deshmukh, S. (2018). Clinical evaluation of preventive effect of fissure sealants on initial carious lesion of permanent mandibular molars pretreated with and without fluoride varnish by fluorescence camera. International

Journal of Clinical Pediatric Dentistry, 11(2), 89-93. https://doi.org/10.5005/jp-journals-10005-1491
Lam, P. P. Y., Sardana, D., Lo, E. C. M., & Yiu, C. K. Y. (2021). Fissure sealant in a nutshell. Evidence-based meta-evaluation of sealants' effectiveness in caries prevention and arrest. Journal of Evidence-Based Dental Practice, 21(3), 101587. https://doi.org/10.1016/j.jebdp.2021.101587
Lindquist, B., & Emilson, C. G. (2020). Sealing proximal non-and micro-cavitated carious lesions using a one-session separator technique: A 2-year randomised clinical study. Caries Research, 54(6), 483-490. https://doi.org/10.1159/000509679
Liu, Y. J., Chang, Q., Rong, W. S., & Zhao, X. L. (2018). Caries prevention effectiveness of a resin based sealant and a glass ionomer sealants: A report of 5-year-follow-up. Zhonghua Kou Qiang Yi Xue Za Zhi, 53(7), 437-442. https://doi.org/10.3760/cma.j.issn.1002-0098.2018.07.002
Lo, Y. F., Pitchika, V., Ilie, N., Hickel, R., & Kuehnisch, J. (2020). Does etching time affect the in vitro performance of a sealant material?. Dental Materials Journal, 39(5), 862-868. https://doi.org/10.4012/dmj.2019-133
Lyman, T., Viswanathan, K., & McWhorter, A. (2013). Isolite vs. cotton roll isolation in the placement of dental sealants. Pediatric Dentistry, 35(2), 95E-99E.
Markovic, D. L., Petrovic, B. B., Peric, T. O., Trisic, D., Kojic, S., & Kuljic, B. L. (2019). Evaluation of sealant penetration in relation to fissure morphology, enamel surface preparation protocol and sealing material. Oral Health & Preventive Dentistry, 17(4), 349-355. https://doi.org/10.3290/j.ohpd.a42689
Martignon, S., & Zarta, O. L. (2017). The use of adhesive systems under fissure sealants improves their retention, with etch-and-rinse performing better than self-etching adhesive systems. Journal of Evidence-Based Dental Practice, 17(1), 56-58. https://doi.org/10.1016/j.jebdp.2017.01.012
Mathew, S. R., Narayanan, R. K., Vadekkepurayil, K., & Puthiyapurayil, J. (2019). One-year clinical evaluation of retention ability and anticaries effect of a glass ionomer-based and a resin-based fissure sealant on permanent first molars: An in vivo study. International Journal of Clinical Pediatric Dentistry, 12(6), 553-558. https://doi.org/10.5005/jp-journals-10005-1702
Mattar, R. E., Sulimany, A. M., Binsaleh, S. S., Hamdan, H. M., & Al-Majed, I. M. (2023). Evaluation of fissure sealant retention rates using isolite in comparison with rubber dam and cotton roll isolation techniques: A randomized clinical trial. International Journal of Paediatric Dentistry, 33(1), 12-19. https://doi.org/10.1111/ipd.13008
Mattar, R. E., Sulimany, A. M., Binsaleh, S. S., & Al-Majed, I. M. (2021). Comparison of fissure sealant chair time and patients' preference using three different isolation techniques. Children, 8(6), 444. https://doi.org/10.3390/children8060444
Memarpour, M., Rafiee, A., Shafiei, F., Dorudizadeh, T., & Kamran, S. (2021). Adhesion of three types of fissure sealant in saliva-contaminated and noncontaminated conditions: An in vitro study. European Archives of Paediatric Dentistry, 22(6), 813-821. https://doi.org/10.1007/s40368-021-00626-1
Memarpour, M., Shafiei, F., Zarean, M., & Razmjoei, F. (2018). Sealing effectiveness of fissure sealant bonded with universal adhesive systems on saliva-contaminated and noncontaminated enamel. Journal of Clinical and Experimental Dentistry, 10(1), e1-e6. https://doi.org/10.4317/jced.54471
Mohapatra, S., Prabakar, J., Indiran, M. A., Kumar, R. P., & Sakthi, D. S. (2020). Comparison and evaluation of the retention, cariostatic effect, and discoloration of conventional clinpro 3M ESPE and hydrophilic ultraseal XT hydro among 12-15-year-old schoolchildren for a period of 6 months: A single-blind randomized clinical trial. International Journal of Clinical Pediatric Dentistry, 13(6), 688-693. https://doi.org/10.5005/jp-journals-10005-1859

Moreira, K. M. S., Kantovitz, K. R., Aguiar, J. P. D., Borges, A. F. S., Pascon, F. M., & Puppin-Rontani, R. M. (2017). Impact of the intermediary layer on sealant retention: A randomized 24-month clinical trial. Clinical Oral Investigations, 21(5), 1435-1443. https://doi.org/10.1007/s00784-016-1890-4

Muñoz-Sandoval, C., Gambetta-Tessini, K., & Giacaman, R. A. (2019). Microcavitated (ICDAS 3) carious lesion arrest with resin or glass ionomer sealants in first permanent molars: A randomized controlled trial. Journal of Dentistry, 88, 103163. https://doi.org/10.1016/j.jdent.2019.07.001

Nahid, A., Zahra, B. G., & Yasaman, R. (2012). Evaluation of the effect of enamel preparation on retention rate of fissure sealant. Contemporary Clinical Dentistry, 3(4), 380-382. https://doi.org/10.4103/0976-237X.107418

Nazar, H., Mascarenhas, A. K., Al-Mutwa, S., Ariga, J., & Soparker, P. (2012). Effectiveness of fissure sealant retention and caries prevention with and without primer and bond. Medical Principles and Practice, 22(1), 12-17. https://doi.org/10.1159/000341155

Ng, T. C., Chu, C. H., & Yu, O. Y. (2023). A concise review of dental sealants in caries management. Frontiers in Oral Health, 4, 1180405. https://doi.org/10.3389/froh.2023.1180405

Nicholson, J. W. (2016). The history and background to glass-ionomer dental cements, glass-ionomers in dentistry. Springer. 1-24. https://doi.org/10.1007/978-3-319-22626-2_1

Ntaoutidou, S., Arhakis, A., Tolidis, K., & Kotsanos, N. (2018). Clinical evaluation of a surface pre-reacted glass (S-PRG) filler-containing dental sealant placed with a self-etching primer/adhesive. European Archives of Paediatric Dentistry, 19(6), 431-437. https://doi.org/10.1007/s40368-018-0379-z

Ogawa, Y., Sayed, M., Hiraishi, N., Al-Haj Husain, N., Tagami, J., Özcan, M., & Hosaka, K. (2022). Effect of surface pre-reacted glass ionomer containing dental sealant on the inhibition of enamel demineralization. Journal of Functional Biomaterials, 13(4), 189. https://doi.org/10.3390/jfb13040189

Özgür, B., Kargın, S. T., & Ölmez, M. S. (2022). Clinical evaluation of giomer-and resin-based fissure sealants on permanent molars affected by molar-incisor hypomineralization: A randomized clinical trial. BMC Oral Health, 22(1), 275. https://doi.org/10.1186/s12903-022-02298-9

Paryab, M. (2013). Sealant microleakage after using nano-filled bonding agents on saliva-contaminated enamel. Journal of Dentistry (Tehran, Iran), 10(3), 227-232.

Passarelli, P. C., Pagnoni, S., Piccirillo, G. B., Desantis, V., Benegiamo, M., Liguori, A., ... & D'Addona, A. (2020). Reasons for tooth extractions and related risk factors in adult patients: A cohort study. International Journal of Environmental Research and Public Health, 17(7), 2575. https://doi.org/10.3390/ijerph17072575

Philip, N. (2019). State of the art enamel remineralization systems: The next frontier in caries management. Caries Research, 53(3), 284-295. https://doi.org/10.1159/000493031

Pitts, N. B., Zero, D. T., Marsh, P. D., Ekstrand, K., Weintraub, J. A., Ramos-Gomez, F., ... & Ismail, A. (2017). Dental caries. Nature Reviews Disease Primers, 3(1), 17030. https://doi.org/10.1038/nrdp.2017.30

Poggio, C., Andenna, G., Ceci, M., Beltrami, R., Colombo, M., & Cucca, L. (2016). Fluoride release and uptake abilities of different fissure sealants. Journal of Clinical and Experimental Dentistry, 8(3), e284-e290. https://doi.org/10.4317/jced.52775

Pratap, B., Gupta, R. K., Bhardwaj, B., & Nag, M. (2019). Resin based restorative dental materials: Characteristics and future perspectives. Japanese Dental Science Review, 55, 126-138. https://doi.org/10.1016/j.jdsr.2019.09.004

Prathibha, B., Reddy, P., Anjum, M., Monica, M., & Praveen, B. (2019). Sealants revisited: An efficacy battle between the two major types of sealants—A randomized

controlled clinical trial. Dental Research Journal, 16(1), 36-41. https://doi.org/10.4103/1735-3327.249551

Ramamurthy, P., Rath, A., Sidhu, P., Fernandes, B., Nettem, S., Fee, P. A., & Muttalib, K. (2022). Sealants for preventing dental caries in primary teeth. Cochrane Database of Systematic Reviews, 2022(2), CD012981. https://doi.org/10.1002/14651858.CD012981.pub2

Ramamurthy, P., Rath, A., Sidhu, P., Fernandes, B., Nettem, S., & Muttalib, K. (2018). Sealants for preventing dental caries in primary teeth. Cochrane Database of Systematic Reviews, 2018(3), CD012981. https://doi.org/10.1002/14651858.CD012981

Rattanacharoenthum, A., Phun, P., & Kantrong, N. (2019). Altered adhesion of dental sealant to tooth enamel microscopically modified by Er:YAG laser irradiation: An in vitro study. Laser Therapy, 28(1), 19-25. https://doi.org/10.5978/islsm.28_19-OR-02

Reddy, P. V. R., Shigli, A., Shirol, D., Deshpande, S., Hugar, S., & Poonacha, K. S. (2014). The evaluation of different methods viz., acid etch and by air abrasion on retentivity of fissure sealant after 6 months: A clinical study. Journal of the Scientific Society, 41(1), 16-21. https://doi.org/10.4103/0974-5009.126709

Reddy, V. R., Chowdhary, N., Mukunda, K. S., Kiran, N. K., Kavyarani, B. S., & Pradeep, M. C. (2015). Retention of resin-based filled and unfilled pit and fissure sealants: A comparative clinical study. Contemporary Clinical Dentistry, 6(Suppl 1), S18-S23. https://doi.org/10.4103/0976-237X.152932

Reic, T., Galic, T., & Negovetic Vranic, D. (2022). Retention and caries-preventive effect of four different sealant materials: A 2-year prospective split-mouth study. International Journal of Paediatric Dentistry, 32(3), 449-457. https://doi.org/10.1111/ipd.12924

Rusnac, M. E., Gasparik, C., Irimie, A. I., Grecu, A. G., Mesaroș, A. Ș., & Dudea, D. (2019). Giomers in dentistry–at the boundary between dental composites and glass-ionomers. Medical-Surgical Journal, 92(3), 123. https://doi.org/10.15386/mpr-1169

Sanders, B. J. (2016). Pit-and-fissure sealants and preventive resin restorations. In R. E. McDonald & D. R. Avery (Eds.), McDonald and Avery's Dentistry for the Child and Adolescent (10th ed., pp. 177-184). Elsevier.

Shahid, S., & Duminis, T. (2019). Glass-ionomer cement: Chemistry and its applications in dentistry. In Z. Khurshid, S. S. Najeeb, M. S. Zafar, & F. Sefat (Eds.), Advanced Dental Biomaterials (pp. 175-195). Woodhead Publishing.

Shen, C., Rawls, H. R., & Esquivel-Upshaw, J. F. (2022). Phillips' science of dental materials (13th ed.). Elsevier/Saunders.

Siripokkapat, K., Nakornchai, S., & Vichayanrat, T. (2018). Comparison of giomer and fluoride releasing resin sealants in caries prevention among primary molars. Southeast Asian Journal of Tropical Medicine and Public Health, 49(3), 527-536.

Soto-Rojas, A. E., Escoffié-Ramírez, M., Pérez-Ferrera, G., Guido, J. A., Mantilla-Rodriguez, A. A., & Martinez-Mier, E. A. (2012). Retention of dental sealants placed on sound teeth and incipient caries lesions as part of a service-learning programme in rural areas in Mexico: Retention of dental sealants placed on sound teeth. International Journal of Paediatric Dentistry, 22(6), 451-458. https://doi.org/10.1111/j.1365-263X.2011.01216.x

Sridhar, L. P., Moses, J., Rangeeth, B. N., & Sivakumar, S. (2016). Comparative evaluation of the marginal sealing ability of two commercially available pit and fissure sealants. Journal of Clinical and Diagnostic Research, 10(7), ZC01-ZC04. https://doi.org/10.7860/JCDR/2016/19404.8150

Ulusu, T., Odabaşv, M. E., Tüzüner, T., Baygin, Ö., Sillelioglu, H., & Deveci, C. (2012). The success rates of a glass ionomer cement and a resin-based fissure sealant placed by fifth-year undergraduate dental students. European Archives of Paediatric Dentistry, 13(2), 94-97. https://doi.org/10.1007/BF03262852

Urquhart, O., Tampi, M. P., Pilcher, L., Slayton, R. L., Araujo, M. W. B., Fontana, M., ... & Brignardello-Petersen, R. (2019). Nonrestorative treatments for caries: Systematic

review and network meta-analysis. Journal of Dental Research, 98(1), 14-26. https://doi.org/10.1177/0022034518800014

Uzel, I., Gurlek, C., Kuter, B., Ertugrul, F., & Eden, E. (2022). Caries-preventive effect and retention of glass-ionomer and resin-based sealants: A randomized clinical comparative evaluation. BioMed Research International, 2022, 7205692. https://doi.org/10.1155/2022/7205692

Worzakowska, M. (2021). UV polymerization of methacrylates—preparation and properties of novel copolymers. Polymers, 13(10), 1659. https://doi.org/10.3390/polym13101659

Wright, J. T., Tampi, M. P., Graham, L., Estrich, C., Crall, J. J., Fontana, M., ... & Dhar, V. (2016). Sealants for preventing and arresting pit-and-fissure occlusal caries in primary and permanent molars: A systematic review of randomized controlled trials—a report of the American Dental Association and the American Academy of Pediatric Dentistry. Journal of the American Dental Association, 147(8), 631-645.e18. https://doi.org/10.1016/j.adaj.2016.06.003

Yilmaz, H., & Keles, S. (2020). The effect of the Er: YAG laser on the clinical success of hydrophilic fissure sealant: A randomized clinical trial. European Oral Research, 54(3), 148-153. https://doi.org/10.26650/eor.20200029

Yu, O. Y., Lam, W. Y., Wong, A. W., Duangthip, D., & Chu, C. H. (2021). Nonrestorative management of dental caries. Dentistry Journal, 9(10), 121. https://doi.org/10.3390/dj9100121

Zhang, Y., Wang, Y., Chen, Y., Chen, Y., Zhang, Q., & Zou, J. (2019). The clinical effects of laser preparation of tooth surfaces for fissure sealants placement: A systematic review and meta-analysis. BMC Oral Health, 19(1), 203. https://doi.org/10.1186/s12903-019-0892-4