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Original Article

Retrospective evaluation of fissure sealants applied by dentistry students

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Abstract

Aim: The purpose of this study was to assess the adequacy and success in meeting protective expectations over time of resin-containing fissure sealants applied by dentistry students in our clinic.

Methodology: Six-month controls were performed on 516 teeth of 85 patients aged 9-15 years. The 6-month controls of the resin-based pit and fissure sealants applied by 5th-grade dentistry students to patients presenting to the Necmettin Erbakan University Faculty of Dentistry Pedodontics Clinic between January 2022 and February 2022 were checked, and their survival was checked. The SPSS 26 statistical program was used in the analysis of the data. The statistical significance level in the study was determined as $p < 0.05$. A total of 85 patients and a total of 516 teeth, including premolars and molars, were included in the study.

Results: A total of 128 teeth were processed in the right maxilla, and total retention was observed in 102 teeth. Right maxilla; When the left maxilla ($p = 0.001$), left mandible ($p = 0.011$), and right mandible ($p = 0.001$) were compared in terms of total retention, a statistically significant difference was found. When the teeth were compared among themselves, the highest rate of loss, a total loss of 50%, was found in teeth 26 and 47. When the teeth were evaluated according to age, teeth numbered 14 ($p = 0.001$) and 24 ($p = 0.001$) were 9 years old, teeth 35 ($p = 0.001$) and 45 ($p = 0.001$) were 9-10 years old, and tooth number 44 (0.012). At the age of 10, the percentage of total loss was higher than in the other age groups, and a statistically significant difference was found. This suggests that the ideal isolation of the permanent premolars may not have been achieved because they do not fully erupt at the age of 9-10.

Conclusion: When all the results were evaluated, it was seen that the retention of fissure sealants depended on multiple factors, and their indications should be carefully examined.

Keywords: Pit and fissure sealant, caries, pediatric dentistry, preventive dentistry

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Introduction

Tooth decay is the most common chronic disease of childhood. It is also recognized as an infectious disease that can be stopped in its early stages. Approximately 90% of caries lesions are located in the pits and fissures of permanent posterior teeth. With preventive treatments, which are as important as interventional treatments in dentistry, it has become the first priority to protect pits and fissures from

external factors, especially in primary and permanent teeth that have not completed their maturation in the pediatric population. Current protective measures include fluoridation of water, topical fluoride application and oral hygiene motivation. In addition, sugar control in the diet is an important factor in preventing caries formation. While the caries protective effect of topical fluoride applications is more pronounced on flat surfaces, this effect is much more limited on chewing surfaces. Due to its surface properties, tooth brushing practice cannot provide sufficient protection in these areas. Pits and fissures have a higher tendency to retain plaque due to their morphological features and adequate protection cannot be provided with these applications (1).

Covering materials are used to prevent pit and fissure caries from forming. Pit and fissure sealants are materials that help prevent dental caries caused by chewing surfaces by preventing cariogenic microorganisms in saliva from colonizing pits and fissures, increasing the surface's cleanability, and protecting the tooth from plaque accumulation. Wilson proposed that pits and fissures be covered with zinc phosphate cement in the 18th century, and this application first appeared (2). Buonocore, on the other hand, proposed the use of pit and fissure sealants made of resin. He contended that the resin material would adhere better to the micro-voids formed by the pickling process (3). The optimal fissure sealant material is still being researched today. Resin-based and glass-ionomer-based materials are the most commonly used in routine applications (4). The resin-based ones are the most commonly used of the two.

Resin-based fissure sealants alter occlusal morphology by forming a micromechanically bonded layer that functions as a physical barrier between the enamel surface and the oral environment (5, 6). A resin-based fissure sealant is generally thought to last longer than a glass ionomer-based fissure sealant (6, 7). The Bis-GMA formulation is used in the majority of restorative resins. To reduce the viscosity of the polymer matrix structure and increase its penetration ability, monomers such as trimethylene glycol dimethacrylate (TEGDMA) or HEMA (hydroxyethyl methacrylate) are added to the fissure sealant. Resin-containing fissure sealants have been shown in the literature to have long-term retention and to reduce the risk of caries formation on the applied surface (8). Because of the technical precision required, resin-containing fissure sealants are not recommended in cases where isolation cannot be achieved (9).

The application technique is crucial to the success of the fissure sealant (10). Roughening the enamel surface with phosphoric acid during application is an important step in increasing retention and maintaining marginal integrity. If proper isolation is not achieved, the acid-etched enamel surface may become contaminated with saliva. This results in insufficient adhesion of the hydrophobic fissure sealant to the enamel surface, premature loss of the fissure sealant, and secondary caries formation due to microleakage (6, 11).

The purpose of this study was to assess the adequacy and success in meeting protective expectations over time of resin-containing fissure sealants applied by dentistry students in our clinic.

Materials and Methods

Ethics committee approval was received for this study from Necmettin Erbakan University, Faculty of Dentistry Scientific Research Ethics Committee, in accordance with the World Medical Association Declaration of Helsinki, with the approval number: 2021/03-33). All volunteers involved in the study provided consent for participation in the study and data storage.

Study Design/Protocol

Six-month controls were performed on 516 teeth of 85 patients aged 9–15 years who were admitted to the Necmettin Erbakan University Faculty of Dentistry Department of Pedodontics between January and February 2022 with fissure sealant indication and who received resin-containing fissure sealants applied by 5th grade dentistry students. Two different observers examined the fissure sealants. Total retention (TR), partial retention (2/3) (PR1), partial retention (1/3) (PR2), and total loss (TK) were used during the control (12).

The study's inclusion criteria:

- 9–15-year-old patients
- Healthy patients
- Pits and fissures free of caries
- Approximal caries-free teeth
- Permanent molars and premolars

The study's exclusion criteria:

- Patients under the age of nine
- Patients older than 15 years
- Children with systemic disorders (heart and kidney disorders, patients with syndrome)
- Rotten fissures and pits
- Approximal caries teeth
- Permanent anterior teeth

Statistical analysis

SPSS Statistics V26 (IBM SPSS Inc., Armonk, NY, USA) was used for statistical analysis within the scope of the study. Categorical data were presented as numbers and percentages. The statistical significance level in the study was set at $p<0.05$.

Results

When all of the data were analyzed, it was discovered that fissure sealant was used on 128 teeth in the right maxilla. With 102 teeth, the overall retention rate was 79.7%. In the left maxilla, 133 teeth were sealed with fissure sealant. With 89 teeth, the overall retention rate was 66.9%. In the right mandible, 134 teeth were sealed with fissure sealant. With 92 teeth, the overall retention rate was 68.7%. In the left mandible, 121 teeth were sealed with fissure sealant. With 79 teeth, the overall retention rate was 65.3%. Thus, total retention in the right maxilla was found to be statistically different from the other quadrants ($p < 0.05$) (see Table 1).

The tooth with the highest total retention was number #17 (100%), followed by tooth number 15 (83.7%). Total loss, on the other hand, was most prevalent in teeth #26 and #47, with a 50% rate (see Table 2). When the findings for tooth number #14 are compared by age, there is a statistically significant difference ($p = 0.001$). In 9-year-old patients, the total loss rate for tooth number 14 was 50%, and in 11-year-old patients, the total loss rate was 11.1%. Other age groups showed no total loss. There was a statistically significant difference in findings related to tooth number #24 based on age ($p = 0.001$). While tooth number #24 had a 50% total loss rate in 9-year-old patients, no total loss was found in other age groups. Total retention was found in 100% of the teeth examined in participants aged 10 to 16 (see Table 3).

Table 1. Comparison of development following fissure procedures based on tooth regions

	Number of Inspected Teeth	Partial Retention 2/3 Available	Partial Retention 2/3 Available	Total Loss	Total Retention
Maxilla right	128	12 (9.4%)	2 (1.6%)	12 (9.4%)	102 (79.7%)
Maxilla left	133	8 (6.0%)	10 (7.5%)	26 (19.5%)	89 (66.9%)
Mandibula right	134	10 (7.5%)	6 (4.5%)	26 (19.4%)	92 (68.7%)
Mandibula left	121	14 (11.6%)	6 (5.0%)	22 (18.2%)	79 (65.3%)

Table 2. Comparison of findings after fissure procedure according to tooth numbers

	Tooth Number	Number of Inspected Teeth	Partial Retention 2/3 Available	Partial Retention 1/3 Available	Total Loss	Total Retention
Maxilla right	14	51	4 (7.8%)	2 (3.9%)	4 (7.8%)	41 (80.4%)
	15	49	6 (12.2%)	0 (0%)	2 (4.1%)	41 (83.7%)
	16	22	2 (9.1%)	0 (0%)	6 (27.3%)	14 (63.6%)
	17	6	0 (0%)	0 (0%)	0 (0%)	6 (100.0%)
Maxilla left	24	53	4 (7.5%)	2 (3.8%)	4 (7.5%)	43 (81.1%)
	25	52	4 (7.7%)	6 (11.5%)	10 (19.2%)	32 (61.5%)
	26	20	0 (0%)	2 (10.0%)	10 (50.0%)	8 (40.0%)
	27	8	0 (0%)	0 (0%)	2 (25.0%)	6 (75.0%)
Mandibula right	34	59	2 (3.4%)	0 (0%)	18 (30.5%)	39 (66.1%)
	35	45	4 (8.9%)	2 (4.4%)	4 (8.9%)	35 (77.8%)
	36	23	4 (17.4%)	2 (8.7%)	4 (17.4%)	13 (56.5%)
	37	7	0 (0%)	2 (28.6%)	0 (0%)	5 (71.4%)
Mandibula left	44	55	8 (14.5%)	2 (3.6%)	10 (18.2%)	35 (63.6%)
	45	42	2 (4.8%)	0 (0%)	6 (14.3%)	34 (81.0%)
	46	20	4 (20.0%)	4 (20.0%)	4 (20.0%)	8 (40.0%)
	47	4	0 (0%)	0 (0%)	2 (50.0%)	2 (50.0%)

When the findings for tooth number 35 are compared by age, there is a statistically significant difference (p = 0.001). The total loss rate for tooth number 35 was 100% in patients aged 9 to 10, but that was not the case in other age groups. Total retention was found in 100% of the teeth examined among the 13- and 16-year-old participants. When the findings for tooth number 44 are compared by age, there is a statistically significant difference (p = 0.012). The total loss rate for tooth number 44 was 100% in 10-year-old patients but not in 9-, 13-, or 16-year-old patients. Total retention was found in 100% of the teeth examined among the 9- and 16-year-old participants. When the findings for tooth number 45 are compared by age, there is a statistically significant difference (p = 0.001). While total loss for tooth number 45 was 100% in patients aged 9 and 10, there was no total loss in patients aged 13, 14, 15, and 16. Total retention was found in 100% of the teeth examined among the 13-, 14-, and 16-year-old participants (see Table 4).

Table 3. Age-Related comparison of teeth 14 and 24 findings

			Partial Retention 2/3 Available	Partial Retention 1/3 Available	Total Loss	Total Retention	p
				14			
Age	9	n	0	2	2	0	0.001
		%	0.0%	50.0%	50.0%	0.0%	
				24			
Age	9	n	0	2	0	2	0.001
		%	0.0%	50.0%	0.0%	50.0%	

Table 4. Age-related comparison of findings for teeth 35, 44, and 45

			Partial Retention 2/3 Available	Partial Retention 1/3 Available	Total Loss	Total Retention	p
				35			
Age	9	n	0	0	2	0	0.001
		%	0.0%	0.0%	100.0%	0.0%	
	10	n	0	0	2	0	
		%	0.0%	0.0%	100.0%	0.0%	
				44			
Age	9	n	0	0	2	0	0.012
		%	0.0%	0.0%	100.0%	0%	
				45			
Age	9	n	0	0	2	0	0.001
		%	0.0%	0.0%	100.0%	0.0%	
	10	n	0	0	2	0	
		%	0.0%	0.0%	100.0%	0.0%	

Discussion

The success of the fissure sealant depends on the material properties, the practitioner's emphasis on isolation, the proper placement of the material on the tooth surface, the type and duration of irradiation, the sealing, and the enamel properties of the applied tooth.

Years of research have revealed that pit and fissure sealants are effective in preventing the formation of caries, and the long-term success of fissure sealants in permanent teeth has been demonstrated (13). After two years of follow-up, fissure sealants applied to primary or permanent molar teeth reduced the risk of caries by 76%, according to a systematic review. Furthermore, after a follow-up period lasting seven years or longer, cavities were found in 29% of children and adolescents who used fissure sealants, compared to 74% of those who did not use them (14, 15).

According to Ulusu et al.'s 2012 study, the most important factor in fissure sealant retention is the isolation of the tooth from saliva. At the same time, they stated that, despite the fact that their studies were carried out by fifth grade dentistry students under the supervision of two specialist pedodontists, they believed the amount of losses was high due to application errors caused by the students' inexperience. Similarly, in our study, fifth grade dentistry students performed applications under the supervision of expert pedodontists. We also believe that the students made mistakes in their applications due to their lack of experience, which is why the overall retention rate is so high (16).

According to a 2009 study, saliva contamination during fissure sealant application in teeth that have not completed eruption will affect mechanical retention, and fissure sealant retention will decrease (17). Topal et al.'s study supports this study by stating that fissure sealant application is required in erupting teeth and that it is difficult to place the material while preventing moisture contamination (18). In our study, applications to premolar teeth among participants aged 9 to 10 resulted in a high rate of total loss. This circumstance leads us to believe that these teeth were not isolated because they did not fully erupt.

The lack of cooperation and awareness of parents of young children reduces the effectiveness of preventive practices. The sealant material has a more difficult time penetrating deep pits and fissures (19). The material's viscosity increases, making it more difficult to penetrate pits and fissures and decreasing its retention. Furthermore, the material's success influences the surface tension, polymerization shrinkage, and thermal expansion coefficient (20, 21).

Inadequate preparation of the enamel surface prior to etching has a negative impact on the bonding of fissure sealants to the enamel. The inability of children to use a rubber dam, as well as the movement of cotton with swallowing and tongue movements in isolation with cotton rolls, easily causes contamination of the tooth surface. As a result, it is predicted that fissure sealants applied with the assistance of auxiliary personnel in isolation with cotton rolls would be more effective (22). The rate of total retention in the maxilla was found to be high in our study. These findings may be attributed to the difficulty of cotton placement and isolation in the lower jaw, particularly in the lingual region.

Conclusions

When all of the results are considered, the effect of fissure sealant applications in preventing caries is far too significant to be overlooked. For these processes to survive, attention should be paid first and foremost to surface preparations and isolation. It is important to remember that their retention is dependent on a variety of factors, and their success will increase with the right indications.

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Ethical Approval: Ethics committee approval was received for this study from Necmettin Erbakan University, Faculty of Dentistry Scientific Research Ethics Committee, in accordance with the World Medical Association Declaration of Helsinki, with the approval number: 2021/03-33).

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References

1. Kitchens DH. The Economics of Pit and Fissure Sealants in Preventive Dentistry: A Review. J Contem Dent Pract 2005;6:95-103. https://doi.org/10.5005/jcdp-6-3-95
2. Wilson I. Preventive Dentistry. Am J Dent Sci 1895;29:10.
3. Buonocore MG. A Simple Method of Increasing the Adhesion of Acrylic Filling Materials to Enamel Surfaces. J Dent Res. 1955;34:849-853. https://doi.org/10.1177/00220345550340060801
4. Feigal RJ, Donly KJ. The Use of Pit and Fissure Sealants. Pediatr Dent. 2006;28:143-150.
5. Muller-Bolla M, Lupi-Pegurier L, Tardieu C, Velly AM ,Antomarchi C. Retention of resin-based pit and fissure sealants: A systematic review. Community Dent Oral Epidemiol 2006;34:321-336. https://doi.org/10.1111/j.1600-0528.2006.00319.x

6. Simonsen RJ. Pit and fissure sealant: review of the literature. Pediatr Dent 2002;24: 393-414.
7. Locker D, Jokovic A, Kay EJ. Prevention. Part 8: The use of pit and fissure sealants in preventing caries in the permanent dentition of children. Br Dent J 2003; 195: 375-378. https://doi.org/10.1038/sj.bdj.4810556
8. Ahovuo Saloranta A, Forss H, Walsh T, Hiiri A, Nordblad A, Mäkell M, et al. Pit and fissure sealants for preventing dental decay in permanent teeth. Cochrane Database Syst Rev. 2013;28:(3):CD001830 https://doi.org/10.1002/14651858.CD001830.pub4
9. Garg N, Indushekar K, Saraf BG, Sheoran N, Sardana D. Comparative evaluation of penetration ability of three pit and fissure sealants and their relationship with fissure patterns. Journal of dentistry, 2018; 19(2):92.
10. Cehreli ZC, Gungor HC. Quantitative microleakage evaluation of fissure sealants applied with or without a bonding agent: results after four-year water storage in vitro. J Adhes Dent. 2008;10(5):379-384.
11. Silverstone LM, Hicks MJ, Featherstone MJ. Oral fluid contamination of etched enamel surfaces: an SEM study. J Am Dent Assoc. 1985;110(3):329-332. https://doi.org/10.14219/jada.archive.1985.0350
12. Smales RJ, Wong KC. 2-year clinical performance of a resin-modified glass ionomer sealant. Am J Dent 1999; 12: 59-61. https://doi.org/10.1002/ltl.40619991212
13. Nowak A, Christensen JR, Mabry TR, Townsend JA, Wells MH. Pediatric Dentistry-E-Book: Infancy through Adolescence. Elsevier Health Sciences (2018).
14. Wright JT, 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. The Journal of the American Dental Association, 2016; 147(8):672-682. https://doi.org/10.1016/j.adaj.2016.06.001
15. Cvikl B, Moritz A, Bekes KJDj. Pit and Fissure Sealants-A Comprehensive Review. 2018; 6(2):18. https://doi.org/10.3390/dj6020018
16. Ulusu T, Odabaş ME, Tüzüner T, et al. The success rates of a glass ionomer cement and a resin-based fissure sealant placed by fifth-year undergraduate dental students. Eur Arch Paediatr Dent. 2012;13(2):94-97. https://doi.org/10.1007/BF03262852
17. Barja-Fidalgo F, Maroun S ,de Oliveira BH. Effectiveness of a GIC used as a pit and fissure sealant in recently erupted permanent first molars. J Dent Child (Chic) 2009; 76: 34-40.
18. Topal B, Kirzioglu Z. Evaluation of the fissure sealants applied to erupting permanent molars in accordance to eruption stages: A prospective study. Nigerian journal of clinical practice, 2019; 22(11):1495. https://doi.org/10.4103/njcp.njcp_534_18
19. Garg N, Indushekar K, Saraf BG, Sheoran N, Sardana D. Comparative evaluation of penetration ability of three pit and fissure sealants and their relationship with fissure patterns. Journal of dentistry, 2018; 19(2):92.
20. Prabhakar A, Murthy SA, Sugandhan S. Comparative evaluation of the length of resin tags, viscosity and microleakage of pit and fissure sealants-An in vitro scanning electron microscope study. Contemporary clinical dentistry, 2011; 2(4):324. https://doi.org/10.4103/0976-237X.91797
21. Selecman JB, Owens BM, Johnson WW. Effect of preparation technique, fissure morphology, and material characteristics on the in vitro margin permeability and penetrability of pit and fissure sealants. Pediatr Dent 2007; 29(4):308-314.
22. Locker D, Jokovic A, Kay EJ. Prevention. Part 8: The use of pit and fissure sealants in preventing caries in the permanent dentition of children. Br Dent J 2003; 195: 375-378. https://doi.org/10.1038/sj.bdj.4810556