



Retention and Caries Development after Pit and Fissure Sealant Placement among 6-14 Years Old School Children from Pimpri Chinchwad Municipal Corporation - Cohort Study

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To check for the retention of sealants and caries experience of the teeth after 9 months.

Methods: An interventional study was planned for the children of Government school in Pimpri, Pune, aged 6-14 years, where a total of 290 occlusal surfaces of molar teeth were selected to place GIC pit and fissure sealant. The oral screening was done to rule out children with carious and unerupted or children who didn't need any sealant placement. The remaining were selected for placement of pit and fissure sealant.

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Results: At the end of the 9th month, the total retention rate was 67.93%. There was also a slight increase in caries experience in 8 children with dislodged sealants but the extent was not severe.

Discussion: The pit and fissure sealants procedure are one of the widely accepted preventive treatments since the 1970s. The effectiveness of pit and fissure is allied with how long the sealants stay over the tooth surfaces and the degree of their presence. The GIC sealants though having the advantage of fluoride release after placement also have the disadvantage of difficulty in handling limiting their adoption and use.

Conclusion: At the follow-up visit in the 9th month it was seen that the retention rate of sealant was 67.93%. Sealants were dislodged from the pit and fissures but remnants of sealants were present on the tooth which could have provided protection to the tooth from caries due to the fluoride-releasing property of GIC.

Keywords: Pit and fissure sealant; Resin based sealants; GIC-based sealants; retention.

1. INTRODUCTION

Glass ionomer sealants (GIC) are an alternative to resin-based sealants, especially for use in partially erupted permanent molars [1].

In terms of fissure anatomy, the resin-based sealant resulted in 40.07 percent of fissures being empty or partially filled, whereas the glass ionomer sealant resulted in 23.12 percent of fissures being unfilled or partially filled. According to the study findings, the most difficult in terms of anatomy are y-shaped fissures which renders it most difficult to penetrate. Saliva proved as a hindrance in the fissures for the flow of sealant materials, in this situation the glass ionomer sealant proved more effective to that of the resin-based sealant as the glass ionomer material could penetrate easily into the moist fissures. Although these were in vitro studies, the results of laboratory studies can be good predictors of the clinical behaviour of materials. At 24 months, resin-based and glass ionomer sealants had comparable retention rates. However, in the glass ionomer group, marginal staining was decreased, and no cavities were identified in the teeth. As a result, when salivary contamination is suspected, glass ionomer sealants may be preferred [1]. High-viscosity glass ionomer cement when used as dental sealant provided same level of protection against dental caries as of auto-polymerizing resin-based sealant [2].

Because glass ionomer cement sealants serve more as a fluoride reservoir than as a physical barrier to bacterial adherence and colonisation, a partially retained GIC may continue to provide caries prevention whereas a partially retained resin-based sealant does not. These findings suggest that, unlike conventional GICs, high-viscosity GICs may penetrate the pits and fissures of permanent molars and remain adhered long enough to provide a clinically

significant benefit to the patient when applied using the (Atraumatic restorative treatment) ART approach's "press-finger" technique [3].

The mean deft/DMFT (Decayed, missing, filled teeth) was 1.95, 3.31 among 12, 15, for the entire country according to the National Oral Health Survey & Fluoride Mapping 2002-2003 India [4]. The mean (Decayed, Missing and Filled teeth (DMFT) of 12 years old children is 5 and 15-years old children are 4.7, for the entire state according to the National Oral Health Survey & Fluoride Mapping 2002- 2003 Maharashtra [5].

Evidence indicates the benefits of School sealant programs (SSPs) exceed their costs when SSPs target schools attended by a large number of high-risk children [6]. As the caries experience among this age group is high it is necessary to carry out pit & fissure sealant treatment for children falling in this age group. This treatment is cost-effective as it prevents the further progression of caries leading to pain and infection and more complex treatment procedures. Hence, this study was conducted with an aim to evaluate the retention of sealant and caries experience after 9 months of sealant placement.

2. MATERIALS AND METHODS

An interventional study was planned for the children of govt. school in Pimpri, Pune aged 6-14 years, where total 279 occlusal surfaces of molar teeth were selected to place GIC pit and fissure sealant (GC Fuji VII, GC Corporation Tokyo, Japan, LOT No: -1904021). Inclusion criteria for sealant application were fully erupted molar teeth with deep Pits and Fissures, susceptible to caries. And exclusion criteria were, the child not willing to undergo sealant application, or the parent not consenting.

- Phase 1:

A general Oral Screening was done and Health Education was given for all the school children between 6-14 years of age. Screening was done in the school premises. All the children meeting the inclusion criteria were selected for the program. Informed consent was taken from the parents of the children through the school principal.

- Phase 2:

All the selected children screened were individually given pit and fissure sealant after selection of the tooth/teeth. Training, blinding, and calibration of the examiners were done prior to the beginning of study. The applicator and the evaluator in this study were two separate individuals. ART method was used to apply the pit and fissure sealant. Treated teeth were checked for retention of sealant and high points. Adequate considerations were made to reduce saliva contamination. The tooth selected was isolated with cotton rolls, and the occlusal surface was conditioned with diluted GIC liquid for 15 seconds and washed and dried with cotton roll pellets. The GIC sealant was hand mixed according to the manufacturer's instructions and applied on the occlusal surface with an applier instrument, slightly overfilling the pits and fissures. The mixed GIC was then pressed into the pits and fissures with petroleum jelly-coated index finger for 30 seconds. Excess material was removed with a carving instrument. Children were instructed not to eat for at least 1 hour. Tooth on which sealants were applied were (Right Upper 1st Molar) 16 (Left Upper 1st Molar) 26 (Left Lower 1st Molar) 36 (Right Lower 1st) 46 (Right Upper 2nd Molar) 17 (Left Lower 2nd Molar) 27 (Left Lower 2nd Molar) 37, and (Right Lower 2nd Molar) 47.

- Phase 3:

Visual and tactile examinations were carried out to check for the retention of sealant. Fully

retained sealants were considered as retained and half/ completely dislodged sealants were considered dislodged. A follow-up visit was conducted to check for the sealant's retention and if any secondary caries at 9 months.

3. RESULTS

A total of 290 occlusal surfaces were sealed using the sealant. Children selected for the application of the sealant varied in age, gender, and class section. 34 children between the age of 6-8 years studying in class 1- 3, 48 children between the age of 9-11 years studying in class 3-5, and 28 children studying in Standard (STD) 5-7. Out of 110 children, 70 were females and 40 were males. [Table:1].

During the initial screening, the total DMFT of each child was recorded. The total DMFT score recorded was 98. In the 9th month, 8 new carious lesions were found on the teeth making a total DMFT of 106. The increased DMFT could be due to the poor oral hygiene of children [Table:2].

The sealant was placed on a total of 290 surfaces. In the 9th month, children were screened to check for retention and caries experience. Out of 290, only 197 sealants were retained on the occlusal surface, remaining sealants were dislodged. Also, some teeth with deep fissures were converted to caries and the caries experience was increased by 8. These underwent complete demineralization [Table:3].

The number of PFS applied to the following teeth 16 was 63, 17 was 6, 26 was 42, 27 was 4, 36 was 73, 37 was 10, 46 was 82, and 47 was 10.

After 9 months, oral screening was carried out to check for the retention of the sealant. At the end of the 9th month, the total no. of sealants retained for tooth no. 16 was 45 (71.4%), 17 were 4 (66.6%), 26 were 38 (90.4%), 27 were 1 (25%), 36 were 48 (65.7%), 37 were 4 (40%), 46 was 53 (64.6%), and 47 was 4 (40%) [Table:3].

Table 1. Demographic details of Participants

		Participants
Age	6-8 Years	34
	9-11 Years	48
	12-14 Years	28
		110
Gender	Male	40
	Female	70
		110

Table 2. DMFT assessment at Baseline and 9 months

Sr. No.	DMFT	At baseline	At 9 months	Deep fissures converted to decayed
1	DT	89	8	97
2	MT	4	0	0
3	FT	5	0	0
DMFT	Total score	98	106	

Table 3. GIC Sealant applied to no. of surfaces at Baseline and at 9 months

Sr. No.	Individual tooth	No. of tooth surfaces (Baseline)	Retained (After 9 months)	No. of sealant dislodged (9 month)
1	16(Right Maxillary 1 st Molar)	63	45	18
2	17(Right Maxillary 2 nd Molar)	6	4	2
3	26(Left Maxillary 1 st Molar)	42	38	4
4	27(Left Maxillary 2 nd Molar)	4	1	3
5	36(Left Mandibular 1 st Molar)	73	48	25
6	37(Left Mandibular 2 nd Molar)	10	4	6
7	46(Right Mandibular 1 st Molar)	82	53	29
8	47(Right Mandibular 2 nd Molar)	10	4	6
Total surfaces-		290	197	

A total of 197 sealants were retained on the occlusal surface. The retention rate of the GIC pit and fissure sealant was found to be 67.93%.

4. DISCUSSION

The pit and fissure sealants procedure are one the widely accepted preventive treatment since the 1970s. The effectiveness of pit and fissure is allied with how long the sealants stay over the tooth surfaces and the degree of its presence. The treatment prevents pits and fissure caries formation and also arrests the existing initial caries. Resin-based sealants and GIC sealants are two commonly preferred sealants in preventive dentistry. The GIC sealants though having the advantage of fluoride release after placement also have the disadvantage of difficulty of handling limiting their adoption and use. The present study aimed at assessing the retention of sealants and caries formation after sealants placement was conducted as a school oral health program in the schools of Maharashtra amidst the covid-19 pandemic. The participants were in the age group of 6-14 years studying in government schools. Out of 290

sealants, a total of 197 sealants (67.93 percent) were retained stating good retention of high viscous sealant.

A study by Antonson SA et al [1] compared sealant retention rate among GIC and resin-based sealants and found GIC group reporting the complete retention rate of 86.5 percent at three months post-preventive treatment. However, by 6 months and 12 months, the retention rate decreased to 77.8 percent and 58.8 percent, respectively. The retention rates of this study are higher at 6 months and lesser at 12 months compared with the results obtained in the present study. The probable reason could be due to the use of bond surface conditioner that produces chelation reaction with calcium thereby providing a hybrid layer for GIC to establish a more stable bond in Antonson SA et al. [1] study. The present study did not use any conditioner prior to the placement of GIC sealant. A study by Graciano KP et al. [7] reported retention rates with respect to tooth type of tooth. The retention rate of tooth 16 was 37 percent, 26 was 54.4 percent, 36 was 50 percent, and 46 was 47.8 percent at a follow-up of 1 year. The sealant

retention rates of the present study were much higher than the study by Graciano KP et al. [7]. This variation was attributed to the technical flaws and occlusal surface forces leading the highest sealant loss in the initial 6 months [7]. Similarly, a study by Sangeeta T et al. [8] also reported sealant retention rate of 60 percent, 29.4 percent, and 13.5 percent at 6 months, 12 months and 18 months providing contrasting results compared to the present study. Correspondingly, Liu BY et al. [9] demonstrated a 55.3 percent retention rate of GIC used as sealant and ART material with a follow-up of 24 months. 57.81 percent of sealants were retained at 6 months among handicapped children reported in the study by Morales-Chivez MC et al [10]. Another study by Barja-Fidalgo F et al. [2] reported a survival rate of GIC pit and fissure sealants as 29 percent which was lower than the results of the present study. However, it should be noted that the study by Barja-Fidalgo F et al. [2] had a follow-up of 5 years whereas the present study results were reported at 9 months follow-up thereby providing higher rates at the initial months.

It should be noted that the retention rates are dependent on various factors. A pit and fissure sealant applied in a field setting with proper illumination, adequate access and availability to clean and dry the fissures would probably demonstrate better results compared to a school setting with limited illumination and compromised working conditions [9]. Additionally, literature stated that the difficult of wetting and inadequate adhesion of the GIC material to the enamel surface through chemical interaction supported by in-vitro and in-vivo studies could be a reason for lower retention rates over other material in general [11]. Similarly, the experience of the operator in performing the procedure also plays an important role. Proper training provided to the operators prior to initiation of the program and well experience operators is likely to provide a quality procedure that would demonstrate higher retention rates compared to an operator with no training or less experience [9]. In the present study, all the pit and fissures were performed by two operator who were post-graduate students (2nd Year and 3rd Year) having adequate experience in pit and fissure sealant application thereby being one of the reasons of higher retention rates observed in the present study over other studies.

In the present study, with respect to the new caries formation, only eight teeth (2.75 percent) were affected by caries after the sealant

application stating anti-cariogenic properties of GIC. Of these, all caries were found in the teeth wherein sealant was lost. A study by Antonson SA et al. reported no caries in the group treated with GIC preventive sealant application at a follow-up of 24 months [1]. Results similar to the present study were seen in a study conducted by Barja-Fidalgo F. et al. [2] where the mean number of sealed surfaces that became carious or filled was 0.2. Likewise, Yengopal V et al. reported caries occurrence at 3 years, 4 years, 5 years, and 7 years in teeth treated with GIC sealants. At 3 years, 12% sealed teeth developed caries. The incidence rate lowered to 2% at 4 years, increased to 10% at 5 years, and 24% at 7 years [12]. The high incidence rate of caries even after application of pit and fissure sealants in can be attributed to the use of low-viscosity GIC sealants leading to compromised clinical application. Moreover, the low-viscosity GIC cannot be applied by pressing the material into the deeper pits and fissures by gloved hands. The use of high viscosity GIC allows a deeper penetration due to the procedural benefit (press-finger technique) which may have also contributed to higher retention and thus lower caries incidence in the present study [12]. Liu BY et al. reported 7.3 percent of caries incidence in children treated with ART GIC sealant at a follow-up of 24 months [9]. Morales-Chavez MC et al. in a 6-monthly follow-up study reported no teeth developing caries after placement of pit and fissure sealants [10]. However, it should be noted that 6-month follow-up period is too small to gauge the effectiveness of any material for the anti-cariogenic property. On contrary, a study by Poulsen et al. [13]. reported higher incidence rates of dental caries in teeth sealed with GIC pit and fissure sealants [12].

In the present study, though only 67.9% of the sealants were retained at 9 months, there were fewer sealants that were partially retained. Thus, the fluoride releasing action of GIC sealants even after being partially lost, continue to provide an anti-cariogenic effect to the teeth. Further, Frencken and Wolke in one of their study stated that the possible anti-cariogenic property of GIC even after the sealant appears to be completely lost may be because some amount of sealant gets logged into the deeper parts of pits and fissures thus continuing their anti-cariogenic activity [14]. This was in agreement with the Graciano et. al., study where retention of resin-based sealants was slightly higher than GIC sealants but the GIC sealant group demonstrated higher anti-cariogenic properties [7].

The study had few limitations, firstly, the follow-up period was short (9 months) which may have accounted for a lower incidence rate reported in the present study. Secondly, no comparison group was used in the study.

5. CONCLUSION

GIC sealant is a significant discovery and has soon demonstrated a widespread, which is an easy, patient-friendly technique that doesn't call for expensive or specialized dental equipment, and may expand children's access to preventative dental care in resource-constrained developing nations.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Antonson SA, Antonson DE, Brener S, Crutchfield J, Larumbe J, Michaud C 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 Feb;143(2):115-22. DOI:10.14219/jada.archive.2012.0121. Erratum in: *J Am Dent Assoc.* 2012 Apr;143(4):336. PMID: 22298552.
2. Barja-Fidalgo F, Maroun S, de Oliveira BH. Effectiveness of a glass ionomer cement used as a pit and fissure sealant in recently erupted permanent first molars. *J Dent Child (Chic).* 2009 Jan-Apr;76(1):34-40. PMID: 19341577.
3. Simonsen RJ. Glass ionomer as fissure sealant--A critical review. *J Public Health Dent* 1996;56 (3 Spec No):146-9; discussion 161-3. DOI:10.1111/j.1752-7325.1996.tb02425.x. PMID: 8915960.
4. Bali RK, Mathur VB, Talwar PP, Chanana HB. National Oral Health Survey & Fluoride Mapping, 2002-2003. 2004 India. New Delhi Dental Council of India.
5. Bali RK, Mathur VB, Talwar PP, Chanana HB, Ramesh GV, Jain J. National oral health survey and fluoride mapping 2002-2003, Maharashtra. New Delhi: Dental Council of India. 2004: 104-6.
6. Ahovuo-Saloranta A, Forss H, Walsh T, Nordblad A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in permanent teeth. *Cochrane Database Syst Rev* 2017 Jul 31;7(7):CD001830. DOI:10.1002/14651858.CD001830.pub5. PMID: 28759120; PMCID: PMC6483295.
7. Graciano KP, Moysés MR, Ribeiro JC, Pazzini CA, Melgaço CA, Ramos-Jorge J. One-year clinical evaluation of the retention of resin and glass ionomer sealants on permanent first molars in children. *Brazilian J of Oral Sci.* 2015 Jul;14:190-4.
8. Sangeeta T, Santosh T, Prasanna Kumar YS, Jagannath GV. A Comparative Study of Retention with Fissure Sealing using a Glass Ionomer and a Resin-based Sealant among School Children of 7-12 years of Age in Bangalore City. *I J Pre Clin Dent Res.* 2015;2(3):9-14.
9. Liu BY, Xiao Y, Chu CH, Lo EC. Glass ionomer ART sealant and fluoride-releasing resin sealant in fissure caries prevention--results from a randomized clinical trial. *BMC Oral Health* 2014 May 19;14:54. DOI: 10.1186/1472-6831-14-54. PMID: 24886444; PMCID: PMC4039987.
10. Morales-Chávez MC, Nualart-Grollmus ZC. Retention of a resin-based sealant and a glass ionomer used as a fissure sealant in children with special needs. *J Clin Exp Dent* 2014 Dec 1;6(5):e551-5. DOI: 10.4317/jced.51688. PMID: 25674325; PMCID: PMC4312685.
11. Brooks JD, Mertz-Fairhurst EJ, Della-Giustina VE, Williams JE, Fairhurst CW. A comparative study of two pit and fissure sealants: two-year results in Augusta, Ga. *J Am Dent Assoc.* 1979 May;98(5):722-5.

- DOI:10.14219/jada.archive.1979.0149.
PMID: 374449.
12. Yengopal V, Mickenautsch S, Bezerra AC, Leal SC. Caries-preventive effect of glass ionomer and resin-based fissure sealants on permanent teeth: A meta analysis. J Oral Sci 2009 Sep;51(3):373-82. DOI:10.2334/josnurd.51.373. PMID: 19776504.
 13. Poulsen S, Beiruti N, Sadat N. A comparison of retention and the effect on caries of fissure sealing with a glass-ionomer and a resin-based sealant. Community Dent Oral Epidemiol 2001 Aug; 29(4):298-301. DOI: 10.1034/j.1600-0528.2001.290409.x. PMID: 11515644.
 14. Frencken JE, Wolke J. Clinical and SEM assessment of ART high-viscosity glass-ionomer sealants after 8-13 years in 4 teeth. J Dent 2010 Jan;38(1): 59-64. DOI:10.1016/j.jdent.2009.09.004. PMID: 19748548.