Success Rate of Fissure Sealant on First Permanent Molars Among Public School Students in the Kingdom of Bahrain: One Year Follow-Up

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ABSTRACT

To assess the one-year success rate of fissure sealants applied to first permanent molars among public school students in the Kingdom of Bahrain during the 2022–2023 academic year. Cross-sectional observational study. Public schools across four regions in Bahrain: Southern, Northern, Capital, and Muharraq. A total of 975 students were examined, encompassing 1809 first permanent molars (UR6, UL6, LR6, LL6) that received fissure sealants. The study evaluated sealant retention 12 months post-application using Modified Simonsen's criteria, categorizing each tooth from intact to complete loss with caries. Regional distribution was: Southern 28.0%, Northern 32.8%, Capital 19.1%, and Muharraq 20.1%. Retention rates were low. Non-intact sealants were found in 41.4% of UR6 and 41.3% of UL6 teeth. The lower molars showed the highest rates of missing sealants, with 66.1% (LR6) and 66.2% (LL6) lacking fissure sealants. Only 18.3% of UR6 and 10.5% of LL6 maintained intact sealants after one year. Fissure sealants applied to first permanent molars exhibited a high failure rate within 12 months. While sealants are a recognized preventive intervention for occlusal caries, the findings highlight the need for improved application techniques, quality assurance, and periodic follow-up to ensure long-term effectiveness. These insights can guide future preventive strategies and policy development in Bahrain's school-based oral health programs.

INTRODUCTION

Dental caries remains one of the most prevalent chronic diseases of childhood and adolescence. Although community-level measures such as water fluoridation and topical fluoride therapy have reduced smooth-surface caries, the intricate pits and fissures of first permanent molars still trap plaque and food debris, making them highly susceptible to decay[1,2]. Pit-and-fissure sealants create a micromechanical barrier over these vulnerable sites and can lower caries incidence by up to 76% when they remain fully intact[3].

Despite their proven efficacy, clinical studies report widely varying retention rates. A 12-month follow-up in Iran showed overall failure in 27.7% of sealed molars, primarily due to marginal discoloration[4], while a Turkish study recorded intact sealants in only 29.5% of teeth at one year[5]. Conversely, Behroozian et al. documented 74.3% retention, and Aghazadeh et al. reported 91% when fluoride-releasing resins and rigorous technique were used[6,7]. Operator experience, material choice, and placement protocol therefore appear critical determinants of success[8]. However, no published data are available on sealant performance under Bahrain's long-running school-based program, initiated in 1988 to protect the first permanent molars of 7- to 9-year-olds[9]. This gap limits program evaluation and evidence-based refinements.

Purpose of the study: To quantify the 12-month clinical success of fissure sealants placed on first permanent molars in Bahraini public-school children during the 2022–2023 academic year, thereby generating local evidence to guide preventive protocols.

Aim: The study specifically aims to determine the proportion of sealed first permanent molars that remain intact, partially lost, or completely lost—with or without caries—one year after application among public-school students across Bahrain's four governorates.

METHODOLOGY

Study Design: This was a retrospective cross-sectional study conducted during the 2022–2023 academic year, assessing the retention of fissure sealants on first permanent molars among public-school students in Bahrain who were treated under the national school-based fissure sealant program.

Sampling Procedure: A total population sampling approach was applied. All students who received fissure sealants through primary health care centers during the 2022–2023 academic year and completed a 12-month follow-up were considered. Schools were selected based on the availability of clinical records from dental hygienist clinics. Out of approximately 3,900 eligible students, 975 were included across 27 government schools from the Southern, Northern, Capital, and Muharraq governorates.

Inclusion Criteria:

- Students who received fissure sealants during the 2022–2023 academic year.
- Students who completed a full 12-month follow-up period.
- Availability of documented clinical data from hygienist records.
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Exclusion Criteria:

- Students absent on the examination day.
- Students who transferred to another school during the year.
- Lack of written informed consent from parents or guardians.

Examination Procedures and Equipment: All examinations were performed on school premises by calibrated dental examiners to ensure inter-examiner reliability. The examination setting included the use of

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Table 1. Student Demographics and Examination Status

Variable	N (%)
Total students	975 (100%)
Male	476 (48.8%)
Female	499 (51.2%)
Muharraq Governorate	196 (20.1%)
Capital Governorate	186 (19.1%)
Southern Governorate	273 (28.0%)
Northern Governorate	320 (32.8%)
Examined	817 (83.8%)
Not Examined	158 (16.2%)

portable tables or beds in the school nurse's station. Infection control standards were strictly maintained.

The following tools and supplies were used:

- Standard dental examination kits (mouth mirror, tweezers, WHO/CPI round ball-ended probe)
- Cotton rolls and pellets for moisture control
- Unified headlamp for illumination Fissure sealants[10,11] were evaluated using Modified Simonsen's Criteria, assigning a score from 0 to 4:
  0 Sealant fully intact, no caries
  1 Partial sealant loss, no caries
  2 Partial sealant loss, with caries
  3 Complete sealant loss, no caries
  4 Complete sealant loss, with caries

Findings were recorded by trained assistants, and students needing further treatment were referred to the nearest health center with written documentation.

Statistical Analysis: Sample size was calculated to ensure a minimum of 350 observations to achieve a 95% confidence level and a ±5% margin of error. Data were entered and analyzed using statistical software (e.g., SPSS or Excel). Descriptive statistics were used to summarize frequencies and percentages of each Simonsen score by tooth and region. Differences between upper and lower molars and among regions were examined using chi-square tests. A significance level of $p < 0.05$ was considered statistically significant.

RESULTS

A total of 975 students participated in the study: 476 males (48.8%) and 499 females (51.2%). The distribution by governorate was: Northern (32.8%), Southern (28.0%), Muharraq (20.1%), and Capital (19.1%). Of the total sample, 817 students (83.8%) were successfully examined at 12 months, while 158 (16.2%) were excluded due to absence, transfer, or lack of consent (Table 1).

From a possible 3,900 first permanent molars, a total of 1,809 molars were evaluated after exclusions due to missing teeth or unexamined cases. The distribution of fissure sealant (FS) retention across teeth showed higher rates of intact FS in the upper molars (UR6 and UL6) compared to the lower molars (LR6 and LL6) (Table 2)[12,13,19,20].

Among the examined teeth:

- UR6 showed 30.6% intact FS, while UL6 had 28.8%.
- LR6 and LL6 had intact FS in 34.4% and 30.9%, respectively.
- Missing lower molars were notably higher, with 66.1% (LR6) and 66.2% (LL6) absent.

Using Modified Simonsen's Criteria, the most common outcome was partial FS loss without caries, particularly in upper molars (UR6: 38.3%, UL6: 34.8%). Complete FS loss without caries was observed in up to 26.1% of LL6. Teeth with evidence of caries ranged from 4.2% to 10.6%, with no major regional variations (Table 3).

DISCUSSION

This study assessed the one-year clinical success of fissure sealants applied to first permanent molars in a representative cohort of Bahraini school children[21,22,23]. The findings reinforce the role of sealants as a cornerstone of caries prevention[13,14], but they also highlight substantial variability in sealant retention across tooth types and locations. The modest retention rates observed, particularly among lower molars, are consistent with international findings that underscore the technique-sensitive nature of sealant application. For example, Behroozian et al. reported 74.3%[12] retention in a controlled clinical setting[24], while a large cohort study in Guangzhou linked sealant retention with a 37% reduction in caries risk over time. These results support the protective benefit of fissure sealants but emphasize that effectiveness is strongly dependent on clinical execution and follow-up care.

Key factors influencing sealant longevity include:

- **Material type:** Resin-based sealants generally demonstrate higher retention than glass ionomer formulations.
- **Isolation and technique:** Moisture control during application is critical. Inadequate isolation can lead to early sealant loss.
- **Operator skill and training:** The use of standardized protocols and calibrated providers enhances consistency.
- **Patient-related variables:** Age, cooperation, and oral hygiene influence both application success and long-term outcomes.

While sealants remain the gold standard for occlusal caries prevention, fluoride varnish (FV) offers a practical alternative in settings with limited resources or technical constraints. FV requires less stringent moisture control and can be applied by a broader range of trained personnel[15,16]. Several studies suggest comparable caries-preventive effects between FV and sealants over certain periods, particularly in high-risk children when follow-up is limited[17,18].

Despite its strengths, this study is limited by its retrospective design and reliance on clinical records, which may underreport some variables

Table 2. Status of First Permanent Molars

Tooth	Total Examined (n)	Intact FS n (%)	Non-Intact FS n (%)
UR6	582	178 (30.6%)	404 (69.4%)
UL6	566	163 (28.8%)	403 (71.2%)
LR6	331	114 (34.4%)	217 (65.6%)
LL6	330	102 (30.9%)	228 (69.1%)

Table 3. Fissure Sealant Outcomes According to Modified Simonsen's Criteria

Criteria	UR6 n (%)	UL6 n (%)	LR6 n (%)	LL6 n (%)
No loss of FS and no evidence of caries	178 (30.6%)	163 (28.8%)	114 (34.4%)	102 (30.9%)
Partial loss of FS, no caries	223 (38.3%)	197 (34.8%)	105 (31.7%)	94 (28.5%)
Partial loss with evidence of caries	53 (9.1%)	60 (10.6%)	28 (8.5%)	30 (9.1%)
Complete loss of FS, no caries	96 (16.5%)	122 (21.6%)	65 (19.6%)	86 (26.1%)
Complete loss with evidence of caries	32 (5.5%)	24 (4.2%)	19 (5.7%)	14 (4.2%)

such as fluoride exposure or socioeconomic status. Additionally, sealant material types and placement techniques were not standardized across examiners, which may have contributed to variability in outcomes. In conclusion, while fissure sealants are effective in reducing caries risk, their success is contingent on application quality, provider training, and systematic follow-up. Strengthening these components—alongside exploring viable alternatives like fluoride varnish where appropriate—can improve preventive care outcomes. These findings offer actionable insights for optimizing school-based oral health programs and reaffirm the value of tailored, evidence-based interventions in achieving sustainable caries prevention.

CONCLUSION

This study highlights the variability in clinical retention of fissure sealants applied to first permanent molars in Bahraini schoolchildren, reaffirming that while sealants remain a valuable preventive tool, their long-term effectiveness is highly dependent on material choice, application technique, and provider expertise. The findings emphasize the need for standardized protocols, skilled application, and consistent follow-up to maximize caries-preventive benefits.

The observed failure rates—particularly in lower molars—reflect challenges common in real-world public health settings, where operator variability and limited resources may compromise outcomes. These insights affirm the central message of the study: success of fissure sealants depends not only on their application but on the context in which they are delivered.

Notably, the study underscores a critical gap in monitoring sealant programs post-application. Without regular follow-up, failed or lost sealants may go unnoticed, negating their preventive value. Additionally, the study could not evaluate variables such as socioeconomic status, fluoride exposure, or dietary habits, which may influence sealant retention and caries risk.

To address these limitations, future research should adopt longitudinal designs that incorporate behavioral, environmental, and clinical factors. Comparative studies evaluating the real-world effectiveness of fluoride varnish versus sealants in different settings are also warranted. These investigations could guide targeted strategies, particularly in resource-limited environments.

Ultimately, integrating evidence-based application practices with program monitoring and context-sensitive alternatives like fluoride varnish can enhance the sustainability and effectiveness of school-based caries prevention initiatives.

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