# REDUCING THE PERCENTAGE OF FISSURE-FILLED TEETH FAILURE AMONG PRIMARY SCHOOLCHILDREN IN PERLIS

*Nuranida Hani Ruslan[1], Nur Izanti Mohd Surat[2], Anis Ezrina Abdul Rahman[2], Amalina Mohamed Zakaria[2], Idham Hafize Supi[3], Husna Hussain[3], Sumaiyyah Md Shukri[3], Mabel Mun Yen Chi[4], Mohamad Hafizal Harudin[5]*

*[1]Kuala Sanglang Dental Clinic, Perlis State Health Department, Ministry of Health Malaysia*

*[2]Kangar Dental Clinic, Perlis State Health Department, Ministry of Health Malaysia*

*[3]Arau Dental Clinic, Perlis State Health Department, Ministry of Health Malaysia*

*[4]State Deputy Director (Dental) Office, Perlis State Health Department, Ministry of Health Malaysia*

*[5]Oral Maxillo-facial Surgery Department, Hospital Tuanku Fauziah, Perlis State Health Department, Ministry of Health Malaysia*

*Corresponding Author: Nuranida Hani Ruslan*
*Email: dr.nuranida@moh.gov.my*

## Abstract

Fissure sealant covers tooth fissures to prevent caries in children. A verification study showed that 84.4% of fissure-filled teeth failed after six months of application among primary schoolchildren in Perlis. Failure of fissure sealant leads to caries of vulnerable teeth and worsened clinical outcomes. The key indicator for improvement was measured using the percentage of fissure-filled teeth failure after six months of application among primary schoolchildren. A standard of 15% was set based on expert consensus. Data were collected from January 2018 to December 2020 involving three phases: i) verification study, ii) implementation of remedial measures (two cycles) and iii) re-evaluation post-intervention (two cycles). The study population included primary schoolchildren from selected high caries-risk schools in Perlis. Data were collated from clinical oral examinations and patient records. Potential contributing factors include improper isolation techniques (30.8%), improper material mixing (81.5%), two-handed dentistry practice (30.8%) and incorrect tooth selection (49.2%). Remedial measures include a checklist designed for fissure sealant application procedure, continuous dental education (CDE) with chair-side training on proper sealant application techniques, redistribution of portable suction to the dental school team, and the introduction of our innovative product – a dental suction anchorage instrument (Suction Anchorage Utility Holder – SAUH) to aid in two-handed dentistry in a limited-resource setting. The first evaluation cycle showed a reduction in fissure-filled teeth failure percentage to 43.1%. Upon implementing the SAUH project and redistribution of portable suction units, a further reduction to 10.8% was achieved, exceeding the standard set of ≤ 15%. We aimed to replicate the SAUH instrument at the national level to benefit the limited resource facilities in providing high-quality dental care.

**KEYWORDS:** Fissure sealant, Preventive dentistry, Application technique, Quality improvement study

## Problem

In Perlis, primary school dental services are provided using an incremental dental care approach delivered by dental therapists from nine primary dental clinics under Perlis Oral Health Division. The services are provided to 76 primary schools in Perlis, with an estimated enrollment of 24,000 primary schoolchildren per year. Each primary school in Perlis will be visited by a school dental team consisting of at least two dental therapists, one dental surgery assistant and one healthcare assistant (*Pembantu Perawatan Kesihatan*) once a year. During these visits, dental check-ups are conducted for all the enrolled primary schoolchildren, and those who require treatment and preventive care will receive appropriate dental services. These include preventive dental care (fissure sealant, fluoride varnish/mouth rinse, preventive resin restoration) and treatment (dental filling, scaling, and loose extraction). During the study period, 68 dental therapists were posted under Perlis Oral Health Division. However, out of these 68 therapists, only 51 were selected for this study, while the remaining 17 were excluded as they were not involved in school incremental dental care delivery during the period of this study.

Traditional caries management strategies that emphasised restorative treatment have gradually shifted towards caries prevention and conservation of tooth structure as the latest approach (1). This includes the use of fissure sealants as one of the main preventive measures against caries. Fissure sealant is a dental material applied on the grooves of a tooth's biting surface, which forms a protective layer against food debris and bacteria, preventing them from getting trapped into the grooves, thus helping to prevent development of caries. Fissure-filled tooth refers to a tooth which is sealed with fissure sealant. There are two main types of materials used for fissure sealant, which are resin-based and glass ionomer-based.

A verification study was carried out from January to June 2018 at Putra Primary School with a total enrolment of 402 students from Standard 1 to 6. Due to a high number of caries cases among the students in 2017, Putra Primary School was rated as a high caries-risk school, which led to its selection for this study. Following dental check-ups on all 402 students, 36 students who required fissure sealant application were identified, and a total of 77 teeth were involved. Their teeth were applied with fissure sealants and re- reviewed again six-month post-application. It was found that 65 out of these 77 teeth showed partial or total loss/ dislodge of fissure sealants, indicating an 84.4% failure rate. This is quite alarming as the effectiveness of fissure sealants as preventive measures against caries for primary schoolchildren becomes questionable. In the event of dislodged fissure sealants, the tooth becomes more susceptible to the development of caries, which may eventually affect oral tooth function through episodes of oral discomfort, pain, and infection. Therefore, this study aimed to reduce the percentage of fissure-filled teeth failure in six-month post-application from 84.4% to 15% or less.

## Background

Carious lesions can be prevented by averting their onset and managed through interventions which can halt the progression from the early stage of the disease, characterised by enamel demineralisation to the point of frank cavitation (2). Fissure sealant is a type of intervention that breaks the caries cycle, therefore, considered as a preventive measure. The effectiveness and preventive ability of fissure sealants are related to the complete retention of the material on the occlusal surfaces (biting surfaces of the tooth) (3). If retention is compromised, the overall anti-carious effectiveness of the sealants becomes uncertain (4).

After fissure sealant application, patients need to be scheduled for recall appointments to assess retention and marginal adaptation of the sealants. A fissure sealant is considered failed if there is partial or total loss of a previously applied sealant. Multiple studies have shown

variations in fissure sealant retention rates and the possible factors contributing to fissure sealant failure. For example, a 79.8% retention rate of fissure-filled teeth among Kuwait schoolchildren was reported after one-year application and it was found that retention rates improved when good moisture control was achieved (5). Another study by Behroozian et al. reported a retention rate of 74.3% with the primary reason for the failure of fissure sealants being marginal discolouration (6). Additionally, Anson et al. documented an 85% retention rate of fissure sealants in six months, with a failure rate of 4% occurring at each subsequent six-month period (7). In Malaysia, a study conducted at Bangsar Dental Clinic in 2008 reported that only 65% of fissure sealants remained intact after a one-year review (8). The main causes of fissure sealant failure include lack of adequate isolation and tooth contamination by saliva or gingival fluid (9), poor application technique (7) and improper morphological details of the occlusal surface of the sealed tooth (10).

Various strategies have been proven to increase the retention rates of fissure sealants. One of these strategies is the use of strict isolation techniques (11). Long-term clinical success is closely related to effective moisture control at each application stage (12). This can be achieved by isolation techniques using a rubber dam or cotton roll to prevent the tooth from being contaminated with saliva during fissure sealant application. While rubber dam isolation may not be practical in a school dental setting, isolation with a cotton roll has been demonstrated to be as effective and yields similar retention results to those using rubber dam isolation (11). Additionally, isolation control can be optimised by implementing four-handed dentistry, where a dental surgery assistant uses a dental suction tip to maintain a dry field during the procedure (13).

Furthermore, the success of fissure sealants also depends on the pit and fissure morphology, making it crucial for the tooth selection criteria to be well-evaluated clinically by operators. The retention of sealants relies upon the ability of the sealant to fill pits and fissures thoroughly and remain completely intact and bonded to the enamel (14). Thus, consideration for tooth selection criteria of caries-free permanent molars exhibiting deep and/or complex fissure patterns will greatly influence the success rate of fissure sealants (15). There are two main types of fissure sealants currently used by dental therapists under Perlis Oral Health Division; resin-based and glass ionomer (GI)-based sealants. Hence, it is reasonable to reference the Clinical Practice Guidelines of the American Academy of Paediatric Dentistry (11) that suggests operators to consider the likelihood of experiencing retention challenges when choosing the type of sealant material most appropriate according to the specific patient and clinical scenario. In situations where dry isolation is proven to be challenging, a more hydrophilic material (GI-based sealant) is preferable, whereas situations where isolation can be effectively achieved, a resin-based sealant is recommended (11).

## Measurement

This quality improvement study involved two cycles that were conducted from the period of January 2018 until December 2020. The objective of the study was to reduce the percentage of failure of fissure-filled teeth in six months post-application by dental therapists among primary schoolchildren in Perlis. The percentage of failed fissure-filled teeth in six months post-application was used as the indicator for improvement. This was calculated based on the total number of failed fissure-filled teeth after six months of application of fissure sealant by a dental therapist over a total number of fissure sealants applied, as shown in the formula below:

$$\text{Percentage of failed fissure-filled teeth in six months post-application} = \frac{\text{Total number of failed fissure-filled teeth after six months of application (n)}}{\text{Total number of fissure-filled teeth (N)}} \times 100\%$$

Fissure sealants were considered failed if they were partially or completely dislodged upon six months post-application review. A standard of ≤15 % for the failure rate of both resin and Glass Ionomer (GI) fissure sealant was set based on the study by Crall et al. (2015)(16).

The selected study population was standard 1 to 6 primary schoolchildren from selected schools in two districts of Kangar and Arau, Perlis, who received incremental dental treatment during the study period. The first round of this study (Cycle 1) involved the participation of 24 dental therapists and 37 students from 7 primary schools, while Cycle 2 involved 27 dental therapists and 27 students from 13 primary schools. These schools were categorised as high caries risk schools based on *Penilaian Risiko Sekolah* (PERSIS). Inclusion criteria were all primary schoolchildren with fully erupted permanent molar teeth. Exclusion criteria were schoolchildren with partially erupted permanent molar teeth, schoolchildren without consent for treatment, primary teeth, teeth with dentinal caries, non-compliant patients and teeth with existing restoration.

Data were collected using patient card records (LP.8), clinical oral examinations, and on-site observation by dental officers trained and calibrated in the Modified Ministry of Health International Caries Detection and Assessment System (MM-ICDAS) charting. These trained dental officers assessed the dental therapist's fissure sealant application technique regarding tooth selection criteria, moisture control handling and post- operative care through observation. In evaluating the operator's knowledge and the general approach used for applying fissure sealant, questionnaires were distributed to dental therapists before and after chair-side briefing and training. All the collected data were tabulated and further analysed using Microsoft Excel.

The verification study found that the failure rate of fissure-filled teeth was as high as 84.4%. With the standard of fissure-filled teeth failure set at ≤15% (16), the Achievable Benefit Not Achieved (ABNA) was noted as 69.4%.

## Initial Assessment of the Problem

The current process of care for the fissure sealant application procedure conducted at primary school setting was reviewed (Figure 1) to determine the critical steps involved in the fissure sealant application procedure. Additionally, the steps involved in the six-month review post-fissure-sealant application are illustrated in Figure 2. Both figures are also applicable in cases of fissure sealant re-application.

Each school dental team will allocate at least a month to conduct dental check-ups and provide treatment for primary schools with approximately 400 to 500 students spanning from standard 1 to 6. At the start of the school dental team's visit to a primary school, all primary schoolchildren are called for a dental check-up in groups (typically according to class). The operator (in this case, the dental therapist) will first identify patients with teeth requiring fissure sealants based on patient and tooth criteria as mentioned in Guidelines: A School-Based Fissure Sealant (15). Primary schoolchildren will be assessed based on the inclusion and exclusion criteria and identified during dental check-ups by the dental therapist. Students who meet the inclusion criteria will have fissure sealant application on the same day following the identification of teeth suitable for the procedure. The first step is tooth prophylaxis which is done by applying pumice powder using a rubber cup/brush and irrigation from the three-way syringe. The tooth will be dried and isolated with a cotton roll to ensure good moisture control. The tooth is then conditioned/ etched, rinsed, and dried for the final time before applying sealant. The sealant will be light-cured/self-cured, according to the manufacturer's instructions, and checked for occlusal interference. Once the occlusion is restored, the patient will be given post-operative instructions and an appointment card for review of the fissure sealant in six months and is finally dismissed. From this process of care, critical steps identified

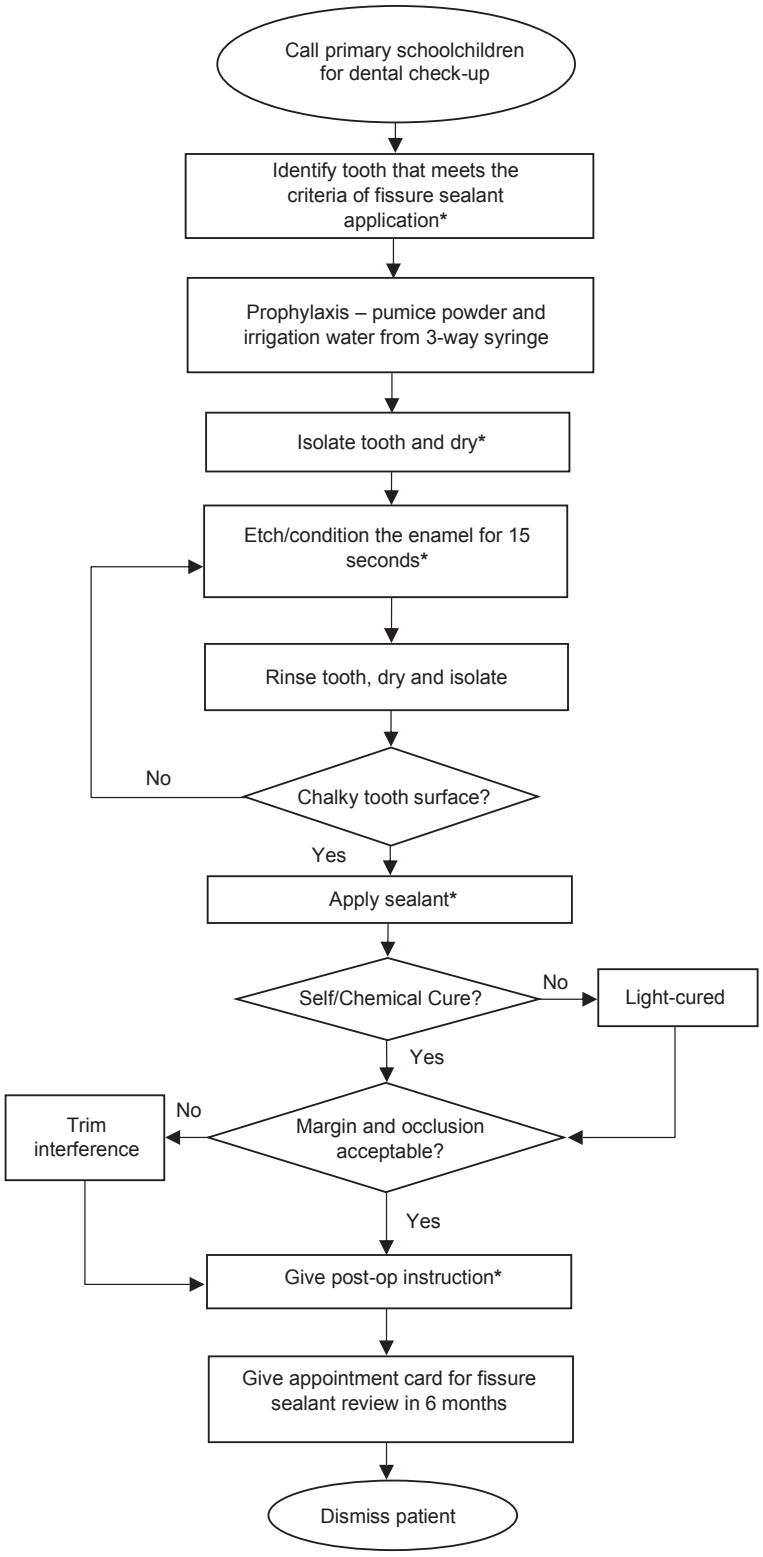



**Figure 1:** Process of care for fissure sealant application procedure (* indicates critical steps)

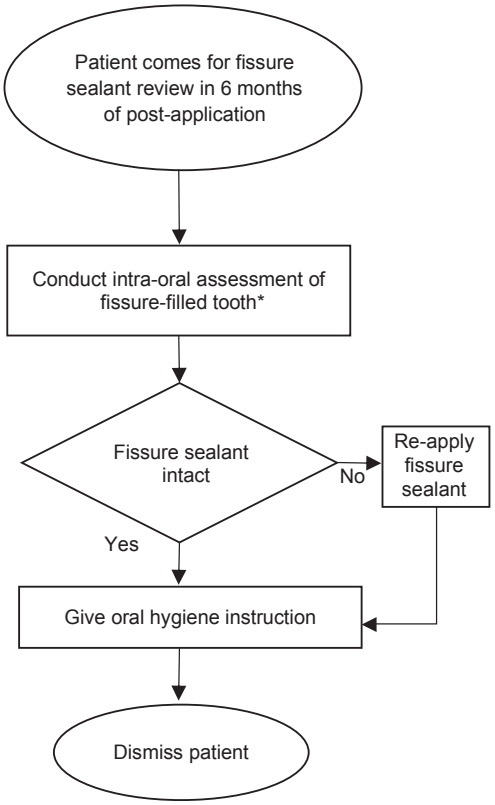



**Figure 2:** Process of care for fissure sealant review in six months of post-application (* indicates critical steps)

were tooth selection, tooth isolation, etch/condition of the enamel, sealant application and post-operative instructions. Improper techniques, incorrect tooth selection, insufficient moisture control and poor post-operative care were identified as the contributing factors of fissure-filled teeth failure, as observed by the trained dental officers during the application of fissure sealant by the dental therapists. A validated questionnaire adopted from an Indian study (17) was distributed to all 68

dental therapists involved in pre and post-session of continuous dental education (CDE) to assess their knowledge of fissure sealant requirements. Results showed that all dental therapists had fair levels of knowledge, with an average score of 74.3% (a score of 80% or more indicates good knowledge). Figure 3 illustrates possible contributing factors identified during the initial assessment of the problem.

The verification study was conducted from January to June 2018 to measure the percentage of fissure-filled teeth failure in six months post-application and identify possible factors contributing to the failure. Findings of the study showed that 30.8% of fissure-filled teeth failed to be isolated properly, thus failing to achieve good moisture control, which is essential in the fissure sealant procedure. In this case, poor isolation was defined as failure to isolate teeth with a cotton roll and/or the absence of a portable suction machine. This was supported by the lack of an assistant to help hold suction for better isolation in addition to standard isolation with cotton rolls (61.5%). The ideal situation for any dental procedure requiring a portable suction machine is to incorporate four-handed dentistry; to have a dental surgery assistant that helps in holding dental suction tip to ensure a dry working area intra-orally. The absence of assistance implies that the patient needs to hold the suction tip themselves, creating a non-ideal situation in moisture control handling. Apart from that, improper mixing of material by the operator due to using hand-mixed material and failure to follow the manufacturer's instructions according to each material used contributed to 81.5% and 38.5% of fissure-filled teeth failure, respectively. This suggests that the operator mishandled the material and did not follow the product's instructions, thus decreasing the retention ability of the fissure sealant material. Moreover, incorrect tooth selection added to 49.2% of fissure-filled teeth failure. The criteria for tooth selection are as outlined in the "Guidelines: A School-based Fissure Sealant Programme" failed to be adhered to. Unsuitable tooth morphology, such as shallow and non-complex fissure, increases the risk of fissure sealant dislodgement. Lastly, no proper written post-operative instructions were provided for all fissure-filled teeth due to absence of readily available written post-operative care. Delivering post-operative instructions verbally is believed to result in lower patient adherence compared to written or printed instructions (18).

## Strategy

Remedial actions involved the implementation of a total of seven strategies, carried out from July to December 2018. Firstly, to address improper techniques that could lead to fissure-filled teeth failure, Continuous Dental Education (CDE) was conducted by trained dental officers in three sessions (at least two hours for each session) involving all 68 dental therapists in Perlis. Tooth selection criteria and fissure sealant application techniques were highlighted during the CDE, which aimed to improve knowledge and awareness of the procedure. Additionally, live chair-side training was also conducted by trained dental officers for dental therapists who were involved in all selected schools in this study. During the live chair-side training sessions, correct techniques of tooth preparation and sealant application were further emphasised to dental therapists to eliminate errors during the fissure sealant application procedure. Fissure Sealant Procedure Checklist (Appendix 1) was created as a reference for every operator before starting the fissure sealant procedure, which contains information on ideal patient selection criteria, tooth selection criteria and overall steps involved in the fissure sealant application procedure.

Furthermore, if the dental therapist preferred Glass Ionomer-based sealant, we substituted the use of Hand-mixed Glass Ionomer-based sealant with Capsulated Glass Ionomer-based sealant. This was to prevent material inconsistency during mixing when using Hand-mixed Glass Ionomer-based sealant. In terms of tooth selection, the use of the Modified Ministry of Health International Caries Detection and Assessment System (MM-ICDAS) Dental Charting among dental

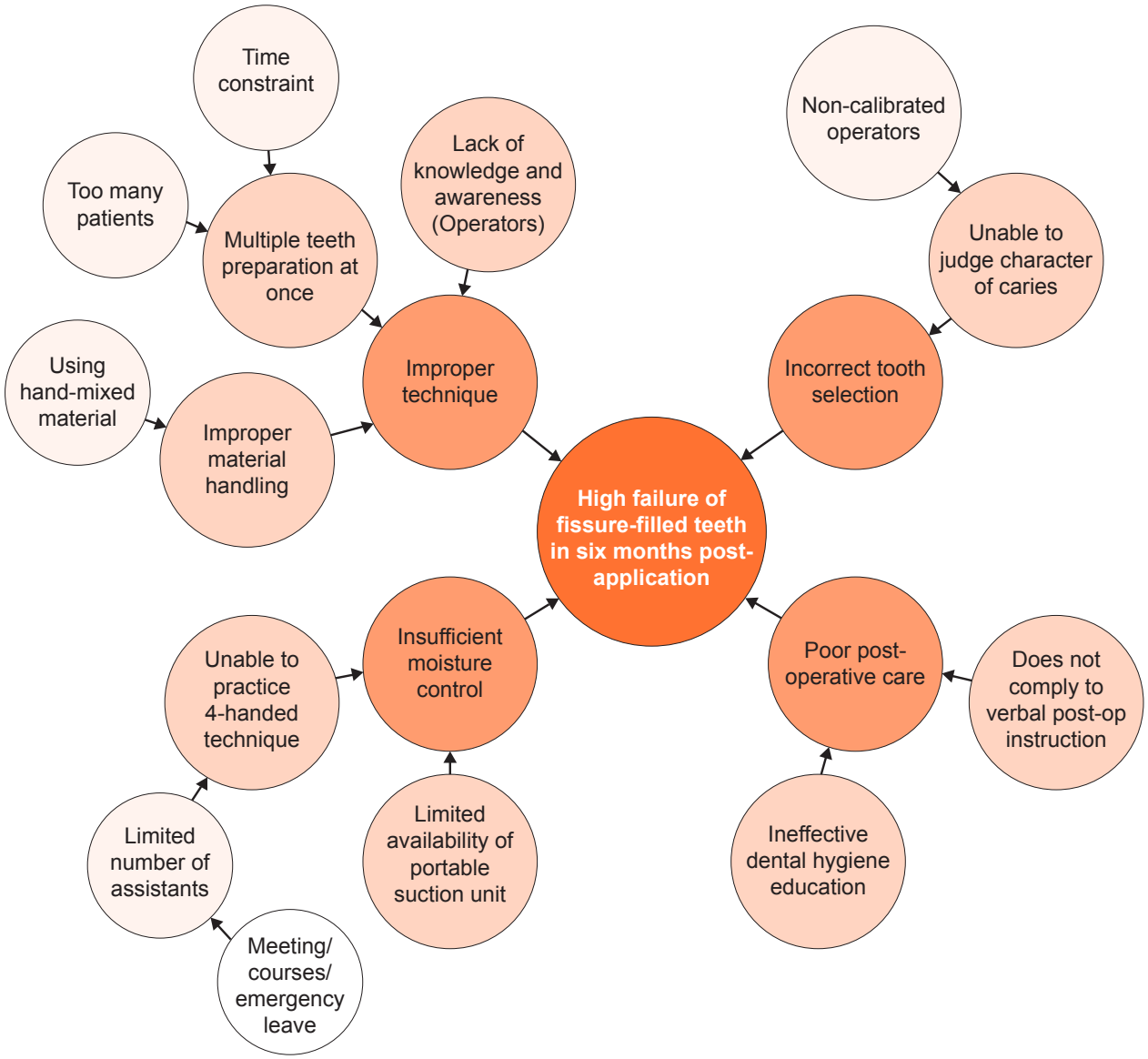



**Figure 3:** Problem analysis chart for failure of fissure-filled teeth in six months of post-application

therapists was made compulsory to ensure that more specific treatment needs and preventive measures would be planned and provided accordingly. The MM-ICDAS Dental Charting (which is more specific in distinguishing the stages of caries progression in enamel and dentin) was implemented to all dental officers and dental therapists in Perlis with recommendations from the Oral Health Division, Ministry of Health Malaysia to replace existing standard charting starting from the year 2018.

Besides that, all dental therapists must be assisted by either a dental surgery assistant or a healthcare assistant (*Pembantu Perawatan Kesihatan*) during the fissure sealant procedure, in accordance with the guideline's recommendation of four-handed dentistry. This approach (one operator with one assistant) ensures effective moisture control throughout the procedure. The dental surgery assistant's role is to manage the intra-oral moisture (saliva or blood) by holding the dental suction tip, thus ensuring adequate moisture control. In enhancing the care provided, we reinforced chair-side dental hygiene education to motivate schoolchildren to maintain optimal oral hygiene. Written post-operative care instructions were provided as flyers, serving as a take-home message to all schoolchildren who received fissure sealant application. The flyers included reminders for a soft diet in the 24 hours following fissure sealant application, instructions on proper toothbrushing to prevent dislodging of the sealant, as well

as the importance of regular dental check-ups at least twice a year.

## Results

In the post-intervention (Cycle 1) stage, the standard of ≤15% was not achieved. Further investigations were carried out to identify the factors contributing to the failure of fissure-filled teeth. It was noted that improper isolation technique and the absence of assistance during the procedure to hold the suction tip for better isolation were factors contributing to the failure, accounting for 45.5% and 54.5% of the failures, respectively. Complying with proper isolation technique was not achievable due to the limited availability of portable suction tips for four dental teams, making it impractical to achieve proper isolation and moisture control. In terms of the absence of assistants, it was largely due to the limitation of human resources within the four school dental teams. Findings of the factors contributing to fissure-filled teeth failure in the verification study, post- intervention (Cycle 1) and post-intervention (Cycle 2) are enlisted as in Table 1. Additional interventions were formulated and reinstituted in Intervention Cycle 2 based on the newly identified contributing factor: inadequate moisture control resulting from the inability to fully implement four-handed dentistry due to a shortage of available assistants. Thus, an innovative product named SAUH (Suction Anchorage Utility Holder) (Appendix 2) was designed. SAUH aids in positioning the dental suction tip accurately without requiring assistance during the fissure sealant procedure. At the same time, it also ensures the efficacy of moisture control and patients' comfort. This matches the situation where limitation in human resource is considered a concern in this study. Furthermore, a redistribution strategy was implemented to optimise the utilisation of existing portable suction units, assigning them to at least two operators per unit. This was to overcome the problem of portable suction apparatus shortage.

Significant improvements were observed following the implementation of interventions planned in Cycle 1 and Cycle 2. All operators were 100% trained in MM-ICDAS charting. Awareness, training, and hands-on sessions provided to dental therapists and assistants significantly improved their level of knowledge, particularly on tooth selection criteria for fissure sealant. There was a significant increase from 49% to 100% in the selection of teeth with suitable morphology (deep, complex fissure). The isolation technique of the tooth during fissure sealant application, which is the most crucial step, also displayed improved from 31% to 68.6% in Cycle 1 and ultimately achieved 100% in Cycle 2. This was achieved by providing each school dental team a saliva ejector unit (portable suction machine) with the ratio of 1 machine to 2 operators (dental therapist). Efficiency in isolation technique also increased with usage of the newly invented SAUH, which also indirectly resolved the issue of staff shortage during a dental procedure.

All in all, it can be concluded that the interventions were regarded as successful in reducing the failure of fissure- filled teeth among primary schoolchildren in Perlis from 84.4% to 43.1% (Reevaluation 1) and later to 10.3% (Reevaluation 2). Detailed improvements of all criteria enlisted in the Model of Good Care are shown in Table 2.

## Lessons and Limitations

This study was the first initiative of Perlis Oral Health Division to assess the overall picture of fissure-sealant retention and failure rates in school dental treatment. The involvement of operators, supervisors of primary dental clinics and the top management during the study had facilitated communication and overcame the barriers in delivering the best preventive measure and treatment in school, specifically in providing fissure sealants as caries preventive action. The results of this study have proven that the outcome of fissure-sealant retention can be improved with proper training and techniques supported by adequate material and equipment. The remedial actions are also presumed suitable and can be used by all operators in a school dental setting.

Apart from that, several

**Table 1:** Contributing factors to the failure of fissure-filled teeth in six months post-application in the verification study and post-intervention cycles

| No | Factors identified | Verification Study | | Post Intervention (Cycle 1) | | Post Intervention (Cycle 2) | |
|---|---|---|---|---|---|---|---|
| | | No. of teeth affected | % of non-compliance | No. of teeth affected | % of non-compliance | No. of teeth affected | % of non-compliance |
| 1 | Improper isolation technique | 20/65 | 30.8% | 10/22 | 45.5% | 0/37 | 0% |
| 2 | Failure to follow manufacturer's instruction for material used (e.g., does not apply conditioner prior to GI sealant placement) | 25/65 | 38.5% | 0/22 | 0% | 0/37 | 0% |
| 3 | Absence of assistant during the procedure to hold suction for better isolation in addition to standard isolation with cotton rolls | 40/65 | 61.5% | 12/22 | 54.5% | 0/37 | 0% |
| 4 | Improper mixing of material (e.g., hand-mixed GI sealant) | 53/65 | 81.5% | 0/22 | 0% | 0/37 | 0% |
| 5 | Wrong tooth selection | 32/65 | 49.2% | 0/22 | 0% | 0/37 | 0% |
| 6 | Improper written post-operative instructions were given to the patient | 65/65 | 100% | 0/22 | 0% | 0/37 | 0% |

brainstorming sessions involving all members of the Quality Unit of Perlis Oral Health Division have produced a great, cost-effective product called Suction Utility Anchorage Holder (SAUH) that resolved the issue of limited human resources in the school dental team. This demonstrates that innovation and a creative work environment can greatly improve the outcome and performance of one's organisation. Safety inspection for SAUH was conducted in collaboration with the Department of Occupational Safety and Health (DOSH), and an official safety recognition is anticipated shortly. This product is currently in the process of obtaining patent

**Table 2:** Improvements of the critical steps in Model of Good Care (MOGC).

| Steps | Process of care | Criteria | Standards | Pre Remedial | Post Remedial 1 (Cycle 1) | Post Remedial 2 (Cycle 2) |
|---|---|---|---|---|---|---|
| 1 | Examination and diagnosis | Operators trained in Modified MOH International Caries Detection and Assessment System (ICDAS) Charting (MM-ICDAS) | 100% | 40% | 100% | 100% |
| 2 | Tooth selection for fissure sealant | • Fully erupted | 100% | 100% | 100% | 100% |
| | | • Non-carious | 100% | 100% | 100% | 100% |
| | | • The tooth with a complex, deep fissure | 100% | 49% | 100% | 100% |
| 3. | Fissure Sealant Procedure Checklist | Must be included in every patient LP.8 as operator guide | 100% | 0% | 100% | 100% |
| 4. | Tooth isolation | • Isolation with cotton rolls plus saliva ejector | 100% | 31% | 68.6% | 100% |
| | | • Availability of assistant to help with moisture control and material handling | 100% | 31% | 88.2% | 100% |
| 5. | Application of dentin conditioner/ etching /light cure | • Follow the manufacturer's guide | 100% | 38% | 100% | 100% |
| | | • One tooth preparation at a time | 100% | 46% | 100% | 100% |
| 6 | Occlusal verification | Ensure no bite interference with articulating paper | 100% | 100% | 100% | 100% |
| 7 | Post-op instruction | Written post-op instructions are given to patients | 100% | 0% | 100% | 100% |
| 8 | Review in six months of post application | Appointment cards are given to patients | 100% | 100% | 100% | 100% |

rights and will be promoted for commercial production.

Despite all the planned strategies, the COVID-19 pandemic which struck in early 2020, has disrupted dental services to patients, including School Dental Services. School Dental Services were temporarily halted as all schools had to be closed during the pandemic, which greatly affected the study plan and negatively impacted the implementation of remedial actions. Nonetheless, modifications of the study Gantt chart were made after School Dental Services were resumed in August 2020, enabling team members to continue with remedial action implementations and evaluations.

## Conclusion and the Next Steps

As we had successfully reduced the percentage of fissure-filled teeth failure in 6 months of post-application to 10.3%, the new Gold Standard will be set at 5% and assigned at the Perlis state level to step up our efforts in ensuring better study outcomes. Further reevaluation will be conducted to identify other possible factors that still contribute to this current failure rate.

Intervention plans will be implemented across all primary dental clinics in Perlis. Additionally, a state-level committee will be formed to develop a training module that can be used as a guide for the operators (both dental officer and dental therapist), which will be shared subsequently with other states in the future. Results from this study can be used as a reference to review current guidelines and provide primary data for the Malaysian context, which can later be used to set a new national standard as an indicator to monitor fissure-filled teeth failure. We also aim that the SAUH product will be patented and replicated nationally to benefit facilities with limited resources in providing high-quality dental care.

## Acknowledgement

The authors would like to thank the Director General of Health Malaysia for his approval to publish this work. Also, the authors would like to extend our greatest appreciation to the State Deputy Director (Dental), Public Health Specialist, Dental Officers-in-charge of Primary Dental Clinics in Perlis, dental therapists and all Perlis Oral Health Division personnel involved in this study.

## Conflict of Interest

The authors declare that there was no conflict of interest.

## Funding

This study received no specific grants from any funding agencies from the public, commercial or non-profit sectors.

## References

1. Lee Y. Diagnosis and Prevention Strategies for Dental Caries. J Lifestyle Med. 2013 Sep;3(2):107-9. Epub 2013 Sep 30.

2. Beauchamp J, Caufield PW, Crall JJ, Donly K, Fiegal R, Gooch B, Ismail A, Kohn W, Siegal M, Simonsen R. American Dental Association Council on Scientific Affairs. Evidence-based clinical recommendations for the use of pit-and-fissure sealants: A report of the American Dental Association Council on Scientific Affairs. J Am Dent Assoc 2008; 139(3):257-68.

3. Kervanto-Seppälä S, Pietilä I, Meurman JH, Kerosuo E. Pit and fissure sealants in dental public health - application criteria and general policy in Finland. BMC Oral Health, 2009; 4; 9:5.

4. Lobo MM, Pecharki GD, Tengan C, da Silva DD, da Tagliaferro EP, Napimoga MH. Fluoride-releasing capacity and cariostatic effect provided by sealants. J Oral Sci, 2005; 47:35-41.

5. Francis R, Mascarenhas AK, Soparkar P, Al-Mutawaa S. Retention and effectiveness of fissure sealants in Kuwaiti school children. Community Dent Health. 2008 Dec;25(4):211-5. PMID: 19149297.

6. Behroozian A, Aghazadeh Z, Sadrabad ZK, Aghazadeh M, Alizadeh V, Esmaili Z, Pirzadeh Ashraf M. Evaluation of the success rate of pit and fissure sealants on first molars: 12 months follow-up study. Int J Dent Hyg. 2022 Aug;20(3):465-470. doi: 10.1111/idh.12566. Epub 2022 Jan 11. PMID: 34902222.

7. Anson RA, Retention of Pit and Fissure Sealants Placed in a Dental School Pedodontic Clinic; A Retrospective Study.1982. The American Academy of Pedodontics/Vol. 4, No. 1.

8. Hajar HR, Vijayamanohar K, Nadia DB, Umi A, Wan Aini WY. Increasing retention rate of fissure sealant application among primary schoolchildren, Bangsar Dental Clinic, 2012.

9. Nogourani MK, A 12 month clinical evaluation of pit-and-fuissure sealants Placed With and Without etch-and-rinse and self-etch adhesive systems in Newly Erupted Teeth, J Appl Oral Sci. 2012 May- Jun; 20(3): 352–356.

10. Muntean A, Sarosi C, Sava S, Moldovan M, Condurache AI, Delean AG. Dental Sealant Composition-Retention Assessment in Young Permanent Molars, Materials (Basel). 2021 Apr; 14(7): 1646.

11. Wright JT, Crall JJ, Fontana M,Gillette EJ, Nový BB, Dhar V, Donly K, Hewlett ER, Quinonez RB, Chaffin J,Crespin M, Iafolla T, Siegal MD, Tampi MP, Graham L, Estrich C, Carrasco-Labra A. Evidence-based Clinical Practice Guideline for the Use of Pit- and-Fissure Sealants. American Academy of Pediatric Dentistry, American Dental Association. Pediatr Dent 2016;38(5): E120- E36.

12. Bandi M, Mallineni SK, Nuvvula S. 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. 2021 Apr, Vol-15(4): p6-9.

13. Griffin S, Jones K, Kolvic Gray S, Malvitz D, Gooch B. Exploring four-handed delivery and retention of resin-based sealants. J Am Dent Assoc. 2016;139 :281–289.

14. Kumaran P. Clinical evaluation of the retention of different pit and fissure sealants: a 1-year study. Int J Clin Pediatr Dent. 2013 Sep;6(3):183-7. doi: 10.5005/jp-journals- 10005-1215. Epub 2013 Oct 14.

15. Oral Health Division, Ministry of Health Malaysia. Guidelines; A School-Based Fissure Sealant Programme Second Edition. Oral Health Division, 2003.

16. Crall JJ, Donly KJ. Dental sealants guidelines development: 2002-2014. Pediatr Dent. 2015 Mar-Apr;37(2):111-5. PMID: 25905651.

17. Asawa K, Gupta VV, Tak M, Nagarajappa R, Chaturvedi P, Bapat S, Mishra P, Roy SS. Dental Sealants: Knowledge, Value, Opinion, and Practice among Dental Professionals of Bathinda City, India. Adv Prev Med. 2014; 2014:469738. doi: 10.1155/2014/469738. Epub 2014 Apr 10. PMID: 24818028; PMCID: PMC4003741.

18. Shenoi RS, Rajguru JG, Parate SR, Ingole PD, Khandaitkar SR, Karmarkar S. Compliance of Postoperative Instructions Following the Surgical Extraction of Impacted of Impacted Lower Third Molars. Indian J Dent Res 2021;32: 87-91.

## Appendix 1

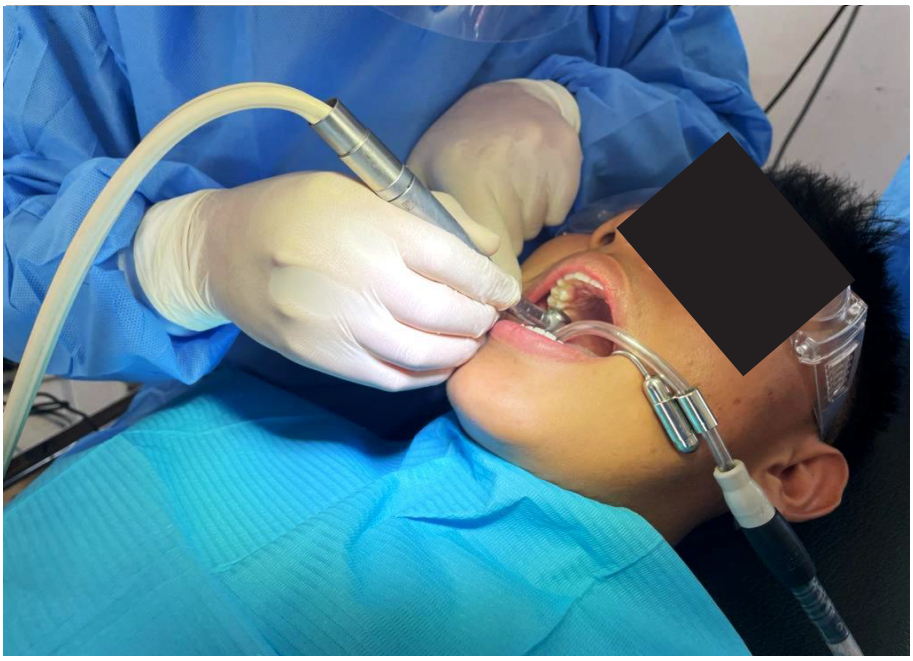
Fissure Sealant Procedure Checklist

| **PATIENT (FULL NAME)** | | | |
|---|---|---|---|
| **ID NUMBER :** | | **Please tick (/)** | |
| **DATE:** | | **DENTAL THERAPIST** | **ASSISTANT** |
| 1. Verification of patient's identity | | | |
| 2. Verification of patient indication for fissure sealant | | | |
| a) Patient selection (caries experience, fair to poor oral hygiene) | | | |
| b) Tooth selection – fully erupted teeth, deep and/or complex fissures | | | |
| 3. Verification of tooth to be treated | | | |
| 4. Verification of assistant to assist | | | |
| 5. Verification of informed consent signed by parents/guardian | | | |
| 6. Verification that the area has been properly prepared | 6.1 Working area disinfected | | |
| 7. Availability of instruments and equipment necessary and is well-sterilised | 7.1 Examination kit<br>7.2 Gauze<br>7.3 Cotton roll<br>7.4 Light cure<br>7.5 GIC/resin*<br>7.6 Portable dental suction<br>7.7 Articulating paper<br>7.8 Etchant/conditioner | | |
| 8. Duration of placement | 8.1 At least 10 minutes (monitor with timer) | | |
| 9. Verification of procedure | 9.1 Surface cleaning<br>9.2 Moisture control (isolation)<br>9.3 Using conditioner/ etchant*<br>9.4 Follow conditioner /etching time<br>9.5 Washing (15 seconds)<br>9.6 Dry the tooth with a 3-way syringe (30 seconds)<br>9.7 Application of sealant<br>9.8 Occlusal adjustment | | |
| 10. Verification of post-op instruction | 10.1 Post-procedure care leaflet is explained and given to the patient | | |
| 11. Verification of proper record of the procedure was noted in the patient's card record (LP.8) | | | |
| Operator's Signature | | | |

## Appendix 2

Innovative products reinstituted in Intervention Cycle 2

Suction Anchorage Utility Holder (SAUH)



SAUH application during procedure