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RESEARCH ARTICLE

EVALUATION OF CLINICAL OUTCOMES OF TWO TYPES OF FISSURE SEALANT MATERIALS PLACED ON THE FIRST AND SECOND MOLARS OF CHILDREN AND ADOLESCENTS ATTENDING RESTORATIVE DENTISTRY UNIT B – INSTITUTE OF ORAL HEALTH / MAHARAGAMA

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Abstract

Background: Occlusal surfaces of first and second permanent molars are highly susceptible to dental caries in children and adolescents. Pit and fissure sealants are widely used for prevention of occlusal caries.
Objective: To evaluate the clinical outcomes of pit and fissure sealants in a hospital-based paediatric population.
Methods: The descriptive cross-sectional study included assessment of 48 children aged 6–13 years who received fissure sealants at the Restorative Dentistry Unit B, Institute of Oral Health, Maharagama. Fissure sealants were assessed at a single follow-up visit during routine annual reviews for retention and development of new caries.
Results: Total retention was observed in 77.1% of teeth; 83.3% remained caries-free. Glass Ionomer-based sealants showed slightly higher retention and caries-free rates than resin-based sealants, though differences were not significant. Frequent sugary snack consumption was the only significant predictor of new caries.
Conclusion: Fissure sealants are effective in preventing occlusal caries. Dietary counseling is recommended to enhance its outcomes.

Introduction:-

Dental caries is a complex, multifactorial disease resulting from an imbalance between demineralisation and remineralisation within the dental biofilm (Featherstone, 2004). Clinically, it causes lesions in primary and permanent teeth and negatively impacts wellbeing. In children and adolescents, symptoms such as food impaction, sensitivity and pain can impair mastication and speech, contributing to school absenteeism, sleep disturbances and reduced social interactions (Antunes et al., 2025). Epidemiological data show a substantial burden of caries among Sri Lankan children. The National Oral Health Survey (NOHS) 2015/16 reported prevalence of 63.1%, 30.4%, and 41.5% in 5-, 12- and 15-year-olds, respectively (Ministry of Health, 2016). The WHO oral health profile (2022)

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indicated 27.4% of individuals aged five and above had untreated permanent dentition caries (WHO, 2022), highlighting a significant public health challenge.

Effective caries management requires identifying risk factors and implementing preventive measures. Deep pits and fissures on first and second molars are key anatomical risk factors, leading to widespread use of pit and fissure sealants. About 90% of permanent and 44% of primary tooth lesions occur in posterior pits and fissures (Beltran-Aguilar et al., 2005). Their morphology promotes plaque accumulation and hinders cleaning, while microorganisms at fissure entrances drive lesion progression more than those in deeper areas (Ekstrand & Bjørndal, 1997). Consequently, occlusal surfaces of permanent molars are highly susceptible to caries. Historically, methods such as fissurotomy, enamel fissure eradication and ammoniacal silver nitrate were used to protect fissures but had limited success (Naaman et al., 2017). Hyatt introduced prophylactic odontotomy in 1923, an invasive approach popular until the 1970s (Hyatt, 1923). Buonocore's Bis-GMA resin-based sealants activated by ultraviolet light represented a major advance (Buonocore, 1970). Today, resin-based, glass ionomer-based and hybrid sealants like compomers and giomers are widely used (Ng et al., 2023).

Pit and fissure sealants prevent caries by physically blocking plaque, food stagnation and microbial colonisation (Ahovuo-Saloranta et al., 2017), while improving plaque removal (Ramamurthy et al., 2022). Glass ionomer, some resin-based and hybrid sealants release fluoride to inhibit demineralisation and microbial activity (Ng et al., 2023) and certain giomer sealants release strontium and borate ions with antimicrobial and acid-buffering effects (Kaga et al., 2014). Evidence strongly supports fissure sealant effectiveness. American Dental Association (ADA) and American Academy of Paediatric Dentistry (AAPD) guidelines recommend sealants for children and adolescents, showing a 76% caries reduction over two years versus no sealant or fluoride varnish (Wright et al., 2016). A 2018 randomized trial reported an 83% lower risk of ICDAS 3–6 lesions in sealed molars (Muller-Bolla et al., 2018).
Despite international evidence, data from Sri Lanka are limited. The 2022 Ministry of Health report recorded 6,870 sealant applications in public clinics (Ministry of Health, 2022), but few studies have assessed retention or caries-preventive outcomes, highlighting the need for research under routine conditions. Given the high prevalence of caries among Sri Lankan children, this descriptive cross-sectional study evaluated sealant retention and caries status on first and second permanent molars in a hospital-based setting, providing a snapshot of clinical outcomes under routine care following a prior clinical audit by the authors.

Materials and Methods:-

The descriptive cross-sectional study was conducted after obtaining approval from the Ethics Review Committee of Sri Lankan Medical Association. The study was carried out at Restorative Dentistry Unit B, Institute of Oral Health (IOH), Maharagama, Sri Lanka. The objectives of this study were to evaluate the clinical outcomes of pit and fissure sealants placed on the first and second molars of children and adolescents, with particular emphasis on sealant retention and caries prevention rates. Additionally, the study aimed to identify factors potentially influencing these outcomes, including patient-related factors such as oral hygiene practices and dietary patterns, the timing of sealant placement in relation to tooth eruption stage and the type of sealant material used. The observed outcomes were further compared with findings reported in established evidence-based guidelines, systematic reviews and meta-analyses. Finally, this study sought to generate recommendations to enhance the application, follow-up and overall delivery of fissure sealant programs in hospital-based dental settings.

Study population and sampling:-

The study population comprised children and adolescents aged 6–13 years who received pit and fissure sealants on their first and/or second permanent molars at Restorative Dentistry Unit B, IOH Maharagama, during the period of January 2022 to December 2024. Data collection for this descriptive cross-sectional study was conducted during December 2025 to January 2026. As the number of children and adolescents indicated for pit and fissure sealant placement was limited to those diagnosed as high caries risk, a convenience sampling technique was adopted. All eligible patients who received pit and fissure sealants at Restorative Dentistry Unit B, Institute of Oral Health-Maharagama, between January 2022 and December 2024 were included, resulting in a total of 48 children and adolescents enrolled in the study. Although convenience sampling was employed, this approach was considered appropriate because the study population was small, highly specific and drawn from routine clinical care. Including all eligible patients ensured comprehensive coverage and enhanced the validity of the findings within this high-risk group. The sampling method was approved by the Ethics Review Committee, reflecting its suitability for the study context.

Inclusion criteria:-
Children and adolescents of both genders, aged 6-13 years, who received pit and fissure sealants on their first and/or second permanent molars.

Exclusion criteria:-
Patients with developmental abnormalities of enamel or dentine
Patients whose fissure-sealed teeth had subsequently been restored or extracted
Patients with fixed orthodontic appliances on the fissure-sealed teeth during the follow-up period
Patients with incomplete or inadequate clinical records

Clinical procedure and data collection:-
Written informed consent was obtained from parents or guardians and assent was obtained from participating children prior to the conduct of the study. Data collection for the study was conducted during patients' routine annual review appointments. No additional clinical visits were scheduled specifically for the purpose of this research. All fissure sealants were evaluated by the same investigator throughout the study period to ensure consistency in clinical assessment. Clinical evaluation of fissure sealants was carried out by a single investigator, by visual inspection using a dental mirror and tactile assessment using a dental probe under routine clinical lighting conditions. No radiographic examination was undertaken specifically for the purposes of this study. Information regarding fissure sealant placement and follow-up was extracted from patients' clinical records. The following variables were recorded: Teeth that received pit and fissure sealants; Type of fissure sealant material used; Operator-related details; Retention status of fissure sealants and Presence and severity of new carious lesions on fissure-sealed teeth.

The following scoring criteria was used:
Retention of fissure sealants
Score 1: Total retention
Score 2: Partial loss
Score 3: Total loss
Caries status
Score 1: No new carious lesions
Score 2: Enamel caries
Score 3: Dentinal caries
Score 4: Pulp involvement

Categorisation of clinical outcomes:-
Clinical outcomes of pit and fissure sealants were categorised as effective or not effective based on retention and caries status. An effective clinical outcome was defined as complete retention of the pit and fissure sealant (Score 1) with no evidence of new carious lesions (Score 1). In contrast, an ineffective outcome was defined as partial or total loss of the sealant (Scores 2 or 3) and/or the presence of carious lesions, including enamel caries, dentinal caries, or pulp involvement (Scores 2–4). This categorisation facilitated assessment of fissure sealant performance and identification of contributory factors related to patient characteristics, oral hygiene practices, dietary habits, timing of sealant placement relative to tooth eruption and sealant material used.

Management of clinical findings:-
For participants with multiple fissure-sealed molars, the worst clinical outcome observed among all sealed teeth was used for patient-level analysis. Following documentation of these outcomes, such teeth were managed appropriately in the clinic, including resealing, repair or restorative treatment as indicated. This approach ensured that clinical management was not delayed for research purposes.

Data Analysis:-
Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 21.0. Descriptive statistics were used to summarise participant characteristics and clinical outcomes. Group comparisons were performed using chi-square tests for categorical variables and ANOVA for continuous variables. Spearman's correlation was used to assess associations between continuous variables. Binary logistic regression analysis was conducted to explore potential predictors of sealant retention and caries status. All the collected data will be discarded 5 years after the completion of the study.

Results:-

Participant Characteristics:-

A total of 48 children and adolescents aged 6–13 years (mean ± SD: 8.0 ± 1.7 years) were included in the study. Females comprised 62.5% (n = 30) and males 37.5% (n = 18). The majority of participants resided in urban areas (89.6%, n = 43). Most children reported brushing their teeth twice daily (68.7%, n = 33) and the average daily consumption of sugary snacks was 2.0 ± 0.9 (range 1–4). Fully erupted permanent molars accounted for 93.8% (n = 45) of the teeth at the time of fissure sealant placement. Glass ionomer (GI) sealants were used in 77.1% of cases (n = 37), while resin-based sealants were applied in 22.9% of cases (n = 11). Sealants were placed by house officers (HO) in 39.6% of cases, senior house officers (SHO) in 10.4% and registrars (REG) in 50% of cases. Baseline clinical records indicated total retention and absence of caries for all participants prior to follow-up.

Retention and Caries outcomes of fissure sealants:-

At the follow-up assessment, total retention of fissure sealants was observed in 77.1% of teeth (n = 37), while 22.9% (n = 11) exhibited partial or total loss. New carious lesions were observed in 16.7% of teeth (n = 8), whereas 83.3% (n = 40) remained caries-free.

Outcomes by Fissure Sealant Material:-

Sealants made of glass ionomer demonstrated a total retention rate of 81.1% (n = 30) and a caries-free rate of 86.5% (n = 32). Resin-based sealants showed a lower retention rate of 63.6% (n = 7) and a caries-free rate of 72.7% (n = 8). However, these differences were not statistically significant (retention, $p = 0.17$; caries, $p = 0.25$). Given the small and unequal distribution of material types, these comparisons should be interpreted as descriptive rather than confirmatory.

Predictors of Fissure Sealant Outcomes:-

Chi-square analysis revealed no significant association between sealant outcomes and categorical variables, including gender, residence, operator, tooth eruption status or tooth brushing frequency. ANOVA test demonstrated no significant differences in age or sugary snack consumption between children with retained vs. lost sealants. Spearman correlation analysis identified a significant positive association between daily sugary snack consumption and the occurrence of new caries ($r = 0.28$, $p < 0.05$). No other continuous variable was significantly correlated with sealant retention or caries development. In the logistic regression analysis, higher frequency of sugary snack consumption was associated with reduced fissure sealant effectiveness (OR = 0.45, 95% CI: 0.20–0.99, $p = 0.047$). The variable was coded so that increasing values corresponded to more frequent consumption. Consequently, the odds ratio greater than 1 indicates a higher likelihood of developing new caries with more frequent sugary snacks. Clinically, this reinforces the importance of dietary counseling alongside fissure sealant placement, as fissure sealants alone cannot fully mitigate the effects of frequent sugar intake. Other factors, including age, gender, residence, tooth brushing frequency, operator, fissure sealant material and tooth eruption status, were not significantly associated with either sealant retention or caries prevention.

Effectiveness of Fissure Sealants:-

At follow-up, fissure sealants of 33 participants (68.8%) were effective (total retention and no new caries), while fissure sealants of 15 participants (31.2%) weren't effective (partial or total loss and/or new caries).

Summary of Findings:-

Overall, the majority of fissure sealants placed in this cohort were retained and effective in preventing new caries. Glass ionomer sealants demonstrated slightly higher retention and caries prevention rates compared to resin-based sealants, though the differences were not statistically significant. High frequency of sugary snack consumption emerged as the primary risk factor for new caries development among participants, highlighting the importance of dietary counseling alongside preventive fissure sealant placement. The study findings are summarized in the tables below (Table 1-7). Abbreviations: M, male; F, female; U, urban; R, rural; GI, glass ionomer–based fissure sealant; RE, resin-based fissure sealant; HO, house officer; SHO, senior house officer; REG, registrar.

Table 1: Descriptive Statistics [Categorical variables – Frequencies (n) & Percentages (%)]

Variable	Category	N	%
Gender	M	18	37.5%
	F	30	62.5%
Residence	U	43	89.6%
	R	5	10.4%
Tooth brushing frequency (per day)	1	15	31.3%
	2	33	68.7%
Material used	GI	37	77.1%
	RE	11	22.9%
Operator	HO	19	39.6%
	SHO	5	10.4%
	REG	24	50%
Tooth eruption	F	45	93.8%
	P	3	6.3%
Current retention	1	37	77.1%
	2	11	22.9%
Current caries	1	40	83.3%
	2	8	16.7%

Table 2: Descriptive Statistics [Continuous variables]

Variable	Mean ± SD	Range
Age (years)	8.0 ± 1.7	6-12
Sugary snacks/day	2.0 ± 0.9	1-4

Table 3: Chi-square Analysis (Current retention vs Material)

Material	Total	Retained	Lost	% Retained
GI	37	30	7	81.1%
RE	11	7	4	63.6%

Chi-square = 1.92, p = 0.17 → Not statistically significant at α=0.05

Table 4: Chi-square Analysis (Current retention vs Operator)

Operator	Total	Retained	Lost	% Retained
HO	19	14	5	73.7%
SHO	5	4	1	80%
REG	24	19	5	79.2%

Chi-square = 0.35, p = 0.84 → Not significant

Table 5: Chi-square Analysis (Current caries vs Material)

Material	Total	No Caries	Caries	% No Caries
GI	37	32	5	86.5%
RE	11	8	3	72.7%

Chi-square = 1.32, p = 0.25 → Not significant

Table 6: Logistic Regression - Outcome 1: Current retention [1=retained, 0=lost]

Predictor	Odds Ratio (OR)	95% CI	p-value
Age	0.95	0.66-1.36	0.77
Gender (F vs M)	1.29	0.36-4.62	0.70
Residence (U vs R)	2.25	0.25-20.2	0.48
Tooth brushing frequency (2 vs 1)	1.55	0.42-5.72	0.51
Sugary snacks/day	0.78	0.44-1.38	0.39

Material (GI vs RE)	2.52	0.60-10.6	0.21
Operator (REG vs HO)	1.33	0.29-6.07	0.71
Eruption (F vs P)	1.95	0.15-24.7	0.60

No factor reached statistical significance for retention

Table 7: Logistic Regression - Outcome 2: Current caries [1=no caries, 0=caries]

Predictor	Odds Ratio (OR)	95% CI	p-value
Age	1.05	0.71-1.56	0.80
Gender (F vs M)	1.50	0.31-7.32	0.61
Residence (U vs R)	3.20	0.25-41.0	0.36
Tooth brushing frequency (2 vs 1)	0.85	0.17-4.30	0.84
Sugary snacks/day	0.45	0.20-0.99	0.047*
Material (GI vs RE)	2.25	0.42-12.0	0.33
Operator (REG vs HO)	2.00	0.33-12.0	0.45
Eruption (F vs P)	0.92	0.05-16.3	0.95

***p < 0.05 → Higher sugary snack frequency significantly increases odds of developing new caries.**

Discussion:-

This descriptive cross-sectional study assessed clinical outcomes of fissure sealants at a single follow-up during routine annual reviews (December 2025–January 2026), although sealants were placed from January 2022 to December 2024. It provides a cross-sectional evaluation rather than a longitudinal assessment. Outcomes focused on retention and caries prevention, with effectiveness defined as total retention and absence of new caries. At follow-up, 69% of participants had effective sealants, while 31% experienced partial or total loss or developed new caries, indicating sealants remain effective in a hospital setting.

Retention is a key determinant of sealant effectiveness. In this study, 77.1% of teeth showed total retention, consistent with international reports of 70–85% over 1–4 years (Ahovuo-Saloranta et al., 2017; Wright et al., 2016). The 83.3% caries-free rate aligns with randomized trials; for example, Muller-Bolla et al. (2018) reported an 83% reduction in moderate to severe caries in sealed molars, confirming sealants as effective for occlusal surfaces of permanent molars in children and adolescents.

Glass ionomer (GI) sealants showed slightly higher retention and caries-free rates than resin-based sealants, though differences were not statistically significant. The small, imbalanced resin group limits power, so findings are descriptive. While resin-based sealants generally show superior long-term retention (Forss et al., 1994; Baseggio et al., 2010; Kaur et al., 2025), overall caries-preventive effectiveness between GI and resin is broadly comparable (Ahovuo-Saloranta et al., 2017; Azarpazhooh & Main, 2008). GI sealants' tolerance to moisture and fluoride release may enhance performance in paediatric patients (Naaman et al., 2017; Kosior et al., 2017), though some modern resin and hybrid sealants also release fluoride (Ng et al., 2023; Şişmanoğlu, 2019). The predominance of GI sealants (77.1%) further limits direct comparison, but they remain practical and effective in hospital programmes, especially where moisture control is challenging.

Unlike some studies linking operator experience or material type to retention (Beltran-Aguilar et al., 2005; Ahovuo-Saloranta et al., 2017), no such associations were observed in this study, likely due to the small sample, GI predominance and standardized placement protocols. Frequent sugary snack consumption was the main predictor of reduced sealant effectiveness, emphasizing the need for dietary counseling alongside sealants. Other factors such as age, gender, residence, brushing frequency, operator experience and tooth eruption status were not significant, likely due to standardized procedures and most teeth being fully erupted (94%).

The high effectiveness supports the use of sealants in hospital-based programs for high-caries-risk children in Sri Lanka. However, results may not generalize to broader paediatric populations. Findings underscore combining fissure sealants with behavioral interventions, like sugar reduction and oral hygiene, for optimal caries prevention. Strengths include standardized assessment by a single investigator, evaluation of both GI and resin-based sealants, focus on clinically meaningful outcomes and consideration of patient-related factors, enhancing reliability and

practical relevance.This study has several limitations. The small sample size (n = 48), especially the imbalanced resin-based group, may have limited statistical power, so non-significant findings may reflect insufficient power rather than true absence of effect. The cross-sectional design allows assessment of associations but cannot establish causality or temporality, though it was feasible for evaluating clinical outcomes in this hospital setting (Zöllner et al., 2024; Ge et al., 2024). The cohort consisted solely of high-caries-risk children in a hospital-based restorative unit, limiting generalizability to lower-risk or community-based populations. Clinical assessments by a single investigator ensured consistency but may introduce observer bias. Caries detection relied on visual and tactile examination without radiographs, possibly underestimating early or interproximal lesions. Self-reported dietary and oral hygiene data may be affected by recall bias. Logistic regression models included multiple predictors relative to few outcomes, increasing the risk of overfitting; findings should be considered hypothesis-generating. Other confounders, such as socioeconomic status and external fluoride exposure, were not controlled. These limitations should guide interpretation and future longitudinal studies of long-term outcomes.

Conclusion:-

Pit and fissure sealants placed on first and second permanent molars in a hospital based cohort of high caries risk Sri Lankan children and adolescents demonstrated high effectiveness in preventing caries, with total retention and absence of new caries observed in approximately two-thirds of participants. Frequent consumption of sugary snacks was identified as the main risk factor for reduced fissure sealant effectiveness. These findings underscore the importance of combining fissure sealant placement with dietary counseling and oral hygiene promotion to optimise caries prevention in similar high caries risk clinical settings. Further research involving larger and more representative paediatric populations is required to enhance generalisability.

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