

1
2 **EVALUATION OF CLINICAL OUTCOMES OF TWO TYPES OF FISSURE SEALANT MATERIALS**
3 **PLACED ON THE FIRST AND SECOND MOLARS OF CHILDREN AND ADOLESCENTS ATTENDING**
4 **RESTORATIVE DENTISTRY UNIT B – INSTITUTE OF ORAL HEALTH / MAHARAGAMA**
5

6 **Abstract**

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

17 **Key words:-**

18 Pit and fissure sealants, clinical outcomes, effectiveness, occlusal caries
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21 **Introduction:-**

22 Dental caries is a complex, multifactorial disease that progresses dynamically over time. It is characterised by
23 changes within the dental biofilm, resulting in a disruption of the balance between demineralisation and
24 remineralisation processes on the tooth surface (Featherstone, 2004). Clinically, this process leads to the
25 development of carious lesions affecting both primary and permanent dentitions. Dental caries exerts a substantial
26 negative impact on an individual's overall wellbeing. In children and adolescents, symptoms such as food
27 impaction, dental sensitivity and pain are common and may result in functional limitations including difficulty in
28 mastication and speech. These clinical consequences may further contribute to school absenteeism, sleep
29 disturbances, irritability and reduced social interactions, thereby adversely affecting quality of life (Antunes et al.,
30 2025).

31 Epidemiological data highlight the considerable burden of dental caries among the paediatric population in Sri
32 Lanka. Findings from the National Oral Health Survey (NOHS) 2015/16 indicate that the prevalence of dental
33 caries among 5, 12 and 15-year-old children were 63.1%, 30.4%, and 41.5% respectively (Ministry of Health,
34 2016). In addition, the World Health Organisation (WHO) oral health country profile for Sri Lanka published in
35 2022 reported that 27.4% of individuals aged five years and above had untreated dental caries in the permanent
36 dentition (WHO, 2022). These statistics highlight the significant public health challenge posed by dental caries,
37 particularly among children and adolescents.

38 Effective management of dental caries requires identification of associated risk factors and implementation of
39 appropriate preventive measures. Among the biological risk factors, the presence of deep pits and fissures on the
40 occlusal surfaces of first and second molars is well recognised. This anatomical susceptibility led to the development
41 and widespread use of pit and fissure sealants in preventive dentistry. It has been reported that approximately 90% of
42 carious lesions in permanent teeth and 44% in primary teeth, occur in pits and fissures of posterior teeth (Beltran-
43 Aguilar et al., 2005). Although pits and fissures are not inherently cariogenic, their morphology favours plaque
44 accumulation and limits effective plaque removal due to the inability of toothbrush bristles to access these narrow
45 and deep areas. Evidence suggests that microorganisms located in the deeper portions of pits and fissures contribute
46 less to caries development, whereas those present at the entrances and in open grooves are metabolically more
47 active, leading to a faster progression of carious lesions in these regions (Ekstrand & Bjørndal, 1997). Consequently,
48 the occlusal surfaces of first and second permanent molars are considered highly susceptible to dental caries.

49 Historically, several strategies were explored to protect pits and fissures from caries. These included procedures
50 such as enamel fissure eradication or fissurotomy, which aimed to widen deep fissures to facilitate cleaning
51 (Naaman et al., 2017), as well as the application of ammoniacal silver nitrate. However, these methods demonstrated
52 limited clinical success (Naaman et al., 2017). In 1923, Hyatt introduced prophylactic odontotomy, in which a Class
53 I cavity encompassing deep pits and fissures was prepared and restored (Hyatt, 1923). Despite its invasive nature,
54 this approach remained popular until the 1970s. A significant advancement occurred when Buonocore introduced pit
55 and fissure sealants using Bis-GMA resin activated by ultraviolet light (Buonocore, 1970). Currently available
56 fissure sealants include resin-based, glass ionomer-based and hybrid materials such as compomer and giomer
57 sealants, all of which are commonly used in clinical practice (Ng et al., 2023).

58 Pit and fissure sealants prevent dental caries through several mechanisms. By sealing the pits and fissures on
59 occlusal surfaces, they act as a physical barrier that prevents plaque accumulation and food stagnation while limiting
60 colonisation by cariogenic microorganisms (Ahovuo-Saloranta et al., 2017). Sealed occlusal surfaces are also more
61 accessible for plaque removal, thereby improving the effectiveness of toothbrushing (Ramamurthy et al., 2022). In
62 addition, glass ionomer-based sealants, certain resin-based sealants and hybrid sealants release fluoride ions, which
63 reduce demineralisation, enhance remineralisation and inhibit microbial activity associated with dental caries (Ng et
64 al., 2023). Some giomer-based sealants further release strontium and borate ions, which possess antimicrobial
65 properties and buffering capacity against lactic acid produced during bacterial metabolism (Kaga et al., 2014).

66 A substantial body of evidence supports the effectiveness of pit and fissure sealants in caries prevention. Clinical
67 guidelines jointly issued by the American Dental Association (ADA) and the American Academy of Pediatric
68 Dentistry (AAPD) recommend the use of pit and fissure sealants in children and adolescents to prevent occlusal
69 caries in posterior teeth, indicating superiority over no sealant placement or fluoride varnish application. These
70 guidelines reported a 76% reduction in caries incidence in fissure sealed teeth over a two-year follow-up period
71 compared with unsealed teeth (Wright et al., 2016). Furthermore, a large randomised clinical trial published in 2018
72 demonstrated that molars receiving fissure sealants had an 83% lower risk of developing ICDAS 3–6 lesions
73 compared with unsealed molars (Muller-Bolla et al., 2018).

74 Despite robust international evidence, data evaluating the effectiveness of pit and fissure sealants within the Sri
75 Lankan context remain limited. The National Oral Health Services Report of Sri Lanka (2022) documented 6,870
76 fissure sealant applications carried out in general dental clinics under the Ministry of Health during that year
77 (Ministry of Health, 2022). However, there is a paucity of published research assessing the retention and caries
78 preventive outcomes of pit and fissure sealants within the Sri Lankan public health system. This lack of local
79 evidence highlights the need for further investigation into the performance of fissure sealants under routine clinical
80 conditions in Sri Lanka.

81 Given the high prevalence of dental caries among Sri Lankan children and adolescents and the importance of
82 evidence-based preventive strategies, this study was conducted to evaluate the clinical outcomes of pit and fissure
83 sealants placed on first and second permanent molars in this population. The present descriptive cross-sectional
84 study aimed to assess the retention status of fissure sealants and their association with caries prevention within a
85 particular Sri Lankan public health setting. This study was undertaken as a consequence of a prior clinical audit
86 conducted by the same authors on the effectiveness of fissure sealants. Insights gained from the audit highlighted the
87 need for a more detailed descriptive analysis, which led to the design and objectives of the present research.

88 **Materials and Methods:-**

89 The descriptive cross-sectional study was conducted after obtaining approval from the Ethics Review Committee of Sri
90 Lankan Medical Association. The study was carried out at Restorative Dentistry Unit B, Institute of Oral Health
91 (IOH), Maharagama, Sri Lanka.

92 The objectives of this study were to evaluate the clinical outcomes of pit and fissure sealants placed on the first and
93 second molars of children and adolescents, with particular emphasis on sealant retention and caries prevention rates.
94 Additionally, the study aimed to identify factors potentially influencing these outcomes, including patient-related
95 factors such as oral hygiene practices and dietary patterns, the timing of sealant placement in relation to tooth
96 eruption stage and the type of sealant material used. The observed outcomes were further compared with findings
97 reported in established evidence-based guidelines, systematic reviews and meta-analyses. Finally, this study sought
98 to generate recommendations to enhance the application, follow-up and overall delivery of fissure sealant programs
99 in hospital-based dental settings.

100 ***Study population and sampling***

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

113 ***Inclusion criteria***

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

116 ***Exclusion criteria***

117 Patients with developmental abnormalities of enamel or dentine

118 Patients whose fissure-sealed teeth had subsequently been restored or extracted

119 Patients with fixed orthodontic appliances on the fissure-sealed teeth during the follow-up period

120 Patients with incomplete or inadequate clinical records

121 ***Clinical procedure and data collection***

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

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133 The following scoring criteria was used:

134 Retention of fissure sealants

135 Score 1: Total retention

136 Score 2: Partial loss

137 Score 3: Total loss

138 Caries status

139 Score 1: No new carious lesions

140 Score 2: Enamel caries

141 Score 3: Dentinal caries

142 Score 4: Pulp involvement

143 ***Categorisation of clinical outcomes***

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

151 ***Management of clinical findings***

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

156 ***Data Analysis***

157 Statistical package for social sciences (SPSS21.0) was used for analysis of the study. The analysis was divided into
158 the following key areas: Descriptive statistics; Comparing groups; Correlations - Spearman's correlation and
159 Regression analysis. All the collected data will be discarded 5 years after the completion of the study.

160 **Results:-**

161 ***Participant Characteristics***

162 A total of 48 children and adolescents aged 6–13 years (mean \pm SD: 8.0 \pm 1.7 years) were included in the study.
163 Females comprised 62.5% (n = 30) and males 37.5% (n = 18). The majority of participants resided in urban areas
164 (89.6%, n = 43). Most children reported brushing their teeth twice daily (68.7%, n = 33) and the average daily
165 consumption of sugary snacks was 2.0 \pm 0.9 (range 1–4). Fully erupted permanent molars accounted for 93.8% (n =
166 45) of the teeth at the time of fissure sealant placement. Glass ionomer (GI) sealants were used in 77.1% of cases (n
167 = 37), while resin-based sealants were applied in 22.9% of cases (n = 11). Sealants were placed by house officers
168 (HO) in 39.6% of cases, senior house officers (SHO) in 10.4% and registrars (REG) in 50% of cases. Baseline
169 clinical records indicated total retention and absence of caries for all participants prior to follow-up.

170 ***Retention and Caries outcomes of fissure sealants***

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

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177 ***Outcomes by Fissure Sealant Material***

178 Sealants made of glass ionomer demonstrated a total retention rate of 81.1% (n = 30) and a caries-free rate of 86.5%
179 (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).
180 However, these differences were not statistically significant (retention, p = 0.17; caries, p = 0.25).

181 **Predictors of Fissure Sealant Outcomes**

182 Chi-square analysis revealed no significant association between sealant outcomes and categorical variables,
 183 including gender, residence, operator, tooth eruption status or tooth brushing frequency. ANOVA test demonstrated
 184 no significant differences in age or sugary snack consumption between children with retained vs. lost sealants.
 185 Spearman correlation analysis identified a significant positive association between daily sugary snack consumption
 186 and the occurrence of new caries ($r = 0.28, p < 0.05$). No other continuous variable was significantly correlated with
 187 sealant retention or caries development. Logistic regression analysis confirmed that the frequency of sugary snacks
 188 per day was the only significant predictor of new caries (OR = 0.45, 95% CI: 0.20–0.99, $p = 0.047$). Other factors,
 189 including age, gender, residence, tooth brushing frequency, operator, fissure sealant material and tooth eruption
 190 status, were not significantly associated with either sealant retention or caries prevention.

191 **Effectiveness of Fissure Sealants**

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

194 **Summary of Findings**

195 Overall, the majority of fissure sealants placed in this cohort were retained and effective in preventing new caries.
 196 Glass ionomer sealants demonstrated slightly higher retention and caries prevention rates compared to resin-based
 197 sealants, though the differences were not statistically significant. High frequency of sugary snack consumption
 198 emerged as the primary risk factor for new caries development among participants, highlighting the importance of
 199 dietary counseling alongside preventive fissure sealant placement. The study findings are summarized in the tables
 200 below (Table 1-7).

201 Abbreviations: M, male; F, female; U, urban; R, rural; GI, glass ionomer-based fissure sealant; RE, resin-based
 202 fissure sealant; HO, house officer; SHO, senior house officer; REG, registrar.

203 **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%
Previous retention	1	48	100%
Previous caries	1	48	100%
Current retention	1	37	77.1%
	2	11	22.9%
Current caries	1	40	83.3%
	2	8	16.7%

204 **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

205 **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%

206 Chi-square = 1.92, p = 0.17 → Not statistically significant at $\alpha=0.05$

207 **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%

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

209 **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%

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

211

212 **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

213 No factor reached statistical significance for retention

214 **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

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

216

217 **Discussion:-**

218 This study evaluated the clinical outcomes of pit and fissure sealants placed on first and second permanent molars of
 219 children and adolescents registered at Restorative Dentistry Unit B of Institute of Oral Health – Maharagama, Sri
 220 Lanka. The study focused on two primary outcome measures: retention rate and caries prevention rate of the pit and
 221 fissure sealants. Effectiveness was defined as total retention of the fissure sealant combined with absence of new
 222 carious lesions. At follow-up, approximately 69% of participants had effective sealants, while 31% experienced
 223 partial or total loss of fissure sealants or developed new caries. These findings indicate that fissure sealants remain an

224 effective preventive strategy in a real-world hospital dental setting, although a subset of participants experienced
225 suboptimal outcomes.

226 Retention of fissure sealants is widely regarded as a key determinant of their long-term caries-preventive
227 effectiveness. In the present study, 77.1% of sealed teeth demonstrated total retention at follow-up, which is
228 consistent with international literature reporting retention rates ranging from 70–85% over 1–4 years (Ahovuo-
229 Saloranta et al., 2017; Wright et al., 2016). The observed caries-free rate of 83.3% further supports the protective
230 benefit of fissure sealants and is comparable to findings from randomized clinical trials. For example, Muller-Bolla et
231 al. (2018) reported an 83% reduction in the risk of developing moderate to severe caries in sealed molars, closely
232 mirroring the caries prevention rate observed in this cohort. Collectively, these findings reinforce the established role
233 of fissure sealants as an effective preventive intervention for occlusal surfaces of permanent molars in children and
234 adolescents.

235 With regard to material comparison, glass ionomer (GI) sealants in the present study demonstrated slightly higher
236 retention and caries-free rates than resin-based sealants; however, these differences were not statistically significant.
237 Although several randomized controlled trials and systematic reviews suggest that resin-based sealants generally
238 exhibit superior long-term retention (Forss et al., 1994; Baseggio et al., 2010; Kaur et al., 2025), overall caries-
239 preventive effectiveness between resin and GI materials appears broadly comparable (Ahovuo-Saloranta et al., 2017;
240 Azarpazhooh & Main, 2008). The comparatively better performance of GI sealants observed in the present study may
241 be attributed to multiple contextual factors. Glass ionomer materials are less technique-sensitive and more tolerant to
242 moisture contamination, which may be advantageous in paediatric patients and routine clinical settings (Naaman et
243 al., 2017). Their fluoride-releasing capacity may also contribute to enamel remineralization and sustained caries
244 inhibition, even in cases of partial material loss (Kosior et al., 2017). It is important to note, however, that fluoride
245 release is not exclusive to conventional glass ionomer materials; certain contemporary resin-based and hybrid sealants
246 have also been formulated to release fluoride ions, thereby enhancing their preventive potential (Ng et al., 2023;
247 Şişmanoğlu, 2019). Additionally, the predominance of GI sealants in this cohort (77.1% of cases) may have
248 influenced the observed outcomes, as the smaller number of resin-based sealants limited direct comparison and
249 reduced the statistical power to detect true material-related differences. Therefore, while GI sealants appeared to
250 perform slightly better in this study, these findings should be interpreted with caution. From a public health
251 perspective, the findings support the continued use of glass ionomer sealants in Sri Lankan hospital-based preventive
252 programs, particularly in situations where moisture control may be suboptimal and fluoride-releasing materials are
253 desirable.

254 Unlike some studies that have identified operator experience or material type as significant predictors of sealant
255 retention (Beltran-Aguilar et al., 2005; Ahovuo-Saloranta et al., 2017), the present study did not demonstrate such
256 associations. This discrepancy may be attributable to the relatively small sample size, the predominance of GI sealants
257 in this cohort and the standardized placement protocols employed within the clinical setting. These factors may have
258 minimized variability related to operator technique and material handling.

259 In this study, dietary habits, specifically the frequency of sugary snack consumption, emerged as the primary
260 predictor of reduced fissure sealant effectiveness. Participants with higher daily consumption of sugary snacks had a
261 significantly higher likelihood of developing new caries. This emphasizes the importance of dietary counseling
262 alongside fissure sealant placement, as sealants alone cannot fully mitigate the effects of frequent sugar exposure.
263 Other factors, including age, gender, residence, tooth brushing frequency, operator experience and tooth eruption
264 status, were not significantly associated with fissure sealant effectiveness. This may reflect the relatively small sample
265 size and the standardized clinical procedures employed, which minimized operator-dependent variability. The lack of
266 association with tooth eruption status may be explained by the fact that most teeth in the study were fully erupted
267 (94%), limiting the ability to detect differences based on eruption.

268 The high effectiveness of fissure sealants observed in this study supports their continued use in preventive programs
269 targeting children and adolescents in Sri Lanka. Importantly, the study highlights that preventive measures should be
270 complemented by behavioral interventions, such as reducing sugar intake and promoting consistent oral hygiene, to
271 maximize long-term caries prevention. These findings are particularly relevant for public health planning, where
272 resources may be limited and dietary counseling can enhance the impact of fissure sealant programs. In addition, this
273 study provides valuable, locally relevant evidence on fissure sealant effectiveness within a Sri Lankan public health
274 system, addressing a gap in national data. Strengths of the study include standardized assessment of all sealants by a
275 single investigator, evaluation of both glass ionomer and resin-based materials, focus on clinically meaningful
276 outcomes such as total retention and caries-free status and consideration of patient-related factors like dietary habits,

277 oral hygiene practices and tooth eruption status, which together enhance the reliability and practical relevance of the
278 findings in routine clinical settings.

279 Despite the valuable insights provided, this study has several limitations. The cross-sectional design allowed
280 assessment of associations between patient, operator and material factors with fissure sealant outcomes but does not
281 permit evaluation of temporality or causal relationships. Although a longitudinal cohort study could provide more
282 robust evidence on incidence and causal effects, a cross-sectional approach was appropriate and feasible for assessing
283 clinical outcomes within the hospital setting and has been successfully used in recent peer-reviewed studies (Zöllner
284 et al., 2024; Ge et al., 2024). The relatively small sample size and the predominance of glass ionomer fissure sealants
285 limited the statistical power to detect differences between material types and operator-related factors. While
286 convenience sampling was employed, it was deemed suitable given the study population was restricted to children
287 and adolescents at high caries risk receiving fissure sealants under routine clinical care; nevertheless, findings may not
288 be generalisable to the wider paediatric population in Sri Lanka.

289 Clinical assessments were performed by a single investigator, ensuring consistency but potentially introducing
290 observer bias and caries detection relied solely on visual and tactile examination without radiographic confirmation.
291 Self-reported dietary and oral hygiene data may be subject to recall bias. Finally, other potential confounding factors,
292 such as socioeconomic status and external fluoride exposure, were not controlled. These limitations should be
293 considered when interpreting the findings and planning future research, including prospective longitudinal studies to
294 evaluate long-term outcomes.

295 **Conclusion:-**

296 Pit and fissure sealants placed on first and second permanent molars in a cohort of Sri Lankan children and
297 adolescents demonstrated high effectiveness in preventing caries, with total retention and absence of new caries
298 observed in approximately two-thirds of participants. Frequent consumption of sugary snacks was identified as the
299 main risk factor for reduced fissure sealant effectiveness. These findings underscore the importance of combining
300 fissure sealant placement with dietary counseling and oral hygiene promotion to optimise caries prevention in
301 paediatric populations.

302 **Acknowledgements:-**

303 The authors acknowledge the staff of the Restorative Dentistry Unit B, Institute of Oral Health, Maharagama, Sri
304 Lanka, for their cooperation and support during the study. We also sincerely appreciate the contributions of all
305 operators and administrative personnel who assisted with the placement of pit and fissure sealants.

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