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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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Pit and fissure sealants, clinical outcomes, effectiveness, occlusal caries

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: A descriptive cross-sectional study included 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 during routine follow-ups 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.

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Introduction:-

Dental caries is a complex, multifactorial disease that progresses dynamically over time. It is characterised by changes within the dental biofilm, resulting in a disruption of the balance between demineralisation and remineralisation processes on the tooth surface (Featherstone, 2004). Clinically, this process leads to the development of carious lesions affecting both primary and permanent dentitions. Dental caries exerts a substantial negative impact on an individual's overall wellbeing. In children and adolescents,

symptoms such as food impaction, dental sensitivity and pain are common and may result in functional limitations including difficulty in mastication and speech. These clinical consequences may further contribute to school absenteeism, sleep disturbances, irritability and reduced social interactions, thereby adversely affecting quality of life (Antunes et al., 2025).

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

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

highly susceptible to dental caries.

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

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

A substantial body of evidence supports the effectiveness of pit and fissure sealants in caries prevention. Clinical guidelines jointly issued by the American Dental Association (ADA) and the American Academy of Pediatric Dentistry (AAPD) recommend the use of pit and fissure sealants in children and adolescents to prevent occlusal caries in posterior

teeth, indicating superiority over no sealant placement or fluoride varnish application. These guidelines reported a 76% reduction in caries incidence in fissure sealed teeth over a two-year follow-up period compared with unsealed teeth (Wright et al., 2016). Furthermore, a large randomised clinical trial published in 2018 demonstrated that molars receiving fissure sealants had an 83% lower risk of developing ICDAS 3–6 lesions compared with unsealed molars (Muller-Bolla et al., 2018).

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

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

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 1 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. 1 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. Information regarding fissure sealant placement and follow-up was extracted from patients' clinical records. The following variables were recorded: Teeth that received 2 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:

1 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

Statistical package for social sciences (SPSS21.0) was used for analysis of the study. The analysis was divided into the following key areas: Descriptive statistics; Comparing groups; Correlations - Spearman’s correlation and Regression analysis. 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).

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. Logistic regression analysis confirmed that the frequency of sugary snacks per day was the only significant predictor of new caries (OR = 0.45, 95% CI: 0.20–0.99, $p = 0.047$). 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 [1] 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%

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%

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 study evaluated the clinical outcomes [2] of pit and fissure sealants placed on first and second permanent molars of children and adolescents registered at Restorative Dentistry Unit B of Institute of Oral Health – Maharagama, Sri Lanka. The study focused on two

primary outcome measures: 1 retention rate and caries prevention rate of the pit and fissure sealants. Effectiveness was defined as total retention of the fissure sealant combined with absence of new carious lesions. At follow-up, approximately 69% of participants had effective sealants, while 31% experienced partial or total loss of fissure sealants or developed new caries. These findings indicate that fissure sealants remain an effective preventive strategy in a real-world hospital dental setting, although a subset of participants experienced suboptimal outcomes.

1 Retention of fissure sealants is widely regarded as a key determinant of their long-term caries-preventive effectiveness. In the present study, 77.1% of sealed teeth demonstrated total retention at follow-up, which is consistent with international literature reporting retention rates ranging from 70–85% over 1–4 years (Ahovuo-Saloranta et al., 2017; Wright et al., 2016). The observed caries-free rate of 83.3% further supports the protective benefit of fissure sealants and is comparable to findings from randomized clinical trials. For example, Muller-Bolla et al. (2018) reported an 83% reduction in 5 the risk of developing moderate to severe caries in sealed molars, closely mirroring the caries prevention rate observed in this cohort. Collectively, these findings reinforce the established 1 role of fissure sealants as an effective preventive intervention for occlusal surfaces of permanent molars in children and adolescents.

With regard to material comparison, glass ionomer (GI) sealants in the present study demonstrated slightly higher retention and caries-free rates than resin-based sealants; however, these differences were not statistically significant. Although several randomized controlled trials and systematic reviews suggest that resin-based sealants generally exhibit superior long-term retention (Forss et al., 1994; Baseggio et al., 2010; Kaur et al., 2025), overall caries-preventive effectiveness between resin and GI materials appears broadly comparable (Ahovuo-Saloranta et al., 2017; Azarpazhooh & Main, 2008). The comparatively better performance of GI sealants observed in the present study may be attributed to multiple contextual factors. Glass ionomer materials are less technique-sensitive and more tolerant to moisture contamination, which may be advantageous in

paediatric patients and routine clinical settings (Naaman et al., 2017). Their fluoride-releasing capacity may also contribute to enamel remineralization and sustained caries inhibition, even in cases of partial material loss (Kosior et al., 2017). It is important to note, however, that fluoride release is not exclusive to conventional glass ionomer materials; certain contemporary resin-based and hybrid sealants have also been formulated to release fluoride ions, thereby enhancing their preventive potential (Ng et al., 2023; Şişmanoğlu, 2019). Additionally, the predominance of GI sealants in this cohort (77.1% of cases) may have influenced the observed outcomes, as the smaller number of resin-based sealants limited direct comparison and reduced the statistical power to detect true material-related differences. Therefore, while GI sealants appeared to perform slightly better in this study, these findings should be interpreted with caution. From a public health perspective, the findings support the continued use of glass ionomer sealants in Sri Lankan hospital-based preventive programs, particularly in situations where moisture control may be suboptimal and fluoride-releasing materials are desirable.

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

In this study, dietary habits, specifically the frequency of sugary snack consumption, emerged as the primary predictor of reduced fissure sealant effectiveness. Participants with higher daily consumption of sugary snacks had a significantly higher likelihood of developing new caries. This emphasizes the importance of dietary counseling alongside fissure sealant placement, as sealants alone cannot fully mitigate the effects of frequent sugar exposure. Other factors, including age, gender, residence, tooth brushing frequency, operator experience and tooth eruption status, were not significantly associated with

fissure sealant effectiveness. This may reflect the relatively small sample size and the standardized clinical procedures employed, which minimized operator-dependent variability. The lack of association with tooth eruption status may be explained by the fact that most teeth in the study were fully erupted (94%), limiting the ability to detect differences based on eruption.

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

Despite the valuable insights provided, this study has several limitations. The cross-sectional design allowed assessment of associations between patient, operator and material factors with fissure sealant outcomes but does not permit evaluation of temporality or causal relationships. Although a longitudinal cohort study could provide more robust evidence on incidence and causal effects, a cross-sectional approach was appropriate and feasible for assessing clinical outcomes within the hospital setting and has been successfully used in recent peer-reviewed studies (Zöllner et al., 2024; Ge et al., 2024). The relatively small sample size and the predominance of glass ionomer fissure sealants limited the statistical power to detect differences between material types and operator-

related factors. While convenience sampling was employed, it was deemed suitable given the study population was restricted to children and adolescents at high caries risk receiving fissure sealants under routine clinical care; nevertheless, findings may not be generalisable to the wider paediatric population in Sri Lanka.

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

Conclusion:-

Pit and fissure sealants placed on first and second permanent molars in a cohort of 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 paediatric populations.

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