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Original Article

Comparison of Retention of Self-Etch Sealants and Flowable Composite in Permanent Molars

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ABSTRACT

Objective: To evaluate the retention of self-etch pit and fissure sealants compared to flowable resin composite in the occlusal pits and fissures of permanent molars.

Study Design: Split-mouth clinical trial. Clinicaltrials.gov (trial registration number: NCT06895096).

Place and Duration of Study: Foundation University College of Dentistry and Hospital, Rawalpindi Pakistan, from Jun 24 to Feb 2025.

Methodology: A total of 84 pairs of first molars in 42 patients between the ages of 8-18 years were included. The first permanent molars were caries-free, having no fracture or hypoplasia, but having pits and fissures showing susceptibility to caries were included in the study. The selected tooth on one side was treated with flowable composite (FC) and the other side was treated with self-etch sealant (SES). The patients were followed up at 3,6 and 9 months interval. For assessment, Modified Simonsen's Criteria for partial or complete loss of sealants was used.

Results: At follow-up in 3 months, 74(88.09%) of teeth with FC had complete retention whereas only 42(50.00%) complete retention was observed in SES. The retention decreased in both groups with time, but flowable composite sustained better performance. At 9 months, complete loss was noted in 3(3.58%) of the teeth that received flowable composite while in teeth that received sealants with 18(21.43%) having complete loss of sealant. There was significant difference in sealant retention rate at 3, 6, and 9 months follow up.

Conclusion: Flowable composites perform better than self-etch sealants, especially in mandibular molars.

Keywords: Dental Caries, Flowable Composite, Pit and Fissures, Sealants.

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INTRODUCTION

Fissure sealants are commonly utilized in dentistry preventing caries initiation in permanent molars.[1] Permanent molars show greater susceptibility to caries development owing to anatomical features like deep fissures and pits, where food debris and bacteria get trapped.[2,3] The sealants impose a physical seal that prevents the colonization of bacteria. Long-term material retention is also a key area in their successful clinical application.[4] Self-etching sealants, which can be easily applied and are less technique sensitive, have become very popular.[5] Flowable composites are favored due to improved mechanical properties as well as patient adaptability.[6] While many studies have reported the retention rates of conventional sealant and self-etch sealants (SES), there is limited data on the comparison of flowable composite (FCS) as sealant and SES retention rates to ascertain which material provides superior long-term protection in high-stress regions such as permanent molars.

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Bhuvaneswari *et al.*, reported that self-adhering flowable composites had complete retention rates of 67% at 6 months and 47% at 12 months, while conventional unfilled resin sealants had considerably lower retention rates of 41% and 8% within their respective intervals.[7] Gisour *et al.*, in their study reported an 40.5% retention at 12 months for self-adhering flowable composites against 13.5% for resin based self-etch sealants.[8] Microleakage study by Sengar *et al.*, found that the etch-and-rinse adhesive system with flowable composite showed the minimum microleakage, which was considerably better than self-etch and self-adhesive ones.[9] This is attributed to the enhanced wear resistance and increased bond strength of flowable composites in regions of high stress. Vichi *et al.*, also indicated significantly low bond strength and worse marginal sealing in SES than multi-step adhesive systems.[10] Another systematic review supported the superiority in retention of flowable composites over fissure sealant after a 1 year follow up.

Nonetheless, while there have been many studies dedicated to examining different sealant materials, there is still limited clinical data comparing the

retention of self-etch resin-based sealants and flowable resin composites in permanent molars over time with standardized assessment measures. This research attempts to bridge this gap by evaluating self-etch sealant and flowable composite retention in permanent molars after nine months.

METHODOLOGY

This split mouth trial was initiated after approval from the institution's ethics review committee of Foundation University College of Dentistry and Hospital (FUCD&H), Rawalpindi Pakistan, (vide letter FF/FUCD/632/ERC/52 dated 26 Jan 2023) and trial registration at clinicaltrials.gov (trial registration number:NCT06895096). The sample size was calculated using the WHO Sample Size Calculator taking confidence interval 95%, margin of error 5%. Based on previous studies reporting complete sealant retention rates of 22.90%[5] for self-etch sealant and 59%[11] for flowable composite, with a 5% significance level and 95.5% power, the required sample size was 35. To compensate for potential loss to follow-up, the sample size was increased by 20%, resulting in a final sample size of 42. The power of the study was calculated using OpenEpi version 3.0, taking level of significance 5% and power of test (1-β) =95.5% (93.4% with continuity correction). The reference retention percentages from which the sample size for this study were calculated from two different research articles as no preexisting literature exists comparing self-etch sealants and flowable composites directly.

Inclusion Criteria: Children aged 8 to 18 years who had fully erupted, caries-free first permanent molars, having no structural defects, restorations, or hypoplastic changes, having adequate oral hygiene and the capacity to collaborate with dental therapy were included.

Exclusion Criteria: Patients with systemic illnesses, immunocompromised states, or any other developmental abnormalities like enamel hypoplasia or fluorosis, having underwent orthodontic treatment by including first molars, history of allergy to the material used, restored, sealed, and those with evidence of cracks or incipient caries teeth were excluded.

Written informed consent was taken from the patients and parent/guardian of patients younger than 18 years for inclusion in the study.

In this study 42 patients aged 8 to 18, each contributed a pair of first permanent molars using a split-mouth design, resulting in a total of 84 pairs (168 teeth). All participants met the eligibility requirements and were successfully enrolled without any exclusions at baseline. Using the split-mouth allocation method, one tooth from each pair was randomly designated to receive flowable composite (Group-A), while the opposite tooth was treated with a self-etch sealant (Group-B). This resulted in 84 teeth being allocated in both the flowable composite and self-etch sealant groups. The participants were monitored at 3, 6, and 9 months, with no dropouts recorded in either group throughout the study. Figure demonstrates patient flow diagram of the clinical trial. During each follow-up visit, all 84 teeth across both groups were clinically assessed for sealant retention, with results classified as complete retention, partial loss, or complete loss according to modified Simonsen's criteria.

In selected teeth the occlusal surface was made free of any debris and biofilm using a slow speed hand piece and polishing brush. The teeth were then examined by a WHO probe and mouth mirror after isolation with cotton rolls. First Molars were treated in pairs; randomization was done for treatment on the right molar and contralateral molar received the other treatment. After treatment allocation the teeth receiving the FC were treated with 37% Phosphoric acid (Scotch bond multipurpose etchant, 3M ESPE) for 20s. Then 2 consecutive coats of bonding agent (Adper single bond 2 adhesive system, 3M ESPE, USA) were applied using clean micro brush. The bonding agent was dried for 5s and polymerized for 10s. Flowable composite (ITENA Reflectys Flow Universal Flowable Composite) was then applied to pit and fissures and polymerized for 20s.

In teeth receiving the SES treatment, SES was applied after making the occlusal surface plaque free followed by application of SES on pit and fissures (ITENA prevent Seal light cure self-etch Sealant). it was light cured for 20 seconds. Occlusal surfaces were checked for high points with articulating paper, after the sealing material was placed. At 3,6, and 9 months follow-up, sealants were clinically evaluated by pedodontist (single-blind study). Intraoral mirror and dental explorer no. 5 were used to evaluate partial or total loss of sealant and caries in accordance to Modified Simonsen's Criteria, focus was placed on retention and the original 5 point scale was collapsed into 3 categories in this study as the follow-up duration was short to observe new caries development. Also partial and complete loss of sealant

were grouped together since sealants need to be replaced regardless, after breakdown. Score 0 signified no loss of sealant and no evidence of caries, score 1: Partial loss of sealant and no evidence of caries (original scores 1 and 2 recorded as 1) and score 2: complete loss of sealant and no evidence of caries (original scores 3 and 4 recorded as 2).

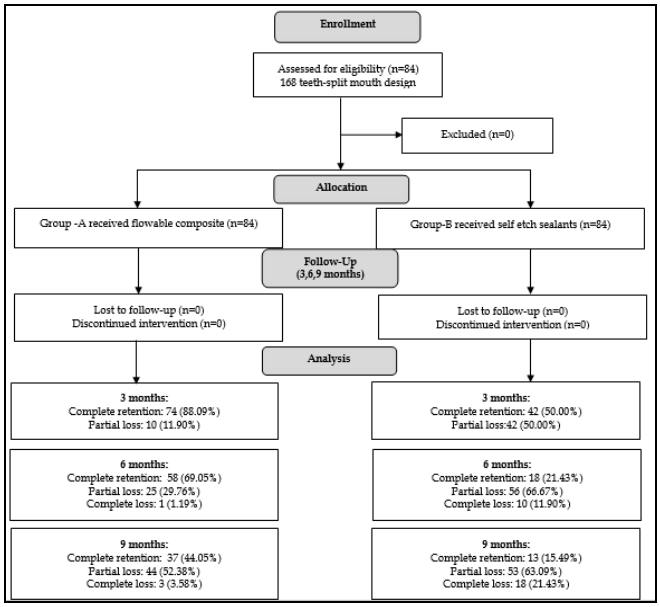

Figure: Patient Flow Diagram (n=84)

Statistical Package for Social Science (SPSS) version 23 was used for performing statistical analyses. Descriptive statistics like mean and standard deviation for age, gender and frequency of teeth in treatment groups were calculated as percentages. For comparison of sealant retention within the treatment group at 3,6,9 months follow up Friedman test was used. To evaluate the change in retention scores over time in both treatment group (inter group comparison) , McNemar's test was employed. *p*-value of 0.05 was considered statistically significant.

RESULTS

In this clinical trial 42 patients were enrolled, each patient received treatments on their maxillary and mandibular permanent first molars in pair, hence 2 pairs of teeth were treated per patient, and a total of 84 pairs was completed with a mean age of 13.33±3.03 years. Among the enrolled patients there were 23(54.80%) females and 19(45.20%) males. In the flowable composite group, complete retention was observed in 74(88.09%) teeth, while 10(11.90%) teeth, showed partial loss at the 3 month mark. By 6th month, complete retention was noted in 58(69.05%) teeth, with 25(29.76%) teeth experiencing partial loss, and 1(1.19%) tooth losing all retention. At 9 months, the findings were 37(44.05%) teeth with complete retention, 44(52.38%) teeth showing partial loss, and 3(3.58%) teeth exhibiting complete loss. In the self-etch sealant group, results at 3 months revealed a split, with complete retention in 42(50.00%) teeth and an equal number experiencing partial loss. By 6th month, only 18(21.43%) teeth maintained complete retention, while the number with partial loss rose to 56(66.67%), and 10(11.90%) teeth had completely lost retention. At 9 months, the situation continued to decline with 13(15.49%) teeth showing complete retention, 53(63.09%) teeth with partial loss, and 18(21.43%) teeth experiencing complete loss.

No patient lost to follow-up and all patients were reviewed till 9 months follow-up visit.

Table-I: Group Allocation and Material Application by Teeth Type (n=84)

Group Allocation	Flowable composite sealant n(%)	Self etch sealants n(%)	Total no of pairs n(%)
maxillary first molar	40(47.62%)	44(52.38%)	84
mandibular first molar	44(52.38%)	40(47.62%)	84

Table-I summarizes the treatment allocation of maxillary and mandibular first molar. Out of 84 pairs 44(52.38%) right maxillary molars and 40(47.62%) mandibular molars received the treatment with flowable composite and contra-lateral molars that is 44(52.38%) left maxillary molars and 40(47.62%) mandibular molars received alternate treatment with self-etch sealants.

Table-II: Intra Group Comparison of Retention Scores (n=84)

Parameters Median (IQR)	3 months (n=84)	6 months (n=84)	9 months (n=84)	*p*-value
Flowable composite	0.00(0.00)	0.00(1.00)	1.00(1.00)	<0.001
Self-Etch sealant	0.50(1.00)	1.00(0.00)	1.00(0.00)	<0.001

In Table-II comparison across 3,6, and 9 months showed significant difference (*p*-value <0.001) in sealant retention within both treatment groups. Retention for both materials decreased considerably over time. According to scoring criteria complete sealant retention was scored 0 and higher scores indicated loss of sealant from tooth surface. Median (IQR) scores for flowable composite increased from 0.00 (0.00) at 3 months to 1.00 (1.00) at 9 months compared to the IQR of self-etch sealants which dropped from 0.50 (1.00) at 3 months to 1.00 (0.00) at 9

months. These changes were statistically significant (Friedman test $\chi 2$ (2)=72.40, n=84, p<0.001).

Table-III presents the distribution of retention scores across both groups at 3, 6, and 9 months. At the 3rd month, flowable composite demonstrated better retention, with 74(88.09%) of applications showing complete retention (score 0), compared to only 42(50.00%) teeth with self-etch sealant. Over time, a reduction in complete retention was observed in both groups by the 6th month with 58(69.05%) teeth with flowable composite showing retention, and self-etch sealant showing 18(21.43%) teeth with complete retention. By the 9th month, complete loss was seen corresponding to 3(3.58%) teeth for flowable composite versus self-etch sealant in which greater loss was seen corresponding to 18(21.43%) teeth. This table shows a statistically significant difference in retention scores within both groups over time (p<0.001). At each follow-up interval (3rd, 6th, and 9th months), the flowable composite outperformed the self-etch sealant in terms of material retention over the 9-month observation period.

Table-III: Association of Retention Score among Groups (n=84)

Time Period	Scores	Flowable composite n(%)	Self-etch sealant n(%)	*p*-value
3 months	Complete retention	74(88.09%)	42(50.00%)	<0.001
	Partial loss	10(11.90%)	42(50.00%)	
6 months	Complete retention	58(69.05%)	18(21.43%)	<0.001
	Partial loss	25(29.76%)	56(66.67%)	
	Complete loss	1(1.19%)	10(11.90%)	
9 months	Complete retention	37(44.05%)	13(15.49%)	<0.001
	Partial loss	44(52.38%)	53(63.09%)	
	Complete loss	3(3.58%)	18(21.43%)	

DISCUSSION

The current study has compared the retention of flowable composite and self-etch sealant over periods of 9 months. FCs complete retention rate was 88.09% after three months, but by the ninth month, it had dropped to 44.05%. On the contrary, SES showed a notable decrease, from 50% complete retention at 3 months to 15.49% at 9 months. These findings show that the flowable composite outperformed the self-etch sealer in terms of retention for the study.

Kucukyilmaz and Savas reported on a 24-month clinical trial evaluating various fissure sealant materials and flowable composites. They found a complete retention rate of 95.70% for Tetric EvoFlow (a flowable composite) and 62.90% for Vertise Flow (a self-adhesive flowable composite), revealing better performance of flowable composites in comparison to self-adhesive types self-etch sealants in terms of retention rates throughout the study.[12] Erdemir *et al.,* concluded in his study comprising a 24-month split-mouth randomized controlled trial in which the comparison between the flowable composite (Tetric EvoFlow) and the conventional resin-based sealant (Helioseal F) was made that the complete retention rates were found to be 100%, 95.50%, 93.80%, and 88.50% for the flowable composite at 1, 6, 12, and 24 months, respectively, and were found to be 98.10%, 95.50%, 94.80%, and 85.40% for the resin-based sealant for the respective intervals.[13] While the two materials proved to have high retention rates, the flowable composite demonstrated improved better sealant retention than the resin sealant. Fluoride-releasing and light-cured sealants showed the highest 3-year retention rates: 86.40% and 83.10%, respectively (95% CI: 73.40–99.30 and 75.60–90.70).[14]

Corona *et al.,* compared the retention of a flowable restorative system and a traditional resin sealant (Fluroshield) at one year. They reported that the flowable restorative system was more retentive, with 100% retention on permanent teeth at 12 months, as compared to partial loss in the traditional sealant group.[15] This is in agreement with the findings observed in the current study, where the flowable composite was found to be more retentive than the self-etch sealant.

Gupta *et al.,* also carried out a randomized controlled trial assessing flowable composites and traditional pit-and-fissure sealants in school children. Their results also found better retention and marginal adaptation of flowable composites compared to traditional sealants, another confirmation of the present study's results.[16] Saravanan *et al.,* compared ormocers and compomers and found more retention in ormocer used as sealants (82%) compared to compomers (68%) at 12 months, indicating that material composition plays an important role in outcomes.[17] Beresescu *et al.,* tested glass carbomer sealants and recorded complete retention in only 58% at 12 months, which is less than that observed in 9-month outcomes with both self-etch and flowable composite sealants observed in the present study.18Retention of 85–90% at 3 to 6 months with the traditional acid-etch resin-based sealants was reported by Bhadule *et al.,* which is very similar to our 88.09% retention with flowable composite at 3 months. Their

review contrastingly reported lesser retention with the simplified self-etch approach, which is similar to our 50% retention for SES at the same period.[19] Ejaz *et al.*, showed that locally produced nanotechnology-enhanced composites provide enhanced strength and marginal adaptation,[20] backing up the sustained retention in our study only 3.58% complete loss with flowable composite at 9 months. Likewise, Svetha *et al.*, had an 18.20% total loss of conventional sealants at 12 months that is similar to our SES group's 21.43% loss at 9 months,[21] which supports self-etch materials being less lasting without added bonding or fillers.

Self-etch materials compared to conventional restorative materials etched with phosphoric acid show limited etching capacity leading to inadequate micromechanical retention.[22] One systematic review supported the superiority in retention of flowable composites over fissure sealants after a 1 year follow up.[11] Bagheri *et al.*, concluded in systematic review that filled resin-based sealants (flowable composite) are superior to unfilled sealants in retention.[23]

Overall, this study demonstrates that flowable composites show superior retention compared to self-etch sealants in permanent molars over a 9-month period. For long term retention and better occlusal seal integrity, flowable composites demonstrated superior durability in high stress areas to self-etch sealants in our study.

LIMITATIONS OF THE STUDY

The limitations of this study include its reliance on visual-tactile assessment, without radiographic assessment which may have underestimated early or subsurface caries. Additionally, the absence of examiner calibration could have introduced subjective bias in retention scoring.

CONCLUSION

In conclusion, flowable composite had much better retention rates than self-etch sealant in permanent molars over 9 months. The findings highlight the clinical preference of using flowable composites in situations where there is a need for long-lasting and durable retention. Although ease of application can be provided by self-etch sealants, lower retention rates of these products imply the need to improve the properties of materials further to meet higher clinical requirements.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SS & NA: Data acquisition, data analysis, critical review, approval of the final version to be published.

MK & NA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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