ACTA SCIENTIFIC PEDIATRICS (ISSN: 2581-883X)

Volume 8 Issue 8 August 2025

Research Article

The Effect of Surface Sealants on Microlekage of Class V Composite Restoration at Enamel and Cementum Margin. An Vitro Study.

Kola Srikanth Reddy[1]*, Pushpalatha HM[1], Shamini[1] and Vijay Kumar KV[2]

[1]Department of Pedodontics and Preventive Dentistry, Meghana Institute of Dental Scienses, Nizamabadh, Telanagana, India

[2]Department of Public Health Dentistry, Malla Reddy Dental College for Women's, Hyderabad, Telangana, India

***Corresponding Author:** Kola Srikanth Reddy, Department of Pedodontics and Preventive Dentistry, Meghana Institute of Dental Scienses, Nizamabadh, Telanagana, India.

Received: July 02, 2025

Published: July 31, 2025

Abstract

Objectives: Microleakage is still one of the most cited reasons for failure of Resin composite restorations. Alternative method to prevent Microlekage has been investigated increasingly. The Aim of the study is to evaluate the Microleakage in class v resin composite restorations with or without application of surface sealants with different filler content.

Materials and Methods: Forty –five cavities were prepared on the occlusaly in Enamel and cervically at Cementum.The cavities restored with an Adhesive system (Ceram x nano Composite M2 shade DENTSPLY) and Resin composite (DENTSPLY). Teeth were stored in distilled water for 24 h and separated in to 3 groups according to the surface sealants (control, Optigurd, Easy glaze). The teeth were Thermo cycled (500 cycles, 5-55 ^{0} c),immersed in basic fushin,sectioned, and analyzed for dye penetration using Steriomicroscope.The data were submitted to Statistical analysis by Kruskal-Wallis test.

Results: The results of the study indicated that there was minimum leakage at the Enamel margins of all groups.Kruskal –Wallis test revealed that Group 11 (Easy Glase) had leaked significantly less compared to Group 111 (Optiguard) and Group 1 (Control) ($p<0.05$).

Conclusion: None of the sealants were able to prevent Microlekage completely. Group 11 showed significantly less Microlekage when compared to Group 1 and Group 111.

Keywords: Microleakage; Resin Composite; Surface Sealants; Surface Sealing; Load Cycling; Water Absorption

Introduction

The term "composite" refers to a three-dimensional combination of two or more chemically different materials with a distinct interface separating the components. Composite resins have been introduced into the field of conservative dentistry to minimize the drawbacks of the acrylic resins that replaced silicate cements, which was the only aesthetic materials previously available in the 1940s [1]. Chemically cured composites required the base paste to be mixed with the catalyst, leading to problems with the proportions, mixing process and color stability. From 1970, composite materials

polymerized by electromagnetic radiation appeared, doing away with mixing and its drawbacks [2].

Composite resins are used widely for Esthetic restorations of class v lesions. Polymerization shrinkage, the main disadvantages of Composite resins can result in micro gap formation subsequent Microlekage in the marginal areas [3]. In particular, bonding Composite resin to Dentin or Cementum poses a significant clinical problem for dentists [4].

Polymerization shrinkage is one of the most critical properties of Composite resin restorative materials, resulting in gap formation along the margin of restoration causing Microleakage [5,6].

Microleakage is defined as the penetration of various ions, liquids, Microorganisms, and molecules between the restorative material and cavity walls. Factors causing Microleakage include inadequate adhesion and thermal expansion coefficient differences between tooth and restorative material, polymerization shrinkage stress, and inadequate moisture control [7-9]. In addition, the main clinical signs associated with the Microleakage are postoperative sensitivity, marginal discoloration, secondary caries, and pulpal inflammation [5,10-12].

In Restorative dentistry, Microleakage due to the deterioration of marginal adaptation has been reported to be one of the main reasons for restorations failure. An optimal marginal seal is an essential factor for the longevity of the restorations [13]. Therefore, the present study investigated different surface sealants effectiveness on the marginal seal of the Class V restorations.

Materials and Methods

Forty five Human maxillary premolars were used for the study. They were cleaned to remove calculus, soft tissue, and other debris using a periodontal scaling instrument.

25 class v cavities were prepared on buccal surfaces of all the teeth with external margins placed in Cementum were made with a no; 330 carbide bur in a high speed hand piece with air water spray.

The cavity out line had a 4 mm long occlusally in Enamel and 3 mm cervically at the Cementum The width of the cavity was kept at 3mm. The depth of the cavity was at 2 mm with the making on the bur.

Immediately after preparation, the cavities were etched with a 37% phosphoric acid (Conditioner 36, Detry) etchant for 15 seconds, and gently air-dried for 2 seconds. Scotch bond multi-purpose primer (3 M Dental products, U.S.A) was applied over the Enamel and Dentin surfaces with a light scrubbing motion and gently air-thinned for 5 seconds .According to the manufacturer's instructions.

The tooth surfaces were polymerized with a conventional halogen light-curing unit (Demetron LC,Kerr, Orange,CA,U.S.A) for 20 sec.

The composite resin (Clearfil majesty ES-2, Kuraray, Tokyo, JAPAN) was inserted in a single instrument with appropriate instruments using the incremental technique; each instrument, about 1 mm thick was light cured for 20 seconds. (Demetron LC, Kerr, Orange, CA, U.S.A).

Following restorations ,all the teeth were stored in distilled water at 37^0c for 24 hours before finishing/polishing and applications of surface covering The restorations were then polished with soflex (3 M-ESPE,ST,PAUL,MN,USA)flexile Aluminum oxide disk of decreasing abrasiveness (course to super fine).

All of the specimens were stored for 7 days in Deionized water at 37 ^{0} c and were submitted to a Thermo cycling regimen of 500 cycles between 5 ^{0} c and 55 ^{0} c water baths .Dwell time was 30 sec in each bath and a transfer time of 10 sec.

After Thermo cycling the teeth divided randomly in to three groups.

- **Group 1:** Teeth received no sealant, acts as a control group.
- **Group 2:** A thin layer of surface sealant easy Glaze applied and light polymerized.
- **Group 3:** A thin layer of surface sealant Optiguard applied and light polymerized.

Group 1 did not receive any sealants and acted as control, Group 11 and Group 111 were acid-etched and thin layer of surface sealants easy Glaze and Optiguard were applied respectively after the sealants were applied, the apical portion of the teeth were sealed with chemically Activated acrylic resin.

Each section was examined at x20nmagnification using a Stereomicroscope (SUE, Leica Microsystems, Wetzlar, Germany) by two previously calibrated independent evaluators separately under the same conditions (Light, temperature, and localization) the evaluators were instructed about the evaluation criteria before the observations, if there were disagreements in scores, consensus was obtained between evaluators photographs were taken from each section with a camera of Stereomicroscope scope (D-Lux 3,Leica, Wetzlar, Germany).

The sectioned samples were identified and fixed on a slide. The margins were analyzed separately using Stereomicroscope. Dye penetration was analyzed in accordance with the following criteria [14,15].

- 0 = Absence of dye penetration.
- 1 = slight Microleakage; dye penetration less than or equal to 1/3 of extent of the tooth restoration interface.
- 2 = moderate Microleakage; dye penetration more than 1/3 and up to ½ of the extent of the tooth-restoration interface.
- 3 = severe Microleakage; dye penetration more than ½ the Tooth-restoration interface.

Statistical analysis

The Data were analyzed with non-parametric statistical methods. The Kruskal-Walliis tests were used to identify any statically significant difference among the groups.

All statistical tests were performed at a $p < 0.05$ Level of significance.

Results

Tables 1 show that there was statistically significant difference noted in Microleakage at Enamel between the study groups. On comparing mean values, the control group had maximum Microleakage (2.33), followed by group II (1.33), group III (0.40) exhibited minimum Micro leakage.

Group	N	Mean	SD	Median	Min.	Max.	Chi-square*	'p' value
Control	15	2.33	1.234	3.00	0	3	13.245	0.001
Easy Glase	15	0.40	1.056	0.00	0	3		
Opti Guard	15	1.33	1.397	1.00	0	3		

Table 1: Comparison of Mean Micro leakage at Enamel.

*Kruskal Wallis Test.

Tables 2 There was no statistically significant difference noted in Microleakage at Cementum between the study groups. On comparing mean values, the control group had more Micro leakage (2.80), followed by group II (2.67), group III exhibited minimum Microleakage (2.13).

Group	N	Mean	SD	Median	Min.	Max.	Chi-square*	'p' value
Control	15	2.80	0.561	3.00	1	3	5.229	0.073
Easy Glase	15	2.13	0.990	3.00	1	3		
Opti Guard	15	2.67	0.816	3.00	0	3		

Table 2: Comparison of Mean Micro leakage at Cementum.

*Kruskal Wallis Test.

Discussion

In the present study, class V cavities were restored and surface sealed on extracted teeth *in vitro*.

Because clinical studies are nearly impossible to perform while controlling the conditioning factors and assessing Microleakage by sectioning the teeth, in vitro studies are of significant value. Moreover, in vitro studies have the advantages of time and cost. However, although the experimental methods were the same as clinical procedures, the bonding of the Restorative material to the vital tooth is inimitable, and the outward flow of pulpal fluid may inhibit the penetration of the surface sealant at the restoration margins. In the future, it will be necessary to develop new experimental methods that allow the precise control of influential factors and that better imitate the in vivo environment.

In this study, different materials were chosen to evaluate how their composition and physical characteristics influenced the fluidity and penetrability thus preventing Microlekage. The results of this study showed that none of the materials tested were completely resistant to Dye penetration (leakage) at the Enamel, Cementum margins. This result was expected due to complex nature of Enamel, Cementum and was in agreement with the similar studies where by decreased permeability and increased sealing ability was observed at the Enamel margins. It was found that the groups treated with filled (Easy glaze) and unfilled (Optiguard) presented the lowest degree of Microlekage while the control (With out treatment) group and group treated with Optiguard presented with highest Microlekage scores at Enamel, Cementum margins.

This result was in accordance with earlier study conducted by Owens et al where the filled Opitguard sealant showed more Microleakage when compared to other filled sealants such as fortify and dura finish [16] .

The probable reason could be 1. The presence of filler partical which helps in counter shrinkage of the sealants itself on curing as the sealants which are basically resins and tends to undergo shrinkage upon curing [17,18]. 2. The effect of sealants depends not only on viscosity but also on the wetabilty [17,18].

In this study Microleakage at Cementum was greater compared to Microlealage at Enamel in all the groups. This was in accordance with other studies conducted by Ramos et al and Erhardth., *et al.* [19,20].

Among the groups, control group showed most Microleakage followed by Optiguard sealant group where as Easy glaze showed the minimum leakage. So this study was performed on class V cavities.

The purpose of this in-vitro study was to evaluate the ability of filled (Eazy glaze) and unfilled (Opti Guard) surface sealants to reduce Microleakage at the tooth-restoration interface at Enamel and Cementum margin when restored with Composite restoration.

Easy glaze is a filled surface sealants containing Diphentylerythritol and Methyl mehtacrylate where as Optiguard is an unfilled surface sealants containing BIS-GMA, Boron trifluoride, TEGDM, and Camphorquinone.

High marginal leakage in Composite resin restoration is related to high polymerization stress associated with cavity configuration factor or C factor.[21] In this study , all restoration were made in standardized cavity preparation (4mm long occlusally in Enamel and 3mm cervically at the Cementum. The width of cavity kept at 3mm) in order to standardize the 'C' factor among all samples. Composite resin were inserted in Incremental layering technique of 1mm as it reduces polymerization shrinkage and also each increment would have more favorable C factor [22].

Studies have shown that finishing of restoration when done after 24 hr under wet condition with Diamond burs for gross finishing and later with sof-lex disks (3M) significantly reduced Micro leakage. Therefore same polishing procedure was utilized in this study [23].

Thermo cycling is often employed in laboratory experiments to stimulate stress in oral cavity. It aims to thermally stress the adhesive joint at the tooth / restoration interface. [24] In current study all specimen were subjected to 1500 cycles of Thermo cycling which equates to number of years of intra oral Thermocycling.

Apex of all the sample were sealed with cold cure resin to prevent Microleakage of dye from the apical region. The teeth were coated with 3 layer of nail varnish except 2 mm window around the restoration .the samples were immersed in 1% Methylene blue dye and later sectioned for Stereo microscopic evaluation.

Microleakage tests are useful methods for evaluating the sealing ability of the materials [25,26]. Among different methods employed, Dye penetration method can be seen as the most commonly used method due to ease of application and reliable results [26]. Also, this method may determine the predicted performance of materials and the extension of marginal gaps toward the axial wall of the restorations.

Dye leakage studies are amongst the most frequently used methods for detecting Micro leakage [27]. Several dyes such as Methylene blue , Toludene , Basic fucshin dye are popularly used in past . Methylene blue dye penetration method provides the evaluators with a perfect and easy visualization of the prepared cavity in the digital images which provide the evaluators with a clear reference point from which to score.

The dye also provides an excellent contrast with the surrounding environment [28]. So a 1% Methylene blue dye was chosen as the agent of dye penetration to measure Microleakage.

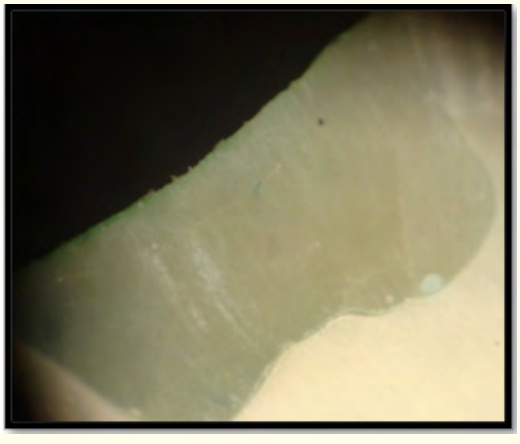

Figure 1: Microleakge in Group I.

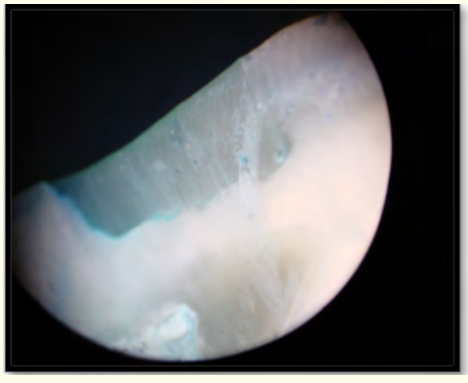

Figure 2: Microleakage in Group II.

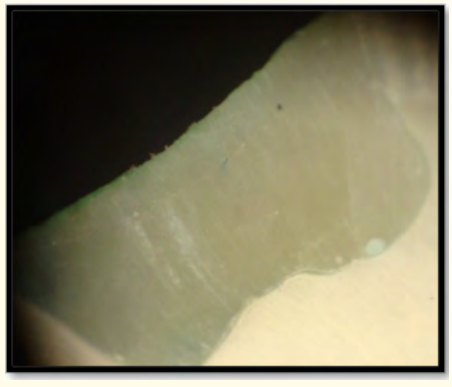

Figure 3: Micro leakage in Group III.

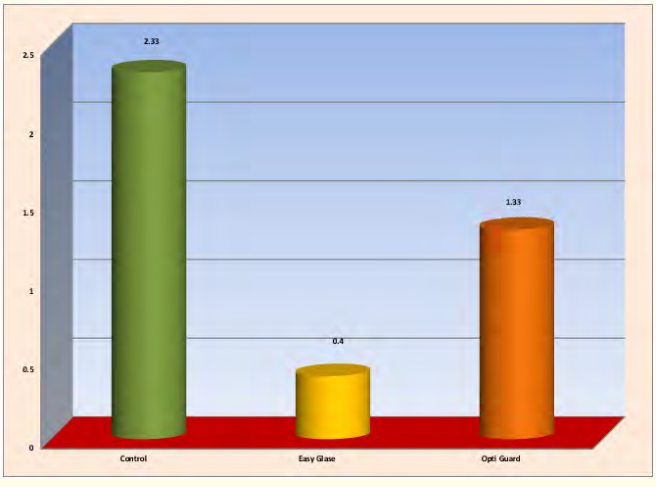

Figure 4: Comparison of Mean Micro Leakage at Enamel in Study Groups.

Conclusion

- Microleakage occurred more at Cementum margin as compared to Enamel margin.
- None of the surface sealants were able to prevent Microleakage completely.
- At both Enamel and Cementum margin Easy glaze surface sealant showed significantly less Mircoleakage as compared to Optiguad.

Bibliography

1. Claudia Poggio., *et al.* "Micro leakage in class V gingival-shaded composite resin restorations". *Annali di Stomatologia* III.1 (2012): 19-23.

2. Adela Hervas Garcia., *et al*. "Composite resins . A review of the materials and clinical indications". *Medicina Oral, Patologia Oral, Cirugia Bucal* 11 (2006): 15-20.

3. CL Davidson and AJ Feilzer. "Polymerization shrinkage and polymerization shrinkage stress in polymer-based restoratives". *Journal of Dentistry* 25.6 (1997): 435-440.

4. Gordon M., *et al*. "Microleakage of several tooth-colored restorative Materials in cervical cavities. A comparative study *in vitro*". *Dental Materials* 2 (1986): 228-231.

5. Kaplan I., *et al*. "Micro leakage of composite resin and Glass ionomer cement restorations in retentive and non-retentive cervical cavity preparations". *Journal of Prosthetic Dentistry* 68 (1992): 616-623.

6. Davidson CL and de Gee AJ. "Relaxation of polymerization contraction stresses by flow in dental Composites". *Journal of Dental Research* 63 (1984): 146-148.

7. HY Chen., *et al*. "Polymerization contraction stress in light-cured packable composite resins". *Dental Materials* 12 (2001): 253-259.

8. CL Davidson and AJ Feilzer. "Polymerization shrinkage and polymerization shrinkage stress in polymer-based restoratives". *Journal of Dentistry* 25.6 (1997): 435-440.

9. Arora R., *et al*. "Evaluation of Microleakage in class II cavities using packable composite restorations with and without use of liners". *International Journal of Clinical Pediatric Dentistry* 5 (2012): 178-184.

10. Lokhande NA., *et al*. "Effectiveness of flowable resin composite in reducing Microleakage – An *in vitro* study". *Journal of International Oral Health* 6 (2014): 111-114.

11. Kasraie S., *et al*. "Microleakage of dual-cured adhesive systems in class v composite resin restorations". *Journal of Dentistry (Tehran)* 9 (2012): 99-106.

12. Sánchez Ayala A., *et al*. "Marginal microleakage of class V resin based composite restorations bonded with six one step self etch systems". *Brazilian Oral Research* 27 (2013): 225-230.

13. Arias VG., *et al*. "Microleakage study of three adhesive systems". *Brazilian Dental Journal* 15 (2004): 194-198.

14. Owens BM and Johnson WW. "Effect of new generation surface sealants on the marginal permeability of class V resin composite restorations". *Operative Dentistry* 31 (2006): 481-488.

15. Sadeghi M., *et al*. "The effect of re bonding using surface sealant or adhesive system on Microleakage of class V resin composite restorations". *Dental Research Journal*10 (2013): 596-601.

16. Reid JS., *et al*. "The effect of bonding agent and fissure sealant on Microleakage of composite resins restorations". *Quintessence International* 22.4 (1991): 295-298.

17. Ma'an M Nayif., *et al*. "Effect of adhesion to cavity walls on the mechanical properties of resin composites". *Dental Materials* 24 (2008): 83-89.

18. Ramos RP., *et al*. "Assessing Microleakage in resin composite restorations rebonded with a surface sealant and three low-viscosity resin systems". *Quintessence International* 33 (2002): 450-456.

19. Erhardt MC., *et al*. "The effect of rebonding on Microleakage of class V Aesthetic restorations". *Operative Dentistry* 27 (2002): 396-402.

20. Karthik K., *et al*. "Polymerization Shrinkage of Composite - A Review". *JIADS* 2.2 (2011): 32-34.

21. MM Stavridakis., *et al*. "Marginal and Internal Adaptation of Bulk –filled Class I and Cuspal Coverage Direct resin Composite Restoration". *Operative Dentistry* 32.5 (2007): 515-523.

22. Celik C., *et al*. "Resin composite repair: Quantitative Microleakage evaluation of resin-resin and resin-tooth interfaces with different surface treatments". *European Journal of Dentistry* 9 (2015): 92-99.

23. Idriss S., *et al*. "Factors associated with Microleakage in class II resin composite restorations". *Operative Dentistry* 32 (2007): 60-66.

24. Ernst CP., *et al*. "Marginal integrity of class V restorations: SEM versus dye penetration". *Dental Materials* 24 (2008): 319-327.

25. Heintze S., *et al*. "Microleakage of class II restorations with different tracers - Comparison with SEM quantitative analysis". *The Journal of Adhesive Dentistry* 10 (2008): 259-267.

26. Amaral CM., *et al*. "Microleakage and gap formation of resin composite restorations polymerized with different techniques". *American Journal of Dentistry* 17 (2004): 156-160.

27. Jacques Dejou., *et al*. "Influence of criteria on the results of *in vitro* evaluation of Micro leakage". *Dental Material* 12.6 (1996): 342-349.

28. Ibrahim M Hamouda., *et al*. "Microleakage of Nanofilled Composite Resin Restorative Material". *Journal of Biomaterials and Nanobiotechnology* 2 (2011): 329-334.