IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 24, Issue 8 Ser. 2 (August. 2025), PP 01-03
www.iosrjournals.org

Effect Of Different Caries Detecting Dyes on Microleakage of Composite Resin Restorations: A Comparative Analysis of Total Etch and Self Etch Adhesive Systems

Shweta[1], Sunil Malhan [2], Gursandeep Kaur Sandhu [3], Vibhuti [4], Jasleen Kaur Virk [5], Poshali[6]

[1] *Post Graduate Student Final Year, Department of Conservative Dentistry and Endodontics, Desh Bhagat Dental College and Hospital, Mandi Gobindgarh.*
[2] *Professor and HOD, Department of Conservative Dentistry and Endodontics, Desh Bhagat Dental College and Hospital, Mandi Gobindgarh.*
[3] *Professor, Department of Conservative Dentistry and Endodontics, Desh Bhagat Dental College and Hospital, Mandi Gobindgarh.*
[4] *Assistant Professor Department of Conservative Dentistry and Endodontics, Desh Bhagat Dental College and Hospital, Mandi Gobindgarh.*
[5] *Assistant Professor, Department of Conservative Dentistry and Endodontics, Desh Bhagat Dental College and Hospital, Mandi Gobindgarh.*
[6] *Post Graduate Student Final Year, Department of Conservative Dentistry and Endodontics, Desh Bhagat Dental College and Hospital, Mandi Gobindgarh.*

Abstract:
Aim: The purpose of this study was to evaluate the effect of caries detecting solution on microleakage of composite resin restoration bonded with two adhesive systems.
Materials and Methods: Class V cavity of standardised dimension was prepared on forty intact extracted premolars. Out of this, 10 teeth each were randomly selected for the four study groups. Group 1: composite restoration after etch and rinse technique without any prior exposure to caries disclosing solution, Group 2: placement of the restoration as mentioned in group 1 after exposing the cavity with caries detecting solution; Group 3: cervical restoration with composite after the use of self-etch adhesive system, with no exposure to caries detecting dye, Group 4: Similar to group 3 except that caries disclosing agent was applied onto the class V cavity before the placement of the composite restoration. The amount of dye penetrated was evaluated using stereomicroscope. The microleakage scores were recorded and data obtained were subjected to statistical analysis using the chi-square test.
Keywords: *Caries disclosing solution, Composite restorations, Dye penetration, stereomicroscope*

Date of Submission: 26-07-2025 Date of Acceptance: 06-08-2025

I. Introduction

The longevity and clinical success of composite resin restorations depend largely on achieving an effective marginal seal, which prevents microleakage — the passage of bacteria, fluids, and molecules between the cavity wall and restorative material (Muliyar et al., 2014). Microleakage has been associated with postoperative sensitivity, marginal discoloration, recurrent caries, and eventual failure of restorations (Pandey et al., 2018).

To minimize microleakage, effective adhesion between restorative material and tooth substrate is essential. Advances in adhesive dentistry have led to the development of two major bonding approaches: the total-etch technique, which employs phosphoric acid to remove the smear layer and expose collagen fibrils before resin infiltration, and the self-etch technique, which combines etching and priming in a single step, preserving part of the smear layer and reducing technique sensitivity (Miranda et al., 2006; Al Habdan, 2017).

Caries-detecting dyes are routinely used to aid in the complete removal of infected dentin, thereby ensuring a sound substrate for bonding (Fusayama, 1988). These dyes selectively stain denatured collagen within carious dentin, providing a visual guide during cavity preparation (Piva et al., 2002). However, previous studies have suggested that the application of caries-detecting agents may alter the surface characteristics of dentin, potentially interfering with adhesive penetration and increasing microleakage (Piva et al., 2002).

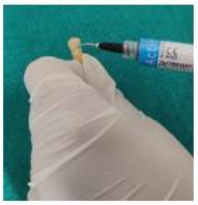
Given the importance of both adhesive selection and substrate condition, it is clinically relevant to investigate how the use of caries-detecting dyes influences the marginal seal of composite restorations bonded

with different adhesive strategies. Therefore, the present study aims to evaluate and compare the effect of different caries-detecting dyes on the microleakage of composite resin restorations using total-etch and self-etch adhesive systems.

II. Materials And Methods

Sample Selection
Specimens: 40 extracted human premolars
Cavity Preparation: Standardized class V cavities were prepared on each tooth. Experimental Groups




Teeth were divided into 4 groups based on:
Group 1 Total Etch system without caries detecting dye
Group 2 Total Etch system with caries detecting dye
Group 3 Self-Etch Adhesive system without caries detecting dye
Group 4 Self-Etch Adhesive system with caries detecting dye

Armamentarium
Stereomicroscope for leakage assessment
Composite restorative material
Caries detecting dyes (brand unspecified)
Etching agents and adhesives Scoring Criteria for Microleakage

Under stereomicroscopic evaluation, microleakage was assessed and categorized into four levels:
Score 0: No dye penetration
Score 1: Dye penetration less than half the cavity depth
Score 2: Dye penetration more than half but not onto axial wall
Score 3: Dye penetration reaching the axial wall

Statistical Analysis:

Chi-square test was used to compare categorical data on microleakage. A p-value < 0.05 was considered statistically significant. Data analysis was conducted using SPSS v16.0.

III. Results

Microleakage scores were recorded for all groups according to the established scoring criteria (Score 0–3). The Chi-square test was used for statistical analysis, with the significance level set at $p < 0.05$.

In both adhesive strategies, cavities treated with caries-detecting dye demonstrated higher mean microleakage scores compared to those without dye application. The total-etch adhesive group showed slightly higher leakage values than the self-etch adhesive group; however, the difference was not statistically significant ($p > 0.05$).

For specimens without caries-detecting dye, self-etch adhesives exhibited lower microleakage scores compared to total-etch adhesives. Similarly, in specimens treated with caries-detecting dye, the self-etch group also showed comparatively reduced microleakage.

Overall, the results suggest that the use of caries-detecting dye increases the incidence of microleakage regardless of the adhesive strategy used, and that self-etch adhesives generally perform better than total-etch adhesives in minimizing leakage, though differences were not significant.

IV. Discussion

The marginal seal of a restoration plays a pivotal role in preventing microleakage, which is a primary cause of restoration failure, secondary caries, postoperative sensitivity, and pulpal irritation (Muliyar et al., 2014). In the present study, the influence of different caries-detecting dyes on microleakage was assessed using both total-etch and self-etch adhesive systems.

The results indicated that cavities exposed to caries-detecting dye exhibited increased microleakage compared to those without dye application. This finding aligns with Piva et al. (2002), who reported that dyes may alter the substrate surface characteristics, potentially leaving residues that interfere with the adhesive penetration. Caries-detecting dyes are generally formulated to bind to denatured collagen in demineralized dentin (Fusayama, 1988). However, the additional surface moisture and altered collagen fibril arrangement after dye application could hinder effective resin infiltration, thus compromising the hybrid layer integrity.

The higher microleakage seen in the total-etch group compared to the self-etch group, though not statistically significant, could be attributed to several factors. In the total-etch approach, phosphoric acid produces a more aggressive demineralization, exposing a thick layer of collagen that must be fully infiltrated by resin monomers to achieve an optimal bond (Davidson, 1986). If infiltration is incomplete, nanoleakage pathways may develop. Conversely, self-etch adhesives, which simultaneously demineralize and infiltrate, tend to produce a thinner hybrid layer with less risk of discrepancy between demineralization and infiltration (Miranda et al., 2006). Moreover, self-etch adhesives have been shown to interact more favorably with the smear layer and may be less sensitive to moisture variations (Al Habdan, 2017).

The presence of coarse collagen fibers and the structural irregularities of cementum may also contribute to adhesive performance differences at the cervical margins (Muliyar et al., 2014). In this study, the self-etch group's lower microleakage scores might reflect its better adaptability to such substrates.

From a clinical standpoint, while caries-detecting dyes remain useful in ensuring complete caries removal (Fusayama, 1988), their potential to increase microleakage should be considered. Thorough rinsing and careful handling of the dentin surface after dye application are essential. Furthermore, clinicians should be aware that the choice of adhesive system may influence marginal sealing, particularly at cervical margins where bonding is more challenging.

V. Conclusion

Within the limitations of this in vitro study, it can be concluded that:

1. The use of caries-detecting dyes increased microleakage in composite resin restorations, regardless of the adhesive strategy employed.
2. Self-etch adhesive systems demonstrated lower microleakage scores compared to total-etch systems, both with and without dye application; however, the differences were not statistically significant.
3. Clinically, while caries-detecting dyes remain valuable for ensuring complete caries removal, their potential impact on marginal sealing should be considered, and careful surface management after dye application is recommended to minimize leakage risk.

References

[1]. Piva E, Meinhardt L, Demarco FF, Powers JM. Dyes for Caries Detection: Influence on Composite and Compomer Microleakage. Clin Oral Investig. 2002.
[2]. Al Habdan AA. Review Of Microleakage Evaluation Tools. J Int Oral Health. 2017.
[3]. Miranda MS Et Al. SEM Evaluation of Non-Rinse Conditioner and Self-Etch Adhesive on Enamel. Oper Dent. 2006.
[4]. Fusayama T. Clinical Guide for Removing Caries Using a Caries Detecting Solution. Quintessence Int. 1988.
[5]. Davidson CL. Resisting Curing Contraction with Adhesive Composites. J Prosthet Dent. 1986.
[6]. Muliyar S Et Al. Microleakage in Endodontics. J Int Oral Health. 2014.
[7]. Pandey R Et Al. Evaluation of Microleakage in MTA And Geristore Root-End Fillings. J Conserv Dent. 2018.