COMPARATIVE EVALUATION OF MICROLEAKAGE ALONG THE ENAMEL-COMPOSITE AND CEMENTUM-COMPOSITE INTERFACE USING TWO TOTALS-ETCH AND TWO SELF-ETCH ADHESIVES - IN VITRO STUDY.

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Purpose: The purpose of this study was to assess and compare the ability of two total-etch and two self-etch adhesives in preventing or limiting microleakage at the enamel-composite and cementum (dentin)-composite interface. Also to compare microleakage at the enamel margin to that at the cementum margin of the restoration.

A major shortcoming of composite resin restoration is polymerization shrinkage which introduces shrinkage stresses, pulling the restoration away from the cavity wall leading to gap formation at the tooth-composite interface. The difference in the coefficient of thermal expansion of the tooth and the composite also plays an important role in formation and widening of this gap. These phenomena lead to marginal leakage which causes ingress of fluids, bacteria, ions and molecules into the gap.

This microgap is the most common cause of pathologic changes in the dental pulp of teeth that have been restored with composites. Clinically it causes marginal staining, postoperative sensitivity and secondary caries. The dental adhesives provide a high degree of bonding between the dental tissues and the composites and thus improve the marginal sealing of the restoration.

MATERIALS AND METHODS

One hundred freshly extracted human premolars that were free of caries, attrition, abrasion, erosion, restorations and craze lines were selected for the study. The teeth were cleaned of any calculus, stains, soft tissue and other debris. They were then polished and stored in distilled water. Class V cavity preparations were done on the buccal surface of each sample using a #57 carbide bur in an air/water cooled high speed turbine. The preparations were centered at the cemento-enamel junction so that half the preparation was located in enamel and half in cementum/dentin. As a result the occlusal margin was in enamel and the gingival margin was in cementum.

The teeth were then randomly assigned to four groups of 25 samples each. The groups corresponded to the adhesive system used ***(Refer to Table 1)***.

All the materials were used strictly following manufacturer's instructions.

Table- 1

Group	Adhesive System	Manufacturer
I	Adper Scotchbond Multipurpose	3M ESPE
II	Prime & Bond NT	Dentsply
III	Adper SE Plus	3M ESPE
IV	G-BOND	GC

The resin composite (Z-100, 3M - Shade A2) was placed in the preparations in one increment with careful manipulation and then light polymerized for 40 seconds from a distance of 1 mm from the outer surface of the composite.

Assessment of microleakage

The samples were blotted dry with a paper towel and the root apices were sealed with sticky wax. Two coats of nail varnish were applied to the entire tooth surface to within 1 mm of the restoration. The teeth were then immersed in 1% methylene blue dye for 24 hours at room temperature, removed and thoroughly rinsed.

The teeth were sectioned with a thin diamond disc with adequate water coolant. Sectioning was done through the center of the restoration from the facial to the lingual surface such that two sections were obtained from each tooth.

The degree of dye penetration in each tooth (n = 25) was assessed under 20X magnification with a stereomicroscope.

Based on the ordinal ranking system, the degree of dye leakage was determined as follows:

0- No dye penetration

1- Dye penetration upto one half the cavity wall length

2- Dye penetration upto the full length of cavity wall, not including the axial wall

3- Dye penetration to the full length of cavity wall, including the axial wall

Dye penetration at the restoration-tooth interface was scored for both occlusal and cervical margins. The results were tabulated and subjected to statistical analysis.

The distribution of microleakage scores, along with the mean score for each group at both enamel and cementum margins are summarized in ***Table no. 1*** and ***Table no. 2***.

Table-1

MICROLEAKAGE SCORES AT ENAMEL MARGIN WITH MEAN SCORES

Score Group	0	1	2	3	Mean of Score	Standard Deviation
Group-I	22	2	1	0	0.16	0.4726
Group-II	23	2	0	0	0.08	0.2769
Group-III	13	8	3	1	0.68	0.8524
Group-IV	11	5	7	2	1.00	1.0408

Table-2

MICROLEAKAGE SCORES AT CEMENTUM MARGIN WITH MEAN SCORES

Score Group	0	1	2	3	Mean of Score	Standard Deviation
Group-I	4	4	5	12	2.00	1.1547
Group-II	3	4	3	15	2.20	1.1180
Group-III	5	8	8	4	1.44	1.0033
Group-IV	8	9	4	4	1.16	1.0677

RESULTS

When comparing the occlusal and gingival scores for each group, the Wilcoxon Signed Ranks test showed the following:

Adper Scotchbond Multipurpose, Prime and Bond NT and Adper SE Plus showed significantly greater dye penetration along the cementum (dentin) margin than at enamel margin. ($p < 0.0001$)

G-BOND showed statistically non-significant difference in dye leakage occurring at enamel margin and cementum margin. ($p = 0.102$)

DISCUSSION

The results of this in vitro study indicate that none of the dentinal adhesives tested completely eliminated microleakage, both at the enamel and cementum (dentin) margins. All the four adhesives showed more microleakage at the cementum (dentin) margin when compared to enamel margin. Although the difference of leakage at enamel margin as compared to the leakage at dentin margin was statistically non-significant for G-BOND **($p>0.05$)**, it was found to be significant for Adper Scotchbond Multipurpose, Prime and Bond NT and Adper SE Plus **($p< 0.0001$)**.

The difference in leakage in this study can be related to the composition of enamel and dentin substrate. Enamel is primarily inorganic in nature with the inorganic component constituting 95%. Hence etching of enamel causes demineralization of the inorganic surfaces, creating microporosities which results in the penetration of adhesive resins into these microporosities, forming a strong bond. Dentin has a higher organic content, tubular structure, odontoblastic processes and a moist surface which precludes ideal bonding. Therefore the bonding to enamel is more stable and efficient than that obtained with dentin, resulting in greater microleakage at dentin interface.

Analysis of data for leakage at enamel margin revealed significantly lower microleakage for both the total-etch adhesive systems viz. Adper Scotchbond Multipurpose and Prime and Bond NT, as compared to both the self-etch systems viz. Adper SE Plus and G-BOND **($p<0.05$)**.

The reasons for greater microleakage with self-etch adhesives at the enamel margins can be attributed to incomplete etching of enamel by the acidic monomers in the self-etch adhesives. SEM studies by **Kanemura N et al. (1999)** and **Perdigao J et al. (1997)** have shown that, phosphoric acid as an enamel etchant improves enamel penetration and subsequent attachment of adhesive monomers. The failure to use a separate acid as a preliminary step on enamel substrate results in insufficient bond strength and sealing ability with enamel.

The seventh generation, 'all-in-one' adhesive, G-BOND showed the highest mean leakage score of 1.00 1.0408 at enamel margin. The reason can be ascribed to G-BOND being a 'mild' self-etch adhesive with a pH of about 2, as compared to phosphoric acid etchants having a pH of 0.5-1, and Adper Prompt with a pH below 1.

At the dentin interface both the self-etch adhesives, G-BOND and Adper SE Plus, showed significantly lesser microleakage than Adper Scotchbond Multipurpose and Prime and Bond NT **($P \leq 0.05$)**.

Increased leakage scores associated with total-etch systems can be attributed to one or more of the following reasons; self-etch systems which are composed of aqueous mixtures of acidic functional monomers do not require a separate acid etch component and subsequent rinsing procedures. In addition, they do not require application of the primer to a particular condition of wetness of dentin due to the self-etch adhesives water content. This significantly reduces technique sensitivity or the risk of making errors during application and manipulation. Another drawback of the etch and rinse / total etch adhesives is that the depth of demineralization and the depth of penetration of the primer is not the same, which may leave exposed and unprotected collagen fibers. In the self-etch approach as the infiltration of resin occurs simultaneously with the self-etching process, the risk of discrepancy between both processes is low or non existant. The Phosphoric acid etching of dentin completely removes the smear layer and opens the dentinal tubules. This increases the permeability of dentin resulting in dentinal fluid flowing to the dentinal surface which may result in interference with adhesion.

CONCLUSION

The results of this study thus indicate that even with the introduction of the latest "all-in-one" adhesives, the cycle of evolution for dentinal adhesives still remains to be completed, with predictable, reproducible and durable marginal sealing yet to be achieved.

The results of this study suggest that it is preferable to choose an adhesive that would be more efficient in the specific case.

REFERENCES

1) **Deliperi S, Bardwell DN, Wegley C (2007)** Restoration interface microleakage using one total-etch and three self-etch adhesives. *Oper Dent;* 32-2: 179-184.

2) **Neveen MA, Abdelaziz KM (2007)** Interface Characterization and Nanoleakage of One-step Self-etch Adhesive Systems. *The Internet Journal of Dental Science;* Volume 5 Number 1.

3) **Kidd EAM (1976)** Microleakage: A review. *Journal of Dentistry;* 4(5): 199-206.