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COMPARATIVE EVALUATION OF DIFFERENT PLACEMENT TECHNIQUES OF COMPOSITE RESIN AND DIFFERENT BONDING AGENTS ON MARGINAL LEAKAGE IN CLASS V TOOTH PREPARATION: AN IN VITRO STUDY

Dental Science

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ABSTRACT

An in vitro study was conducted to compare microleakage in nanohybrid composite restorations in Class V cavities using total etch and self-etch adhesives and two different horizontal layering techniques. Cavities were made on buccal and lingual surfaces of forty extracted premolar teeth and divided into groups A and B containing buccal surface cavities treated with total etch adhesive system and lingual surface cavities treated with Single step adhesive respectively. Cavities were restored using nanohybrid composite and randomly divided into four subgroups depending on incremental technique used. Specimens were then immersed in methylene blue dye for 24 hours and analysed under stereomicroscope for dye penetration. Results indicated microleakage with all groups with total etch group showing superior results than self etch group and group in which occlusal increment was placed first showing superior results than group with gingival increment placed first.

KEYWORDS

microleakage, incremental layering technique, self etch, total etch.

INTRODUCTION

In the past two decades, significant improvement has taken place in restorative dentistry, primarily the composite resin.[1] Despite advances that have been made one of the most undesirable characteristics of composite resin is its polymerization shrinkage.[2] Stresses are generated within the restoration and at the margins, and if these stresses exceed the bond strength, gap formation and microleakage may occur at the tooth restoration interface.[3]

The magnitude of this shrinkage stress is influenced by several factors including the cavity design, nature of the bonding agents, type of composite resin, C-factor, different incremental techniques for composite placement, polymerization rate etc.[4] The self etch bonding agent introduced in the mid 2000s is said to drastically reduce the microleakage between tooth–resin interfaces when compared with the total etch bonding system, but is still significant in terms of its dental use.[5] Therefore, it is necessary to compare it with its previous generation. The contraction gap at the gingival margin caused by polymerization shrinkage could be prevented by incremental placement of composite material starting in dentin portion of the preparation.[6] Therefore this in vitro study was conducted to evaluate the effect of different adhesives and different placement techniques of nanohybrid composite on marginal adaptation in Class V composite restoration.

MATERIALS AND METHODS

This in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics of a reputed Dental College in Western India. Forty sound human premolars extracted for orthodontic reasons were included in this study. Standardized box-shaped Class V cavities (3mm occluso-gingival, 3mm mesio-distal and 2mm depth) were prepared using no. 245 tungsten carbide burs in a high-speed handpiece under copious water spray. Cavities were made on buccal and lingual cervical thirds of each tooth 1mm above cementoenamel junction to ensure that gingival cavity wall is in enamel, so a single tooth served as two samples.(40 teeth = 80 samples in total). Positions and dimensions of cavities were standardized through using a template (3 x 3mm) prepared in a metal band strip. Samples were divided as 2 groups

Group A - Buccal surface cavities were treated with total etch adhesive system

Group B - Lingual surface cavities were treated with Single step adhesive.

All cavities were acid etched using 38% orthophosphoric acid for 15 seconds and rinsed away with air/water spray. Excess moisture was removed with a cotton pellet applied on the dentin while the enamel was gently air-dried. After this the bonding agent was applied to cavity walls using an applicator tip. The excess bonding agent was removed by air drying for 5 seconds and then light cured using LED Light Cure unit for 20 seconds. This bonding procedure was repeated for buccal and lingual surface cavities on all specimens.

All specimens were restored with nanohybrid composite using two composite placement techniques i.e. two horizontal incremental placement techniques. The samples were then divided randomly into 4 subgroups as follows (n=20)

Buccal surface cavities –

Subgroup A1 – Cavities restored with occlusal increment of composite placed and cured first followed by the gingival increment placement.

Subgroup A2 – Cavities restored with gingival increment of composite placed and cured first followed by the occlusal increment placement.

Lingual surface cavities –

Subgroup B1 - Cavities restored with occlusal increment of composite placed and cured first followed by the gingival increment placement.

Subgroup B2 – Cavities restored with gingival increment of composite placed and cured first followed by the occlusal increment placement.

All external surfaces of each specimen were isolated with 2 layers of nail polish except 2mm around the restoration followed by immediate immersion of the specimens in 0.5% methylene blue dye for 24 hours at room temperature. The specimens were then sectioned buccolingually through the centre of the restoration with a diamond disk resulting in two halves of each restoration as depicted in Figure 1.

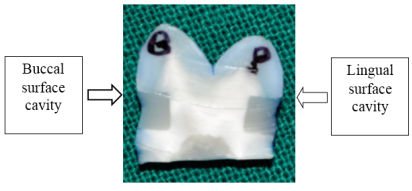

Figure 1: Sample after sectioning

The sections were then observed under the stereomicroscope at 40X magnification and the extent of dye penetration was assessed along cavity walls using the scores given below-

0 = No dye penetration
1 = Dye penetration up to 1/3 along the occlusal/gingival wall
2 = Dye penetration up to 2/3 along occlusal/gingival wall without reaching the axial wall
3 = Dye penetration reaching the axial wall.

The data thus obtained was subjected to statistical analysis and was analysed using one way ANOVA test for significance.

RESULTS

Table 1: Group A that contained Total–etch adhesive system, showed less microleakage in Subgroup A1, as compared to Subgroup A2, with difference not statistically significant

Group A		Buccal surface cavity				Total
		Score 0	Score 1	Score 2	Score 3	
Subgroup A1	Count	6	12	2	0	20
	% within Group	30.0%	60.0%	10.0%	0.0%	100.0%
Subgroup A2	Count	4	14	1	1	20
	% within Group	20.0%	70.0%	5.0%	5.0%	100.0%
Total	Count	10	26	3	1	40
	% within Group	25.0%	65.0%	7.5%	2.5%	100.0%
Chi square value: 1.887 P value: 0.596						

Table 2: Group B that contained Self-etch adhesive system showed less microleakage in Subgroup B1, compared to Subgroup B2, with difference not statistically significant.

Group		Lingual surface cavity			Total
		Score 0	Score 1	Score 2	
Subgroup B1	Count	10	6	4	20
	% within Group	50.0%	30.0%	20.0%	100.0%
Subgroup B2	Count	8	10	2	20
	% within Group	40.0%	50.0%	10.0%	100.0%
Total	Count	18	16	6	40
	% within Group	45.0%	40.0%	15.0%	100.0%
Chi square value: 1.889 P value: 0.389					

Table 3: In intergroup comparison between Subgroup A1, containing Total-etch adhesive system, and Subgroup B1, containing Self-etch adhesive system, where samples in both the groups were restored by placing occlusal horizontal increment first, Subgroup A1 showed more microleakage than Subgroup B1 which was not statistically significant.

Groups		Score 0	Score 1	Score 2	Total
Subgroup B1	Count	6	12	2	20
	% within Group	30.0%	60.0%	10.0%	100.0%
Subgroup B2	Count	10	6	4	20
	% within Group	50.0%	30.0%	20.0%	100.0%
Total	Count	16	18	6	40
	% within Group	40.0%	45.0%	15.0%	100.0%
Chi square value: 1.889 P value: 0.389					

Table 4: In comparison of microleakage between Subgroup A2, containing Total-etch adhesive system, and Subgroup B2, containing Self-etch adhesive system, where samples in both groups were restored with gingival horizontal increment placed and cured first, Subgroup A2 showed more microleakage as compared to Subgroup B2 which was not statistically significant.

Groups		Score 0	Score 1	Score 2	Score 3	Total
Subgroup A2	Count	4	14	1	1	20
	% within Group	20.0%	70.0%	5.0%	5.0%	100.0%
Subgroup B2	Count	8	10	2	0	20
	% within Group	40.0%	50.0%	10.0%	0.0%	100.0%
Total	Count	12	24	3	1	40
	% within Group	30.0%	60.0%	7.5%	2.5%	100.0%
Chi square value: 3.333 P value: 0.343						

DISCUSSION

The restoration of class V cavities is a common procedure in dentistry but it has a high C-factor value, and margins of the cavity are usually placed on dentin. So dentists continue to seek an ideal technique to restore these defects. In such restorations, absence of enamel or presence of a very thin layer of enamel at gingival margin may make the bonding process more difficult in these areas. As a result of this, microleakage may increase.[7]

In Group A containing Total–etch adhesive system, Subgroup A1 showed less microleakage compared to Subgroup A2 with difference not statistically significant. This may be due to better bonding at occlusal cavity wall as compared to gingival cavity wall which was attributed to diversity in the composition of dentin and enamel i.e. presence of higher organic component, tubular configuration, fluid pressure and the lower surface energy of dentin that may cause different level of microleakage. So that lack of enamel at gingival edge causes more leakage than at occlusal margin. Thus, the adhesives used, sealed the occlusal margin far better than the gingival margin.

Group B containing Self-etch adhesive system showed less microleakage in Subgroup B1 compared to Subgroup B2 with difference not statistically significant. Though it was a single step procedure the diversity in the composition of enamel and dentin played a significant role in better marginal adaptation. Also, the dentinal tubules arrange roughly parallel to gingival margin of class V cavity thus, structure of hybrid layer was damaged and consequently, microleakage at dentinal wall of gingival edge occurs more than enamel margin.[8]

In Self Etch adhesives the acidic characteristics of active monomers are responsible for dissolving the smear layer and demineralizing the underlying dentin. This demineralization is self-limiting because acidity of monomers is gradually buffered by mineral content of dentin. This implies that the resultant morphological aspect of bonded interface is largely dependent on the characteristics of dentin to which the adhesive is being applied and on aggressiveness of acidic monomers. Success of Self Etch adhesives is largely related to their simplicity of use and to the theoretical ability to etch and infiltrate simultaneously, thus preventing discrepancies between demineralization and infiltration.[9]

Also in the current study, it was found that there was less microleakage seen in groups in which the occlusal increment was placed and cured first i.e. Subgroups A1 and B1 as compared to groups in which the gingival increment was placed and cured first i.e. Subgroups A2 and B2 respectively. If composite resin is bordered all around by acid-etched enamel, a reliable and high-bond strength of restorative to tissue is guaranteed. If the restoration is completely surrounded by dentin, retention is based only on dentin bonding agents that still provide limited bond strength and, moreover, are not always reliable. In Class V cavity, the restoration is coronally attached to acid-etched enamel and apically on dentin and has to rely on dentin bonding agents for bonding. Bonding of composite to dentin is far more difficult and unpredictable than bonding to enamel.[10]

CONCLUSION

Within the limitations of this in vitro study, it can be concluded that none of the bonding agents and incremental techniques could prevent microleakage completely. Among the bonding agents, Self-etch adhesive system showed lesser microleakage as compared to Total-etch adhesive system. Among the incremental techniques, cavities restored with occlusal increment placed and cured first showed lesser microleakage than cavities restored with the gingival increment placed and cured first.

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