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"Comparative Evaluation Of Microleakage Of Self-Adhesive And Conventional Composite Restoration: An In Vitro Study"

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Abstract:
This in vitro study aimed to compare the microleakage of self-adhesive and conventional composite restorations in class V cavities. Forty freshly extracted human mandibular premolars were randomly divided into two groups (n=20): Group A restored with conventional composite (Omnichroma, Tokuyama, Japan) and Group B restored with self-adhesive composite (Constic, DMG, Germany). Class V cavities were prepared, adhesive applied, and composites restored. Teeth were immersed in methylene blue dye, sectioned, and evaluated for microleakage. Kruskal-Wallis and Mann-Whitney U tests were used for statistical analysis. Results showed no significant difference in microleakage scores between groups in incisal walls (p=0.125) but a significant difference in gingival walls (p=0.003). Self-adhesive composite exhibited less microleakage in gingival walls compared to the conventional composite. Selective enamel etching did not improve bond strength. In conclusion, the conventional composite showed better bonding to enamel and dentin than self-adhesive composite, suggesting caution in using self-adhesive composite in class V restorations of primary anterior teeth.

Keywords*: class V, microleakage, self-adhesive composite, conventional composite , scanning electron microscope.*

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I. Introduction

In restorative dentistry, composite resins show promise as materials that resemble teeth. Many dentists still favour composite resins because of its favourable qualities, which include adherence, aesthetics, and preservation of tooth structure. [1-3]Resin composites do, however, have certain drawbacks, such as technique sensitivity, shrinkage during polymerization, and the potential for microleakage and secondary caries. The placement of direct composites has become more consistent and dependable recently because to the development of new materials with improved compositions, properties, and looks. [4-5]

In dental clinics, the restoration of carious or non-carious lesions in the cervical region is still regarded as difficult. Tooth isolation is a challenge when dealing with class V cavities because of the anatomical features of the cervical region that restrict where the rubber dam and clamp can be placed. [6,7]

With the advent of the self-etching technique, which is easier to use and requires less time to complete because clinical treatments are usually brief, it also lessens postoperative sensitivity. Two-step bonding systems (sixth generation) and one-step bonding systems (seventh and eighth generations) are the two categories into which self-etching systems have been divided [7,8].

The self-adhesive composite was made possible by bulk fill restorations, which are now widely used since they take less time and steps to apply [9]. The traditional methacrylate system is combined with the same acidic monomers found in self-etch bonding materials to create self-adhesive composites. Bis[2-(methacryloyloxy) ethyl] phosphate, 4-methacryloxyethyl trimellitic acid, and glycerol phosphate dimethacrylate [GPDM] are some examples of these monomers.

In 2009, the first self-adhesive composite was released. In addition to being utilised as pit and fissure sealants, these materials are primarily suggested for use in class I and class V cavities as well as non-carious

cervical lesions [11]. Because of its fluid structure, the self-adhesive composite has a low viscosity, which enables it to fit well into the prepared cavity [12]. Removing bonding methods also made repair application easier, reduced bond application errors, and shortened the curing time [13]

II. Materials And Method

The present Experimental in vitro study included 40 Freshly extracted human mandibular premolars (for orthodontic purpose). Carious tooth, Restored tooth, teeth with severe attrition, erosion or fracture were excluded.

The teeth were removed from the dye and rinsed completely and gently under running water for three minutes to remove any remaining color. The aluminium foil wrapper was removed, and any leftovers on the teeth were thoroughly cleansed.

The teeth were vertically sectioned through the centre of the restoration, by a cutting machine (cutting machine, E96, USA) using a diamond disk (diamond disk, EDENTA Golden S.A.W, Swiss made) in a buccolingual direction along their long axis to assess the microleakage at the cervical margins.

The sections were then evaluated under a stereomicroscope (SMZ 800, Nikon, Tokyo, Japan) at ×40 magnification, and enamel and dentin restoration margins were evaluated blindly by one observer.

The microleakage score was determined based on the dye penetration depth at the occlusal and gingival margins according to ISO/TS, 11405: 200311.

Score Dye penetration depth indicative of the microleakage
Score 0 No dye penetration
Score 1 Dye penetration to half the depth of gingival floor
Score 2 Dye penetration exceeding half the depth of gingival floor but not reaching the axial wall
Score 3 Dye penetration to the axial wall but not involving the wall
Score 4 Dye penetration involving the axial wall

The microleakage scores were analysed using IBM SPSS Statistics version 25.0 statistical package (SPSS, Chicago, IL, USA). The Kruskal–Wallis nonparametric test was used at 0.05 level of significance to compare the microleakage scores of study group.

III. Result

To study the differences in the microleakage within the incisal and gingival cavity walls between the three groups, the Kruskal-Wallis test was applied (Table *1*).

Studied area	Groups	Score 0	Score 1	Score 2	Score 3	Rank Mean	Chi value	p-value
Incisal walls	Group A	15%	0%	30%	55%	35.78	4.153	0.125
	Group B	45%	15%	0%	40%	25.13		
Gingival walls	Group A	15%	25%	15%	45%	38.13	11.558	0.003*
	Group B	65%	0%	10%	25%	20.88		

Table 1: Basic sample characters and Kruskal-Wallis test results

* Indicates a statistically significant difference

Group A: self-adhesive composite; group B: conventional composite

Table *1* shows that there are no statistically significant differences in the microleakage scores between the both the groups in the incisal cavity walls (p=0.125), while a statistically significant difference was found in the gingival cavity walls (p=0.003), and for pairwise comparisons, the Mann-Whitney U test was applied as shown in Table *2*.

Groups	U-value	p-value
Group A v/s Group B	156.0	0.016

Table 2: Mann-Whitney U test for pairwise comparison microleakage scores in the gingival cavity walls

* Indicates a statistically significant difference

Group A: self-adhesive composite; group B: conventional composite

Table *2* shows that a statistically significant difference was found between the self-adhesive composite group and the conventional composite group (p=0.016) (Figure 1)

Figure.

SELF ADHESIVE COMPOSITE

CONVENTIONAL COMPOSITE

IV. Discussion

Microleakage is a major problem and is the main cause of composite restoration failure. Studies evaluating the microleakage of self-adhesive composite resins are few in comparison to those measuring the microleakage of conventional composite resin restorations, which have been the subject of several investigations [9,15]. Thus, the purpose of this study was to assess the self-adhesive composite restorations' microleakage in primary canines.

To establish uniform standards, the study involved creating class V buccal cavities that are as identical as feasible in terms of shape, size, and position. The cavities were prepared at the cementoenamel junction, where the incisal wall enamel-dentine and the gingival wall are dentin only, to test the differences in microleakage, if any, at the level of enamel and dentin [16].

Following the application of the restorations, the teeth were subjected to 500 cycles of thermocycling, which simulated the environment found in the oral cavity [17, 18]. Because research on permanent teeth have shown that self-adhesive flowable composite has less microleakage, this type of composite was selected for the current investigation.

Constic composite was used in present study, which composed of 10-methacryloyloxydecyl dihydrogen phosphate. MDP, in a comparison with glycerol phosphate dimethacrylate (GPD), which a monomer used in other self-etch adhesive resins, is found to hold on to a greater number of hydrophobic spacer chains . MDP has shown to form strong bonding with the hydroxyapatite crystals, forming stable 10-MDP-Ca salts..[19]

Selective enamel etching has been suggested before applying the self-etching bond because there are many studies indicating that it improves bonding with the enamel [20,21].

Microleakage was investigated by penetration of methylene blue, which is an indication of incomplete sealing. Inadequate sealing in the oral environment can result in microleakage, which can cause caries to develop and ultimately fail the restoration procedure. Research on microleakage provides insight into the binding strength of both the tooth structure and the restoration material[22]

According to Poitevin et al. and Peterson et al.'s studies [22, 23], the bonding forces in the self-adhesive composite group are lower than in the conventional composite group. These findings are consistent with the results of the current investigation. This study also supports the findings of Çelik et al.'s investigation, which showed that while 100% of restorations using traditional composite resin were successful, 27 out of 40 restorations using self-adhesive composite resin failed [24].

The present study's findings are consistent with a systematic review carried out by Troconis and Pérez [25]. Conversely, the findings of Sachdeva et al. [26] did not demonstrate any noteworthy variations concerning microleakage, presumably due to their lack of thermocycling prior to applying dye penetration.

500 thermocycling was used to measure the microleakage. Because the clinical conditions in this study are more complex, this is a significant restriction. Furthermore, no comparisons were made between the microleakages at various thermocycling temperatures.

V. Conclusion

Within the confines of this investigation, the conventional composite attached to enamel and dentine more effectively than self-adhesive composite resin applied either alone or following selective enamel etching;

additional selective etching did not enhance the binding to enamel. It is not advised to utilise the self-adhesive composite for class V restorations on main anterior teeth.

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