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MICROLEAKAGE EVALUATION OF COMPOSITE RESTORATIONS IN PROXIMAL CAVITIES OF PRIMARY AND PERMANENT TEETH AFTER USING A TWO-STEP SELF-ETCH BONDING SYSTEM (CLEARFIL SE BOND); AN IN VITRO STUDY

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ABSTRACT

Objectives: Due to structural differences, adhesion to dentin and enamel in primary and permanent teeth seems to be different. The aim of this study was to compare microleakage of posterior composite restorations in primary and permanent teeth after using a two-step self-etch bonding system [Clearfil SE Bond (CSEB)]. **Materials and Methods:** In this in vitro study, cavity preparation in mesial or distal surfaces was performed on 20 human primary molars and 20 human permanent premolars. The gingival margin was 2mm above the cervical line .All of the cavities were filled using adhesive system of Clearfil SE Bond and Heliomolar composite resin. After finishing, polishing and thermocycling, the samples were immersed in 2% basic fuchsine for 24h. The linear sectioning dye penetration was then evaluated with a stereomicroscope. Chi-square test was used for comparison of microleakage between groups.

Results: Out of 40 teeth, only 3 primary and 2 permanent teeth showed microleakage indicating absence of this defect in 85% of primary and 90% of permanent with no penetration to the pulp. No significant difference was found between 2 groups of primary and permanent teeth (P=0.307). **Conclusion:** Since CSEB system showed acceptable clinical result in primary and permanent teeth, it should be considered as a reliable system for composite restorations of proximal cavities.

Keywords: Microleakage; Primary Teeth; Permanent Teeth; Dentine bonding system; Composite Resins

INTRODUCTION

Currently, the complications related to amalgam restoration have led to an increased tendency in dentists and patients to use tooth colored restorations such as dental composite resins. In order to have suitable composite bonds, more effective bonding systems are required (1). Microleakage between teeth gaps and restorations is one of the most important factors contributing to the long term efficacy of the restorations (2). Microleakage can cause marginal staining of restorations, recurrent carries, postoperative sensitivity and ultimately pulp damage (3-7).

Dental bonding systems play a key role in marginal sealing and microleakage reduction. With these systems there is no need to use common methods for creating retention and resistance (6). This is highly important in restoring primary teeth that have less mineral tissue compared with permanent teeth (7). One of the best dental bonding systems currently available is the Self-etch bonding system. Compared with multistage Total-etch systems (3-step etch and rinse adhesive system), the Self-etch systems have several advantages such as rapid application, ease of use due to the omission of etch and rinse stages, reduced error during application, as well as less problems regarding dentin humidity. Moreover, with Self-etch the problems related to collagen fibril collapse are diminished rendering a reliable and easily accessible bond in permanent teeth (2,8,9).

Primary and permanent teeth differ in mineral structure so that primary teeth have thin and uniform enamel with enamel prisms on the surface which is parallel to the dental enamel junction (DEJ)(10). Moreover, in the cervical region the enamel thickness is zero and the thickness or volume of the dentin , its calcium and phosphor content and intertubular material is less(11).

Although different studies have assessed and compared different dentin bonding

agent systems, few studies have investigated and compared them in primary and permanent teeth (12). Moreover, previous studies have mainly focused on cervical restorations (7, 13). Since proximal restorations constitute a great proportion of dental restorations especially in primary dentition, we aimed to compare microleakage in composite proximal restorations using a two-stage Self-etch bonding system called Clearfil SE Bond (CSEB) in primary and permanent teeth.

MATERIALS AND METHODS

This study performed on 20 intact permanent human premolars that had been extracted because of orthodontic reasons and 20 intact primary molars, after approval from the Ethics Committee of the Faculty of Dentistry, Guilan University of Medical Science (Rasht, Iran). The teeth were maintained in chloramine-T solution 0.5% for one week (13) and put in saline water until the time of the study. Initially the teeth were scaled to remove stain and calculus. Then, proximal cavities with 2 mm width and 2 mm height without any bevel were prepared using a diamond 008 fissure bur (Iran, Teezkavan. no 29) with high speed hand piece and all gingival margins are placed above CEJ.

Then, the cavity was rinsed and dried using water and air spray and the enamel was etched for 15 seconds by phosphoric acid gel 35% (Ultra-Etchant gel, 3M dental USA) and rinsed for 5 seconds. After etching the enamel Clearfil SE Bond (Kurarray, Japan) was applied on the surface of the cavities according to the manufacturer's instructions and polymerized for 10 seconds by controlled light using the curing light halogen device (Dent America) with an intensity of 550 mw/cm^2. After following all the bonding stages, the cavities were filled with (A_2) Heliomolar resin composite (Ivoclar, Vivadent. Liechtenstein), (Table 1) using the incremental method (first 1 mm on the gingival wall and then 2 mm layers triangularly). Each layer was exposed to light for 40 seconds.

Table1: Used materials and their components

Material	Characteristic	Main Components	Manufacturer
Ultra-Etch	Etchant gel	%35 Phosphoric acid	3M/Dental USA
Clearfil SE Bond	Two-step self-etch adhesive	Primer:MDP,HEMA,hydrophilic dimethacrylate,dicamphorquinone,N,N-Deithanol-P-toluidine,water Adhesive:MDP,Bis-GMA,HEMA,hydrophilic dimethacrylate,dicamphorquinone,N,N-Deithanol-P-toluidine, silanted colloidal silica(%10 microthin)	Kuraray
Heliomolar A2	Microfilled resin composite	Bis-GMA,Urethane dimethacrylate and decandiol dimethacrylate(40/5 wt%)	Ivoclar Vivadent

Bis-GMA=Bisphenol-A glycidylmethacrylate; HEMA=Hydroxyethylmethacrylate
MDP=Methacryloxydecydihidrogen phosphate

After 40 seconds postcuring restorations were finished with flame shaped diamond bur (Teezkavan,Iran.no219) and polished with rubber polishing points (Ivoclar, Vivadent. Liechtenstein). Then all samples were exposed to thermocycles of 5-55 degrees centigrade for 800 times (30 seconds at each temperature with a transfer time of 10 seconds). Root apices were sealed with sticky wax. After that all dental surfaces except the restored regions and their surrounding-1 mm -, were covered with 2 layers of nail polish. All samples were ultimately stored in basic fusion solution 0.5% for 24 hours in room temperature. Then, each tooth was vertically put in clear polyester, and cut by thin carbide disks mesiodistally from the center of the restoration. Ultimately, both halves were assessed for dye penetration by stereomicroscope (OLYMPUS CORPORATION, SZX2-ILL2, JAPAN) at ×40 magnification. The half that showed higher microleakage was considered as penetrated. Then the penetration scoring was done as follows: score 0: no penetration, score 1: color penetration under half of the gingival cavity margin, score 2: color penetration over the half of gingival cavity margin but not to the pulp, and score 3: color penetration to the pulp.

Data were analyzed using SPSS software, version 19. Chi-square test was used as appropriated.

RESULTS

Table 2 shows the frequency distribution of microleakage degrees of Clearfil SE Bond in the two groups (primary and permanent teeth). In the permanent teeth group 18 (90%) samples did not reveal any microleakage and only 2 (10%) indicated second degree microleakage.

In the primary teeth group 17 (85%) samples had no microleakage, 2 (10%) had first degree microleakage and 1 (5%) had second degree microleakage. We found no microleakage in the pulp region in both groups.

No significant statistical difference in terms of degrees of microleakage was found between the two primary and permanent teeth groups (P=0.307).

Table 2: Frequency of dye penetration degrees in composite restorations in primary and permanent teeth

Degree of dye penetration	No Penetration		Less or Equal to Half of Gingival Wall		More Than half of Gingival Wall		To pulp		Sum	
	number	Percent	number	Percent	number	Percent	number	Percent	number	Percent
Primary	17	85	2	10	1	5	0	0	20	100
Permanent	18	90	0	0	2	10	0	0	20	100
Total	35	87.5	2	5	3	7.5	0	0	40	100

DISCUSSION

In this study, we found that microleakage of primary (15%) and permanent (10%) teeth were relatively similar.In studies that have been done in this field, regardless of differences in the method, some studies

have found similar results (7, 12, 20-24), although other researchers have shown that the bond strength of primary teeth to permanent teeth is lower (19, 20, 25) It seems that all these are because of chemical, physiological and micromorphological differences on mineralized structures of the primary and permanent teeth(14, 20, 21, 23, 26-28).It seems that the degree of tooth mineralization(29), the number and diameter of dentinal tubules (30), the concentration of calcium and phosphate in the peritubular and intertubular dentin(31) of primary teeth are less than permanent teeth.This difference raises the question of how to obtain a durable bond in primary teeth.

Studies have shown that in etch & rinse adhesive systems, with applying mineral acid etchant , primary dentin demineralization happen faster than permanent dentin with thicker hybrid layer and less dentin bond strength (32, 33).Organic acids also have shown to be more effective in primary teeth (33). It has been shown that the mineral and more concentrated acids make deeper demineralization leaving debris on the dentin surfaces that impairs bonding process(33).

Rontani et al (25) in a study on the different dentin etching times with two etch and rinse adhesive systems stated that a reduction in the etching time increases the bond strength of the primary teeth. So that changing in the structure of the substrate can affect adhesion with changing the concentration and time of the etchant (25, 31, 34).Thus, self-etch adhesive systems due to simultaneous etching and priming of dentin, lack of technique sensitivity and saving of time might be a good choice in primary teeth (35).

Our results are similar to that of Bhat who worked on Xeno III and iBond in primary and permanent teeth (7). Shimada and colleagues also found similar results by working on Clearfil SE Bond and Single Bond on primary and permanent teeth (36). Other researchers found that the strength of Adper Single Bond to the dentin of primary teeth was lower that permanent teeth while Clearfil SE Bond showed similar bonding strength (37). In some studies, microleakage in primary teeth when applying the self-etch adhesive systems is shown more than etch & rinse adhesive systems, but due to limitations in our study (38-40), using the Clearfil SE Bond which is a two-stage self-etch system is justified for primary teeth compared with permanent teeth in proximal cavities similar to their use in cervical cavities. With respect to the importance of facilitating and shortening the clinical stages in children and the desirable results

of Clearfil SE Bond in proximal restorations of primary teeth (similar to cervical restorations), it seems that this system could be used to reduce microleakage in composite resin restorations. We found no difference between primary and permanent teeth in this regard. This indicates that Clearfil SE Bond is reliable for use in composite restorations of proximal cavities of primary and permanent teeth. However, since this study was done in vitro, we recommend further in vivo studies to investigate the life span of the restoration.

CONCLUSIONS

We found no significant difference between the 2 groups of primary and permanent teeth. The CSEB system can be recommended as a reliable system for composite restorations of proximal cavities in primary and permanent teeth.

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