Original Article

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Comparison of the Micro Leakage of Class 5 Restorations with Universal Self-etch Bonding and 5th Generation Total-etch Bonding in Anterior Deciduous Tooth: an in-Vitro Study

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ABSTRACT

BACKGROUND AND OBJECTIVE: Micro leakage is one of the major causes of failure to repair and subsequent caries. The difference in the structure of enamel and dentin in deciduous teeth can affect the selection of bonding agents. The purpose of this study was to compare the micro leakage of class 5 restorations using self-etch universal bonding and fifth-generation total etching in primary anterior teeth.

METHODS: In this in-vitro study, 45 healthy anterior deciduous extracted teeth were randomly divided into three groups of 15 each. Class 5 cavities were created on the buccal surface of all teeth. Then restoration was done in first group by using Universal Self-etch Bonding Saremco, in the second group using Universal Self-Bonding G Permio Bond and in the third group using 5th generation Total-etch TNT Tetric-Bond, and using Filtek Z250 composite. Micro leakage was investigated using methylene blue based on the intensity of 0 to 3.

FINDINGS: In Tetric-N Bond group, 33.3% had no micro leakage, 53.3% had first degree micro leakage, and 13.3% had second degree micro leakage. In group G Permio Bond, 33.3% had first degree micro leakage, 53.3% had second degree micro leakage and 13.3% had third degree micro leakage. In Saremco-Bond group, all teeth had grade 3 micro leakage. The distribution of micro leakage intensity in the Saremco group was significantly different from the Tetric-N group (p= 0.000) and the G-permio group (p= 0.002).

CONCLUSION: The results of the present study showed that the Universal Self-etching Saremco Unibond had more micro leakage than the other two bonds.

KEY WORDS: *Dental Bonding, Dental Cements, Deciduous Tooth.*

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Introduction

Nowadays people pay special attention to their beauty and therefore the demand for restoration with tooth-colored materials has increased significantly. Various materials have been proposed from this spectrum, including composite resin, which has been extensively used as a posterior tooth restorative material (1). If for any reason, there is a gap between the tooth and the restoration, the micro leakage occurs. Micro leakage in restaurants is the most important factor in reducing their lifespan (2).

Micro leakage can cause caries recurrence, marginal fractures, discoloration and sensitivity of teeth. In one report, after 3 years of composite restoration, 85% of the cases were satisfactory and detachment was one of the most important causes of failure (3,4). The use of dentin stick has an important role in blocking the remaining spaces between the restoration and the tooth and thereby improving their bonding. A good dentin adhesive should be able to withstand the mechanical forces applied to the composite and the polymerization shrinkage force and able to have good edge sealing (5).

Despite the use of adhesives, the problems and barriers to resin bonding to dentin such as micro leakage appear to have not yet been completely eliminated and the bond between resin and dentin has been degraded over time (6). Another micro leakage that may occur is micro leakage through the dentine bonding material through the small spaces of the hybrid layer. These small spaces can be expanded over time by thermal stresses and excessive forces in the oral environment (7).

Today, self-etch adhesive dentins are designed to reduce the workflow. In the newest generation, these dentin, acid, primer and adhesive sticks are combined in one bottle. This reduction in workflows reduces technical sensitivity and reduces errors during operation (8). Self-etch systems unlike total etch systems, do not require separate etching, and etching and priming occur simultaneously in enamel and dentine (9). Different studies have reported different results for different types of dentin adhesives and different bonding generations. The results of one study showed that in permanent teeth, both self-etch adhesives and total etch adhesion have good sealing ability (10). Another study in permanent teeth showed that 2% chlorhexine had no negative effect on the enamel micro leakage of composite restorations in different bonding systems (11). The results of a study on deciduous teeth showed that new universal adhesives could be a good alternative to two-stage adhesives (12). Due to the thinner structure of dentin and enamel in deciduous teeth than the permanent teeth and faster decay propagation, proper bonding selection can increase the success of composite restoration. Despite some major differences in some of the micro mechanical and histological features of dentin in deciduous teeth as well as differences in hardness and minerals compared to permanent teeth, manufacturers provided specific instructions for the use of adhesives in primary dentition restoration (13, 14). Due to the few studies on the micro leakage of new universal bonding specially in deciduous teeth, this study was performed to compare the micro leakage of class 5 restorations using self-etch universal bonding and fifth generation of total etch bonding in primary anterior teeth.

Methods

This laboratory study was performed after obtaining approval from the Ethics Committee of Qom University of Medical Sciences in 1397 with the ethics code IR.MUQ.REC.1397.092. Sample size was calculated using PASS 11 software, taking into account Kruskal-Wallis analysis and Martins et al. (15) study results and considering 80% power and 5% type I error equal to 15 teeth in each group and total of 45 teeth. The samples were 45 healthy extracted primary anterior teeth. The extracted teeth were all extracted due to mobility and at the request of the patient's parents. All healthy anterior primary teeth were examined and teeth with cracks in dentine, decayed teeth and fractured teeth were excluded. In all teeth, after fixation in the wax, a Class 5 cavity with occlusal edge and enameled Gingival edge (5 mm long, 2 mm wide, 2 mm deep) was cut on buccal surface with Fissure Diamond Milling 008 (Teeskavan, Iran) , washed with normal saline and then dried. All samples were numbered and divided into three groups using random numbers using Excel software. Restoration was done by different dentin adhesive as bellow: in the first group, by using Saremco Saremco Unibond (Saremcodental / switzerland) dentin adhesive, in the second group by using GPermioBond (Gc/japan) dentin adhesive and in the third group by using NTetric-Bond (Vivadent/liechtenstein) dentin adhesive (Table 1). The enamel of all samples to be tested for total etching was etched with 35% Ultradent-Ecno acid (Ultradent, Jordan) and after applying any type of dentin adhesive (according to the manufacturer's instructions), the cavities were restored with 3M ESPE (USA) Filtek Z250 composite. Each composite layer was cured for 40 seconds. Woodpecker LED E (Optilux 501, Kerr, USA)

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was used to harden the composites and bonds with an intensity of 1000 mW/cm2. Also, after bonding, they went under thermocycler for 5000 times with 20 seconds immersion in water at 5 and 55° C to cause tooth erosion (16). To investigate the micro leakage, the coronal and radicular surfaces of the teeth were covered with two layers of nail varnish except for repair and 1 mm around the margins, and the teeth were sealed in the apical area with an adhesive wax layer to prevent color penetration to the apex. The teeth were then immersed in 2% methylene blue solution to penetrate the tooth tissue and to evaluate the micro leakage for 24 hours. After staining, the samples were washed and dried. They were classified as: 0-1-2-3, according to standard criteria (Zero= no dye penetration between adhesive and tooth wall, 1= dye penetration up to one third of the cavity wall length, 2= dye penetration up to two thirds of the cavity wall length, 3= dye penetration of more than two thirds of the cavity wall length) (17). Data were analyzed by SPSS 17 software. The micro leakage was analyzed by Kruskal-Wallis test and Dunnett's post hoc test and $p<0.05$ was considered significant.

Table1. Adhesives used in the study

Adhesives	Compounds	Procedure
G Premio Bond(Gc/japan)	MDP, 4MET, MDTP, bis-GMA, hydrophobic dimethacrylate, photoinitiators, ethanol, water, silanated colloidal silica; pH 2.7	Dry the surface of the tooth. Apply G Permio Bond to all surfaces and dry for 10 seconds at high air pressure for 5 seconds and cured for 10 seconds.
Saremco unibondSaremco (dental/switzerland)	H3PO4, Methacrylate, Water, ethanol, primer, bis-ema,ph:2.9	The cavity was first dried with a cotton ball. Then, by adding an adhesive layer and rubbing it on the cavity for 20 seconds, the solvent evaporation was carried out with a quiet air power for 5 s, and then cured for 10 s with light.
Tetric- N- bond (Vivadent/liechtenstein)	MDP,water, hydrophobic dimethacrylat .ph:2.5-3	First, etching was performed for 15 seconds, followed by washing for 40 seconds, drying with low air pressure, bonding and spraying with low air flow and curing for 10 seconds.

Results

Of the 45 teeth studied, only 5 (11.1%) had no micro leakage (zero intensity). All teeth bonded with Saremco-Bond had a micro leakage intensity of 3, in G Permio Bond group, 13.3% had a micro leakage intensity of 3, in other cases the micro leakage intensity was 1, Tetric-N Bond group 33% had no color penetration and 53% had one third of color penetration (Figures 1 to 4). Tetric-N Bond group had less micro leakage intensity than the other two groups, so that had more teeth without micro leakage or more teeth with micro leakage intensity of 3 (Table 2). There was a significant difference between the amount of dye penetration by bonding type ($p<0.000$) so that the highest dye penetration based on Mean Rank was related to Saremco-Bond (Table 3). Comparison of two groups showed that Saremco-Bond with Tetric-N Bond ($p=0.000$) and Saremco-Bond with G-permio ($p=0.002$) have significant difference in micro leakage intensity but G-permio is not significantly different from Tetric-N Bond.

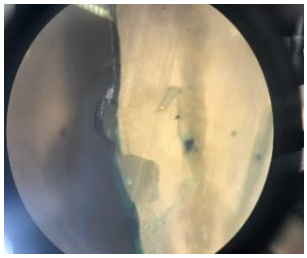

Figure1

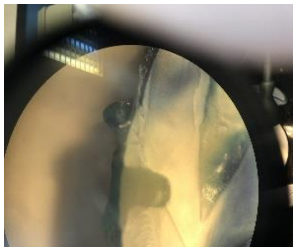

Figure2

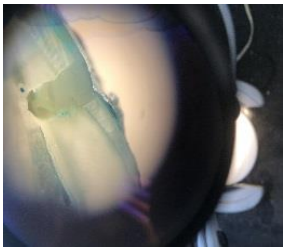

Figure3

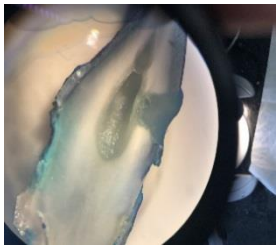

Figure4

Figure 1. Stereo Microscope (×100), Tetrid N Bond-Total etch adhesive micro leakage Ranked 0
Figure 2. Stereo Microscope (×100), Universal-Self etch adhesive micro leakage Ranked 1
Figure 3. Stereo Microscope (×100), Universal-Self etch adhesive micro leakage Ranked 2
Figure 4. Stereo Microscope (×100), Universal-Self etch adhesive micro leakage Ranked 3

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Table 2. Dye penetration intensity (micro leakage) according to the type of bonding used

Bonding agent	Dye penetration intensity			
	zero	1	2	3
	number(%)	number(%)	number(%)	number(%)
Tetric-N Bond	5(33.3)	8(53.3)	2(13.3)	0(0)
G Permio Bond	0(0)	5(33.3)	8(53.3)	2(13.3)
Saremco-Bond	0(0)	0(0)	0(0)	15(100)
Total	5(11.1)	13(28.9)	10(22.2)	17(37.8)

Table 3. Comparison of dye penetration according to the type of bonding used by Kruskal-Wallis test

	Bonding Type	Number	Mean Rank	p-value
Dye penetration	Tetric-N Bond	15	10.53	<0.001
	G Permio Bond	15	21.47	
	Saremco-Bond	15	37	
	Total	45	100	

Discussion

The results of this study showed that in grade 5 restorations of anterior primary teeth, Saremco Unibond Universal Self-etch bonding had more micro leakage than the other two bonding. Limited evidence is available on the efficacy of new generations of dentin adhesives such as universal dentin adhesives using self-etching and total etching processes (9,18,19). These adhesives can be used in either self-etching (in the case of enamel cutting) or total etching (in the case of non-cutting enamel), as claimed by Universal Dental Adhesives Manufacturers (20). Although the evidence for the superiority of seventh and universal adhesive systems using separate etching has been identified (20), the evidence for the effectiveness of these systems without etching is contradictory (18,21). The results of the present study showed high micro leakage of self-etched universal adhesives without enamel-free etching. However, doing 15 seconds of etching in the Tetric-N-bond group prevented and significantly reduced micro leakage. This finding suggests that the use of self-etching system in universal dentin adhesives diminishes their effectiveness for proper sealing in primary teeth. However, it may also depend on the type of universal dentin adhesives as observed in the present study. Due to the thinner structure of dentin and enamel in primary teeth than permanent teeth and faster caries propagation, selection of appropriate bonding can increase the success of composite restoration. If you use bonds that require a shorter repair time, you can take advantage of the shorter repair time and thus reduce the likelihood of contamination. However, the available evidence is inconsistent and suggests that the use of the etching system may provide a more clinical advantage and better sealing for primary teeth than the self-etching process (22). Comparison of Micro leakage of Class 5 Cavity Healing with Composite Resin Using Fifth and Seventh Generation Adhesives (G Bond, Clearfil S3 Bond Self-etching and Single Bond 2-etching Tutorial) there was no significant difference between the micro leakage with respect to the type of bonding used (23), which is consistent with the present findings for the self-etch universal dentin adhesives. Makarem et al., similar to ours, observed that the application of Gluma One Bond total dentin adhesive to iBond self-etching system in primary and permanent teeth reduces micro leakage in adhesive restorations (24). In permanent teeth, total etching seems to have similar or superior sealing effect to self-etching. Contrary to the present results, Jodi et al., using older single-step self-etch bonding (S3 Clearfil Bond) and two-step total etching (Adper Single Bond 2), have similar edge sealing ability in Class 5 restorations among the above bonding factors (10). In the study of Owens et al., restoration of permanent teeth using self-etch adhesion system and total etch adhesion did not show a significant difference in the micro leakage in the dentin margin between the adhesive groups, although the total etch system had less micro leakage in the enamel edge (25) which is close to the findings of the present study. By evaluating the enamel surface under electron microscopy, Bishara et al observed that resin coatings obtained from phosphoric acid etching were much thicker and more uniform than resin coatings obtained from primers and self-etching processes which strengthens the hybrid layer (26). Their findings could be a reason to justify the weakness of the self-etch system in the present study. In addition to the etching process and the resin material, the anatomical region of the repair cavity may affect the micro leakage.

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In the study of Abo et al., apical micro leakage for two self-etch adhesives AD Bond and Clearfil SE Bond was not significant during the repair of premolar teeth cavities (17). According to our study, it seems that the efficacy of self-etch systems is inadequate where the cavity has enamel edges. Osorio et al. did not observe significant differences in dentin micro leakage during endodontic treatment using Clearfil, SE Bond, Etch & Prime B self-etch adhesives. However, the SE Bond showed the lowest micro leakage in the dentin (27). The cavities created in the present study, unlike most microleakage studies in both the apical and coronal sections, included enamel, as the cavities in the anterior primary teeth have mostly enamel edges, and usually Class 5 cavities do not extend to the dentin. One of the limitations of this study was the qualitative evaluation of micro leakages. Also, many influential factors such as the conditions of sample collection, the conditions of sample storage can make it difficult to compare the results of different studies. The high cost, the difficulty of having the same depth of incision in the teeth and the difficulty of working with very small primary teeth prevented a larger sample size study. It was also difficult to maintain enamel around the cavity for micro leakage with etching. The present findings showed that self-etched universal dentin adhesives had higher coronal micro leakage for grade 5 cavities of primary teeth restored with resin composite compared to the fifth generation of total etch bonding system, and universal systems, contrary to the claim of the manufacturer without a separate etching, they don't have good sealing. Further studies are needed to confirm this finding.

Conflict of interest: The authors of the article reported no conflict of interest.

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