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Dr. Uday Kamath
Professor and Head of the Department, Department of Conservative, Dentistry and Endodontics, Dr. Syamala Reddy Dental College, Hospital and Research Centre, Bangalore, Karnataka, India

Dr. Arun CR
Department of Conservative dentistry and Endodontics, Dr. Syamala Reddy Dental College Hospital and Research Centre, Bangalore, Karnataka, India

Correspondence
Dr. Uday Kamath
Professor and Head of the Department, Department of Conservative, Dentistry and Endodontics, Dr. Syamala Reddy Dental College, Hospital and Research Centre, Bangalore, Karnataka, India

Comparative evaluation of Microleakage of class ii composite restoration by using 6th 7th and 8TH generation dentin bonding agents: An *in vitro* study

Dr. Uday Kamath and Dr. Arun CR

Abstract

Aims: To determine the microleakage of the 6th, 7th, and 8th generation dentin bonding agents.
Materials and Methods: Standardized Class II cavities were prepared on the mesial and distal aspects of Forty-five extracted human molars. According to the generation of bonding agent used, the samples were divided into three groups. 6th generation bonding agent (Parabond) is bonded in group I, 7th generation (One coat 7) in group II and 8th generation (G premio bond) in group III respectively. Nano-ceramic composite (Ceram X) is restored in all the prepared cavities. The samples were then thermocycled between 5 and 55 ± 2°C for 100 cycles and immersed in 2% methylene blue for 48 h, Sectioning is done for evaluation of microleakage under a stereomicroscope in 20X magnification.)
Statistical Analysis Used: The data was statistically analyzed using analysis of variants (ANOVA), and post hoc analysis based on Bonferroni test was applied to compare the various groups.
Results: The highest value of microleakage was in Group II (7th generation bonding agent) followed by Group I (6th generation bonding agent) and least in Group III (8th generation bonding agent).
Conclusions: Statistically significant results was seen in the 8th generation dentin bonding agents as least microleakage when compared to the 6th and 7th generation dentin bonding agents.

Keywords: bonding agents, nanoceramic composite, class II cavities, microleakage

Introduction

The principles of adhesive dentistry date back to 1955 when Buonocore, after observing the industrial use of phosphoric acid to improve adhesion of paints and resin coatings to metal surfaces, applied acid to the teeth to 'render the tooth surface more receptive to adhesion. He discovered that the human enamel could be bonded to that of acrylic resin after 85% phosphoric acid conditioning. Buonocore predicted some uses for this new technique, including pit & fissure sealants and class III and class V restorations. Development of dentin adhesives was very slow until 1950s. Bowen synthesized a “surface active comonomer” that can mediate water resistant chemical bonds of resins to dentinal calcium. But these commercial products based on this comonomer gave very poor clinical performance Buonocore's pioneering work led to major changes in the practice of dentistry. Today, we are all in the age of adhesive dentistry [1, 2].

As we enter the new millennium, we find a meteoric rise in the use of bonded composite restorations with immense success. Evolution began by Castan in 1938 and has reached a hallmark of self-etching systems. Self-etching adhesives came to be known as "6 generation dentin bonding agents." Noteworthy feature was the use of acidic primer giving us an advantage of eliminating the acid etching step. Apart from simplification of three-step to two-step application, the rationale behind this system was to superficially demineralize dentin and simultaneously penetrate it with monomers, which could be polymerized in situ. Although the bond to the dentin remains strong enough (23 MPa), the multiple components and multiple steps in the technique could cause confusion and led to error [3].

Currently, "7th generation self-etch systems" combine an etchant, primer, and adhesive in one container compared to total-etch or etch and rinse systems, whereby separate etchant, primer, and adhesive monomers are utilized. The 7th generation dentin bonding agents are called as self-etching or all in one adhesive which required no mixing. Thus, they were time-saving.

Further, modification was achieved by introducing light- and self-cured bonding agent called as the "8th generation dentin bonding agent." It worked both in self- and light-cure mode. It was new single dose delivery system and prevents solvent evaporation, a common problem in a variety of other bonding systems. It ensured an immediate stick effect which guaranteed that the bond will not be blown out of the cavity while air drying. This resulted in a superior marginal integrity and protection against dentinal sensitivities [3, 4].
Thus, this study was conducted to determine the microleakage of the 6th, 7th, and 8th generation dentin bonding agents.
The present *in vitro* study was carried out in the Department of Conservative Dentistry and Endodontics Syamala Reddy Dental College Marathahalli Bangalore

Materials and Methods

Sample Preparation

A total number of 45 freshly extracted molars were collected. The teeth were cleaned by ultra-sonic scaler and washed thoroughly and autoclaved. The teeth were mounted on plaster of paris upto 2mm apical to the cemento enamel junction and stored in distilled water in a refrigerator. Class II box cavities were made on both the proximal sides of molar using a Straight fissure diamond abrasive bur (SF12 mani) in a water cooled high- speed air turbine handpiece.

Division of Samples

The collected 45 samples were randomly divided into the three groups and color coded accordingly. Group I - (red) samples were bonded with parabond (6th generation dentin bonding agent), Group II - (blue) samples were bonded with one coat7 (7th generation dentin bonding agent), and Group III - (green) samples were bonded with G premio bond (8th generation dentin bonding agent) In all the experimental groups Bonding agents were applied (Groups I–III) according to the manufacturer's instructions.

Group I

Sample teeth in this group were bonded with parabond (6th generation, light-cured dentin bonding agent). First etchant (37%phosphoric acid) is applied in the prepared cavity undisturbed for 10s washed the cavity and air dried, the primer was applied thoroughly on the prepared cavity for 5 s, left undisturbed for 10s, and dried with air for 5 s. An even layer of bonding agent was then applied with an applicator tip on the entire surface for 5s then light cured for 10s.

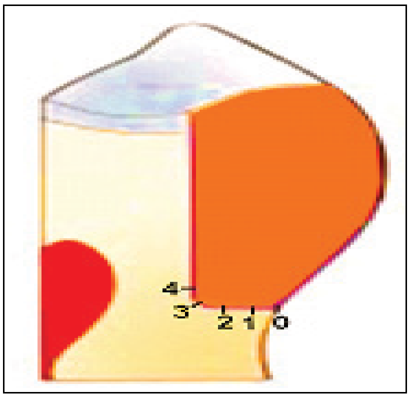
Group II

Sample teeth in this group were bonded with 1 coat7 (7th generation, self-etching, light-cured dental adhesive). It was supplied as an easy squeeze bottle. With an applicator tip, one coat of the bonding agent was applied on the prepared cavity, left undisturbed for 20s, dried with air for 5 s, and was then light cured for another 20s.

Group III

Sample teeth in this group were bonded with G premiobond (8th generation, self-etching, dual-cured dental adhesive). One drop of Liquid was dispensed and mixed with an applicator tip, it was then applied onto the prepared cavity with a rubbing motion, gently air dried for 5 s, and then light cured for 20s.
The prepared samples were subjected to thermocycling in water baths for 500 times between 5^0 and 55^0 with a dwell time of 30s in each bath and a transfer time of 30s to simulate the oral conditions.
After thermocycling, the apices of teeth were sealed with sticky wax.
All tooth surfaces were triple coated with finger nail varnish, except 0.5-1.mm window around the restoration margins. The teeth were immersed in 2% methylene blue for 48 hours after which they were rinsed with water and air-dried.
Each tooth was sectioned mesiodistally with diamond discs. The section with the deepest dye penetration was determined by examination under the stereomicroscope according to a five- point scale, as elaborated below.

0 No dye penetration
1 Dye penetration less than half of the gingival wall
2 Dye penetration along the gingival wall
3 Dye penetration along the gingival wall and less than half of axial wall
4 Dye penetration along the gingival and axial wall



Statistical analysis

Results of evaluation of leakage were subjected to statistical analysis. Possible differences between the various experimental groups were explored with the ANOVA and post hoc analysis

Table: Microleakage analysis

Groups	Score 0	Score 1	Score 2	Score 3	Score 4
Group I (6th generation bonding agent)	3	6	4	2	0
Group II(7th generation bonding agent)	2	2	5	3	3
Group III(8th generation bonding agent	5	5	3	2	0

Mean values of microleakage values among all groups

In graph highest mean microleakage was observed for the Group II where 1 coat 7 (7th generation bonding agent) was used, followed by group I (Parabond - 6th generation bonding agent) and Group III (G- premio bond - 8th generation bonding agent).

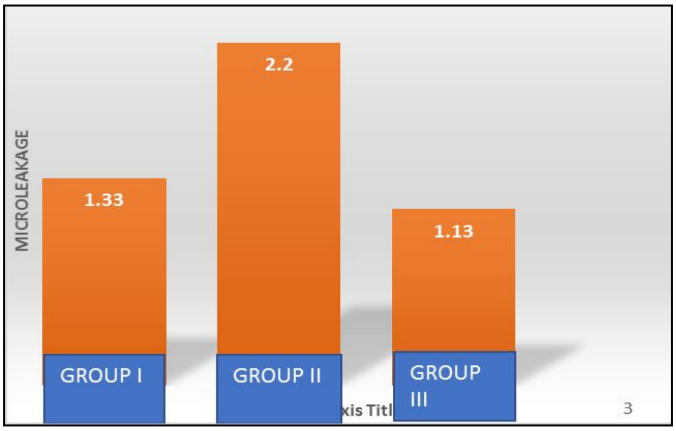


Fig: Microleakage

Discussion

Adhesives in dentistry has been evolving at a rapid rate during the last four decades. It leads to a significant expansion of the worldwide base of knowledge and resulting in the development of many new products. Extensive research coupled with the widespread demand for dental adhesives has broadened their range of application. The continued development of adhesive material is now focused on gaining a better understanding of factors affecting adhesion in the oral environment to improve the clinical longevity of restorative materials. These agents along with their expanded clinical applications dawn a new horizon with a promising outlook towards the future [5].

One of the major objectives of tooth restoration is the protection of exposed dentine against bacteria and their toxins. The interface between the restoration and dental hard tissue is an area of clinical concern as insufficient sealing can result in marginal discoloration, secondary caries, and pulpitis. For that reason, adequate sealing is essential for optimal clinical performance. However, the literature is not always consistent with the terminology of leakage [6].

Modern posterior resin composites undergo 2.6 to 7.1% volumetric contraction during polymerization. This shrinkage can result in microleakage and its ensuing sequelae. The factor responsible for microleakage is the inherent shrinkage in the organic matrix. Methacrylate-based composite resins have linear reactive groups and polymerize by addition reaction which results in high polymerization shrinkage. Use of organically modified ceramic nanoparticles and Nanofillers combined with conventional glass fillers in Ceram X has improved the natural esthetics, reduced the monomer release, but polymerization shrinkage is still high, i.e., about 2.3% according to the manufacturers [7].

Microleakage is usually evaluated with *in vitro* models. A number of techniques including bacterial, chemical or radioactive tracer molecules infiltration are available. The most commonly employed techniques in studies are Colour dye penetration techniques. In this study dye (2% methylene blue) penetration method was used to evaluate the microleakage, because it is a simple and inexpensive technique and has shown better penetration results. Methylene blue has a low molecular weight, and its molecular size is smaller compared to the diameter of dentinal tubules (1 - 4µ) as well as bacteria (2 - 4µ), allowing it to penetrate easily into the dentinal tubules, mimicking the passage of bacterial toxins into the dentinal tubules. The dye also provides an excellent contrast with surrounding environment [6].

The present study aimed to determine microleakage in class II nanoceramic composite restoration using newly introduced 8th generation dentin bonding agent. It also compares the microleakage in composite restoration using 8th generation dentin bonding agent with 6th and 7th generation dentin bonding agent. Microleakage of the experimental group was in the decreasing order order: 7th Generation Bonding agent > 6th Generation Bonding agent > 8th Generation Bonding agent. The difference between micro leakage observed in these compounds were statistically significant. The latest adhesive system (8th Generation) proved to have the best properties to counter balance microleakage.

This is a promising result suggesting that the newer material has better properties. The latest simplification of adhesive system is represented by 7th generation or one-bottle self-etching system. In this system all the ingredients for bonding are placed in and delivered from a single bottle. This greatly simplifies the bonding protocol as the claim was that could be achieved consistent bond strengths while completely eliminating the errors that could normally be introduced by the dentist. The bond strength of this system were consistent and there was no mixing required. These are the main advantages of seventh generation adhesives [1].

The 8th generation dentin bonding agent contains polyfunctional adhesive monomers (phosphoric acid modified methacrylate esters). When these acid esters mixed with water, it produces a favourable ph value of 1.4. Which is less when compared to 6th and 7th generation bonding agents (2.4 and 1.8). The lower ph value of 8th generation bonding agent favors the complete removal of smear layer and it dissolve the hydroxy apatite crystals. It creats a deeper retentive pattern by forming a deeper resin tag comparing with the other bonding agents. Moreover, the 8th generation dentin bonding agent (G premio bond) forms a thicker adhesive layer and It is having more flexible interface [3].

These superior properties of 8th generation bonding agent help to counteract stress resulting from polymerization shrinkage of the resin composite. In our study in the 8th generation bonding agent most amount of microleakage was seen in the level of No dye penetration (score0) and less than half of the gingival wall (score 1). The result of our study showed the similarity with previous microleakage studies regarding bonding agents [8, 9].

Microleakage tests helps to determine clinical success and longevity of the adhesive systems. Although this study was conducted *in vitro*, this can be a screening apparatus for ensuing *in vivo* studies. Previous researches points that data obtained from *in vitro* microleakage testing may be useful but not always necessarily reproducible in clinical *in vivo* settings.

The results of this study shows the dynamic nature of the dentin substrate morphology is indeed an important factor and, possibly, an insurmountable impediment for the proper adhesion of restorative materials to the tooth structure. Clinical trials should be done for carious and noncarious Class II cavities to assess the performance of these new adhesive systems before proper conclusions can be formulated.

References

1. Sofan E, *et al*. Classification review of dental adhesive systems: from the IV generation to the universal type, Anna Di Stomat. 2017; 8(1):1-17.
2. Vaidyanathan TK, Vaidyanathan. Recent Advances in the Theory and Mechanism of Adhesive Resin Bonding to Dentin: A Critical Review, J Biom Mat Res. 2008, 558-566.
3. Somani R, Jaidka S, Arora S. Comparative evaluation of microleakage of newer generation dentin bonding agents: An *in vitro* study, Indian J Dent Res. 2016; 27(1):86-90.
4. Rizvi S *et al*., Dentin Bonding Agents – An Overview, J Dent and Med Sci. 2015; 14(11):97-100.
5. Gupta S *et al*., Dentin Bonding Agents: An Overview, J Adv Med Dent Scie. 2014; 2(1):82-84.
6. Fabianellia A, pollingtonc S, Davidson L, Cagidiacoa MC, Goraccia C. the relevance of micro-leakage studies, Int Dent; 9-3:64-74.
7. Bogra P, GuPta S, kumar S. Comparative evaluation of microleakage in class II cavities restored with Ceram X and Filtek P-90: An *in vitro* study, Contem Clinic Dent. 2012; 3(1):9-14.
8. Deliperi S, Bardwell DN, Wegley C. Restoration Interface Microleakage Using One Total-etch and Three Self-etch Adhesives, Oper Dent. 2007; 32(2):179-184.
9. Vinay S, Shivanna V. Comparative evaluation of microleakage of fifth, sixth, and seventh generation dentin bonding agents: An *in vitro* study, J conerv Dent. 2010; 13(3):136-140.