Comparative evaluation of traditional and self-priming hydrophilic resin

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Abstract

Background: The purpose of this study was to compare the microleakage of traditional composite (Charisma/Gluma Comfort Bond) and self-priming resin (Embrace Wetbond).

Materials and Methods: Standardized Class V cavities partly in enamel and cementum were prepared in 20 extracted human premolars. Teeth were divided into two groups. Group 1 was restored with Charisma/Gluma Comfort Bond and Group 2 with Embrace Wetbond. The specimens were stored in distilled water at room temperature for 24 h and then subjected to 200 thermocycles at 5°C and 55°C with a 1 min dwell time. After thermocycling teeth were immersed in a 0.2% solution of methylene blue dye for 24 h. Teeth were sectioned vertically approximately midway through the facial and lingual surfaces using a diamond saw blade. Microleakage was evaluated at enamel and cementum surfaces using 10× stereomicroscope.

The statistical analysis was performed using Wilcoxon signed-rank test.

Results: Wetbond showed less microleakage at occlusal and gingival margins as compared with Charisma/Gluma Comfort Bond and the results were statistically significant (P < 0.05).

Conclusion: Class V cavities restored with Embrace Wetbond with fewer steps and fewer materials offers greater protection against microleakage at the tooth restorative interface.

Keywords: Class V; conventional composite; embrace wetbond; microleakage; self-priming resin

INTRODUCTION

Ever since the development of unfilled resin by Bowen in 1962, the concept of conservative restorative dentistry has grown rapidly.[1] Dental composite with dentine adhesive systems are currently the most popular materials for fabrication of restorations. The main advantages of these include esthetic properties, conservative tooth preparation, and ability to be directly placed without laboratory procedures. Although composite resins have better esthetics and mechanical properties compared with glass ionomer cements, their inherent drawbacks are polymerization shrinkage and high coefficient of thermal expansion as compared with tooth structure. Polymerization shrinkage and shrinkage stresses may lead to gap formation and microleakage.[2] Microleakage may result in percolation, postoperative sensitivity, secondary marginal caries, and loss of esthetics.[3] Also restoration of even a tiny lesion with composites is a long and complex procedure requiring acid etching, priming, bonding, light curing, placement of the restorative material and then light curing again.[4] With the introduction of Wetbond the time-consuming procedures have been reduced to acid etching and placement of restorative material and light curing.

The Embrace Wetbond Resin Technology (Pulpdent, Watertown, MA, USA) is an advanced bonding chemistry and new generation of hydrophilic dental restorative material that chemically and micromechanically bonds to the tooth. The materials are formulated from a unique dental resin that is self-priming, wet bonding, water miscible, hydrophilic, and hydrobalanced. Embrace Class V is the first wet bonding restorative resin specially designed for class V restorations. It incorporates di-, tri, and multifunctional acrylate monomers into a hydrophilic, resin acid integrating network (R.A.I.N.). It bonds, seals, and desensitizes, with no need for bonding agents. Traditional composite resins when used to restore class V lesions invariably result in leakage at gingival margin, whereas Wetbond integrates with the tooth and provides excellent...
MATERIALS AND METHODS

Twenty noncarious extracted human premolars of patients in the age group of 21–40 years were selected. The teeth were cleaned of calculus, soft tissue, and debris with hand instrumentation and stored in a 1% chloramine solution for not more than 1 month after extraction. Each specimen provided 2 surfaces for preparation, facial and lingual, resulting in 40 samples for evaluation. Class V cavities (2 mm occlusogingivally, 2 mm mesiodistally, and 1.5 mm in depth) were prepared with cylindrical diamond bur in an air-/water-cooled high-speed handpiece (NSK PAN AIR high-speed air turbine handpiece, Nakanishi Inc., Tochigi-ken, Japan). The occlusal margins of the cavities were located in the enamel and gingival margins in dentin. Dimensions of cavities were standardized using a template (2 × 2 mm) prepared in a metal band strip and depth by marking the burs at 1.5 mm length prior to use. Each bur was used to cut 4 preparations only. The occlusal and gingival cavosurface margins were sharp and nonbeveled. The teeth were randomly assigned into 2 groups of 10 teeth each (20 Class V cavities).

Group 1: Teeth were restored with Charisma and Gluma Comfort Bond (Heraeus Kulzer, LLC, USA).

Group 2: Teeth were restored with Embrace Wetbond (Pulpdent, Watertown, MA, USA) according to manufacturer’s instructions.

In Group 1 (Charisma/Gluma Comfort Bond) dentin and enamel were etched with 37% phosphoric acid gel for 15 s. The cavities were rinsed with water for 30 s. Excess water was removed with blotting paper. Two coats of Gluma Comfort Bond were applied with a brush to the prepared cavities, which were then left for 15 s, lightly air dried by a gentle stream of air for 10 s followed by light curing for 20 s. The restorative material Charisma shade A2 was placed and cured.

In Group 2 (Embrace Wetbond) only enamel was etched with 37% phosphoric acid gel for 15 s. The cavities were rinsed with water for 30 s and excess water was removed with blotting paper. No bonding agent was applied. Wetbond was placed and light cured for 20 s.

After 24 h storage in distilled water at 37°C, the restored teeth were subjected to 200 thermocycles between 2 baths at 5°C and 55°C. The immersion time in each bath was 1 min and the time of transfer between baths was 10 s.

After thermocycling the apices of the teeth were sealed with sticky wax. All tooth surfaces, except for 1 mm around margins of each restoration, were sealed with 2 coats of nail polish. The teeth were immersed in 0.2% methylene blue for 24 h. Upon retrieval from the dye, the teeth were washed for 4 h under running water and left to dry for dye fixation. Each tooth was sectioned longitudinally in a buccolingual direction through the center of each restoration with a slow-speed diamond disk. The cut surfaces were examined at the occlusal and gingival margins using a stereomicroscope at 10× magnification. Dye penetration at the composite–tooth interface was evaluated for both occlusal and gingival margins using the following scoring system:[6]

- No dye penetration
- Dye penetration less than half the length of the gingival or occlusal wall
- Dye penetration up to the full length of the gingival or occlusal wall
- Dye penetration along the gingival wall and extending to the axial wall

The data was statistically analyzed using Wilcoxon signed-rank test at the 0.05 level of significance.

RESULTS

Table 1 shows the distribution of dye penetration scores at the occlusal and gingival margins in all groups. In Group 1 (Charisma/Gluma Comfort Bond) mean microleakage score at the occlusal margin (1 ± 0.9177) was less than the gingival margin (1.9 ± 1.1653). In Group 2 (Embrace Wetbond) also mean microleakage score at the occlusal margin (0.25 ± 0.4443) was less than the gingival margin (1.65 ± 1.1821).

When microleakage at occlusal and gingival margins were compared, the results were statistically significant in both the groups (P < 0.05) [Table 1].

When Group 1 (Charisma / Gluma Comfort Bond) and Group 2 (Embrace Wetbond) were compared, mean microleakage score on both occlusal and gingival margin was more in Group 1 (Charisma/Gluma Comfort Bond). The results were statistically significant (P < 0.05) [Table 2].

DISCUSSION

Composite resins were introduced as restorative material about half a century ago. But till date it has a number of limitations, such as it requires a large number of steps and bonding of composite to enamel is reliable but dentin bonding is still not reliable. Research is going on to introduce a material to combat the drawbacks of composite resins. Therefore, Wetbond has been introduced, which
Microleakage is defined as the clinically undetectable passage of bacteria, fluids, molecules, or ions between a cavity wall and the restorative materials applied to it.[7,8] Microleakage around resin composite restorations results from marginal gaps due to shrinkage that resin composites undergo during polymerization. Oral environmental bacteria may invade a cavity via gaps at the margin of dental restoration resulting in inflammatory alteration of subjacent tissue,[9] discoloration of the restoration, marginal breakdown, recurrent caries, pulpal inflammation, and postoperative sensitivity, which can affect the longevity of the restoration as well as the vitality of the dental pulp.[10-12]

In the present study, all the Class V cavities had same dimensions. No bevel was placed so as to standardize the preparations. In Group 1 (Charisma/Gluma Comfort Bond) cavities were restored with conventional composite, which required acid etching of dentin as well as enamel, application of Gluma Comfort Bond, and insertion of Charisma composite resin. In Group 2 (Embrace Wetbond) teeth were restored with self-priming, wet bonding, water miscible, hydrophilic and hydrobalanced Wetbond, which required only enamel etching and insertion of composite. The same shade A2 was used for both Charisma and Wetbond for standardization.

After restoration the teeth were subjected to thermocycling. Thermocycling is the in vitro process of subjecting the restoration on the tooth to temperature extremes compatible with the oral cavity. This simulates introduction of hot and cold extremes in the oral cavity and shows the relationship between coefficient of thermal expansion between tooth and restorative material.[23]

In Group 1 (Charisma/Gluma Comfort Bond) mean microleakage score at the occlusal margin (1 ± 0.9177) was less than the gingival margin (1.9 ± 1.1653) and the results were statistically significant (P < 0.05). The results are in concurrence with the findings of other studies.[14-16] When the teeth were restored with various composite resins, occlusal margin shows lower microleakage scores than the gingival margin.[17-21] Although the enamel is a reliable substrate for bonding, yet bonding to dentin is far more challenging because dentin is a living tissue, it is heterogenous and its tubular nature provides variable area through which dentinal fluid may flow to the surface on account of pulpal pressure and adversely affect adhesion.[22] In Group 2 (Embrace Wetbond) also mean microleakage score at the occlusal margin (0.25 ± 0.4443) is less than the gingival margin (1.65 ± 1.1821) and the results were statistically significant (P < 0.05). The reason is same as for Group 1 as well.

When compared with Group 1 (Charisma/Gluma Comfort Bond), Group 2 (Embrace Wetbond) exhibited less dye penetration at occlusal as well as gingival margin and the results were statistically significant (P < 0.05). The difference could be attributed to bonding mechanism between tooth and Wetbond as it chemically and micromechanically bond to the tooth structure. But there is no substantial scientific proof that demonstrates the development of significant chemical bonding between dentin adhesives and tooth surface under intraoral conditions.[22] This can be augmented by secondary bonds, which have formed between hydrophilic resins (as in Embrace Wetbond) and tooth. However, a larger sample size combined with in vivo studies seems to be necessary to further investigate the results.

**CONCLUSION**

- Significantly less microleakage was found in teeth restored with Wetbond than traditional composite.
- More microleakage was observed in gingival margins than occlusal margins.

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