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One Year Clinical Evaluation of Two Different Types of Composite Resins in Posterior Teeth

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Abstract

Aim: The aim of this study was to assess the clinical performance of two adhesive restorative systems (Single Bond/Filtek P-60 and Single Bond/Filtek Z-250) in posterior teeth using a modified United States Public Health Service (USPHS) system.

Methods and Materials: A total of 70 restorations were placed in molars and premolars in 30 patients (14 females and 16 males; 18-40 years) by one operator. All restorations were directly evaluated by two examiners at baseline, six months, and 12 months using the following modified USPHS rating criteria: marginal integrity, marginal discoloration, surface texture, contour, postoperative sensitivity, and recurrent caries.

Results: At six and 12 months all restorations were available for evaluation of marginal discoloration, surface texture, contour, postoperative sensitivity, and recurrent caries that remained with 100% Alpha-ratings at recalls for both restorative systems. Marginal integrity for P-60 was scored as 94.3% and 91.4% Alpha at six and 12 months, respectively, and rates for Z-250 were 100% and 97.1% Alpha at six and 12 months, respectively. Statistical analysis was completed with Fisher's exact and McNemar Chi-square tests at a significance level of 5% ($P<0.05$).

Conclusion: All restorations were clinically satisfactory and no significant differences were found among them.

Clinical Significance: Posterior resin composite restorations placed under appropriate conditions provide a satisfactory clinical performance.

Keywords: Composite resins, clinical evaluation, dental materials, posterior teeth

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Introduction

The development of enamel and dentin acid conditioning techniques together with the improvement of adhesive restorative systems have resulted in restorations with a notable increase in durability and longevity because the adhesion of resin composite to dental tissues reduce or eliminate the need for removing healthy dental structures to gain adequate resistance and retention form.[1,2,3] New adhesive systems are being continuously developed to improve the adhesion of resin composite to dental structure,[4] favoring its retention and reducing marginal microleakage.

Based on improvements of the original formulation of resin composite, countless professionals started to substitute these resinous materials for amalgam restorations.[2,3,4,5,6] Although the initial results appeared promising, the intense clinical utilization of resins revealed serious deterioration and longevity problems.[2] As a result, their use in posterior teeth has been questioned, especially in molar teeth.[8]

Concerns have focused on the tendency for excessive wear and polymerization shrinkage that are properties inherent in composite resins. Resin shrinkage generates stresses that may contribute to the disruption of the adhesive bond between the material and the dental structure if not dissipated. This can create gaps leading to marginal leakage resulting in postoperative sensitivity and penetration of microorganisms and/or their toxic products which in turn can cause pulpal lesions and recurrent caries.[3,8] In fact, early resin composite restorations placed in posterior teeth demonstrated severe marginal leakage, occurrence of secondary caries, and substantial loss of material resulting in the loss of anatomic form and malocclusion.[2]

Although composite resins have become substantially better, many problems related to their original formulation have been only partially solved. Unfortunately, the manipulation characteristics of these materials remain relatively unaltered. As a result, restoring posterior teeth with resin composite using the same norms associated with amalgam results in a myriad of problems including postoperative sensitivity and an unacceptably high level of secondary caries.[2]

It is difficult for a clinician to select the most appropriate restorative system for posterior teeth due to the large number of brands of composite material available and with few differences among them. Two products available are Filtek P60 and Filtek Z250 (3M ESPE, St. Paul, MN, USA) which are light-cured, radiopaque composite resins designed for use as a direct posterior restoration with Filtek Z250 also indicated for anterior use. Filtek P60 has a total weight load of 84% and filled to 61% by volume and contains a greater number of smaller particles making it specifically designed for use as both a direct and indirect posterior tooth restorative material.

Many studies have been done to analyze marginal discoloration and integrity; evaluate the color, contour, and surface texture of restorations;

assess the development of secondary caries; and to verify the effectiveness of adhesive restorative systems in the restoration of posterior teeth.[2,4,9-11]

Thus, the aim of this study was to evaluate the clinical performance of two resin composites (Filtek P60 and Filtek Z250) in Class I and II restorations using a modified United States Public Health Service (USPHS) system.

Methods and Materials

A total of 30 patients (14 females and 16 males), ranging in age from 18 to 40 years old were chosen for the study. Most of subjects were policemen from a corporation established in Bauru, SP, Brazil. They were properly informed about the study, and the project was approved by the ethics committee of the Bauru School of Dentistry. The criteria for inclusion were:

- Appropriate oral hygiene
- Low decay index
- Absence of periodontal disease
- Absence of parafunctional habits
- Presence of a minimum two posterior teeth (molars and/or premolars) with carious lesions
- Teeth with unsatisfactory restorations in need of replacement

The ratio of Class I to Class II restorations and the ratio of premolars to molars were 1:2.

Each patient received a minimum of two restorations placed with the adhesive restorative systems, Single Bond/P-60 and Single Bond/Z-250 (3M ESPE, St. Paul, MN, USA), as described in Table 1. The restorations were placed in premolars and molars; some in carious teeth, and some in unsatisfactorily restored teeth as presented in Table 2.

Clinical Procedures

The teeth were carefully cleaned with a slurry of pumice, rinsed with water, and air dried. All restorations were placed by the same operator

Table 1. Composition of the materials, lot number, and manufacturer.

Material	Composition	Lot	Manufacturer
Single Bond	Ethanol, BIS-GMA, HEMA, glycerol, dimethacrylates, copolymer of polycarboxylic acid, and canforoquinona	09099	3M
Filtek P60	BIS-GMA, BIS-EMA, urethane dimethacrylate, aluninum oxide, silica, and zirconia	09099	3M
Filtek Z250	BIS-GMA, BIS-EMA, urethane dimethacrylate, silica, and zirconia	12090	3M

Table 2. Number of restorations performed according to tooth groups and etiology of the treatment.

Material	Tooth Group			
	PM	M	Carious	Other than Caries
Single Bond + Z250	17	18	4	31
Single Bond + P60	16	19	3	32
Total	33	37	7	63

and rubber dam isolation was used in all cases. Care was taken to produce cavities with adequate dimensions.

The removal of unsatisfactory material (amalgam and/or resin composite) and the final cavity preparation were carried out with a #245 carbide bur (Jet Burs, Sybron Beavers Dental, Morrisburg, Ontario, Canada) at high speed using a water coolant. All internal angles were rounded, and the dislodged enamel prisms along the gingival wall were removed with a gingival margin trimmer. Cavity preparation margins were finished with smooth-spherical burs in a size compatible with the cavity using a conventional low speed handpiece (20,000 RPM). Cavosurface angles were sharp with the external surface of the tooth with no bevel.

Cavity preparation and the application of adhesive materials were carried out by a single operator.

Every detail of the cavity preparation such as the following was recorded:

- Cavity depth
- Presence of enamel at the cervical margin
- Presence of sclerosed dentin
- Possible pulp exposure
- Presence of fissures and defects in the enamel and cavity extensions

The surface treatment of substrates (enamel and dentin) was performed according to the manufacturer´s instructions, and the resin composite was inserted into the cavities in increments of 2 mm of maximum thickness. Each increment was inserted to provide the greatest free surface area possible to accommodate the stress generated during polymerization contraction. Each increment was light cured for 40 seconds using a XL 3000 visible light cure unit (3M Dental Products, St. Paul, MN, USA) with minimum power density of 600mW/cm^2. In Class II cavities the proximal wall was reconstructed to transition into a Class I cavity. Resin insertion in the occlusal box was done using cone-shaped increments similar to a progressive waxing technique.

Excessive composite material was removed immediately then the intermediate finishing was done after one week. The finishing was done starting with a 12-fluted tungsten carbide bur (Jet Burs, Sybron Beavers Dental, Morrisburg, Ontario, Canada), followed by using the Enhance Polishing System (Dentsply, Rio de Janeiro, Brazil), and then with Sof-Lex polishing discs (3M Dental Products, St. Paul, MN, USA).

Clinical Evaluation

The operator who placed the restorations was not involved in the evaluation process. Two examiners blinded to the identity of the restorative materials used evaluated all restorations using modified USPHS criteria (Table 3). The criteria were used to evaluate marginal discoloration, marginal integrity, surface texture, contour, postoperative sensitivity, and recurrent caries at baseline, after six months, and at one year. The data collection forms used at baseline and all recall periods were identical.

Statistical Analysis

Comparisons of ratings for restorations and between baseline and follow-up examinations were analyzed using the Fischer and McNemar Chi-square tests for each category. The value $p \leq 0.05$ was set as the standard value considered to demonstrate statistically significant differences.

Results

All patients were available for six and 12-month recalls. The restorations were evaluated for marginal discoloration, surface texture, contour, postoperative sensitivity, and recurrent caries remaining with 100% Alpha-ratings for both restorative systems. No statistically significant differences were found between the materials at six months and one year in any of the evaluation criteria. The only criterion that presented a numerical (but not statistically significant) difference was marginal integrity, which is presented in Table 4.

Figure 1 illustrates the restoration of molar tooth that had an unsatisfactory restoration. Figure 2 illustrates a Class II cavity preparation for the restoration of a molar tooth that had a carious lesion.

Discussion

The use of posterior resin composites has grown considerably. Nevertheless there are a number of problems associated with the use of direct restorations. *In vivo* studies with previous composites have reported poor wear resistance in contact areas, difficulty in generating favorable proximal contours, lack of an appropriate contact,

Table 3. Modified-USPHS rating criteria.

Category	Rating	Criteria
Marginal Discolaration	Alfa (A)	No discoloration
	Bravo (B)	Superficial staining (without axial penetration)
	Charlie (C)	Deep staining (with axial penetration)
Marginal Integraty	Alfa (A)	Closely adapted, no visible crevice
	Bravo (B)	Visible crevice, explorer will penetrate
	Charlie (C)	Crevice in which dentin is exposed
Surface Texture	Alfa (A)	As smooth as the surrounding enamel
	Bravo (B)	Rougher than surrounding enamel
	Charlie (C)	Very rough
Contour	Alfa (A)	Continuous
	Bravo (B)	Discontinuous, no dentin exposed
	Charlie (C)	Discotinuous, dentin exposed
Postoperative Sensivity	Alfa (A)	None
	Charlie (C)	Present
Recurrent Caries	Alfa (A)	No caries present
	Charlie (C)	Caries present

Table 4. Data from marginal integrity.

	Baseline		6 Months		12 Months	
	A	B	A	B	A	B
P-60	100	0	94.3	5.71	91.4	8.6
Z-250	100	0	100	0	97.1	2.9

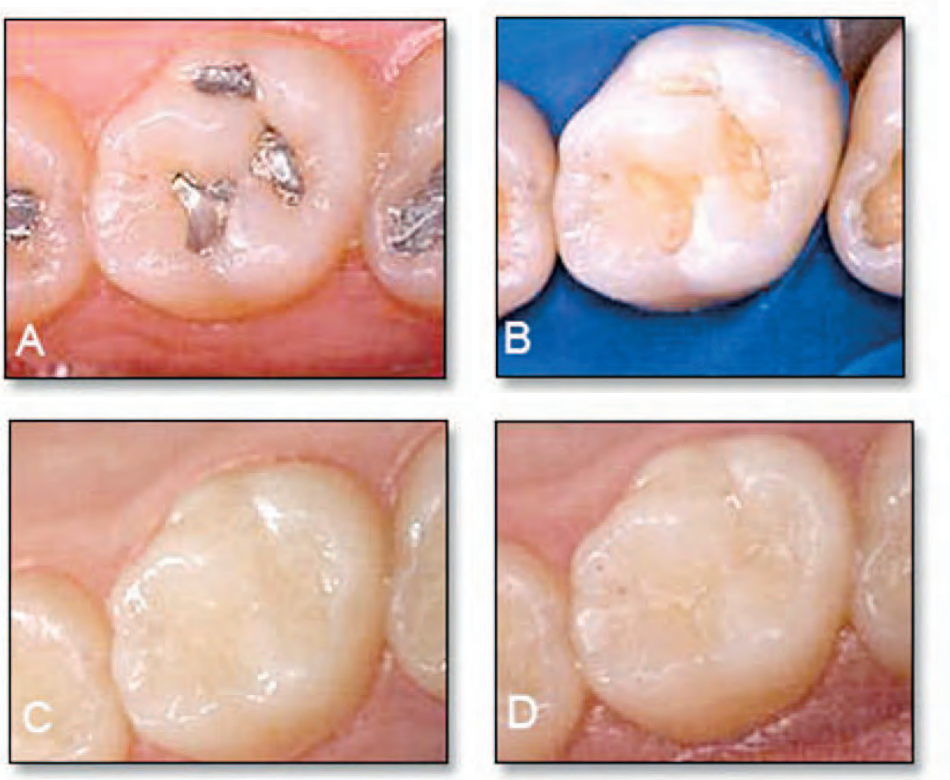

Figure 1. A. Initial condition **B.** Cavity preparation **C.** Baseline **D.** One year follow-up.

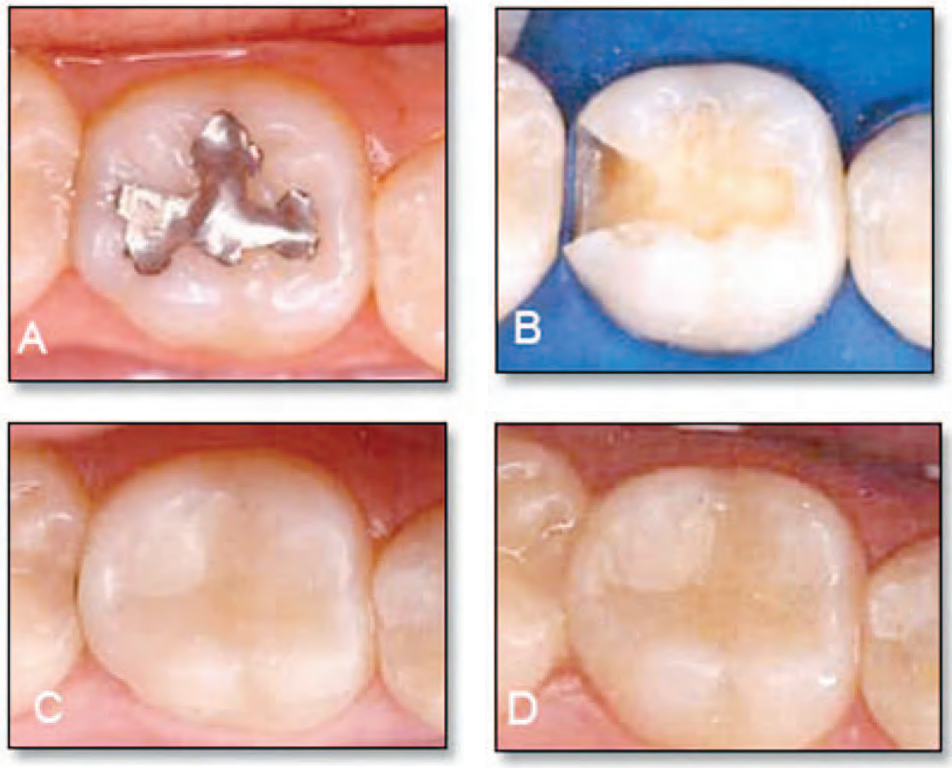

Figure 2. A. Initial condition **B.** Cavity preparation **C.** Baseline **D.** One year follow-up.

inadequate marginal integrity, and postoperative sensitivity.[2,12-15] Most of these problems have been addressed with recently developed composite materials.

The sample size of 30 patients, the number of restorations (35 per material), the distribution of restoration (maximum of three pairs in the same patient), the ratio of Class I to Class II restorations, and the ratio of premolars to molars were 1:2 and are in accordance with American Dental Association guidelines for testing a new material.[16]

All patients were available in all evaluated periods resulting in a recall rate of 100%. Availability is expected to be high at other evaluation intervals because of a contractual agreement between the Bauru Military Police and the School of Dentistry for this project as the majority of the subjects are officers in the Bauru Military Police.

There were no statistically significant differences among the tested materials using the evaluation criteria, and the restorations were rated as clinically acceptable. It can be suggested the lack of a significant difference occurred due to similarities in the chemical composition of the composites used (Table 1). However, differences could develop over longer periods of use. It is possible a better performance can be obtained using Filtek P60, since it is a resin composite specifically designed for restoring posterior teeth. It contains higher concentrations of filler particles (P60 = total load of 84% by weight and Filtek Z250 = total load of 78% by weight).

According to Leinfelder et al.[2] only those professionals who really take the necessary time to fabricate a composite resin restoration by precisely following all required procedures expect a high level of success. These procedures include the application of the adhesive system, insertion of the material, use of proper light-cured techniques as well as appropriate finishing and polishing of the restorations.

Contour, surface texture, and marginal discoloration presented 100% Alpha and were essentially unchanged from baseline for all restorations. This is due to the composition of the microhibrid resin system with an organic matrix of TEGDMA, UDMA, and bis-EMA.

A few resin composite restorations (1 for Z-250 and 2 for P-60) exhibited a decline in rating for marginal integrity (Alpha to Bravo). This is probably due to small fractures of the cavosurface margin and restorative material. Excellent marginal integrity with no postoperative sensitivity can be attributed to the quality and the efficient application of the adhesive system. Türkün and Aktener[11] differed in their one year results with a slight crevice found along the marginal interface with 11.5% of Z-100 restorations being Bravo-rated and 16.7% of Prisma TPH restorations also being Bravo-rated. Lopes et al.[3] also differed in their findings at a one year evaluation with a decline of Alpha to Bravo (1 to Prodigy Condensable and 8 to Definite).

The results of this study revealed an excellent level of quality in the composite resin restorations with no unacceptable restorations in any aspect of the evaluation. Krejci, et al.[9] in a 12-month evaluation of posterior composite restorations demonstrated the same results with 98-100% Alpha for evaluated criteria. In another study of two year clinical evaluation Türkün and Aktener[8] recorded the same results with all restorations rated as excellent for color match, marginal discoloration, and anatomical form.

Conclusions

After one year of clinical evaluation, all restorations appeared to be clinically acceptable. Therefore, a longer observation period is indicated for substantiating the clinical performance of composite resin systems.

Clinical Significance

The preliminary results using the two adhesive restorative systems showed posterior composite resin restorations placed under appropriate conditions provide a clinically satisfactory performance.

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