

T. O. Närhi · J. Tanner · I. Ostela · K. Narva ·
T. Nohrström · T. Tirri · P. K. Vallittu

Anterior Z250 resin composite restorations: one-year evaluation of clinical performance

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Abstract The purpose of this practice-based study was to compare the clinical performance of a new universal composite resin material (Z250) used for Class III and V cavities in anterior teeth. Restorative materials (Z250 and Z100; 3 M ESPE) placed by six operators were used for a total of 150 restorations during the 6-month enrollment period. After 1 year, 141 restorations (76 Z250 and 66 Z100) were available and evaluated for overall quality, color match, marginal adaptation, surface appearance and the presence of secondary caries, using modified USPHS criteria. The overall quality was excellent for both materials and no significant changes were noted during the follow-up. None of the scores between the two materials were statistically significant. Major changes were seen in color match and surface appearance. At baseline, the color match of 71% of Z250 and 62% of Z100 was rated as Alfa, after 1 year the figures were 60 and 65%. Regarding surface appearance, 97% of the Z250 were rated Alfa at baseline, whereas at 1 year the figure was 76%. For Z100, the scores were 94 and 79%, respectively. After 1 year, the clinical performance of Z250 restorative composite resin was clinically acceptable and similar to that of Z100.

Keywords Composite resin · Esthetics · Margin · Surface

Introduction

Various clinical studies have found that 63–82% of all Class III and V composite resin restorations remain acceptable after 5 years of clinical service [4, 5, 8], although their esthetical appearance may disappear much

faster. Altering the amount and quality of the filler particles can change the esthetics and mechanical properties of restorative composite resins. Furthermore, lowering a material's viscosity by modifying the composition of the monomer system permits a higher filler load and at the same time improves the handling properties. Recently, a new restorative composite resin with a new resin system has been introduced on the market.

The purpose of this study was to evaluate the short-term clinical performance and esthetic qualities of a novel restorative composite resin in anterior Class III and V restorations, and to compare it with a traditional hybrid composite resin material.

Materials and methods

Two light curing restorative composite resin materials (Z250 and Z100; 3 M ESPE, St. Paul, MN, USA) were evaluated. The resin system of Z250 consists of urethane dimethacrylate (UDMA)/Bisphenol A polyethylene glycol diether dimethacrylate (BIS-EMA)/TEGDMA, whereas in Z100 it is A-glycidyl methacrylate (BIS-GMA) and TEGDMA. Similar types of fillers (100% zirconia/silica) with a particle size distribution of 0.01 μm to 3.5 μm , and an average particle size of 0.6 μm , are used in both materials. Z250 restorative contains a larger number of small particles than does Z100. Both materials were provided for six general practitioners working in five different dental offices in Finland (in the cities of Turku, Salo and Hyvinkää). Each dentist was assigned to make 32 restorations, 16 Class III and 16 Class V restorations, during a 6-month enrollment period. Healthy adults were recruited for the study, excluding patients whose history revealed parafunctional habits or use of medications that potentially could cause hyposalivation. All cavities were restored using either Z250 or Z100 restorative composite resin. Materials were randomly allocated using a computer program taking into account the jaw and the cavity class. Thus, each dentist was provided with 32 envelopes (16 for mandible and 16 for maxilla) indicating the type of restoration material they ought to use. Envelopes were opened after the cavity preparation. The dentist was unaware of the type of restorative material to be used during the tooth preparation. Written informed consent was obtained from each subject.

All cavities, including the dentin, were acid etched for 30 s, rinsed thoroughly for 15 s, bonded with Scotchbond Multipurpose (3 M ESPE) and light cured for 10 s (Visilux, 3 M ESPE) prior to placing the filling material. Restorations were light cured for 40 s, finished with diamond burs and polished with Kenda hybrid

T. O. Närhi (✉) · J. Tanner · I. Ostela · K. Narva · T. Nohrström ·
T. Tirri · P. K. Vallittu

Department of Prosthetic Dentistry and Biomaterials Research,
Institute of Dentistry, University of Turku,
Lemminkäisenkatu 2, 20520 Turku, Finland
e-mail: timo.narhi@utu.fi
Tel.: +358-2-3338295
Fax: +358-2-3338390

Table 1 Clinical assessment criteria for the restorations (criteria for rating the overall quality)

Alpha: Restorations without faults	
No defects	
Single pit	
Bravo: Minor defects; restorations should be observed	
Marginal discoloration	
Discoloration of the restoration surface	
Ditching	
Limited wear	
Charlie: Major faults; restoration should be replaced within the next few weeks	
Missing proximal contact	
Significant wear	
Delta: Restoration must be renewed at once	
Fracture of the restoration	
Secondary caries	
Tooth fracture	
Pulpitis/persistent postoperative pain	
Loss of restoration	
Renewal for other reasons	
Specific criteria for rating the restorations	
Surface appearance	
Score A:	Glossy or glass like surface
Score B:	Dull, matte surface
Score C:	Shallow surface pitting is present
Score D:	Deep surface irregularities are present
Color match	
Score A:	The restoration matches in color and translucency to the adjacent tooth structure
Score B:	The mismatch in color and translucency is within the acceptable range of tooth color and translucency
Score C:	The mismatch in color and translucency is outside the acceptable range of tooth color and translucency
Marginal adaptation	
Score A:	No discoloration is present anywhere on the margin between restoration and tooth structure
Score B:	The discoloration has not penetrated along the margins in a pulpal direction
Score C:	The discoloration has penetrated along the margin in a pulpal direction
Secondary caries	
Score A:	Restoration is judged caries free
Score B:	Secondary caries is detected

composite pre- and super-polishers (Kenda, Vaduz, Liechtenstein). Class V restorations were placed using transparent cervical matrices (Hawe Neos Dental SA, Bioggio, Switzerland). All tooth preparation and restoration was carried out using magnifying loops.

Restorations were evaluated at baseline and after 1 year. Modified USPHS criteria described by Geurtsen and Schoeler [3] were used for rating the overall quality of the fillings. Surface appearance, color match, marginal adaptation, discoloration and anatomic form, as well as the presence of secondary caries, were analyzed using the specified criteria (Table 1).

Altogether, 150 restorations were placed in 48 subjects during the 6-month enrollment period and 141 were available for follow-up evaluation (75 Z250 and 66 Z100). The nine restorations that were lost from follow-up were placed in three subjects. These subjects could not be located after 1 year.

Baseline evaluations of the restorations were made during a separate appointment approximately 1 week after finishing the tooth restoration. The clinicians who placed the restorations also

completed the evaluation forms. The clinical evaluation procedure was familiarized with the practitioners in a study group meeting both before the commencement of the study and again before the 1-year recall.

Statistical analysis was performed using an SAS program. Chi square test was used to study differences in category variables between the two groups.

Results and discussion

In order to maintain the study group, clinical evaluations had to be organized in the practices where the restorations were made. An effort was made to simplify the evaluation process. Previously described evaluation criteria [2, 3] were modified and used for the clinical evaluations.

Half of the Class III or Class V restorations were placed due to caries (secondary or primary). Previous studies have also shown that secondary caries is the most prevalent reason for replacing a restoration, regardless of the material used for restoring the tooth [1, 7].

Surface discoloration was also a frequent indication for renewing a Class III restoration (30%), whereas poor marginal adaptation was the second most common indication for replacing a Class V restoration (29%). Good visibility of the Class III restorations may explain the fact that many of the old Class III restorations are replaced due to surface discoloration. Class V restorations usually extend onto the root surface and are only partly bonded to enamel. In old Class V restorations, dentin bonding has been poor, which may be the reason for their insufficient marginal adaptation. On the other hand, microfilled restoratives have frequently been used in small anterior restorations. A significantly higher rate of marginal discoloration has been reported for microfilled restoratives than for other types of composite resins [6].

No significant differences in the overall quality of the restorations were observed between the two materials at baseline and after 1 year. At baseline, 98% of Z100 and 96% of Z250 restorations were rated as Alfa. None of the restorations were regarded as unacceptable. At 1 year, 96% of Z100 and 86% of Z250 restorations received an Alfa rating, while the remaining restorations were rated as Bravo.

A 1-year follow-up period is short but it can be sufficient for detecting material-related initial changes in color and surface topography. In this study only minor changes were noticed in the specific variables studied, none of them being statistically significant. The greatest difference was seen in the surface appearance; of the Z250 restorations, 97% scored Alfa at baseline, whereas at 1 year the score had reduced to 76%. For Z100, the Alfa scores were 94 and 79%, respectively.

At baseline, the Z250 composite resin restorations demonstrated a better color match with the neighboring teeth; 70% of the restorations were rated as Alfa compared to 62% of the Z100 restorative. At 1 year this difference disappeared as the number of Z250 restorations with Alfa rating decreased to 60% while 65% of Z100 received Alfa rating. One reason for this could be their

chemical composition. Z250 restorative composite contains an UDMA/BIS-EMA/TEGDMA monomer system, which after polymerization results in polymer matrix with higher water sorption than that of Z100, which has a BIS-GMA/TEGDMA monomer system. Generally, it must be emphasized that the differences between the materials in this respect were small and not statistically significant.

Marginal adaptation was found to be good for all the restorations, with 93% of the Z250 and 98% of Z100 scoring Alfa at baseline. At the 1-year follow-up these figures decreased slightly, 89% of both materials receiving an Alfa rating.

Conclusions

Within the limitations of this study it can be concluded that both the Z100 and Z250 restorative composites have equal clinical appearance after 1 year, with both materials demonstrating satisfactory clinical performance.

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