

Evaluation of Sealing Ability of New Composite Filling Material

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Key words

tetric T-econom,
evo ceram, IPS
empress,
microleakage.

Abstract

This study was conducted to investigate the sealing ability (microleakage) of new composite restorative materials at tooth/composite interface.

Thirty non carious, extracted human premolars teeth were mounted in acrylic resin, the teeth were randomly divided into three groups (n=10) according to the type of composite (tetric T-Econom, Evo ceram,IPS Empress). A standardize class V (5×3×2) mm dimensions cavity was prepared on the facial surface of each tooth (each group with corresponding bur type). After the specimens were filled with three types of composite restoration. They stored for one month in 37°C distilled water, thermo cycled for 500 cycles between (5°C & 55°C) and immersed in 2% methylene blue solution for 24h., and then sectioned longitudinally. For both occlusal and gingival margins, dye penetration at the tooth/composite interfaces were scored from 0-3 under stereomicroscope at a magnification x10. Data were analyzed using unpaired T-test, ANOVA, and Duncan's multiple rang test at 5% significant level.

Kruskal-wallis test show that there was a significant difference in microleakage between the three types of composite it represent that there was less microleakage in group filled with IPS Empress while tetric T-Econom show the highest leakage.

There was no significant difference in microleakage between IPS Empress and Evo ceram composite filling.

AS Conclusions; Within the limitations of this in vitro study the results show that there was less microleakage in the cavities filled with IPS Empress composite and EVO ceram composite as compared with Tetric T-Econom composite.

Introduction

There have been more changes and developments in dentistry over the past decade than in the previous hundred years. In the current age of adhesive dentistry or

microdentistry, conservation of tooth structure is paramount. The growing demand for tooth-coloured restorations and the quest for amalgam replacements have led to an increased demand for direct composite materials in the past few years. Dental manufacturers have developed modern composites and ceramic-based materials, which are almost

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indistinguishable from natural dentition. Nanocomposites are the premises of new materials that can be applied in many fields due to their improved mechanical properties (determined by the reinforcement of nanoparticles in the organic part), to their lightweight, and to their light conducting properties.⁽¹⁻⁵⁾ It is important for the longevity of resin composite restorations that the formation of marginal gaps and cracks can be prevented or at least controlled to the greatest degree possible, if this could be achieved, it would be possible to minimize microleakage and its consequences, such as post operative sensitivity, pulp inflammation and caries recurrence, which are known to jeopardize the clinical longevity of the restoration^(1,2). Dentinal surface morphology and smear layer formation are the main factors in the successful union of dental structure and restoration⁽³⁻⁸⁾. There has always been a keen interest in the adaptation of dental restorative materials to the wall of the cavity and the retentive ability of a material to seal the cavity against ingress of oral fluids and microorganisms⁽⁹⁾. New adhesive systems continually have been improved to obtain an effective sealing at tooth/restoration interfaces. Polymerization contraction stress is still one of the major problems when restoring teeth with resin composite since a contraction forces can be created and may disrupt the bond to cavity walls or create stresses to surrounding tooth structure and may result of tooth cracks or fractures. The Polymerization shrinkage and the viscosity were found to be a significant determinants of gap formation around resin composite^(1,10,11). Microleakage is defined as the clinically detectable passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative materials applied to it and is the major problem in clinical dentistry. Achieving a micromechanical and biomechanical bond between the restoration and tooth is considered effective and a standard procedure in clinical practice.^(6,12) The purpose of this in vitro study was to evaluate the sealing ability (microleakage) of new types of resin composite restorative

materials at the restoration/tooth structure interfaces.

Materials and Methods

This study was performed in vitro on 30 human premolar teeth after polishing the teeth with rubber cup and pumice, they were checked for caries and crack and exclude any tooth if has problem. The teeth were stored in normal saline before cavity preparation, and then standardized class V cavity preparation on buccal surface was done. The cavities were 5mm in length, 3mm in width and 2mm in depth 1.0 mm below and 1.0 mm above the cemento-enamel junction. The cavities were prepared using a diamond straight fissure burs No.1092 (KG Sorensen Ind com. Ltd., Brazil) using a high speed turbine under constant water cooling, cavosurface walls were finished to a butt joint to standardize the cavities (each 1 bur was used to prepare five cavities)⁽²⁾. The cavities were conditioned with 37% phosphoric acid (Vivadent, Liechtenstein) for 30 seconds on the enamel and 15 seconds on the dentin, and then rinsed with a spray of water and air for 60 seconds. Excess water was removed from the dentin using a cotton pallet, which remained in position during the drying of the enamel to keep the dentin moisture. The adhesive system (Excite bonding agent) (Vivadent, Liechtenstein) was applied according to the manufacturer's instructions using a disposable applicator. The solvent was evaporated with a gentle air-blast for five seconds, and the adhesive was light-cured using a halogen light (Viva dent, Schaan Liechtenstein, Austria) for 20 seconds with a standard light at 480 mw/cm² assessed with a radiometer every 5 restorations. Then the specimens were divided into 3 major groups according to the restorative material 10 cavities for each

Group I: cavities filled with universal composite Tetric T-Econome (Vivadent, Liechtenstein) The restorations were placed in two increments with each layer not being more than 1mm thickness and light cured for 40 seconds, then the

restorations were finished and polished with Sof-Lex disks (3M,USA).

Group II: cavities were filled with Evo ceram composite (Vivadent, Liechtenstein) The restorations were placed in two increments with each layer not being more than 1mm thickness and light cured for 40 seconds, then the restorations were finished and polished with Sof-Lex disks (3M,USA).

Group III: cavities filled with IPS Empress composite (Vivadent, Liechtenstein) The restorations were placed in three increments (according to the manufacturer instructions dentin which is the first layer then enamel which is the second layer and translucent which is the superficial layer) with each layer cured for 40 seconds, then the restorations were finished and polished with Sof-Lex disks (3M,USA).

Then all teeth were stored in distilled water at 37°C for one month. After this the teeth were thermocycled 500 time at a temperature of 5°C±2°C and 55°C±2°C, with dwell times of 60 second in each water bath and 60 second transfer time between the baths⁽¹⁾. For all specimens the entire tooth surface were painted with two coats of nail varnish except for an area of 1mm a way from the cavosurface margins to prevent dye penetration anywhere other than the restoration margins. The samples were immersed in 2% methylene blue solution at 37°C for 24hs⁽¹⁰⁾. Then the teeth were rinsed in running water, dried and then sectioned buccolingually at the center of the cavity using a diamond wheel saw (KG Sorensen SP, Brazil). Dye penetration at the occlusal and gingival margin was examined blind and independaly by two evaluators using a stereomicroscope (Hamilton by AITAY International Italy) at a magnification level of x10 scored according to the following criteria as described by Santini etal⁽¹³⁾ (Figure 1).

0: no dye penetration.

1: dye penetration to less than the half of occlusal or gingival wall.

2: dye penetration along the occlusal or gingival wall but not including the axial wall.

3: dye penetration to and along the axial wall.

The data was subjected to statistical Analysis to compare the microleakage at the tooth composite interface using non parametric kruskal-wallis test was conducted to find if there was a significant differences in the leakage among the groups at (p<0.05).

Results

The mean values and standard deviations frequency of microleakage scores of all groups are presented in table (1). Kruskal-wallis test Show that there was a significant difference in microleakage between the three types of composite (p>0.05). table (2). There was no significance difference between IPS Empress and Evoceram filling although the leakage score of IPS empres is less than Evo ceram but this statistically not significance. Tetric T-Econom filling show significantly high score of leakage than the other groups.

Discussion

Microleakage is defined as the clinically detectable passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative materials applied to it and is the major problem in clinical dentistry. Achieving a micromechanical and biomechanical bond between the restoration and tooth is considered effective and a standard procedure in clinical practice.⁽¹⁴⁾ Results of this study showed that group filled with Tetric T-Econom composite produced more leakage than the other groups filled with tetric Evo ceram and IPS Empress composite.

This decrease in microleakage in cavities filled with this new composite materials could be related to the factors that this composite has high filler load, the nano filler technologies decrease the percentage of organic monomers which is responsible for increasing the hygroscopic expansion of composite which is the main cause of increasing of leakage. (It can be seen that the mechanical properties depend on the

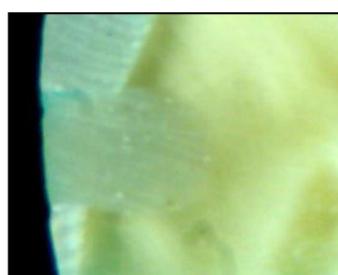
nature and the concentration of the inorganic filler).In this study statistical analysis showed no significant differences in microleakage between the IPS Empress and Evo ceram resin composites and this may be due to the insertion technique used in this study also the use of same color shade which may be reduce the effect of colorants on light polymerization in addition to the use of same curing unit. This result agree with the results of Gupta et al⁽¹⁴⁾ they show that the nanofiller composite give least leakage as compared with other filling materials.

Conclusions

Within the limitation of this invitro study, it could be concluded that:
All the restorative materials used in the study were unable to prevent the microleakage completely. Out of all the restorative materials.there was less microleakage in the cavities filled with IPS Empress composite and tetric EVO ceram composite as compared with Tetric T-Econom composite.



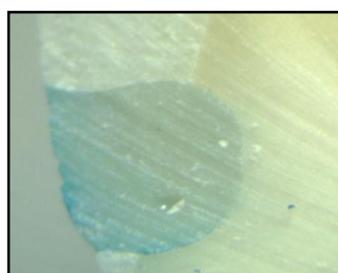
(1):- Sectioned tooth represent no dye penetration.



(2):- Sectioned tooth represent score (1) of dye penetration.



(3):- Sectioned tooth represent score (2) of dye penetration.



(4):- Sectioned tooth represent score (3) of dye penetration.

Fig.(1):- show the die penetration score.

Table (1) :- Descriptive Analysis Of Micro-Leakage For three types of Composite Restoration.

Type of Composite	N	Min.	Max.	Mean	SD.	Frequency of Scores (%)			
						0	1	2	3
Group I T-Econom	10	1.00	3	1.7	0.67	–	40	50	10
Group II Evoceram	10	0	1	0.6	0.52	40	60	–	–
GroupIII Ips empres	10	0	1	0.4	0.52	60	40	–	–

Table(2):- Comparison of Micro-Leakage Among Different Types Of Composites restorations.

Type of Composite	N	Chi-Square	Significance
T-Econom	10	14.88	0.001*
Evoceram	10		
Ips empress	10		

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