Evaluation of the effect of preheating on micro leakage of Class II composites Restoration (A comparative in vitro study)

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ABSTRACT

Background: The aim of this in vitro study was to evaluate and compare the effect of preheating microleakage among three different filler size composites which include Filtek™ Z250 micro hybrid, Z250™ Nano hybrid and nanocomposite Z350™. In Class II cavity preparation.

Materials and methods: sixty maxillary first premolars were prepared with class II cavities. Samples were divided into three groups according to material used Group A (FiltekZ250 micro hybrid), Group B(Z250™ Nano hybrid). Group C (nanocomposite Z350™)and each group divided into two subgroups of ten teeth according to temperature of composite: Group A1 Teeth are restored by composite at room temperature(24±1˚C), A2 Teeth are restored by same composite at preheated temperature(54±1˚C). After 24 hrs. immersion in 2% in methylene blue, samples were sectioned and micro leakage was estimated.

Results: The greater scores of micro leakage mentioned in Group A( Z250 micro hybrid) in cervical margin while in Group B( Z250™ Nano hybrid) and Group C (Z350™ nanocomposite) have least score of micro leakage especially in occlusal margin.

Conclusions: The scores of micro leakage for all groups varied with different material, margin and temperature. Generally, preheating decreased micro leakage in all groups of composites but Preheating decreased micro leakage effectively in Z250 micro hybrid more than Z250™ Nano hybrid and Z350™ nanocomposite micro leakage .

Key words: Microleakage, preheating, Class II restoration. (J Bagh Coll Dentistry 2017; 29(2):21-25)

INTRODUCTION

Increasing esthetic demands and side effects of mercury in amalgam are making direct composite restorations more popular than conventional amalgam restorations(1). Polymerization and degree of conversion of the composite are the most important features which responsible for clinical success of the composite restorations (2). Composites with high viscosity are very difficult to adapt well to cavity preparations and may cause unnecessary voids, while the composite with low viscosity (flowable composites) easier to use, since many factors which affect the viscosity of resin. (3). High polymerization shrinkage considered most determining factor for success of direct resin composite restoration .throughout polymerization, the pre gel phase changes to a post gel phase. Since during the pre-gel stage, the resin can reorganize themselves without elaborating more internal and interfacial stresses to compensate the volumetric shrinkage (3). While, in the post gel stage ,the resin has partially set and has no more internal and interfacial stresses (plastic deformation) to compensate for any volumetric shrinkage.

So, tensile stresses are elaborated at the resin tooth interface and causes pulling of the material away from the tooth surfaces (4). Configuration factor(C-factor) is the ratio of unbonded to bonded surface which makes changing in the polymerization shrinkage of the restoration. Only free surfaces of a restoration are consider as a margin for plastic deformation in the pre gel stage. So, clinically decreasing the C-factor, cause decreasing the polymerization shrinkage(5)

Recently, low viscosity composites used due to its ability to increases adaptation and decreases micro-leakage along the restoration tooth interface. Many efforts have been made like using flowable composites, fiber inserts, or chemical and laser treatments of dentin (6). Preheating of composite resins before photopolymerisation causing decrease viscosity and increase flowability by increasing the degree of conversion. Both the radical and monomer mobility increases causing more highly cross-linked polymer network, When temperature increases(7). Mechanical and physical properties of the composite are increased due to increase in conversion ,in addition, pre-warming composites have a better surface hardness and greater depth of cure (8).

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MATERIALS AND METHODS
Sixty sound human maxillary premolar teeth used in this study collected from multiple health centers extracted for orthodontic reasons from patients with age range from 18-22 years, these teeth were stored in distilled water at room temperature, for a maximum of three months before samples were used in the study. Dehydration of the samples was avoided by kept it in distilled water through all stages of the study. Exclusively sound teeth with no cracks when checked by using trans-illumination fiber optic of the light curing unit and with regular occlusal anatomy and approximately mimic crown size were chosen to decrease disturbing variables (10). Digital caliper used to measure the maximum bucco-lingual and mesio-distal dimensions and inter-cuspal distance for each tooth (11). A restoration template was prepared; Acrylic Teeth upper first molar and upper second premolar were inserted in self-cure acrylic resin in a metal box of (8×12 cm), then a hole for the experimental tooth was drilled representing the space of upper first premolar. These were put in one piece of self-cure acrylic resin and acrylic canine was inserted in a second piece of the cold cure acrylic resin alongside other teeth the two pieces were originally one piece then divided into two parts to accommodate the concept of the device and trimmed gradually to fit in the metal box. A screw was used to position the teeth in contact with each other The space for the experimental tooth was filled with condensation silicon material (light body) prior to placement of the tooth to simulate the periodontal ligaments. The experimental tooth was fixed in the restoration template then make a cavity of the tooth using dental surveyor (13). All the cavity preparations of specimens standardized by using a modified dental surveyor. The specimen was positioned on surveyor’s table which fixed in the horizontal plane, a high speed handpiece was attached to modified arm, and by moving these arm mesially and distally created a mesio-occluso (MO) cavity. Flat-ended fissure Diamond bur was used to perform all preparation and every four preparations bur was substituted by a new one to preserve cutting efficiency On mesial surface of each sample , a standardized Class II cavity was prepared (3mm buccopalatal width, 3-4mm axial height measured from 1mm above the cemento- enamel junction, and 2mm misodistal depth) with occlusal extension 2mm away from distal tooth margin , width 3 mm, 2mm depth then all preparations were cleaned with water from triple dental syringe for 30 seconds and dried with cotton palate for 15 seconds before restoration (14). Three groups of Specimens are prepared in extracted non-carious premolars, each group consist of 20 teeth, which divided to two subgroup each one consist of 10 teeth previously stored in deionized distilled water at room temperature.

Group A: The teeth are restored by Filtek tm Z250 micro hybrid universal ; Group A1: Teeth are restored by Filtek tm Z250 micro hybrid universal at room temperature(24±1˚C).Group A2: Teeth are restored by Filtek tm Z250 micro hybrid universal at preheated temperature(54±1˚C).

Group B: The teeth are restored by Z250 Nano hybrid; Group B1: The teeth are restored by Z250 Nano hybrid at room temperature (24±1˚C).Group B2: The teeth are restored by Z250 Nano hybrid at preheated temperature (54±1˚C).

Group C: The teeth are restored by nanocomposite ; Group C1: The teeth are restored by Z350 nano hybrid universal at room temperature (24±1˚C).Group C2: The teeth are restored Z350 nano hybrid universal at preheated temperature (54±1˚C). All cavities was etched with 37% phosphoric acid for 15 seconds, washed thoroughly by water for 15 seconds and dried for 15 seconds with absorbent paper , Then bonding agent, scotch Bond, was applied according to the manufacturer instructions, by brush for two layers and left for 10 seconds to allow the solvent to evaporate then cured for 10 seconds with a light cure device (type LED, light intensity: 856mW/cm2). Digital radiometer used to check the intensity of curing device before every single use of curing to make sure good curing light then metal band OMNI-MATRIX (Ultradent-USA) was used around each prepared tooth for all groups and then inserted wooden (10) Approximately 2 mm composite increments applied in all restoration groups then light-cured for 20 sec for each increment for both control (room temperature) and preheated groups. In control groups the composite increments applied directly and cured ,While in preheated groups the Preheated unit used to warm composite to specific temperature(54±1˚C) as shown in Figure(1A) then using the sensor metal rod to ensure that the temperature of material reached (54±1˚C) as shown in Figure(1B), after that composite applied to cavity in Preheated group immediately after taking it out from the preheated unit. Excess materials are removed with a No.170 bur, then finishing and polishing with disk system (TOR VM Russian Dental Manufacturing company) as shown in Figure (1D).

Evaluation of the effect...
dye penetration <half the length of cervical wall, 2: dye penetration up to full length of cervical wall, 3: dye penetration up to half length of the axial wall, 4: dye penetration along full the axial wall. (14) Statistical analysis of the collected data analyzed using SPSS (Statistical Package for the Social Science) (version 20). statistical methods used to analyze and assess the result which includes: 1- Descriptive statistics which include Statistical tables and graphical presentation by (Bar-Charts) and Arithmetic mean, Standard deviation (SD), Minimum value and Maximum value and Inferential statistics which include: 1-Kruskal-Wallis test (p ≤ 0.05) used to detect the significant difference between different groups, 2- Mann-Whitney U test was conducted for pair-wise comparisons among groups. Statistical significance according to probability value (P) was determined to be as: Non-significant at P > 0.05 and Significant at P≤0.05 , Highly significant at P≤0.01.

RESULTS:
which include :
1-The comparison of micro leakage between groups (materials) in occlusal margin totally at by temperatures using Kruskall-Wallis and Mann-Whitney U tests: In total comparison among groups the descriptive statistics (mean rank, mean and median) of Group A are higher than Group B and Group C in occlusal margin, occlusal microleakage in Group A(Z250) is higher than those of Group B(Z250 xt) and Group C(Z350 xt) with highly significant in total (p=0.006) and in room temperatures (p=0.002) since p<0.01, While is not significant at preheated temperatures (p=0.556).While,In multiple comparison using Mann witney U test, in total microleakage results is not significant between materials except that between Group A and Group C is highly significant (p=0.006) since p<0.01, and significant at room temperature between Group A and Group B (p=0.057) since p<0.05, while between Group A and Group C (p=0.025) since p<0.01 is highly significant.
2- The comparison of micro leakage between groups (materials) in cervical margin totally at by temperatures using Kruskall-Wallis and Mann-Whitney U tests. In total comparison among groups the descriptive statistics (mean rank, mean and median) of Group A are higher than Group B and Group C in cervical margin and median are same for Nano hybrid and Nano filled (0.00). Cervical microleakage occur mostly in Group A(Z250) then followed by Group B(Z250 xt) , While the lowest was found in Group C(Z350 xt) with highly
significant in total (p=0.001) and in room temperatures (p=0.000) since p<0.01. While is not significant at preheated temperatures (p=0.454). While in multiple comparison using Mann-Whitney U test, in total and at room temperature microleakage results is highly significant between materials since p<0.01 except that between Group B and Group C is not significant (p=1.00) at room temperature and totally since p>0.05.

3- The comparison of micro leakage between temperatures in occlusal margin totally and by materials using Mann-Whitney U tests. In total comparison between temperatures the descriptive statistics (mean rank, mean and median) of groups at room temperatures are higher than preheated groups in occlusal margin except mean of Nano composite at room temperatures is lower than preheated groups. Microleakage results in total and by materials affected mostly at room temperatures than that of preheated temperatures, but still not significant for all Groups and totally p>0.05, except Group A which is highly significant (p=0.007) since p<0.01.

4- The comparison of micro leakage between temperatures in cervical margin totally and by materials using Mann-Whitney U tests. In total comparison between temperatures the descriptive statistics (mean rank, mean and median) of groups at room temperatures are higher than preheated groups in cervical margin except mean rank of Nano hybrid at room temperatures is lower than preheated groups, while median and mean are the same data for both temperatures except in microhybrid at room temperatures are higher than preheated one. Microleakage results in total and by materials affected mostly at room temperatures than that of preheated temperatures, but still not significant for all Groups and totally p>0.05, except Group A which is highly significant (p=0.002) since p<0.01.

**DISCUSSION:**

From the results of this study, preheated treatment at 54°C showed the least micro leakage in Micro hybrid composite in compared with same material at room temperature, while micro leakage in both Nano hybrid and Nanocomposite not significantly effected compared with same materials at room temperature. The Micro hybrid it’s the most effected one due to gliding of composite monomers alongside each other readily as reflecting of thermal vibration which is already arranged like this way in Nano hybrid and Nanocomposite due to the smallest filler which contained and this allows more effective wetting of the cavity walls. During application of preheated composite we must do it in time not exceed 15 second, because 50% of the temperature attained will be lost after 2 minutes and close to 90% after 5 minutes when composite removal from heating device. Delaying the curing of preheated composite after application in cavity cause increasing in microleakage when compared it with application immediately, because the composite has a memory which represented by its elastic deformation (composite has two deformation viscous and elastic and both of them occurs at the same time) so, composite retracts to its shape when cooled and moved away from the walls of the tooth surface faster. According to this explanation, increasing the temperature of preheating over 60°C cause rapid increase thermal contraction (elastic deformation) and this lead to increase micro leakage significantly. In this study, regardless of temperatures there is minor microleakage in occlusal margin mentioned when compared it with cervical margin, this occurred due to many reasons such as stronger bonding of composite to enamel also the longer vertical dimension in cervical margin could cause more composite shrinkage, these result agree mostly with all studies on micro leakage.

**CONCLUSION:**

Under the experimental circumstances of this in vitro study, the following conclusion can be mentioned: The scores of micro leakage for all groups varied with different material, margin and temperature; The greater scores of micro leakage mentioned in Z250 micro hybrid in cervical margin. While lowest in Z250 Nano hybrid and Z350 nanocomposite especially in occlusal margin. Generally, preheating decreased micro leakage in all groups of composites; Preheating decreased micro leakage effectively in Z250 micro hybrid, While, Z250 Nano hybrid and Z350 nanocomposite micro leakage not effected by preheating significantly.

**REFERENCE:**


**Restorative Dentistry**


