Original Article

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POSTOPERATIVE HYPERSENSITIVITY OF DIFFERENT COMPOSITE RESIN RESTORATION

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ABSTRACT:

Aim: This research is designed aiming to assess Postoperative hypersensitivity of different composite resins restorative materials.

Materials and Methods: In the current study, a total of 30 composite restorations class I were performed and assessed after about one week in terms of postoperative sensitivity and pain by using electric pulp tester readings pre and post-opertive.

Results: results shown less sensitivity in teeth restored with (Bullkfill, 3M) composite the mean value of pre and post operative pulp testing was (**-3.40)** when compared with composite (Filtek Z350, 3M) **(2.70)** and (Filtek Z250, 3M) (**-1.60)** .

Conclusions:

1-Bullkfill composite could be a new material used to control polymerization shrinkage of composite resin and reduce postoperative hypersensitivity in Class I cavities.

2-Further investigation should be done in the future.

Keywords: Composite resins, Hypersensitivity,Post-operative, DiagnoDent device, Electric pulp tester.

INTRODUCTION

In modern dentistry, the worldwide use of resin-based composite continues to increase, and in some countries has entirely replaced mercury amalgams. Such trends are due to government legislation on the use of mercury-containing products and obvious material improvements such as esthetic quality, a fast and on-demand setting process, strong physico-mechanical properties and the potential for chemical affinity with tooth tissue. Research is therefore required to solve the specific drawbacks of resin composites and improve material performances.[5]

Despite the improvement in the material and techniques, polymerization shrinkage and postoperative sensitivity still remains a threat to restoration success. Some level of postoperative pain associated with any restorative procedure is normal and the patient should be warned in advance. However, once postoperative sensitivity becomes persistent, the only treatment available is to remove the restoration. Studies investigating this phenomenon report as low as 5% to as high as 30% chance of experiencing postoperative sensitivity. The improvement in material properties and development of strict operating protocols with the passage of time has reduced the postoperative sensitivity in posterior composite restorations.[5]

Post-operative sensitivity in resin composite restorations is a common

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occurrence that causes discomfort in the patient and inconvenience to the professional, because it has various causes. Although frequent, it has still not been fully explained. Therefore, it is important to study the problem to establish a work routine to avoid it.

Post-operative sensitivity due to Restorative phase Pain may trigger following placement of a restoration for several possible reasons for resin composite restoration, post-restorative hypersensitivity may be elicited due to leakage, improper bonding procedure, cuspal strain, fractured restoration.

This research is designed aiming to assess Postoperative hypersensitivity of different composite resin restoration.

MATERIALS AND METHODS

1.1. Three types of composite resin restorative materials. *(Figure 1), (Figure 2), (Figure 3)*

1.2. Electric pulp tester. *(Figure 4)*

1.3. Diagnostic Instruments: Mouth Mirror, Explorer, Tweezer

1.4 Periodontal probe.

1.5 DiagnoDent device. *(Figure 5)*

2. Methods:

2.1. Selection of teeth:

Thirty permanent premolars and molars teeth affected by primary carious lesions class I were included in the study to participate according to inclusion criteria.

2.1.1 Inclusion criteria

the selected teeth had the following criteria:

a) Clinically diagnosed as primary caries class I

b) Patients aged eighteen to sixty years of age

c) Only male will be included

d) Had at least one neighboring tooth in occlusion with the antagonist teeth

e) Had healthy or mildly inflamed gingival tissues, without gingival recession/alveolar bone loss

f) Healthy patients with no systemic disorders.

g) Reading of DiagnoDent device more than 35

2.1.2 Exclusion criteria

a) Pathologic pulpal diagnosis with pain (non-vital)

b) Defective restoration adjacent to or opposing the tooth

c) Rampant caries

d) Atypical extrinsic staining of teeth or staining of any existing tooth-colored restorations

e) Poor oral hygiene

f) Severe or chronic periodontitis

g) Heavy bruxism

h) Allergy to materials used in this trial

i) With previous restorations, tooth surface loss (attrition, erosion, abrasion or abfraction)

j) Diagnosed as "cracked tooth syndrome"

k) Received orthodontic treatment within the previous three months

2.2. Grouping of teeth:

The teeth were divided into three main equal groups according to the resin composite restoration. Group1 was restored by (**Filtek Z350, 3M**) with self-etch adhesive. Group 2 was restored by (**Filtek z250, 3M**) with self-etch adhesive. Group 3 was restored by (**Filtek bulkfill, 3M**) with self-etch adhesive.

2.3. Preoperative Records:

The protocol was presented to and approved by institutional review board of UQUDEN school ,Umm Al-Qura university. charting of records - medical and dental history were done. Diagnosis as primary caries done by Clinical examination . Patients who willing to participate in this study included Informed consent from all the patients were taken. the selected tooth were record pre operative by dignodent reading , air syringe one cm away from tooth for four seconds and pre operative hypersensitivity by using electric pulp tester on the middle of buccal tooth surface.

2.4. Caries Removal and Cavity Preparation:

The selected tooth was isolated with cotton roll and caries removed by using #245 bur under air-water coolant. Cavity depth at the deepest point were measured (in mm) using a periodontal probe was less than 2mm and the teeth were excluded if either the cavity depth after caries removal was more than 2 mm.

2.5.Restorative procedure:

Cavities were restored in the following manner. Every group (10 teeth) were restored by type of composite restoration (group A) were restored by composite (Filtek Bullkfill, 3M) with self-etch adhesive. (Group B) were restored by (Filtek Z350, 3M) with self-etch adhesive. (group C) were restored by (Filtek Z250, 3M) with self-etch adhesive. Etching was done with 37% phosphoric acid for 15 to 20 seconds. The cavities were then rinsed copiously and air dried for 5 seconds. Bond resin was applied with applicator brushes and cured for 20 seconds. Using one bonding system .After restored cavity by composite using white stone finishing bur and articulate paper to check occlusion and no gaps.

2.6. Postoperative evaluation

Postoperative evaluation of each restoration were recorded after one week by using an electric pulp tester and air blast 1cm away from tooth for 4 second by using verbal describtive scale (asking the patient). All the procedures

and evaluations were performed by one operator (principal investigator) according to manufacturer's instructions to minimize the technical / procedural variations.

2.7. Statistical Analysis:

All the data were collected, tabulated and statistically analyzed. Data were presented as means and standard deviations (SD). One-way ANOVA was used for comparison between the mean cuspal deflection values of the tested groups. Table Tukey's post hoc test was used for pair-wise comparison between the means when ANOVA test was significant. The significance level was set at 0.05. Statistical analysis was performed with IBM SPSS statistics version 23 (Statistical Package for Scientific Studies) for Windows.

RESULTS:

Table (1) revealed that Filtek Z350 composite group had the highest mean value (2.70) followed by Filtek Z250 composite group (-1.60), while the bulk-fill composite group had the least mean value (-3.40).One- way ANOVA revealed significant difference between the tested groups (P=0.022).[Table 2]. Tukey's test revealed statistically significant difference between the mean values of Filtek Z350 composite group and bulk-fill composite group (P=0.020).[Table 3]. There was no statistically significant difference between the mean values of Filtek Z350 and Filtek Z250 composites groups (p=0.122) and also between the mean values of Filtek Z250 and bulk-fill composite groups (P= 0.674).

DISCUSSION

In the current study, a total of 30 composite restorations class I were performed and assessed after about one week in terms of postoperative sensitivity and pain.When sensitivity appears, it is generally in the first week after the restorative treatment, since it is in this time that patients usually report their complaints. It was the reason that we selected Day seven to recall for all patients.

The class I cavity design was selected because it resembles clinically with complex cavity preparation and restoration; and the results showed that the cavity configuration factor and the shrinkage potential of the composite affected the bond strength.

To standardize the procedures, all teeth were selected using DiagnoDent device that provide high accuracy to detect fissure caries and reading tooth display between 35-50 were only included in the study. All the procedures and evaluations were performed by one operator (principal investigator) according to manufacturer's instructions to minimize the technical / procedural variations. All composite resins restorative materials used were selected from the same manufacturer (3M ESPE) for dental product.

In this study a precise diagnosis was establish before any restorative

procedure, in order to be certain that the pain reported by the patient does not originate from pre-existing causes, such as cracks, tooth fractures, dentinal sensitivity resulting from dentin exposure in the cervical region, or reversible or irreversible inflammatory processes in the pulp.

Several theories have been proposed over the years to explain the transmission of pain: The first theory proposes that the dentinal tubule has a nerve running along the entire tubule length to the free surface. The second theory proposes that odontoblasts could serve as receptors. But the most widely accepted explanation of tooth sensitivity is the hydrodynamic theory. According to this theory, dentin sensitivity is mediated by fluid movements within the dentinal tubules. Factors that can cause this fluid movement include dentin drying, heat resulting from cavity preparation, chemical agents and bacterial penetration. Sensitivity may also result from polymerization shrinkage and deformation of the restoration under occlusal stress, which transmits hydraulic pressure to the odontoblastic processes. Dentinal adhesives are able to bond the restorative material to the tooth structure and obliterate open dentinal tubules.Well sealed dentinal tubules pre Polymerization shrinkage can usually provoke a gap forming between the resin composite and the hybrid layer.

By using electric pulp tester readings pre and post-opertive to assess postoperative hypersensitivity have shown less post-operative hypersensitivity in teeth restored with (Bullkfill, 3M) composite (**-3.40)** in comparison with composite (Filtek Z250, 3M) (**-1.60)** and (Filtek Z350, 3M) **(2.70)** . **as shown in table 1**

The biggest drawbacks of composite materials are polymerization shrinkage and thermal expansion greater than the expansion of the tooth. Polymerization shrinkage is responsible for the formation of internal stresses in the material and leakage between the filling and the walls of the cavity and the formation of post treatment sensitivity. In order to reduce the risk of postoperative hypersensitivity, the appropriate techniques should be applied that reduce the polymerization shrinkage

Polymerization shrinkage stress can contribute to adhesive failure between the tooth and composite, which may result in post-operative sensitivity, marginal leakage and marginal discoloration. If the bond does not fail, polymerization stress may cause fracture of the enamel adjacent to the cavosurface, which may contribute to marginal ditching over time. Polymerization stress may also cause an inward deflection of the cusps in Class II restorations. Over time, composites have been observed to absorb sufficient water to compensate for some or most of this deflection.

Filtek™ Bulk Fill Posterior Restorative contains two novel methacrylate monomers that, in combination, act to

lower polymerization stress. One monomer, a high molecular weight aromatic dimethacrylate (AUDMA) decreases the number of reactive groups in the resin. This helps to moderate the volumetric shrinkage as well as the stiffness of the developing and final polymer matrix—both of which contribute to the development of polymerization stress. The second unique methacrylate represents a class of compounds called addition-fragmentation monomers (AFM). During polymerization, AFM reacts into the developing polymer as with any methacrylate, including the formation of cross-links between adjacent polymer chains. AFM contains a third reactive site that may cleave through a fragmentation process during polymerization. This process provides a mechanism for the relaxation of the developing network and subsequent stress relief. The fragments, however, still retain the capability to react with each other or with other reactive sites of the developing polymer. In this manner, stress relief is possible while maintaining the physical properties of the polymer.

Currently, incremental placement is the most researched and supported filling and curing method. Current bulk-fill resins show potential improvements in some properties, however there are still challenges exist for such restorative materials.Firstly, volumetric shrinkage and stress is not less than other conventional restorative resins, moreover light cure does not reach the bottom of deep preparations. In addition to fast curing lights do not deeply cure bulk-fill resins. Beside that some flowable resins cannot be used on occlusal surfaces and making tight contact areas can be difficult. Finally preventing voids in crucial locations is unpredictable. At this time, bulk-filling as a concept may have promising potential and may perform well in certain situations, but material improvements are necessary to overcome the described challenges. The current study is in agree with **Jan WV et al (2004)** that reported no postoperative hypersensitivity at three year follow up,196 restoration-74 class 1 and 122 class 2 were evaluated and concluded that the bullkfill technique showed good clinical effectiveness during the three year follow up.

According to One year clinical performance report on bullkfill composite none of the patients reported any postoperative sensitivity and although the restorations were slightly translucent, all of the recalled restorations exhibited excellent esthetics at one year. Only one of the 68 restorations fractured and had to be replaced and none exhibited chipping.

On the other hand **Unemori et al (2001)** analyzed restorations placed in increments and found that less post-operative sensitivity than restorations placed in bulk Polymerization shrinkage continues to challenge the adhesive interface; the stresses that concentrate contribute to the eventual demise of the restoration. These shrinkage stresses can be significant enough to induce cuspal

deformation, enamel crazing or even cracking, all of which is capable of causing sensitivity. The degree of cuspal deformation is influenced by the configuration factor. A high configuration factor, as observed in class I cavities, means the absence of adequate free surface for flow related stress compensation. Incremental placement and rubber dam isolation for example have become a mandatory for composite restorations. Howevere in the current study the shrinking mass was increased by incremental placement and limited cavity depths; the buccolingual widths remained unchecked and in some cased resulted in considerable occlusal table correction which perhaps may be the reason for unchecked polymerization shrinkage and postoperative sensitivity.

Moreover **Samet et al (2006)** found gaps with bulk technique and suggested that the incremental technique may result in fewer gaps and therefore it is a valid technique for composite placement.

CONCLUSION:

It was concluded from the results that :

1- Bullkfill composite could be a new material used to control polymerization shrinkage of composit resin and reduce postoperative sensitivity in Class I cavities.

2- Further investigation should be done in the future.

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TABLES:

Table (1):reprsents the mean values and standard deviations (SDs) of the difference between post and pre- EPT readings in each tested group.

Tested group	Mean	SD
Bulk-fill composite group	-3.40 *	3.75
Filtek Z250 group	-1.60	4.60
Filtek Z350 group	2.70 *	5.62
P-value	0.022	

Significance level was set at 0.05

* Mean values are statistically significantly different

Table (2):represents One-way ANOVA used for comparison between the mean cuspal deflection values of the tested groups

ANOVA					
Difference between Post & Pre- EPT readings					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	196.467	2	98.233	4.414	.022
Within Groups	600.900	27	22.256		
Total	797.367	29			

Table (3): Represents Tukey's test between Post & Pre- EPT readings of tested groups

Multiple Comparisons						
Dependent Variable: Difference between Post & Pre- EPT readings Tukey HSD						
(I) Type of composite restorative material	(J) Type of composite restorative material	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Bulk-fill composite	Filtek Z350	-6.10000*	2.10977	.020	-11.3310	-.8690
	Filtek Z250	-1.80000	2.10977	.674	-7.0310	3.4310
Filtek Z350	Bulk-fill composite	6.10000*	2.10977	.020	.8690	11.3310
	Filtek Z250	4.30000	2.10977	.122	-.9310	9.5310
Filtek Z250	Bulk-fill composite	1.80000	2.10977	.674	-3.4310	7.0310
	Filtek Z350	-4.30000	2.10977	.122	-9.5310	.9310
*. The mean difference is significant at the 0.05 level.						

Table (4): Represents descriptives of difference between Post & Pre- EPT readings

Descriptives								
Difference between Post & Pre- EPT readings								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Bulk-fill composite	10	-3.4000	3.74759	1.18509	-6.0809	-.7191	-7.00	4.00
Filtek Z350	10	2.7000	5.61842	1.77670	-1.3192	6.7192	-6.00	8.00
Filtek Z250	10	-1.6000	4.59952	1.45449	-4.8903	1.6903	-11.00	4.00
Total	30	-.7667	5.24361	.95735	-2.7247	1.1913	-11.00	8.00

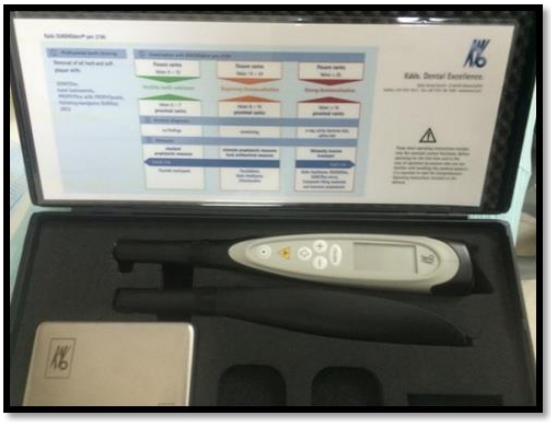
FIGURES:

(Figure 1)

(Figure 2)

(Figure 3)

(Figure 4)



(Figure 5)