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Postoperative sensitivity after placement of bulk-fill posterior restoration

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ABSTRACT

The purpose of this observational retrospective clinical study was to assess the post-operative sensitivity reported by patients following the placement of bulk-fill composite restorations. Patient records of the seventy-two subjects with previously untreated teeth requiring restorations due to caries lesions were used. Seventy-two restorations that were radiographically judged to be located in neither middle nor inner one-third of dentin were included in the study. Two resin composites had been used: Group 1- bulk-fill posterior resin composite (Filtek Bulk Fill Posterior Restorative); Group 2- conventional resin composite (Filtek Z250). The same resin adhesive system (Single Bond Universal Adhesive) had been used with both composites. Patients had been contacted on days 2, 7, 14 and 30 postoperatively and asked about any presence sensitivity, the stimuli that created the sensitivity, if any, the duration of any sensitivity, and the intensity of any sensitivity using a rating from none too severe. The chi-square test showed cavity deepness (p=0.003) significantly affected post-operative sensitivity, while no significances between the different resin composites (p=0.465), cavity sizes (p=0.702) were revealed at day 2, respectively. By day 2, 8.3% of restorations placed in the middle one-third, and 37.5% of restorations placed in the inner one-third of dentin were slightly sensitive. By day 14, there had been no sensitive tooth. Both composite types have potential post-operative sensitivity with limited duration following their placements. The use of bulk-fill posterior restorative for restoration of the deep carious lesion does not seem to affect postoperative sensitivity of composite restorations.

Key Words: post-operative sensitivity, bulk-fill posterior, Restorative Dentistry

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INTRODUCTION

Resin composite restorative materials have been more and more used for restoration of posterior teeth recently as alternative restorative for dental amalgam [1, 2]. Explanations behind this demand would be that greater aesthetic and the apparent health risk of dental amalgam. However, the concepts of cavity preparation introduced in the early 1900s have significantly changed, due to more conservative restorative approaches and the use of restorative adhesive materials that mechanically and/or chemically bond to tooth substrates [1].

Despite recent scientific advances in formulations of resin composite restorative materials and dental adhesives, resin composite restorations may present marginal discoloration, micro leakage, postoperative sensitivity and develop secondary caries over time, which can lead to restoration failure [2, 3]. Among resin composite restoration preparations, failure rates of Class II composite restorations are higher, due to the technique sensitivity of restorative procedures on posterior teeth, material properties, cavity size and residual stresses from polymerization shrinkage that may cause debonding, and postoperative sensitivity [4].

The volumetric polymerization shrinkage on curing is the most serious issue with dental composite for the majority of the dental research community [5]. Polymerization shrinkage results in gaps between the resin composite and the preparation walls. In the midst of different issues, this prompts pain on biting and postoperative sensitivity. To reduce polymerization shrinkage, it is strongly suggested that resin composites be put in increments of close to 2 mm to take into account limited polymerization depth furthermore to guarantee that as it were one surface is bonded at once [1]. Polymerization

shrinkage on curing is regularly referred to as a critical reason for postoperative sensitivity. However, further factors were proposed as taking important association, which involves size of cavity, the depth of the decay towards to the dental pulp, the adhesive system and the operator [6].

Enhancements in material sciences have implied that novel era of "bulk-fill" composite restoratives that are alleged to allow the composite restoration build-up in layers, up to 4-5 mm would quickly be turned into the main decision for the restoration of posterior teeth [7, 8]. Bulk-fill composite materials have some advantages over the conventional composites including, increased depth of cure, which possibly come from greater translucency [9], and low shrinkage stress are related to modifications in the filler/resin matrix formulations [7]. So far there have been limited numbers of studies investigating incremental resin composites and bulk-fill composites in respect to postoperative sensitivity after the restoration placement. The aim of the present observational retrospective study along these lines was to look at a bulk-fill resin restorative and an incremental resin composite in respect to postoperative sensitivity and pain on biting. The null hypothesis was in this manner that the use of bulk-fill resin restorative had no effect on to postoperative sensitivity and pain on biting when compared with conventional incremental resin composite.

MATERIALS AND METHODS

Patient records of individuals with primary caries lesions resulting in class 2 resin composite restorations were used in the study. The depth of each restoration had been classified radiographically to be in outer, middle or inner one-third of the dentin on postoperative periapical radiography. Only patient records which involve lesions in the middle and inner of the dentin were included in the study (Fig 1). Totally, seventy-two patient records which each one had neither one lesion which was restored with either bulk-fill resin composite (Filtek Bulk Fill Posterior Restorative, 3 M ESPE, USA) nor conventional incremental microhybrid resin composite (Filtek Z250, 3M ESPE, USA) were selected for evaluation of postoperative sensitivity (n=36). The number of patient records for groups to observe a 25% reduction in postoperative sensitivity was determined by previous clinical study [10]. Single Bond Universal adhesive (3M ESPE, USA) had been used for all resin composite restorations regardless composite placement technique (Table 1).

Restorations had been placed in patients treated in the dental clinic at Biruni University, Faculty of Dentistry by M.K.A (DDS, Ph.D.). The mean age of the patients had been 35.15 years with a range from 15 to 74 years. After cavity preparation had been completed, dentin treatments had been applied according to the manufacturer's instructions (Table 1). The restorations had been checked for appropriate occlusion and contact points if applicable.

Patients had been contacted on days 2, 7, 14 and 30 postoperatively by M.K.A. They had been questioned in terms of the presence or absence of sensitivity [11]. Dentin-sensitivity stimuli had included cold (ice cream, cold drinks), heat (coffee or tea), chewing, and spontaneous sensitivity. If sensitivity and/or discomfort had been experienced, they had reported which stimuli created the sensitivity, the length of time it lasted, and its intensity, using a rating 0-3 scale: 0 for no sensitivity, 1 for slight sensitivity, 2 for moderate sensitivity, and 3 for severe sensitivity. All patients, including those who had not had a positive sensitivity record on days 2 and 7, had been instructed to report to the investigator if any sensitivity or other discomfort had been experienced.

For consistency purposes, both cavity depth judgment and the contact of patients for sensitivity responses were done by only one operator throughout the study. Data management and analysis were done with the chi-square test, using a software package (SPSS 18.0 for Windows, SPSS Inc., Chicago, IL, USA).

RESULTS

A total of seventy-two patient records (46 molars and 26 premolars) was included in the study (Table 2). A total of 48 inner dentin restorations had been filled of which 23 had been with bulk-fill resin composite and 25 had been with conventional incremental resin composite. 24 middle dentin cavities had been filled of which 13 were restored with bulk-fill composite and 11 were incrementally restored (Figure 1). All teeth had been followed up at days 2, 7, 14 and 30 postoperatively.

Postoperative sensitivity

Twenty 20 of the seventy-two filled teeth had had postoperative sensitivity at day two, and the statistical analysis showed that the incidence of sensitivity was told by patients in bulk-fill group (9 teeth) was not significantly different from that of Z250 group (11 teeth) at day 2 (p=0.395). At day 7, there had been 2 teeth sensitive teeth for both composite placement techniques. At day 14, there was no sensitive tooth for any composite placement technique.

Pain feeling on biting

Three of the seventy-two filled teeth had had pain feeling on biting at days 2. The statistical analysis showed that difference between the group of the bulk-fill resin composite and the group of conventional incremental resin composite regarding to in pain feeling on biting at any days 2 was not significant (p=0.500)

Cavity classification

Eighteen (28.6%) of the 63 MO/DO cavities filled had postoperative sensitivity after restoration placement at day 2; conversely, two of the 9 MOD restorations had been postoperatively sensitive. The difference between MO/DO and MOD cavities regarding to the postoperative sensitivity at days two was not significant (p=0.446). Regarding to pain feeling on biting, there was no significant difference regarding to the cavity classification (p=0.702).

Restoration depth

Eighteen of the 48 restorations placed in the inner 1/3 of dentin had exhibited postoperative sensitivity after restoration placement, whereas only two restorations of the 24 restorations placed in the middle 1/3 of the dentin had presented sensitivity at Day 2. Statistical analysis showed a significant difference between the bulk-fill resin composite and incremental resin composite groups regarding to cavity depth (p=0.003). On the other hand, on day 7 there was no significant difference between restorations placed inner dentin and restoration placed in middle dentin groups regarding to cavity deepness (p=0.155).

DISCUSSION

Current resin composite restoratives exhibited good clinical performances for restoration of posterior teeth [12, 13]. However, postoperative sensitivity is well-known as a problem with resin composite restorations [6, 14]. Previous clinical researches showed that up to 30% of the study populations have stated postoperative sensitivity after resin composite restoration placement [15, 16]. Recent clinical studies still suggested that postoperative sensitivity has been still a problem for incremental resin composite restoration [17]. Although other factors that contain patient-related variables, the adhesive system deployed and the operator were proposed as contributing factor for postoperative sensitivity. The present study was designed to control some of these factors, dealing with the adhesive system deployed and the operator.

Dentin thickness has been suggested as playing an important role in modifying the responses of the pulp to restorative procedures [18]. Theoretically, the thicker the remaining dentin in the floor of a cavity preparation, the lower the concentration of the substance diffusing into the pulp [19]. The rate of permeation is determined by the number of tubules per mm^2, the dentin thickness, the diameter of the dentinal tubules, the molecular size of the penetrant, and the pulpal tissue fluid pressure [19]. The larger the cavity preparation, the larger the area of dentin tubules exposed. The number of tubules/mm^2 in the mid-dentin areas coronally is about 30,000, with a range from 10,000 peripherally to more than 50,000 close to the predentin [20]. The diameter of the dentinal tubules near the pulp chamber is about 2.5 μm in newly erupted teeth, while in the middle part of the dentin the diameter is 1.2 μm. On the other hand, age is an important factor, since in older patients, partial or complete obturation of tubules may occur, resulting in the growth of the peritubular dentin [21]. Sclerosis may also be a reaction to caries by crystalline deposits within the tubules. Caries will also result in the localized formation of irregular secondary/tertiary dentin, which may affect the sensitivity reaction of teeth [22]. The mean age of patients who experienced sensitivity in this study was 24 years, as opposed to 39.7 years for patients who did not experience any sensitivity. Since the number of dentinal tubules per mm^2 is higher in deeper than in shallower cavities, it could be expected that the teeth with restorations located in the inner one-third would be more sensitive than those located in the middle one-third. However, the significant difference was observed in postoperative sensitivity between restorations placed in middle dentin and restorations placed in inner dentin, regardless composite placement technique in the present study. Bulk-fill resin composites would be considered as novel direct restorative materials since they have very recently marketed

[8]. However, whether filling a prepared cavity in just one step with bulk-fill restorative would result in higher incidence of postoperative sensitivity is a definitive question requiring to be answered for the most of the clinicians before deciding the use of bulk-fill composites as a standard of care for restoration of teeth with profound decay. Unfortunately, clinical data regarding to their interactions with vital teeth with deep carious lesions seem very limited in the literature. One clinical study evaluated the clinical effectiveness of the flowable bulk-fill composite technique in posterior restorations in comparison with incremental composite technique [23]. They reported that no difference in prevalence of postoperative sensitivity after restoration placement between groups was existed. The findings of the present study correlate with that of this study, as it was found that postoperative sensitivity reported by patients after the restoration placement did not affect by resin composite type (bulk-fill versus incremental composite). Lower polymerization stress and greater depth of cure properties of bulk-fill posterior restorative tested would be attributed to this level of post-operative sensitivity of the placement of bulk-fill composite restorations.

In the present study Likert Scale was used to measure postoperative pain as a method. Likert Scale is a frequently used method, but, it does have the weakness of being a quite restricted since the pain/discomfort measurement range is fairly discrete. On another hand, the visual analog scales have greater metrical properties than discrete scales. Therefore, a Visual Analogue Scale (VAS) may be a more efficient substitute [24]. However, Likert Scale was validated in literature, thus proposes that the findings of the present study provide valued further evidence regarding to the immediate problems of restoring teeth with bulk-fill composite material used.

Table 1: Adhesive and composites

Brand, Manufacturer	Type	Composition	Application steps
Filtek Bulk Fill Posterior Restorative (3M ESPE, St. Paul, MN, USA)	Bulk fill paste composite	proprietary AUDMA and AFM, DDDMA and UDMA	5 mm layers, light cured 10 s
Filtek Z250 (3M ESPE, St. Paul, MN, USA)	Microhybrid, incremental composite	Bis-GMA, UDMA, Bis-EMA	2 mm layers, light cured 20 s
Single Bond Universal adhesive (3M ESPE, St. Paul, MN, USA)	Universal adhesive (used in self-etch strategy	MDP phosphate monomer, dimethacrylate resins, HEMA, methacrylate-modified polyalkenoic acid copolymer, filler, ethanol, water, initiators, silane	Apply the adhesive to the entire preparation with a microbrush and rub it in for 20 s. If necessary, rewet the disposable applicator during treatment. Direct a gentle stream of air over the liquid for about 5 s until it no longer moves and the solvent has evaporated completely. Light polymerize for 10 s.

Abbreviations: Bis-EMA, Bisphenol-A polyethylene glycol diether dimethacrylate; Bis-GMA, Bisphenol-A diglycidyl ether dimethacrylate; EBPDMA, ethoxylated Bisphenol-A-dimethacrylate; TEGDMA, triethylene glycol dimethacrylate; DDDMA, 1,12-dodecanediol dimethacrylate; UDMA, urethane dimethacrylate; proprietary AUDMA: high molecular weight aromatic dimethacrylate; proprietary AFM, addition-fragmentation monomers, Procrylat (2,2-bis[4-(3 methacryloxypropoxy)phenyl]propane).

Table 2: Positive sensitive response and pain feeling on biting according to the resin composite at Day 2.

POSITIVE RESPONSE Study Groups					
	Cavity Depth	Z250	Bulk Fill	n	n sensitive
Post-operative sensitivity	Middle 1/3	2	-	24	2 [a]
	Inner 1/3	9	9	48	18 [b]
	Number of teeth	11	9	72	20
Pain feeling on biting	Middle 1/3	-	-	24	-
	Inner 1/3	1	2	48	3
	Number of teeth	1	2	72	3

Different superscripts indicate significant differences in the same column.

Figure 1: Representative radiographs of the restorations placed either in middle 1/3 (A) of inner 1/3 (B) of dentin.

CONCLUSION

It would be concluded that the conventional resin composite and the bulk-fill resin composite would result in postoperative complications with limited duration after restoration placement. However, the bulk-fill composite tested resulted in a similar postoperative sensitivity and pain feeling on biting incidences for restoration of proximal caries with those of conventional resin composite tested. It should be mentioned that these postoperative problems with bulk-fill composite tested in this study are temporary and the use of bulk-fill composite reduce a clinical time to place composite restoration proposed are a appropriate substitute to the incremental placement of composite restorative.

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