CLINICAL ASSESSMENT OF POSTOPERATIVE SENSITIVITY WITH TWO DIFFERENT BULK-FILL RESIN RESTORATIVE MATERIALS

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Abstract

Aim: The aim of the present study was to assess and compare the clinical performance of post-operative sensitivity among two types of bulk-fill resin-based composite in class II posterior restorations using visual analog scale (VAS).

Materials & Methods: Twenty patients having proximal caries were arbitrarily selected and divided into two groups according to type of the restorative materials. Fourty class II cavities were prepared and restored with Sonicfill2 bulk fill resin composite, (Kerr Crop., Orange, CA, USA) (n = 20) and Fill Up dual cure bulk fill resin composite, (Coltene, Whaledent, Switzerland) (n =20). POS of restored teeth was assessed with a standardized cold test and air stimulus by air blow from air syringe. Patient responses were assessed at an interval of 24 h, 1month, 3 months, and 6 months using a Visual Analog Scale (VAS). Statistical analysis was performed using paired t-test, independent t- hoc test using SPSS program version 21 (SPSS Inc., Chicago, IL., USA).

Results: The statistical analysis showed after 3 months as well as 6 months, there was no statistically significant disagreement between the two bulk fill resin composite types. However, after 24 h as well as 1 month POS was seen a less notable in Fill up bulk fill resin composite. Finally, in comparing between the two bulk fill resin composites no statistically significant disagreement was recorded.

Conclusion: The postoperative sensitivity is related to many factors as the type of resin composite used, the procedure of cavity preparation and the placement technique of the resin composite.

Keywords: Noradrenaline, terlipressin, and hepatorenal syndrome

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1. INTRODUCTION

With the increasing patients' awareness and dentists' recourse to posterior composite restorations there is a rise in the demand for tooth-colored restorative materials. So dental composites, have been an obvious choice for restorative materials. Careful case selection, innovations in materials, and improved insertion techniques have made it feasible to create restorations that are incredibly esthetic and durable.

Polymerization shrinkage of composite restorations is a significant problem and limits its benefits. This shrinkage causes the restoration to deteriorate leading to formation of a marginal gap between the restoration and tooth structure, which in turn permits fluid and bacteria to continuously leak into the dentinal tubules in 24-36 hours and cause pulp inflammation. Increased risk of secondary caries and post-operative sensitivity are the clinical outcomes. [1]

Therefore, when the damaged tooth is subjected to heat or other stimuli, the dentinal fluid expands and contracts in the gap that is created, causing fluid movement in the dentinal tubules and resulting in post-operative discomfort. [2] So dentinal sensitivity is described as a sharp, well-defined pain brought on by chewing or by coming into contact with hot, cold, sweet, or sour stimuli.

The conventional layering technique used is cumbersome and time consuming. This has led to the innovation of a new class of resin-based composites materials (bulk fill resin-based composites). Bulk fill composite has been developed, the pioneering technology behind bulk fill composite restoratives, which are said to allow the building up of composite restorations in layers as thick as 4-5 mm, is a result of advancements in the material sciences. In comparison to traditional composites, bulk fill composite materials offer much greater depth of cure and reduce the shrinkage stress during polymerization. [3]

This is accomplished by adding fillers like ytterbium trifluoride, mixed oxides, and barium aluminum silicate filler. In addition, a prepolymer filler (a shrinkage stress reducer) with silanes has been used, which is thought to lessen shrinkage stress. Also, bulk placement can be up to 4mm by a cure duration of 10 seconds. Therefore, it may be assumed that bulk-fill composite resin is ideal to lessen post-operative sensitivity and polymerization shrinkage. [4] Therefore, the objective of this study was to assess and compare the clinical results of post-operative sensitivity among two types of bulk-fill composite resin restorations as posterior restorations using visual analog scale (VAS).

The null hypothesis there was no difference in the clinical performance of postoperative sensitivity between sonic-activated bulk-fill resin composite restoration and dual cure zinc oxide containing bulk fill composite based on clinical assessment and the research question was: Do sonic activated bulk fill resin composite restorations perform similarly to the dual cure zinc oxide containing bulk fill resin composite restorations?

2. PATIENTS AND METHODS

II.1Materials:

Table (1): Materials used, their specifications, chemical composition and manufacturers are presented in.

Material	Specification	Composition	Manufacturer	Lot Number
SonicFill™2 bulk fill restorative material	sonic activated bulk fill resin composite	The Filler System: Silicone dioxide, Glass oxide, Chemicals, Zirconium compound and Ytterbium trifluoride. The Resin System: BIS- GMA and TEGDMA	Kerr Crop., Orange, CA, USA https://wwwkerrdental.com/sonicfill	7352416
Fill Up bulk fill restorative material	Dual cure zinc oxide containing bulk fill resin composite	The Filler System**:** zinc oxide, benzoyl peroxide. dental glass, amorphous silica **(**0.1-5µm average of 2 µm): 65% by weight ,49% by volume The Resin System**:** BIS- GMA, UDMA, TEGDMA, TMPTMA	Coltene, Whaledent, Switzerland https://www.coltene.com/products/	J26201

II.2Methods:

- **Ethical regulations and registration**

The protocol of this study and the template informed consent form were reviewed with respect to scientific content and compliance with applicable research and human subjects, regulations and approved by the IRBs/ECs (Institutional Review Boards/Ethical Committees) in the Faculty of Dentistry, Minia University, Egypt with serial number (391) and also registered and approved on the Clinical Trials Registry (www, Clinicaltrials.gov) (Ref. no. 15/10/2022) with registration number is (NCT05485863).

- **Study design**

The study was conducted in the clinic of Conservative Dentistry Department, Faculty of dentistry, Minia University, Egypt. This study is a 6-months follow up of a prospective clinical trial designed as four-armed split-mouth and double-blinded (clinical examiner and volunteer).

- **Participants**

All patients were enrolled from the clinic of Conservative Dentistry Department, Faculty of Dentistry, Minia University. The selection was completed according to the patients need for class II cavity preparations followed by final resin composite restorations. A total of patients was enrolled for this study from January 2022 till January 2023. All included patients received an oral explanation and detailed information about the treatment procedure and were asked to sign an informed consent.

Inclusion and Exclusion criteria of participants

For the inclusion in the study the teeth to be restored were vital without pulpal or periodontal disease with at least one neighboring tooth present and an existing occlusal contact. The specific exclusion criteria included patients with poor oral hygiene, pain and preoperative sensitivity, serious health problems, heavy bruxism, allergy to the materials used in the study.

- **Sample size calculation:**

This study sample size calculation was based on the clinical success rate of composite restoration observed in a previous study (93% at 6 months). Using a significance level of 0.05, power of 80%, and equivalence limit of 20%, the sample size required was 20 restorations. Considering the possible dropout, 20 restorations of each group were performed (a total of 40 restorations), and thus, considering the split-mouth design adopted, 20 patients were selected.

- **Allocation & randomization:**

Each participant was allocated a number from sequentially numbered opaque sealed envelopes when they were seen for consent and baseline

records. After choosing an envelope by the participant, it was signed by the patient and the supervisor and the number on the envelope was recorded in the patient chart to ensure that the patient was assigned. The allocation sequence was generated by one contributor other than the outcome assessors. With each new patient, the next sealed envelope containing the allocation sequence was opened.

- **Blinding:**

A double blinded study since the participants and the outcomes assessors be unaware of the type of resin composite materials that is used. Blinding of the operator was not possible; because of the difference in tested materials, operative and application procedures between the control and intervention groups. The operator was blinded until allocation into groups to avoid bias regarding the selection of the type of resin composite restorative material to each tooth.

- **Procedure methodology**

Wholly clinical steps were achieved by only one operator, cavity preparations were done, participants were stated a short explanation about the examinations and all informed to participate and sign a consent form. Sensitivity tests were performed with cold stimuli (ice steak) and hot gutta percha stick in order to initiate pulp condition and determine whether there was be any abnormal pulpal responses which could jeopardize the final sensitivity results.

Periapical radiographs were taken for each selected tooth to evaluate cavity proximity to the pulp and any sign of periapical radiolucency. Each selected patient was anesthetized by (Mepecaine-L: Mepevacaine 31.36 mg/1.8 ml).

Class II cavities were prepared by using tungsten carbide burs straight fissure bur NO.245(Mani Inc., Japan)) and NO.330 (Mani Inc., Japan) mounted in high-speed handpiece (NSK Inc., Japan) with copious air water spray. A new bur was used every four preparations to maintain cutting efficiency. Adhesive cavity design was prepared according to the principles of minimally invasive dentistry. The common characteristics of this preparation design were the following: 1- none of the cavity preparations involved one or more cusps; 2- all of the gingival margins included in sound enamel and were placed above the gingival sulcus, and 3- no beveling was applied to the preparation walls and margins. The buccolingual width of the preparations didn't exceed one third of this distance. The dimensions of the cavities were checked using a graduated periodontal probe. All procedures were done under rubber dam isolation with no any lining or base material under the resin composite restorations. Each patient received two restorations, subjecting them to the same clinical conditions.

The cavities were rinsed thoroughly with a water spray from the dental unit and dried with cotton pellet or by gently blowing with air spray. Etching gel (Meta Etchant, Meta Biomed, Korea) was applied to the prepared cavity enamel surface only (selective etching) by disposable needle with 37% phosphoric acid gel for 15 seconds followed by rinsing with water for 15 seconds then gentle air dryness for 5 seconds to leave the cavity almost moist. Bonding procedure was done according to the manufacturer's instructions. Single coat universal adhesive bonding agent (Bisco all bond universal, Bisco, INC Schaumburg, IL, USA) was applied to the prepared cavity walls and floor by disposable adhesive micro brush, rubbing the surface for 20 seconds was done, then light cured for 20 seconds according to the manufacturer's instruction using Blue phase LED light-curing unit (Blue phase, Ivoclar, Vivadent) with a power density of 1200 mw/ cm^2. The intensity of the light curing unit was verified using Blue phase Meter II dental radiometer (Blue phase Meter II, Ivoclar, Vivadent).

A metal ring with a pre-contoured metallic sectional matrix band and a plastic wedge (Bioclear Matrix System, South Warner St, Tacoma, WA to 98409 USA) give the restoration its shape during resin composite packing.The treated cases separated into 2 equal groups according to types of restorative materials were used; Sonic activated high viscosity bulk fill resin composite (SonicFill 2) and dual cure zinc oxide containing bulk fill resin composite (Fill Up) as follows:

Group A1: for Sonic activated bulk fill resin composite unidose tip was applied to the cavities according to the manufacturer instructions by using the Sonic-fill handpiece and the KaVo multiflex coupling (Sonicfill Handpiece, Kerr), then dispensed to the prepared cavity.

Group A2: for dual cure zinc oxide containing bulk fill resin composite according to the manufacturer instructions, as their application was done by using an automix syringe directly into the cavity, then dispensed using gentle pressure in the cavity with keeping the syringe tip submerged into the base of the cavity to avoid air voids and to obtain an even thickness.

After complete application of bulk fill resin composite light curing for 20 seconds then after removal of the matrix, all the restoration were light cured from proximal, buccal, and lingual/ palatal aspects for 40 seconds.

The restorations were finished under water cooling with finishing burs and finally polishing was performed using discs (Opti Disc, Kerr) and rubber points (HilusterPlus polishing System, Kerr).

Evaluation of postoperative sensitivity

Postoperative sensitivity was assessed of each restored tooth at an interval of 24 h, 1 month, 3months and 6 months using the VAS (Visual Analog Scale Score) fig (1) with a standardized cold test (ice steak) and air stimulus by air blown from the air coolant tip for fixed distance of approximately 5 mm. The patient responses were assessed using VAS scoring index. Every patient was instructed to place a

mark on the VAS line to point out the intensity of sensitivity level after the administration of the stimuli for each tooth and determined the sensitivity scores and quantified each patient's response to each restoration by measuring the distance in cm from the anchor word (0 cm) to the mark.

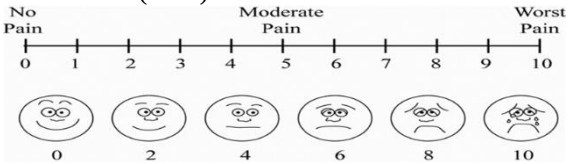

Fig (1) Visual Analog Scale

STATISTICAL ANALYSIS

Data analysis was performed using IBM SPSS advanced statistics (Statistical Package for Social Sciences). Version 21 (SPSS Inc., Chicago, IL., USA). To evaluate and compare the postoperative sensitivity of patients with class II cavities using two types of bulk-fill resin composite restorative materials. The following tests were used:

-Descriptive statistics (mean, SD, CI).
-Paired t- test.
-Independent t- test.
-One-way ANOVA test.
-Tukey's post hoc test.

-The mean and standard deviation of the postoperative sensitivity was calculated for each group. The data showed normal distribution, and there was homogeneity of variances between the groups. The results were evaluated with a 95% confidence interval. The significance level was set to be less or equal to 0.05 was considered statistically significant. The Comparison of mean values of two groups was done using independent t- test for two sample means. Paired t- test was carried out to compare mean value between the time period (24h, 1 month, 3 months and 6 months).

3. RESULTS

In the present study, a total of 20 patients were considered, they were between ages 20-40 years. The statistical analysis showed a significant difference in the clinical evaluation of postoperative sensitivity at 24 h and 1month among the two resin composite types (SonicFill™2 bulk fill restorative material and Fill Up bulk fill restorative material) but after 3 months and 6 months interval, there was no significant difference in the two resin composite types.

Using Sonic fill 2 bulk fill restorative material, there were no cases with hypersensitivity after 24 h as well as from 1moth to 6 months. While using Fill Up bulk fill restorative material, there was a statistical notable difference in the prevalence of hypersensitivity after 24 h as well as after 1 month. There were no cases with hypersensitivity after 3 months as well as 6 months.

In comparison between the prevalence of hypersensitivity after using the two bulk fill resin restorative materials. Results showed postoperative sensitivity recorded in two patients at 24 h and at 1 month using Fill Up bulk fill restorative material while there were no cases of postoperative sensitivity using Sonic fill 2 bulk fill restorative material. At 3 months and 6 months all cases had no sensitivity in compare between the two restorative materials.

Results revealed that when bulk fill composite was used, there was no statistically notable difference between the two restorative materials after 24 h as well as 1 month. After 3 months as well as 6 moths, all cases had no sensitivity.

Results revealed that Sonic fill2 bulk fill resin restorative material had no postoperative sensitivity during all time intervals (24 h, 1month, 3 months and 6 months). While Fill Up bulk fill resin restorative material had postoperative sensitivity in two patients at 24 h and 1 month then subside from 3 months to 6 months.

4. DISCUSSION

Resin based composite restorative materials reveal good clinical performance for restoration of posterior teeth. Nonetheless, postoperative sensitivity is a well-known problem with the resin composite restorations. Postoperative sensitivity, discolored margins, recurrent caries and fractures of restoration margins may be due to marginal leakage of saliva and its components. These clinical results are the major reasons for substitution of restorations and describe why polymerization shrinkage is considered as the major limitation of these materials. [5]

This clinical trial study was undertaken in order to evaluate the clinical performance of Sonic activated high viscosity bulk-fill resin composite (sonicfill2) restorations and another bulk-fill resin composite Dual cure bulk-fill resin composite (Fill up) in class II cavities.

Age is an important factor, young patients have larger pulp champers and larger dentinal tubules, making it more likely that their teeth would be more sensitive to hydrodynamic stimuli as compared to older individuals in which sclerosis, secondary dentin formation may reduce the sensitivity. In this study most of the patients belong to the age group between 20-40 years. [6]

Risk and intensity of postoperative sensitivity manifested when applying the bulk-fill technique and the conventional 2mm incremental technique. An ideal resin composite that it can be cured in a single increment, promoting placing should be considered and may be referred to some effects of the bulk fill materials which makes it very close to incrementally cured resin composite, except that higher depth of cure can reach. [7] , [8]

Recently, several new resin composite materials have been marketed as Bulk fill having higher depth of

cure as well as having lower shrinkage. Most bulk fill resins can be cured to depth of minimum 4mm, this was accomplished by making the resins more sensitive to light activation. Some bulk fill resins work by increasing their translucency, that allows for more light penetration, and others incorporate new photoinitiators in the resin, while simultaneously demonstrating a decrease in internal stress through lower polymerization shrinkage and stress relieving technology. [9] , [10]

Two bulk fill composites were assessed in this study; the first was Sonic Activated bulk fill resin composite (Sonicfill2): a bulk fill resin composite applied through its Sonicfill handpiece that offers sonically activated delivery of the material. As claimed by manufacturer, it contains a rheological modifier that reacts to the sonic energy produced from the handpiece and causes the viscosity to drop by 87% that allows the sonicfill composite to rapidly flow into the cavity, allowing intimate adaptation of the composite to the cavity walls. It also displays a more gradual viscosity build up compared to traditional composites. These benefits are combined with a high depth of cure that allow a cavity depth up to 5mm to be filled and cured in a single bulk increment. [11] , [12]

The second bulk fill resin composite was Dual cure zinc oxide containing bulk fill resin composite (Fill Up): as their application was done by using an automix syringe directly into the cavity, then dispensed using gentle pressure in the cavity with keeping the syringe tip submerged into the base of the cavity. It can be placed and cured in depths between 4-8 mm, in order to simplify and speed-up the placement of large posterior composite resin restorations. According to the manufacturer, the curing of the material must be initiated by the application of light, but after mixing the base and catalyst pastes through the self-mixing, chemical activation takes place and ensures the polymerization of more deep, where light does not penetrate. It has a polymerization modulator that is chemically incorporated into the resin matrix.

A method has been described to measure postoperative sensitivity at interval of 24 h, 1month, 3 months and 6 months was assessed using cold test and air blast test with Visual Analog Scale Score (VAS). It is an instrument that measures subjective characteristics that can't be measured directly. When responding to a VAS, respondents specify their level of agreement to a statement by indicating a position along a continuous line between two end points. A 10 cm line with the anchor words (no sensitivity) at one end and (intolerable sensitivity) at the other end, a VAS (values 0 – 10) providing effective statistical test evaluation and exact measure of pain. [13]

In the present study, comparing and evaluating two types of bulk fill resin composite restorations postoperative sensitivity showed that on using Sonic fill 2 bulk fill restorative material, there were no cases with hypersensitivity after 24 h as well as from 1moth to 6 months. While using Fill Up bulk fill restorative material, there was a statistical notable difference in the prevalence of hypersensitivity after 24 h as well as after 1 month. There were no cases with hypersensitivity after 3 months as well as 6 months.

The lack of postoperative sensitivity in the current study could be the result of the manufacturer's instruction for adhesive application in addition to the low polymerization shrinkage and polymerization shrinkage stress of both materials. These results were in agreement with Sancakli et al., who reported that outcome of postoperative sensitivity determined by both operator skill and experience. [14]

Ashgar et al., attributed the low postoperative sensitivity to the lower post gel shrinkage of bulk fill composites. However, it was reported that postoperative sensitivity is a patient related factor, such as pain experience and amount of discomfort that can vary between patients. [15]

In the present study, comparing postoperative sensitivity of two types of bulk fill composite relative to the time intervals. when bulk fill composite was used, there was no statistically notable difference between the two restorative materials after 24 h as well as 1 month. After 3 months as well as 6 moths, all cases had no sensitivity.

Our results are favored by Berkowtiz G et al., who found that postoperative sensitivity did not affect by the cavity depth. [16] Browning WD et al., reported that immediate postoperative sensitivity was not affected by either the adhesive strategy or the filling technique and 20.3% was the overall risk of it, but related to other many factors during cavity preparations and restorative procedures. [17]

The results demonstrated that low postoperative sensitivity is due to the careful application of the treatment steps, the right use of adhesive materials by following the manufacturer's instructions, and clinical placement techniques that might depend on resin composite materials used.

5. CONCLUSION

1-The postoperative hypersensitivity is related to many factors as the procedure of cavity preparation, adhesive approach, and the type of resin composite.

2-Both of the bulk fill techniques showed acceptable clinical results statistically over the evaluation periods.

3-According to the results of this study, bulk fill restorations can overcome the difficulties with multi-layer technique, saving time and efforts with satisfactory clinical outcome.

4-Initial postoperative sensitivity at intervals of 24 h and 1 month is seen least with Fill up restorative material.

5-Postoperative sensitivity is absent with Sonicfill2 restorative material at the evaluation periods.

6. REFERENCES

1. **Van Dijken JW**, Durability of resin composite restoration in high C-factor cavities: A 12 year follow up. J Dent 2010; 38(6): 469-474.
2. **Dhanapal D, Sureshbabu NM.** Comparison of postoperative sensitivity using two flowable composites in noncarious cervical lesions: A randomized controlled blinded trial. J Oper Dent Endod 2017; 2:55-60.
3. **Ayer MK.** Postoperative sensitivity after placement of bulk-fill posterior restorations. J Res Med Dent Sci2017; 5:53-8.
4. **Llie N, Bucuta S, Draenert M.** Bulk fill resin-based composite: An invitro assessment of their mechanical performance. Oper Dent. 2013; 38(6): 618-625.
5. **De Melo Monterio GQ, Montes MA, Rolim TV, de Oliveira Mota CC, de Barros Correia Kyotoku B, Gomes AS, de Freitas AZ.** Alternative methods for determining shrinkage in restorative resin composites. Dental Materials. 2011; 27(8): 176-185.
6. **Vaid DS, Shah NC, Bilgi PS.** One-year comparative clinical evaluation of EQUIA with resin-modified glass ionomer and a Nanohybrid composite in noncarious cervical lesions. J Conserv Dent 2015; 18:449-52.
7. **Hirata R, Kabbach W, Andrade OS, Bonfante EA, Giannini, Coelho PG.** Bulk-fill resin composites: An anatomic sculpting technique. Journal of Esthetic and Restorative Dentistry. 2015; 27(6): 335-343.
8. **Benetti AR, Havndrup-Pedersen C, Honore D, Pedersen MK, Pallesen U.** Bulk-fill resin composites: Polymerization contraction, depth of cure, and gap formation. Operative Dentistry. 2015; 40(2): 190-200.
9. **Agarwal RS, Hiremath H, Agrawal J, Garg A.** Evaluation of cervical marginal and internal adaptation using newer bulk fill composites: an invitro study. J Conserv Dent 2015; 18: 56-61.
10. **Leprince JG, Palin WM, Vanacker J, Sabbagh J, Devaux J, Leloup G.** Physico-mechanical characteristics of commercially available bulk fill composites. J Dent 2014; 42:993-1000.
11. **Luu C, Drechsler U.** 2010. Sonicfill portofolio of scientific research. Available at: http://www.kerrdental.com.
12. **Ahmed I,** Deep reins, white fillings: Anew technique for composite restorations. Cosmetic dentistry 2013;12-8.
13. **Kersten P, White PJ, Tennant A.** Is the pain visual analogue scale linear and responsive to change? An exploration using Rasch analysis. PLos One 2014,9: e99485.
14. **Sancakli HS, Yildiz E, Bayrak I, Ozel S.** Effect of different adhesive strategies on the postoperative sensitivity of class I composite restorations. European Journal of Dental Education.2014;8(1):15-22.
15. **Asghar S, Ali A, Rashid S.** Assessment of postoperative sensitivity in posterior resin based composite restorations with two placement technique. Journal of Pakistan dental association. 2013; 22(2):98-103.
16. **Berkowiz G, Spielman H, Matthews A, Vena D, Craig R, Curro F, Thmpson V.** Postoperative hypersensitivity and its relationship to preparation variables in class I resin-based composite restorations: findings from the practitioners engaged in applied research and learning (PEARL) Network, Part 1. Compendium of Continuing Education in Dentistry. 2013; 34(3): e44-e52.
17. **Browning WD, Blalock JS, Callan RS, Brackett WW, Schull GF, Davenport MB, Brackett MG.** Postoperative sensitivity: a comparison of two bonding agents. Operative Dentistry. 2007;32(2): 112-117.