ORIGINAL ARTICLE

POST-OPERATIVE SENSITIVITY IN COMPOSITES USING BULK-FILL VS. OBLIQUE INCREMENTAL PLACEMENT TECHNIQUE: A DOUBLE-BLIND, RANDOMIZED TRIAL

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Background: Post-operative sensitivity is a potential drawback of composite restorations. Placement strategies have a profound impact on sensitivity. This trial is aimed to compare the occurrence and severity of sensitivity in composites using bulk-fill technique and oblique incremental technique. **Methods:** This double-blind, randomized clinical trial was conducted at the Department of Operative Dentistry and Endodontics, School of Dentistry, Islamabad from December 20, 2022, to July 24, 2023. A total of 90 participants with moderate-sized Class II carious lesions were recruited and randomly distributed into two groups A and B (n=45). After informed consent, restorative intervention was accomplished using an etch-and-rinse adhesive strategy. In group A, a nanohybrid composite resin was placed using an oblique incremental strategy with a thickness of 2 mm while in group B, bulk-fill strategy was employed with a thickness of 4 mm. Participants were instructed to rate their sensitivity status at evaluation periods using Visual analogue scale. Data was analyzed using the Independent Sample T-test. The level of significance was calibrated at ≤0.05. **Results** According to results of this trial, a significant difference was discerned between two groups after one day (p=0.00) and one week (p=0.01) but the statistical contrast between two groups was not as significant (p=0.05) after two weeks period. **Conclusion** Post-operative sensitivity at all three-time intervals using Bulk-fill technique was reported to be less than Oblique incremental approach. This corroborates the claim that utilizing the bulk-fill strategy for composite restoration mitigates post-operative discomfort.

Keywords: Composite resins; Dental Caries; Dentin Sensitivity; Visual Analogue Scale

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INTRODUCTION

Since the advent of modern healthcare methods, humanity has been on a journey to improve dental materials, explore more efficient techniques, and progress past the mere restoration of a decayed tooth. The emergence of adhesive restorations was a breakthrough in an era well dominated by macro-mechanically retentive amalgam.[1] Recent researches scientifically supports the supremacy of composite resins over other restorative materials.[1,2] Direct restorative materials should prevent stress generation, withstand occlusal loading, and avoid gap formation in the restoration. The sensitivity encountered post-restoration has been a cause of deteriorating patient confidence in the treating clinician and has always presented itself as a challenge to search for materials and strategies to cope with it.[2]

The inauspicious event of sensitivity is explicated in the hydrodynamic theory as an unpleasant sensation upon stimulation, causing fluctuations in tubular fluid flow and pressure variations leading to the activation of terminal nerve fibers within the pulpal tissue. Polymerization shrinkage, owing to the compromised dental-adhesive interface and marginal gap formation, is the chiefly accredited cause of sensitivity in composites.[3,4] The presenting post-operative sensitivity was countered by the institution of innovative restorative materials as well as the application of different placement strategies to eradicate it. The two universally accepted composite placement strategies are the bulk fill technique and the incremental placement technique.[5]

The incremental approach is the prime placement strategy in composite resins. It has multitudinous types, with oblique incremental, being the most widely practiced. It limits the incremental thickness to 2 mm, thus minimizing the C-factor and polymerization shrinkage.[6] Bulk-fill composites, a contemporary approach, can immensely contribute to adhesive dentistry by providing a high-quality aesthetic restoration with minimal post-restorative sensitivity. High-viscosity bulk-fill materials, having a 4-5 mm thickness, overcome some of the infamous attributes of the incremental approach by enhancing the degree of conversion and depth of cure.[7]

Apart from evaluating the clinical efficacy of the two placement strategies, the study at hand is aimed at producing evidence of the most desired technique for reducing sensitivity post composite restoration. The null hypothesis states that the occurrence and severity of sensitivity are lower in bulk-fill composites in comparison to the oblique incremental approach.

MATERIAL AND METHODS

This randomized clinical trial is in coherence with the Consolidated Standards of Reporting *Trials* (CONSORT) 2010 guidelines. It was devised as a double-blind, parallel-group randomized trial with a 1:1 allocation ratio. An approval was permitted by the Institutional Ethical Committee (SOD/ERB/2022/04), and this interventional study was enrolled at ClinicalTrials.gov. (ID: NCT06092567). This trial was conducted at the Department of Operative Dentistry & Endodontics, School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad, from December 20, 2022, to July 24, 2023. All participants received a methodical briefing of the intervention's potential benefits and pitfalls. Each participant submitted a written consent letter. Table 1 depicts the inclusion and exclusion criteria. The sample size was calculated using the WHO sample size calculator to be 90 (45 participants in groups A and B) with a level of significance of 5% and a power of test of 90%. The anticipated population proportion is 4.1% for Group A, and it is 26.7% for Group B.[8,9] A consecutive non-probability sampling technique was employed for this trial. Participants were randomly distributed into the two interventional groups (A and B) using a lottery method. Participants complying with the inclusion criteria were filtered from the Outpatient department. An opaque, sealed envelope with designated coding for each interventional group was used for allocation concealment. In accordance with the double-blinding of this intervention, the participants and the outcome evaluator were kept blinded regarding the designated groups. Both blinding and allocation concealment were executed by a trial-autonomous researcher in each assigned group. Owing to the nature of this intervention, the operator (Principal investigator) could not be blinded.

After the nominated patients validated their participation, a circumstantial medical-dental history was taken. The carious lesion was diagnosed by practicing meticulous clinical and radiographic examination. By considering the patient's comfort during the intervention, the tooth was locally anesthetized using Lignospan Special-lidocaine hydrochloride 2% with 1:80,000 epinephrine (Septodont, USA), and caries excavation was done using a high-speed handpiece under rubber dam isolation. The cavity design was delineated by the extent of the carious lesion and prior faulty restorations. A CPITN periodontal probe was utilized to assess the adequate depth of the prepared cavity. Before commencing restorative intervention, a Palodent Plus Sectional Matrix System (Dentsply Sirona, USA) was used to procure the desired proximal contour of the restoration. The fundamentals of adhesive dentistry were exercised for the subsequent steps. An acid etchant Meta 37% phosphoric acid (Meta Biomed, Korea) was used for 15 seconds, followed by rinsing and air-drying using an air-water coolant. The etched tooth substrate was coated with a bonding agent Meta P & Bond (Meta Biomed, Korea) using a micro brush for 20 seconds vigorously. This was followed by a second application of a bonding agent for 20 seconds. The adhesive layer was light-cured using LED curing light Woodpecker DTE LUX E Plus (Woodpecker, China) for 40 seconds.

Group A (Oblique Incremental placement technique):

In this interventional group, a Nanohybrid composite resin Nexcomp (Meta Biomed, Korea) was placed using an oblique incremental technique with increments not exceeding 2 mm in thickness. This was followed by light curing for 40 seconds.

Group B (Bulk-fill placement technique):

In this group, a composite Beautifil-Bulk Restorative (SHOFU dental) was utilized for restorative purposes using a bulk-fill technique with a thickness of 4 mm followed by light curing for 40 seconds.

After the restorative procedures were accomplished, the rubber dam was removed. The restoration was evaluated for any occlusal adjustments, and finishing was performed. By using the Jiffy Original Composite System (Ultradent, USA), restoration was polished. Subsequently, the participants were given post-operative instructions and were thoroughly trained by the principal investigator for using the Visual Analogue Scale (VAS) score. All participants received a document to record their sensitivity level using VAS score after one day, one week, and a two-week evaluation period. The Visual Analogue Scale (VAS) is a psychometric computing tool for subjective attributes that cannot be measured. It is a 10 cm long scale with markings from 0 to 10, calibrated for sensitivity scores: 0 (none), 1 to 3 (mild), 4 to 6 (moderate), and 7 to 10 (severe).[9,10] Additionally, they were directed to specify whether the pain was spontaneous or stimulated, and if stimulated, mention the provoking stimulus. Data analysis was performed using SPSS version 26 software. An Independent Sample T-test was applied to compare post-restorative sensitivity between the two groups at follow-up periods. The level of significance was calibrated at ≤ 0.05.

RESULTS

This intervention enrolled 138 participants in total. Out of these, 48 dropped out either because they did not satisfy the inclusion criteria, repudiated participating, or had other concerns. The clinical trial comprised 90

participants that were allocated into two groups of 45 individuals each. This has been explicated in the Consort 2010 flowchart (figure 1). In this study, there were 44 (48.9 %) male and 46 (51.1 %) female participants. There were 30 (33.3 %) premolars and 60 (66.7 %) molar teeth nominated for the restorative intervention.

Concerning the immediate appraisal of post-restorative sensitivity, the analysis reveals substantial support for the hypothesis. After one day post-restoration, the incremental placement strategy remarkably outperformed the bulk-fill strategy in terms of sensitivity statistically significant (p=0.00). According to these findings, patients who have restorative therapy using the bulk-fill technique are going to have fewer critical occurrences of post-operative discomfort at once. After a week, the trend of declined sensitivity in favor of the bulk-fill technique persevered and participants reported significantly less sensitivity than with the oblique incremental group (p=0.01).

Nonetheless, after two weeks, there was less of a difference in post-operative pain between the two approaches. While the results manifested that the oblique incremental approach brought about significantly more sensitivity than the bulk-fill approach, the statistical contrast between the two was not as significant (p = 0.05) *(*Table 2). This suggests that the benefit of the bulk-fill technique in terms of diminished sensitivity tends to fade over time, even though it still demonstrates a propensity in this direction. Figure 2 delineates the variation in mean sensitivity between the compared groups at three evaluation periods.

This undoubtedly delineates that at all three-time intervals (one day, one week, and two weeks), participants who had their restorative intervention using the Bulk-fill approach, were reported to have less post-operative sensitivity than those who underwent restoration using the Oblique Incremental Technique. This corroborates the claim that utilizing the bulk-fill strategy for composite restoration mitigates post-operative discomfort.

DISCUSSION

The discipline of restorative dentistry has blossomed with the institution of resin composites. Owing to their superior aesthetic attributes and by fortifying the fundamentals of adhesive dentistry and minimally invasive strategies, composites have revolutionized clinical practice. Nevertheless, polymerization shrinkage is a substantial limitation in composite restorations. This volumetric contraction by potentiating debonding at the tooth-restorative interface, provokes post-operative sensitivity, marginal discoloration, recurrent caries, and microleakage. Sensitivity, being a notable post-operative complication in composites, has always been at a dagger's drawn to the clinician and efforts have been put in to curtail it using innovative materials and techniques.[11,12]

The placement strategies have a profound impact on sensitivity in composite restorations. Bulk-fill approach with its minimal reported volumetric shrinkage and enhanced depth of cure, has transfigured composite restorations by overcoming the potential drawbacks of the incremental layering approach.[13] This trial collated the bulk-fill strategy with the oblique incremental technique to evaluate post-operative sensitivity in composite resin restorations. The postulation states that the bulk-fill strategy would result in less significant post-restorative sensitivity than the oblique incremental placement technique.

This study,by comparing both strategies,support the rejection of the null hypothesis, indicating that bulk-fill placement results in less post-operative sensitivity than the oblique incremental technique. These results go hand in gloves with the studies carried out in the European population.[14,15] But at the same time, a study done in Brazil at the School of Dentistry from the State University of Ponta Grossa, has contradicted our results stating that there is a 20.3% overall probability of post-operative sensitivity and it is not dependent on the technique of restoration.[16] Meanwhile, a study conducted by Channa *et al.*[10] at Liaquat University of Medical and Health Sciences has also deduced satisfactory results in favour of Bulk-fill placement strategy in posterior composites. However, the results of two systematic reviews have enlightened that bulk-fill and conventional incremental composites have no appreciable difference in terms of their clinical efficacy.[17, 18]

The hallmark of this double-blind trial is centered around its predetermined criteria of including moderate-sized Class-II cavitation. This authenticates the results by standardizing the nominated teeth for the trial. Nonetheless, this study has certain limitations as well. The trial employed an etch-and-rinse adhesive strategy owing to its promulgated evidence of post-operative sensitivity.[19] However, several studies have highlighted that adhesive strategy (self-etch or etch-and-rinse) does not influence sensitivity in composite restorations.[16,20] Additionally, a short evaluation period was an obvious shortcoming of this trial. The two-weeks period, although feasible for the participants, could be enhanced to further validate the authenticity of the trial. Moreover, this study did not evaluate the impact of clinical variables like cavity depth, cavity design, and adhesive strategies on post-operative sensitivity. Henceforth, this domain of restorative dentistry demands further research work in the future. This trial by elucidating the influence of placement strategy on post-operative sensitivity, can contribute tremendously to clinical dentistry in resolving a renowned limitation of composite restorations. This study supports further research work in the future based

on innovative techniques that could magnify the physiochemical attributes of bulk-fill composites in enhancing the marginal seal and minimizing the sensitivity. It warrants further research work in the field of restorative and minimally invasive dentistry. Novel strategies could be employed in providing high quality dental treatment to the patients. This study can broaden the horizon of research by evaluating the impact of nano-reinforced composites on placement techniques.

CONCLUSION

In conclusion, this study supports the hypothesis that the bulk-fill strategy lessens the intensity and occurrence of post-operative pain in composite restorations. It sets forward compelling evidence that restorative intervention employing bulk-fill technique could benefit restorative dentistry by resolving the long-established predicament of sensitivity in posterior composites. It will provide an evidence-based practice for clinicians to rely upon when nominating the premier placement strategy for composite resin restorations. This study can open gateways for further research work in the future by introducing innovative placement techniques, employing various adhesive techniques, and utilizing fiber-reinforced or nano-composites to uplift the specialty of restorative dentistry.

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AUTHORS' CONTRIBUTION

NA: Conception, methodology, data collection, write-up. HBM: Literature review, write-up, proof reading. HZ: Methodology, data collection, write-up. AI: Write-up, proof reading. KH: Data analysis, interpretation.

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