

# Influence of Cavity Depth and Liner on Postoperative Hypersensitivity in Posterior Composite Restorations

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Cavity Depth and  
Liner on  
Postoperative  
Hypersensitivity

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## ABSTRACT

**Objective:** To determine the effect of cavity depth and liner application on postoperative hypersensitivity in posterior composite restorations.

**Study Design:** Quasi Experimental Study

**Place and Duration of Study:** This study was conducted at the Department of Operative Dentistry, Foundation University College of Dentistry and Hospital, Islamabad for six months August 2020 to January 2021.

**Materials and Methods:** Patients of both genders 18 to 60 years of age in need of posterior composite restorations due to carious lesions, defective restorations and secondary caries were included in the study. On the first visit posterior teeth, both molars and premolars having good occlusal contact with antagonist and with the adjacent teeth showing positive response on electric and thermal vitality testing, were selected. After complete caries excavation depth of cavities were measured using WHO probe and cavities were divided into three groups; shallow depth 2mm (Group 1), medium depth 3mm (Group 2) and deep cavities measuring 4mm or more (Group 3). Group 1 cavities received light cured composite restoration without any liner or base material. In Group 2 cavities, resin modified glass ionomer base was applied before composite restoration. In Group 3 cavities, calcium hydroxide medicated liner was applied in deepest part of cavity, medicated liner was then protected with resin modified glass ionomer base before restoring cavities with posterior light cured composite restorative material. For evaluation of pain associated with postoperative hypersensitivity patients were asked to use a VAS (Visual Analogue scale) to record whether they experienced postoperative hypersensitivity. Patients were asked to fill the pain score forms at 24 hours, 7<sup>th</sup> day, 15<sup>th</sup> day and 30<sup>th</sup> day after the procedure. Additionally patients were instructed to record whether postoperative hypersensitivity was spontaneous or induced by heat, cold or mechanical stimulus.

**Results:** Total 273 patients enrolled in the study with a mean age of 35.65±9.1 years and age-range of 17-64 years. One-way ANOVA and significant differences were further explored for within-group comparison via bonferroni post-hoc test. Other comparisons were made by using independent samples t-test and Chi-square test as appropriate. A significant value of  $\leq 0.05$  was considered significant.

**Conclusion:** In posterior resin composite restorations post-operative hypersensitivity increased with depth of cavities and was not affected by placement of protective layers beneath the restoration. This postoperative sensitivity in deep cavities restored with resin composite however, reduced over a period of time.

**Key Words:** Cavity depth, liner, posterior composite restoration, post-operative hypersensitivity

**Citation of article:** Abbas B, Gulfam F, Anwar FS, Zara B, Aamer S, Zafar S. Influence of Cavity Depth and Liner on Postoperative Hypersensitivity in Posterior Composite Restorations. Med Forum 2021;32(3):121-125.

## INTRODUCTION

Composite resin is popular material for restoration of carious posterior teeth recently being increasingly used

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Received: January, 2021

Accepted: February, 2021

Printed: March, 2021

due to phasing down of amalgam, longitudinal studies show comparable longevity and clinical performance in both composite and amalgam restoration. However postoperative hypersensitivity is common in posterior composite restoration resulting in significant patient discomfort<sup>1</sup>. In contemporary dental practice trend towards the use of posterior composites as restorative material of choice is growing owing to improvements in handling characteristics, physical properties, and advancements in adhesive systems all these leading to better longevity and enhanced performance of these restorations. Important factors that led to more common use of posterior resin restorations are Minamata Convention phase- down of the use of dental amalgam for restoration of cavitated teeth, as well as move away from extension for prevention philosophy and growing

trend towards preventively oriented, minimal intervention dentistry<sup>2</sup>.

Minamata Convention to phase down the use of mercury containing dental amalgam has been signed by 128 countries including UK. Resin based composite restorations are mercury free, have improved aesthetics, comparable longevity as more traditional posterior restorative materials. There are certain limitations for use of posterior composite restorations rubber dam isolation is critical to strength of bond formed between adhesive and underlying dentine. Placement of composite is technique sensitive and time consuming as incremental layering is currently recommended in order to ensure complete curing and reducing polymerization shrinkage. However, this technique can lead to presence of restoration voids and partially cured composite at the base of restoration which results in postoperative sensitivity and restoration failure<sup>3</sup>. Another mercury free tooth coloured alternative could be glass ionomer material but in vitro studies have shown that it has significantly inferior compressive and tensile strengths when compared to modern resin based composites<sup>4</sup>. To reduce technique sensitive application of large RBCs bulk fill RBCs are available with depth of cure up to 4 - 10mm considerably shortening the restoration of time<sup>5</sup>. Bulk fill RBCs use also claim to minimize polymerization shrinkage which is main cause of microleakage resulting in secondary caries, marginal staining and postoperative hypersensitivity<sup>6</sup>.

Clinical studies across the globe has demonstrated successful application of RBCs in wide range of clinical procedures ranging from aesthetic full mouth rehabilitation, restoring carious complex multi surface cavitated lesions to minimally invasive preventive resin restorations<sup>7</sup>. Optimization of every clinical step and specialized skill is required to place a good quality posterior composite resin restoration which is demanding in terms of clinical time and clinician must keep up with latest evidence-based protocols. As with any other clinical procedure proper case selection is of utmost importance need for meticulous moisture control requires rubber dam isolation<sup>6</sup>. Posterior resin restoration placement is technique sensitive which requires allocation of appropriate time for appointment, attention to every step must be given to minimize factors resulting in increased polymerization shrinkage stresses. composites should be avoided in patients who have history of allergy to adhesive or resin based materials. Alternative tooth coloured material which is mercury free is glass ionomer, but it has inferior aesthetics and compressive strength when compared with composite resin restoration. In an attempt to improve mechanical properties and wear resistance of resin modified glass ionomer is developed by adding components like nanoparticles and photopolymerizable resin particles but still RMGICs are not restoration of choice for posterior carious lesions<sup>8</sup>.

## MATERIALS AND METHODS

Patients were interviewed briefly counselled about the procedure written and verbal informed consent was taken. At first appointment detailed history extraoral, intraoral examination was recorded in all patients with necessary monitoring of patient vital signs. Patient safety is ensured by adhering to inclusion and exclusion criteria which is an utmost concern in dental treatment. All participants were informed about nature of study before enrolment.

The minimum sample size required for this quasi experimental study was 273 calculated by open epi calculator, with 95% confidence level and 5% margin of error where the hypothesized frequency of postoperative hypersensitivity was considered to be (23%+/-5) as reported by sabbagh et al(7).

Patients of both genders in age range between 18 to 60 years of age in need of posterior composite restoration due to carious lesion, defective restoration, and secondary caries were included in clinical trial. Posterior teeth both molar and premolar having good occlusal contact with antagonist and adjacent teeth showing positive response on electric and thermal vitality testing were selected. Participants in need of endodontic teeth, nonvital teeth, showing radiographic and clinical signs of apical periodontitis, periodontal problems, reporting history of allergy to resin based materials were excluded from the study. Pregnant, breast feeding women, patients taking anti-inflammatory drugs, analgesics and psychotropic drugs were also excluded before selecting participants in the study.

All cavities were prepared with high speed rotary instrument with air water coolant under rubber dam isolation. After complete caries excavation depth of cavities were measured using WHO probe and cavities were divided in three groups shallow measuring 2mm (group 1), medium depth 3mm (group 2), deep cavities measuring 4mm or more (group 3). Group 1 cavities received light cured composite restoration without any liner or base material. In group 2 cavities resin modified glass ionomer base was applied before composite restoration. In group 3 cavities calcium hydroxide medicated liner was applied in deepest part of cavity medicated liner was then protected with resin modified glass ionomer base before restoring cavities with posterior light cured composite restorative material. Atraumatic finishing and polishing was performed 20 minutes after restoration placement. All restorations were placed by operators having 5 or more years of clinical experience. For evaluation of pain associated with postoperative hypersensitivity patients were asked to record whether they experienced postoperative hypersensitivity using a VAS scale. Patients were explained in the 0-10 VAS scale, the participants had to place a line perpendicular to a 10 mm line, with zero at

one end, indicating “no sensitivity,” and at 10 mm in the other end, indicating “unbearable sensitivity. Patients were asked to fill the pain score forms at 24 hours, 7<sup>th</sup> day, 15<sup>th</sup> day and 30<sup>th</sup> day after the procedure. Additionally patients were instructed to record whether postoperative hypersensitivity was spontaneous or induced by heat, cold, or mechanical stimulus.

**Statistical analysis:** The data was entered and statistically analysed by using IBM SPSS (version 23.0) data management software. The descriptive statistics for continuous data were presented as mean and standard deviation, while categorical data was presented as frequency and percentages. The dependent variable, mean VAS score was compared with independent study groups by using one-way ANOVA and significant differences were further explored for within-group comparison via bonferroni post-hoc test. Other comparisons were made by using independent samples t-test and Chi-square test as appropriate. A significant value of  $\leq 0.05$  was considered significant.

## RESULTS

Data for 274 patients was considered for analysis in this study. The mean age of study participants was  $35.65 \pm 9.1$  years, with age range of 17 – 64 years. There were 131 (47.8%) males and 142 (51.8%) females in the study group, where mean age of males was  $36.53 \pm 9.6$  years and  $34.85 \pm 8.5$  years for females ( $p=0.128$ ). In 205 (75.1%) patients, cavity of molar tooth was involved, whereas premolar cavities were there for 68 (24.9%) of the patients.

There were three study groups made on the basis of cavity depth, each with 91 patients. Among shallow cavities group, there were 39 (42.9%) males and 52 (57.1%) females, among medium cavities group there were 44 (48.4%) males and 47 (51.6%) females, whereas in deep cavities group there were 48 (52.7%) males and 43 (47.3%) females. There was no significant difference in gender distribution of all three groups ( $p=0.409$ ) as shown in table 2. On the other hand, a significant difference was observed in terms of age distribution among shallow, medium and deep cavities group ( $37.38 \pm 9.2$  vs  $35.96 \pm 9.7$  vs  $33.62 \pm 8.0$ ,  $p=0.018$ ) where deep cavities were more frequently observed in younger age group. Deep cavities were significantly

more common in among molars as compared to premolars, while shallow cavities were more frequently encountered in premolars ( $p<0.001$ ) as summarized in table 2.

A significant difference was observed between mean VAS score at 24 hour post-treatment and three study groups where VAS score was highest for deep cavities, followed by medium and shallow cavities ( $3.89 \pm 1.1$  vs  $3.20 \pm 0.95$  vs  $2.52 \pm 0.93$ ,  $p<0.001$ ). Bonferroni post-hoc test revealed significant within-group mean difference between three study groups as shown in table 4. Similarly, mean VAS score at 7 days was significantly higher in deep cavity group as compared to medium and shallow cavities ( $2.92 \pm 0.79$  vs  $2.15 \pm 0.68$  vs  $1.86 \pm 0.73$ ,  $p<0.001$ ) with significant within-groups mean differences among all three study groups.

At 15 days post treatment, the mean VAS score for dental sensitivity pain was still significantly higher in deep cavity group as compared to medium and shallow cavity group ( $2.91 \pm 1.0$  vs  $1.98 \pm 0.74$  vs  $1.75 \pm 0.88$ ,  $p<0.001$ ). According to Bonferroni post hoc within-group comparison, significant difference was found between deep cavity and medium/shallow cavity groups but mean score at 15 days post treatment was not significantly different between medium and shallow cavity groups as depicted in table 4. On the other hand, at 30 days post treatment, no significant difference was observed in mean VAS score of deep, medium and shallow cavity groups ( $1.87 \pm 0.82$  vs  $1.60 \pm 0.71$  vs  $1.74 \pm 0.80$ ,  $p=0.076$ ).

**Table No.1: Summary of demographic characteristics of study group (n=274)**

Sr. No.	Characteristics	Frequency (n)	Percentage (%)
1	Age (mean $\pm$ SD)	35.65 $\pm$ 9.1 years	
2	Age range	17 – 64 years	
3	Gender		
	Male	131	47.8%
	Female	142	51.8%
4	Tooth type		
	Molar	205	75.1%
	Premolar	68	24.9%

**Table No.2: Comparison of demographic characteristics among study groups (n=274)**

Sr.	Charac-teristics	Study Groups			p-value
		Shallow cavity (n=91)	Medium cavity (n=91)	Deep cavity (n=91)	
1	Age (mean $\pm$ SD)	37.38 $\pm$ 9.2	35.96 $\pm$ 9.7	33.62 $\pm$ 8.0	0.018
2	Gender				0.409
	Male	39 (42.9%)	44 (48.4%)	48 (52.7%)	
	Female	52 (57.1%)	47 (51.6%)	43 (47.3%)	
3	Tooth type Molar				<0.001
	Premolar	55 (60.4%)	72 (79.1%)	78 (85.7%)	
		36 (39.6%)	19 (20.9%)	13 (14.3%)	

**Table No.3: Comparison of VAS score at different time points post-treatment between study groups (n=274)**

Sr. No.	VAS Score time points	Mean VAS Score among study groups (mean±SD)			p-value
		Shallow cavity (n=91)	Medium cavity (n=91)	Deep cavity (n=91)	
1	VAS score at 24 hour post-treatment	2.52±0.93	3.20±0.95	3.89±1.1	<0.001
2	VAS score at 7 days post-treatment	1.86±0.73	2.15±0.68	2.92±0.79	<0.001
3	VAS score at 15 days post-treatment	1.75±0.88	1.98±0.74	2.91±1.0	<0.001
4	VAS score at 30 days post-treatment	1.60±0.71	1.74±0.80	1.87±0.82	0.076

**Table No.4: Within-group mean VAS score comparison between study groups (Bonferroni post-hoc test)**

VAS Score	Study groups	Mean Difference	p-value	
VAS score at 24 hour post-treatment	Deep Cavity	Medium Cavity	-0.692	<0.001
		Shallow Cavity	-1.374	<0.001
	Medium Cavity	Shallow Cavity	-0.681	<0.001
VAS score at 7 days post-treatment	Deep Cavity	Medium Cavity	-0.769	<0.001
		Shallow Cavity	-1.066	<0.001
	Medium Cavity	Shallow Cavity	0.297	0.022
VAS score at 15 days post-treatment	Deep Cavity	Medium Cavity	-0.934	<0.001
		Shallow Cavity	-1.165	<0.001
	Medium Cavity	Shallow Cavity	-0.231	0.250
VAS score at 30 days post-treatment	Deep Cavity	Medium Cavity	-0.132	0.764
		Shallow Cavity	0.264	0.069
	Medium Cavity	Shallow Cavity	0.132	0.764

## DISCUSSION

In this study that included 274 patients, 3 groups were made with equal number of patients. The division into three groups was based on cavity depth. There was no influence of gender distribution on cavity depth however age effected the cavity depth<sup>9</sup>. Individuals in the younger age group showed increased frequency of deep cavities as compared to those in an older age group which is in contrast to the reported higher incidence of caries in older age groups than younger ones<sup>10,11</sup> but consistent with the higher and more aggressive rate of caries spread in deciduous teeth than permanent teeth<sup>12</sup>.

In the present study each group received composite restorations. The composite restorations in shallow depth cavities (Group 1) were placed without any protective layer under the restoration material. While in Group 2 of medium depth cavities a resin modified glass ionomer was used as a base under the composite restoration. In group 3 which consisted of deep cavities a medicated liner with resin modified glass ionomer base were applied beneath the restorative material. The placement of liners and bases in medium and deep cavity group in this study is consistent with other similar studies<sup>13</sup> where these protective layers are applied only in deep and medium depth cavities as shallow cavities do not require extra layer of protection<sup>14,15</sup>.

In this study Visual Analog Scale (VAS) was used to assess postoperative sensitivity in the participants of all three groups. The results of VAS score after 24 hours showed highest occurrence of post-operative sensitivity in group 3 which had the deepest prepared cavities. These results are consistent with a similar study in which post-operative sensitivity was experienced by patients within 48 of restorative treatment with composite.<sup>16</sup> The increased occurrence of postoperative sensitivity in deep cavities can be attributed to multiple factors. One is that the large cavity design in posterior teeth requires a larger bulk of composite for restoration which contributes to polymerization shrinkage and shrinkage stress. In addition to this the reduced thickness of the residual dentin also contributes to postoperative sensitivity as in the deeper the cavity the dentin tubular density increases and dentin tubular permeability increases<sup>1</sup>.

In the present study the VAS score for the deep cavities group were also high on day 7 and 15 after treatment compared to that for shallow and medium depth cavities, while there was no significant difference between medium and shallow cavities. The important finding was no significant difference in the VAS score for the three groups on day 30. This is in accordance with the results of similar studies which show that the occurrence of postoperative sensitivity reduces over time in posterior teeth restored with resin composite

and is not affected by cavity depth and use of protective layers under composite restoration<sup>17,18</sup>.

## CONCLUSION

In posterior resin composite restorations post-operative hypersensitivity increased with depth of cavities and was not affected by placement of protective layers beneath the restoration. This postoperative sensitivity in deep cavities restored with resin composite however, reduced over a period of time.

### Author's Contribution:

Concept & Design of Study: Beenish Abbas  
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**Conflict of Interest:** The study has no conflict of interest to declare by any author.

## REFERENCES

- Bhatti UA. The Phenomenon of Postoperative Sensitivity and Composite Restorations-A Review. JPDA 2019;28(01):34.
- Blum IR, Wilson NH. An end to linings under posterior composites? J Am Dental Assoc 2018;149(3):209-13.
- Chesterman J, Jowett A, Gallacher A, Nixon P. Bulk-fill resin-based composite restorative materials: a review. Bri Dent J 2017;222(5):337-44.
- Dokumacigil G, Korkut B, Atali PY, Topbasi FB. Aesthetic Rehabilitation of Enamel Hypomineralization with Microabrasion and Direct Composites (18 Month-Follow-up Report). Clin Experimental Health Sci 2019;9(3):236-40.
- REHMAN AU, Naeem S, Rehman S, Ahsan A. Comparison of composite resin and resin modified glass ionomer restorations on dentinal hypersensitivity in non-carious cervical lesions. Pak Oral Dental 2019;39(3):281.
- de Oliveira NG, Lima ASLC, da Silveira MT, de Souza Araújo PR, de Melo Monteiro GQ, de Vasconcelos Carvalho M. Evaluation of postoperative sensitivity in restorations with self-adhesive resin: a randomized split-mouth design controlled study. Clinical Oral Investigations 2019;1-7.
- Sabbagh J, Fahd JC, McConnell RJ. Post-operative sensitivity and posterior composite resin restorations: a review. Dental Update 2018;45(3):207-13.
- Bezerra IM, Brito ACM, de Sousa SA, Santiago BM, Cavalcanti YW, de Almeida LdFD. Glass ionomer cements compared with composite resin in restoration of noncarious cervical lesions: A systematic review and meta-analysis. Heliyon 2020;6(5):e03969.
- Shaffer JR, Leslie EJ, Feingold E, Govil M, McNeil DW, Crout RJ, et al. Caries experience differs between females and males across age groups in Northern Appalachia. Int J Dentistry 2015;2015.
- Bernabé E, Sheiham A. Age, period and cohort trends in caries of permanent teeth in four developed countries. Am J Public Health 2014;104(7):e115-e21.
- Heng CC. Tooth decay is the most prevalent disease. Federal Practitioner 2016;33(10):31.
- Çolak H, Dülgergil ÇT, Dalli M, Hamidi MM. Early childhood caries update: A review of causes, diagnoses, and treatments. J Natural Sci, Biol Med 2013;4(1):29.
- Blum IR, Younis N, Wilson NH. Use of lining materials under posterior resin composite restorations in the UK. J Dent 2017;57:66-72.
- Izgi AD, Kaya E, Kale E, Zortuk M. Effect of Two Antibacterial Luting Protocols with and without Immediate-Dentin-Bonding on Microtensile Bond Strength of Glass Ceramic to Bur-Cut Cavity Floor Dentin. Balkan J Dent Med 2020;1(ahead-of-print).
- Ausiello P, Ciaramella S, De Benedictis A, Lanzotti A, Tribst J, Watts D. The use of different adhesive filling material and mass combinations to restore class II cavities under loading and shrinkage effects: a 3D-FEA. Computer methods in biomechanics and Biomedical Engineering 2020:1-11.
- Costa T, Rezende M, Sakamoto A, Bittencourt B, Dalzochio P, Loguercio A, et al. Influence of adhesive type and placement technique on postoperative sensitivity in posterior composite restorations. Operative Dentist 2017;42(2):143-54.
- Briso ALF, Mestreneur SR, Delício G, Sundfeld RH, Bedran-Russo AK, de Alexandre RS, et al. Clinical assessment of postoperative sensitivity in posterior composite restorations. Operative Dentistry 2007;32(5):421-6.
- Veloso SRM, Lemos CAA, de Moraes SLD, do Egito Vasconcelos BC, Pellizzer EP, de Melo Monteiro GQ. Clinical performance of bulk-fill and conventional resin composite restorations in posterior teeth: a systematic review and meta-analysis. Clin Oral Investigat 2019;23(1):221-33.