



# Post-operative sensitivity of Class I, II amalgam and composite resin restorations: Clinical evaluation in an undergraduate program

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## Key words

Amalgam restoration, composite restoration, post-operative sensitivity

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## Abstract

**Aim:** The aim was to evaluate the post-operative sensitivity (POS) of composite and amalgam restorations performed by 4<sup>th</sup> and 5<sup>th</sup> grade undergraduate dental students (under supervision) at Syrian Private University, and determine the possible relationship between POS and restorative material type, preparation depth, and cavity classification.

**Materials and Methods:** A clinical follow-up was conducted on 137 Class I and II conservative amalgam and composite restorations with varying pulp protection protocols (no liner: Shallow preparations, calcium hydroxide liner [Life]: Moderate depth preparations, calcium hydroxide [Life] with a RMGIC base [Ionoseal]: Deep preparations). USPHS sensitivity evaluation was done after 24 h, 1 week, 1 month, and 2 months.

**Results:** POS for amalgam restorations (18.1%) was higher than composite restorations (9%) in all periods ( $P < 0.05$ ). A statistically insignificant higher sensitivity was observed in Class II (16.9%) compared with Class I (13.3%) in all periods ( $P > 0.05$ ). POS in deep preparations (22.6%) was higher than medium (14.6%) and shallow (8.8%) depth preparations in all periods ( $P < 0.05$ ). Regardless of restoration type, POS appeared in 36.5% after 1 day and it was decreased till almost disappeared after 2 months.

**Conclusions:** (1) POS for amalgam restorations was more than composite restorations. (2) Cavity design has no influence over POS. (3) The more the cavity depth, the more the POS. (4) POS decreased within time.

## Introduction

Restorative dentistry deals with the treatment of tooth tissue defects, based on the priority to restore the function as well as esthetics without compromising the biology.<sup>[1]</sup> Amalgam had always been used mostly in clinical practice for many years, because of its good mechanical properties, easy application technique, and its acceptable cost.<sup>[2]</sup> However, on the other hand it has been raged over the biocompatibility of amalgam restorations because of mercury vapor and unaesthetic appearance.<sup>[3]</sup> These controversies lead to the development of resin composite restorations because of its higher esthetic appearance, minimal tissue preparation needs, and good bonding properties to tooth structures.<sup>[4]</sup>

Polymerization shrinkage of composite material forms a major problem and limits its advantages.<sup>[5,6]</sup> This shrinkage will lead to a marginal gap between the restoration and tooth structure, which in turn allows continuous and sustained leakage of bacteria and fluid to the dentinal tubules causing pulp inflammations and

post-operative sensitivity (POS).<sup>[7]</sup> POS can be defined as pain in a tooth associated with mastication or with contact with hot, cold, sweet or sour stimuli that occurs 1 week or more post-treatment.<sup>[8]</sup> Pain associated with clenching, which may indicate a restoration in hyper occlusion, is typically excluded from definitions of POS. At dental schools worldwide, there is a change from teaching amalgam as the only restorative material for Class I and II cavities to the use of resin composite restorations as well.<sup>[9]</sup> Therefore, the objective of this study was to evaluate the POS between amalgam and composite restorations and its relation to depth and cavity design.

## Materials and Methods

### Subjects

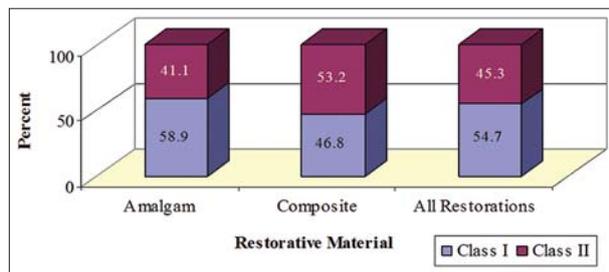
A clinical follow-up to detect POS was conducted on 137 Class I, II amalgam and composite restorations with varying depths performed for 104 patients (14-59 years old) referring

to Operative Dentistry Department at Syrian Private University [Graph 1, Table 1].

**Clinical procedure**

At the beginning ethical approval from Ethical Committee at Syrian Private University as well as informed consent from the patients were obtained. Teeth were prepared for Class I or Class II according to the extension of caries and restored with amalgam and composite randomly according to requested cases from students. The preparations were done by the 4<sup>th</sup> and the 5<sup>th</sup> grade undergraduate dental students under supervision by the instructors. High-speed rotary cutting instruments and air-water spray were used. Caries excavation was done by low-speed round burs and/or manual hand excavators. After caries complete removal, preparation depth was measured by the instructor with Williams probe from the deepest point of the cavity till the cavo-surface angle. Cavities were categorized to: Shallow, medium or deep, and treated with different protection protocols: No protecting liner was placed for shallow cavities measuring from 1 to 2 mm (Group 1), calcium hydroxide liner (Kerr, life) for medium cavities measuring more than 2-4 mm (Group 2), calcium hydroxide (Kerr, life) as a liner, and RMGIC (Voco, ionoseal) as a base for deep cavities more than 4 mm [Table 1].

Cavities then were restored with amalgam and composite according to standard criteria illustrated in Sturdevant’s art and science of operative dentistry.<sup>[10]</sup> In the next appointment after 24 h, restorations were fully examined and POS was assessed according to USPHS criteria.<sup>[11,12]</sup> Then patients were followed to assess POS after 1 week, 1 month, and 2 months.



**Graph 1:** Restorations distribution according to restorative material and cavity classification

**Table 1:** Restorations distribution according to restorative material and cavity depth

Cavity depth	Amalgam (N)	Composite (N)	All restorations (N)
Shallow	7	13	20
Medium	72	24	96
Deep	11	10	21
Total	90	47	137

**Results**

POS after 24 h was 42.2%, 25.5% for amalgam, and composite restorations, respectively with a total POS of 36.5% for all restorations. This POS was decreased after 1 week till it was almost disappeared, after 2 months with 1.1% for amalgam, and no POS for composite restorations [Table 2]. A Chi-square test revealed significant differences in POS occurrence after 1-week and for (all studied periods) between amalgam group and composite group restorations ( $P < 0.05$ ).

According to cavity classification, POS after 24 h was 33.3%, 40.3% for Class I, and Class II, respectively [Table 3]. A Chi-square test revealed insignificant differences in POS occurrence for (all studied periods) between Class I and Class II restorations ( $P > 0.05$ ).

POS after 24 h was 15.0%, 38.5%, 47.6% for shallow, medium, and deep cavities, respectively with no significant differences ( $P > 0.05$ ). However, in all studied periods the percentage was 8.8%, 14.6%, 22.6% for shallow, medium, and deep cavities, respectively and revealed significant differences ( $P < 0.05$ ) [Table 4].

**Discussion**

Amalgam restorations do not bond to tooth structures, and for that reason special care must be taken while preparing the cavity to obtain sufficient retention, which may lead to more sound tooth structure removal contributing in POS. In order to prevent post-operative problems such as sensitivity and pulp inflammation after composite restorations, dentinal tubules, which are opened by dentine conditioning or etching need to be completely sealed. However, this is a technically sensitive operation for students who are new to clinical dentistry. It is quite likely therefore that clinical supervisor take extra caution by directing them to use conventional bases and liners to protect dentine from acid etching. In this study, the percentage of POS in amalgam restorations was more than in composite restorations, that might be related to several factors such as thermal connectivity, electrical conductivity as it is a metallic material, and it requires more preparation of tooth structures to obtain sufficient retention.<sup>[10]</sup> While composite restoration doesn’t need excessive removal of tooth structure because retention depends on bonding to tooth structures by bonding agents.<sup>[4]</sup> In addition, bonding agents provide sealing to the dentinal tubules which may play an important role in decreasing the POS,<sup>[13]</sup> also composite has less thermal connectivity when compared to amalgam. Other study<sup>[13]</sup> showed no differences in POS between amalgam and composite restorations; this finding differs from ours and this could be attributed to differences in cavity classification between two studies. It was noticed in our study that the percentage of POS is more in Class II than Class I cavities but without significant difference, that might be related to more removal of tooth structure in Class II and more exposure of the dentinal tubules. Another study<sup>[14]</sup> also found

**Table 2:** POS occurrence according to restorative material and the studied period

Studied period	Restorative material	POS not occurred (%)	POS occurred (%)	Total (%)	Chi-square test	P value	Significant difference
After 1 day	Amalgam	57.8	42.2	100	3.711	0.054	No
	Composite	74.5	25.5	100			
	All restorations	63.5	36.5	100			
After 1 week	Amalgam	76.7	23.3	100	4.547	0.033	Yes
	Composite	91.5	8.5	100			
	All restorations	81.8	18.2	100			
After 1 month	Amalgam	94.4	5.6	100	0.866	0.352	No
	Composite	97.9	2.1	100			
	All restorations	95.6	4.4	100			
After 2 months	Amalgam	98.9	1.1	100	0.526	0.468	No
	Composite	100	0	100			
	All restorations	99.3	0.7	100			
All studied periods	Amalgam	81.9	18.1	100	7.885	0.005	Yes
	Composite	91.0	9.0	100			
	All restorations	85.0	15.0	100			

POS: Post-operative sensitivity

**Table 3:** POS occurrence according to cavity classification and the studied period

Studied period	Cavity class	POS not occurred (%)	POS occurred (%)	Total (%)	Chi-square	P value	Significant difference
After 1 day	Class I	66.7	33.3	100	0.715	0.398	No
	Class II	59.7	40.3	100			
After 1 week	Class I	82.7	17.3	100	0.093	0.760	No
	Class II	80.6	19.4	100			
After 1 month	Class I	97.3	2.7	100	1.161	0.281	No
	Class II	93.5	6.5	100			
After 2 months	Class I	100	0	100	1.219	0.270	No
	Class II	98.4	1.6	100			
All studied periods	Class I	86.7	13.3	100	1.384	0.239	No
	Class II	83.1	16.9	100			

POS: Post-operative sensitivity

that POS is more in Class II and it is related to the complexity of the preparation design. In relation to cavity depth and POS, this study shows that POS in deep cavity is more than medium and shallow cavities, that might be the result of pulp injury from deep preparation, and also the diameter of the dentinal tubules near the pulp is more than the diameter near the dentine enamel junction.<sup>[15]</sup> This may lead to more pulpal insult and thermal connectivity to the pulp, so more POS is expected in deep cavities. Other studies<sup>[16,17]</sup> also shows that the more the depth of the cavity the more is the POS.

## Conclusion

Amalgam restorations have more POS than composite restorations especially in deep cavities and it is not related to the preparation design.

## Clinical Significance

Amalgam restorations which need more removal of tooth structure to obtain sufficient retention produce more POS when compared to composite restorations.

**Table 4:** POS occurrence according to study depth and the studied period

Studied period	Cavity depth	POS not occurred (%)	POS occurred (%)	Total (%)	Chi-square	P value	Significant difference
After 1-day	Shallow	85.0	15.0	100	5.282	0.071	No
	Medium	61.5	38.5	100			
	Deep	52.4	47.6	100			
After 1 week	Shallow	80.0	20.0	100	0.637	0.727	No
	Medium	83.3	16.7	100			
	Deep	76.2	23.8	100			
After 1 month	Shallow	100	0	100	6.198	0.045	Yes
	Medium	96.9	3.1	100			
	Deep	85.7	14.3	100			
After 2 months	Shallow	100	0	100	5.564	0.062	No
	Medium	100	0	100			
	Deep	95.2	4.8	100			
All studied periods	Shallow	91.3	8.8	100	6.340	0.042	Yes
	Medium	85.4	14.6	100			
	Deep	77.4	22.6	100			

POS: Post-operative sensitivity

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