

Clinical Assessment of Postoperative Sensitivity in Posterior Composite Restorations

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Clinical Relevance

Posterior teeth restored with resin composite have been known to exhibit postoperative sensitivity. The type, size and design of the cavity, material properties and handling technique may influence the incidence of this sensitivity.

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SUMMARY

This incidence of postoperative sensitivity was evaluated in resin-based posterior restorations. Two hundred and ninety-two direct restorations were evaluated in premolars and molars. A total of 143 Class I and 149 Class II restorations (MO/OD and MOD) were placed in patients ranging in age from 30 to 50 years. After the cavity preparations were completed, a rubber dam was placed, and the preparations were restored using a total-etch system (Prime & Bond NT) and a resin-based restorative material (TPH Spectrum). The patients were contacted after 24 hours and 7, 30 and 90 days postoperatively and questioned regarding the presence of sensitivity and the stimuli that triggered that sensitivity. The Chi-square and Fisher's Exact Test were used for statistical analysis. Evaluation at 24 hours after restorative treatment revealed statistically significant differences among the types of cavity preparations restored and the occurrence of postoperative sensitivity ($p=0.0003$), with a higher frequency of sensitivity in Class II MOD

restorations (26%), followed by Class II MO/DO (15%) and Class I restorations (5%). At 7, 30 and 90 days after restorative treatment, there was a decrease in the occurrence of sensitivity for all groups. The percentage of sensitivity among the groups was not significantly different. This study shows that the occurrence of sensitivity is correlated with the complexity of the restoration.

INTRODUCTION

The demand for aesthetic adhesive restorations and advances in oral health with fluoride-based materials has revolutionized restorative dental procedures. The concepts of cavity preparation introduced in the early 1900s¹ 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.²⁻³

Current adhesive systems can be used successfully in both enamel and dentin. It is important to notice that the success of adhesive restorative treatment relies not only on the improvement of the material properties and handling technique, but also on the skills and knowledge that general practitioners possess in regard to a material's properties, limitations and correct use.⁴⁻⁶

Despite recent scientific advances in restorative dentistry, adhesive restorations may present marginal discoloration, microleakage, postoperative sensitivity and develop secondary caries over time, which can lead to restoration failure.⁷⁻⁸ Among resin composite restoration preparations, Class I and II composite restorations are more prone to clinical failure, due to the technique sensitivity of restorative procedures in posterior teeth, materials properties,⁹⁻¹⁰ cavity size¹¹⁻¹² and residual stresses from polymerization shrinkage that may cause debonding, enamel crack propagation and postoperative sensitivity.¹³

Several clinical studies have reported that nearly 30% of patients present postoperative sensitivity after placement of resin composites in posterior teeth.¹⁴⁻¹⁵ Minimal information is available regarding the relationship between postoperative sensitivity and clinical technique. This study evaluated the occurrence of postoperative sensitivity in resin composite restorations at 24 hours and 7, 30 and 90 days, correlating these findings with clinical technique factors. The null hypothesis tested was that different cavity configurations would not affect the occurrence of postoperative sensitivity of resin composite restorations placed in posterior teeth.

METHODS AND MATERIALS

For this study, 292 direct restorations were evaluated in premolars and molars. A total of 143 Class I and 149

Class II restorations (107 MO/OD and 42 MOD) were placed in patients ranging in age from 30 to 50 years. The study design was reviewed and approved by the IRB at Araçatuba Dental School (FOA-2005-02222). Volunteers were screened and patients who presented occlusal disturbances or TMJ problems involving symptomatic pain were excluded from the study. Restorative treatments were performed in teeth that presented primary carious lesions, secondary caries or replacement for esthetic reasons. Teeth already presenting pain and patients taking analgesics were excluded from the study.

Only shallow- and mid-sized cavity preparations were included in the study. Deep cavity preparations were excluded due to the need for cavity liners for pulp protection. All procedures were performed by 20 undergraduate dental students under the supervision of one instructor. The instructor supervised the students throughout all steps of the procedure: caries/restoration removal, cavity preparation, restoration placement and occlusal adjustments. Diamond burs (#1150-KG Sorensen, Barueri, SP, Brazil) were used with a high-speed handpiece and constant water-cooling to access the carious lesion. Carious dentin was removed using carbide burs and a low-speed handpiece. Carious tooth structure was removed until hard tissue was detected by tactile examination of the cavity using dental probe #5 (Duflex, SS White, Rio de Janeiro, RJ, Brazil).

To avoid any tearing or cutting of the rubber dam, it was placed after cavity preparation. The enamel and dentin surfaces were etched using 37% phosphoric acid (Dentsply, Indústria e Comércio Ltda, Petrópolis, RJ, Brazil) for 30 and 15 seconds, respectively. The cavity was thoroughly rinsed for 15 seconds and gently air-dried to remove excess moisture. The adhesive Prime & Bond NT (Dentsply/Caulk, Milford, OH, USA) was applied with a microbrush and gently spread with an air syringe to remove excess adhesive and to evaporate the solvent. The adhesive was light-cured for 20 seconds at 400 mW/cm² (Ultralux, Dabi Atlante, Indústria, Ribeirão Preto, São Paulo, Brazil). A second layer of adhesive was applied, similarly treated according to the manufacturer's instructions and light cured for 10 seconds.

For Class II preparations, sectional metal matrices with rings (Unimatrix, TDV Dental Ltda, Pomerode, Santa Catarina, Brazil) and wood wedges (TDV Dental Ltda) were placed prior to the restorative procedures. When Class II MOD preparations were restored, each proximal box was individually filled; the matrix was first placed at one side, which was built up with resin composite, then another metal matrix was placed at the other proximal box.

The teeth were restored using TPH Spectrum micro-hybrid resin composite (Dentsply), which was placed in approximately 2-mm thick oblique increments. For the Class II preparations, proximal boxes were initially restored using oblique increments. The increments were light cured from the occlusal surface using Ultralux at a light intensity of 400 mW/cm² for 40 seconds. After final build-up, the restoration was further polymerized for 40 seconds in three directions: occlusal, buccal and lingual.

After final polymerization of the restoration, the rubber dam was removed and occlusal adjustment was performed in maximum intercuspation and eccentric movements, with the patient seated and the occlusal plane parallel to the ground. Premature contacts detected with the articulating paper Accufilm (MDF, Parkell, Inc, Edgewood, NY, USA) were removed with diamond bur #1014 (KG Sorensen, São Paulo, SP, Brazil) in a high-speed handpiece under air-water cooling. The restoration was finished and polished using diamond bur #1190F (KG Sorensen) and an abrasive silicone tip (Dentsply). Using cotton roll isolation, the restored occlusal region was etched with phosphoric acid for 20 seconds, rinsed, then dried for application of a layer of surface sealant Fortify (BISCO, Inc, Schaumburg, IL, USA), which was light cured for 20 seconds. Following treatment, oral hygiene and post-operative instructions were given to the patients.

To assess the occurrence of postoperative sensitivity, the patients were contacted at 24 hours and 7, 30 and 90 days after the restorative procedures. To evaluate any possible postoperative sensitivity, the patients were verbally questioned regarding the following aspects: sensitivity to cold and/or hot; spontaneous pain, either prolonged or not and pain during mastication and sensitivity from other stimuli.

The data were statistically analyzed by Chi-square and Fisher's Exact tests at a 5% level of confidence. The Fisher's Exact test was used when the pain frequency was less than five occurrences of postoperative sensitivity.

RESULTS

The restorations were evaluated at all study periods considered in the current investigation. The results are depicted in Table 1 for the study periods (24 hours and 7, 30 and 90 days after the restorative procedures). In the 24-hour evaluation period, there were statistically significant differences among the types of cavity preparations and occurrences of postoperative sensitivity ($p=0.0003$). A higher frequency of sensitivity was reported in Class II MOD restorations (26.19%), followed by Class II MO/DO (13.46 and 16.46%) and Class I restorations, which presented the lowest frequency of postoperative sensitivity (around 5%).

At seven days after restorative treatment, there was a decrease in the occurrence of sensitivity for all groups. The percentage of sensitivity among the groups was not significantly different ($p=0.0627$). Similar results were observed at 30 and 90 days in those instances where there was no statistically significant difference among groups (Table 1).

Table 2 presents the different types of sensitivity reported by the patients. It was observed that a higher frequency of sensitivity was reported for preparations involving proximal boxes compared to occlusal restorations only. In Class I restorations, most postoperative sensitivity was reported during mastication (75%); whereas, sensitivity to cold temperatures (25%) was prevalent in Class II restorations regardless of the type of preparation (MOD, MO or DO). The presence of post-operative sensitivity at 7, 30 and 90 days was predominantly reported by the same subjects who reported pain after 24 hours, except for one patient, who reported sensitivity in a Class I restoration 90 days after restorative treatment.

DISCUSSION

In recent decades, there has been an increase in the frequency of replacing amalgam restorations with direct composite restorations due to aesthetics² and health issues. The increased amount of resin composite restorations placed in posterior teeth has resulted in increased post-operative sensitivity of direct restorations.^{6-7,10,14-16}

Table 1: Occurrence of Postoperative Sensitivity According to the Cavity Preparation Design (O, MO, DO, MOD) and Study Period (24 hours and 7, 30 and 90 days)

	Period											
Cavity Configuration	24 Hours			7 Days			30 Days			90 Days		
	Yes	no	%	yes	no	%	yes	no	%	yes	no	%
O	7	136	4.9	6	137	4.2	3	140	2.1	4	139	2.8
MO	7	45	13.46	5	47	9.61	2	50	3.84	2	50	3.84
DO	9	46	16.36	5	50	9.09	4	51	7.27	4	51	7.27
MOD	11	31	26.19	6	36	14.29	3	39	7.14	3	39	7.14
TOTAL	34	258	11.64	22	270	7.53	12	280	4.11	13	279	4.45
p value	p=0.003*			p=0.0627			p=0.1422			p=0.3080		
*Statistically significant differences between groups.												

Table 2: Frequency of Different Stimuli Triggering Postoperative Sensitivity				
Class I	24 Hours	7 Days	30 Days	90 Days
cold	3	2	1	1
hot	0	0	0	0
chewing	4	4	0	3
spontaneous	0	0	0	0
Class II MOD	24 Hours	7 Days	30 Days	90 Days
cold	11	5	3	3
hot	1	0	0	0
chewing	2	0	0	0
spontaneous	1	1	1	1
Class II DO/MO	24 Hours	7 Days	30 Days	90 Days
cold	13	9	4	4
hot	2	1	0	0
chewing	4	2	1	1
spontaneous	0	0	0	0

At Araçatuba Dental School–UNESP, posterior composite restorative procedures were introduced into the curriculum in 1983. Since then, the students have been performing posterior adhesive restorations following the school’s protocol for indications and technique both by pre-clinical training and by working on selected patients in the Restorative Dentistry clinics. In 2004, Opdam and others¹⁷ investigated the survival rates of posterior resin composite restorations placed by students over a five-year period and concluded that dental students are able to place resin composite restorations in posterior teeth with an acceptable mean failure rate. Accordingly, the authors of this study further highlight the need for students to be properly prepared to perform restorations according to a strict and calibrated protocol. The students who performed restorations in this study have been comprehensively trained on the clinical procedures that were instituted. The variability of these 20 students may more closely represent “real life” than one calibrated instructor placing all the restorations.

In this study, 5% of 143 Class I restorations presented sensitivity; one case occurred only on the first day and three cases reported sensitivity seven days after restorative treatment. A possible explanation for these results is related to the dimensions and depth of the cavity preparations, the enamel marginal sealing and the occlusal adjustments accomplished after treatment.¹⁸ Nevertheless, in three cases, sensitivity was present for 90 days, requiring replacement of the restoration, which may have been associated with the material and restorative technique.

Polymerization shrinkage, inherent to resin composites, can induce stresses at the adhesive interface and result in cusp deflection due to an unfavorable cavity configuration.⁹ Resin composites should be handled so as to generate the least amount of stress at the tooth

and bonded interfaces.^{5,9,19-24} Excessive stress during polymerization has been related to the formation of dentin cracks on the pulp floor and sensitivity during chewing.⁶ Utilization of an incremental technique and polymerization methods can increase the gel phase, thus improving the flowability of the material and, consequently, the marginal adaptation and minimizing the occurrence of possible damage to the adhesive interface.²³⁻²⁶

The use of an incremental technique is frequently performed to overcome the effects of polymerization shrinkage. In small restorations, the possibility is greater that, in a few cases, each oblique increment went into contact with multiple walls. In such situations, adhesive failures caused by polymerization stress can affect the integrity of the bonded interface immediately after polymerization of the material⁹ or later, causing rupture of marginal seals, movement of fluids and sensitivity.²⁷⁻²⁹ It is important to add that the occurrence of sensitivity in one patient after 90 days following Class I restoration placement can be related to the stresses generated by polymerization of the resin material^{28,30} at the bonded interfaces and/or by possible accelerated degradation of the adhesive system.³¹ In addition, it is important to emphasize that the occurrence of sensitivity was low, because the criteria used for selection of patients and cavity preparations were standardized. Hence, ideal conditions for restorative placement avoiding bacterial contamination and occlusal interferences can individually or entirely contribute to the low incidence of postoperative sensitivity.³²

In Class II restorations, approximately 15% of MO/DO and 26% of MOD cavities presented sensitivity during the first study period, with an increased frequency in larger cavity preparations. Even though the cavity configuration (C-factor) of Class II preparations is more favorable to dissipating polymerization stresses, the destruction of dental structure seems to have been a determining factor in the occurrence of postoperative sensitivity.³³⁻³⁵ The cavities were filled with the least excess possible to minimize the occlusal adjustment and finishing and polishing procedures. This fact should be emphasized, because, in many cases, premature or exaggerated contacts are responsible for post-

operative sensitivity present during mastication, as well as temperature variations.^{19,33,36-38}

Another important fact is that there were no differences in postoperative sensitivity of replaced restorations due to secondary caries formation and primary carious lesions restorations. Even though carious lesions resulted in the formation of secondary, tertiary and sclerotic dentin,²² the probable formation of tertiary dentin,³⁴ in cases of replacement of the restorations, may have resulted in similar protective effects to the pulp tissue.^{22,36,40}

It is the responsibility of dental professionals to inform their patients that any treatment of a tooth can cause postoperative sensitivity. Knowledge of scientific evidence, detailed diagnostics, correct treatment planning, experience with various techniques, restorative materials and their clinical indications are essential factors to assure the longevity of restorations and the patient's comfort, as well as the desired esthetics. The null hypothesis was rejected, since the occurrence of postoperative sensitivity in posterior composite restorations, though temporary, varied among the different cavity designs.

CONCLUSIONS

Within the limitations of this *in vivo* study, it can be concluded that:

- the occurrence of postoperative sensitivity is correlated to the complexity of the design and the restorative procedure.
- the occurrence of postoperative sensitivity in posterior teeth restored with a resin composite tends to decrease over time.

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