



Clinical Evaluation of Postoperative Sensitivity in Class I Resin Composite Restorations

Avaliação clínica da sensibilidade pós-operatória em restaurações classe I em compósitos restauradores

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ABSTRACT

Objective: To evaluate the postoperative sensitivity in posterior restorations with different resin composites and adhesive systems as well as the influence of the depth and extent of the dental cavity. **Material and Methods:** A double-blind clinical trial was carried out with 80 class I restorations of 16 patients. The participants were divided into 4 groups according to the adhesive system + composite: F + P (Filtek P90™ + P90™); R + S (Rok™ + Stae™); P + A (P60™ + Adper SE PLUS™); E + X (Evolux™ + XPBond™ Adhesive). After 7, 15 and 30 days, the presence of postoperative sensitivity was evaluated and classified according to type and intensity. The data were submitted to Pearson's chi-square test, Fisher's exact teste, Student's t-test and ANOVA. A significance level of 5% was used for all tests. **Results:** The presence of postoperative sensitivity was approximately 6% of the total sample. The sensitivity decreased with the evaluation time, with the smallest reduction occurring from the 7-day evaluation compared to the other evaluations. **Conclusion:** There was found no evidence of influence of the resin composite and adhesive type, depth and extension of the cavities for the presence of postoperative sensitivity.

KEYWORDS

Dentistry; Dentin sensitivity; Adhesives; Composite resins.

RESUMO

Objetivo: Avaliar a prevalência da sensibilidade pós-operatória em dentes posteriores restaurados com diferentes resinas compostas e sistemas adesivos em relação a profundidade e extensão da cavidade dental. **Material e Métodos:** Estudo clínico duplo-cego foi realizado com 80 restaurações classe I em 16 pacientes. Os pacientes foram divididos em 04 grupos de acordo com compósito restaurador e sistema adesivo: F + P (Filtek P90™ + P90™); R + S (Rok™ + Stae™); P + A (P60™ + Adper SE PLUS™); E + X (Evolux™ + XPBond™ Adesivo). Após 7, 15 e 30 dias, a presença de sensibilidade pós-operatória foi avaliada e classificada quanto ao tipo e intensidade. Os dados foram analisados estatisticamente mediante os testes estatísticos qui-quadrado de Pearson, exato de Fisher, t de Student e ANOVA. Um nível de significância de 5% foi utilizado para todas as análises. **Resultados:** A presença de sensibilidade pós-operatória foi de aproximadamente 6% na amostra. A sensibilidade reduziu com o tempo de avaliação, sendo que a menor redução ocorreu da avaliação de 7 dias para as outras avaliações e a menor de 15 para 30 dias. **Conclusão:** Não se evidenciou influência do tipo de compósito e adesivo, profundidade e extensão das cavidades na presença de sensibilidade pós-operatória.

PALAVRAS-CHAVE

Odontologia; Sensibilidade da dentina; Adesivos; Resinas compostas.

INTRODUCTION

The success in direct restorations is attributed to their functionality and longevity. The esthetic standards in modern society and the improvement of restorative materials have made resin composites an alternative to amalgam restorations, since by using resin composites it is possible to mimic the optical behavior of the dental structure [1,2].

The clinical success with resin composites allows their safe use in anterior and posterior teeth [1,3]. A decisive fact in this context is the adhesive technology [4,5]. Initially, the adhesive systems used acted by the conventional adhesive technique and had several preliminary steps to insert the resin composite, making the protocol susceptible to errors [6]. With the incorporation of acidic resin monomers to the composition of the bonding agents, the self-etching technology came out, which eliminated steps of the conventional adhesive technique, such as washing and drying the cavity [7].

Despite technical and scientific advances, postoperative sensitivity is still a concern in restorative procedures [8-15]. It can be defined as a toothache, after restorative procedure, associated with the contact with thermal, chemical and mechanical stimuli, which produce fluid movement inside the dentinal tubules [10,16].

The objective of present study was to evaluate the presence of postoperative sensitivity in posterior teeth restored with different types of resin composites and adhesive systems as well as the influence of the depth and extension of the dental cavity.

MATERIALS AND METHODS

This double-blinded clinical trial was approved by the Research Ethics Committee of the Centro Integrado de Saúde Amaury de Medeiros (CISAM), Recife, PE, Brazil (# 0003.1.250.000_10). Eighty Class I restorations were performed in molars and premolars of sixteen male (n=5) and female patients

(n=11), aged between 23 and 46 years, of the CISAM. Sample size was calculated according to previous studies [13,17,18]. The restorations were divided into four groups according to adhesive system and the resin composite used (Figure 1). Table I shows the group distribution and manufacturer's information regarding the resin composites and adhesive systems used in the study.

Table I - Group distribution and manufacturer's information regarding the resin composites and adhesive systems used in the study.

Group	Resin Composite					Adhesive System				
F+	Filtek P90™					P90™				
	Particle type and size	Matrix	Classification	Manufacturer	Batch #	Composition	Solvent	Classification	Manufacturer	Batch #
P	0.4 µm quartz and yttrium fluoride	Silorane	Micro-hybrid	3M, Saint Paul, Minnesota, USA	N136711 N130171	Silane-treated silica particles	Water alcohol	Self-etch	3M, Saint Paul, Minnesota, USA	N139733; 9BK
R+	Rok™					Stae™				
	Particle type and size	Matrix	Classification	Manufacturer	Batch #	Composition	Solvent	Classification	Manufacturer	Batch #
T	40 nm-25 µm Quartz	Bis-GMA UDMA Bis-EMA	Hybrid	SDI, Bayswater, Victoria, Australia	82907	UDMA and silicon dioxide	Acetone	Etch-and-rinse	SDI, Bayswater, Victoria, Australia	82907
F+	Filtek™					Adper SE PLUS™				
	Particle type and size	Matrix	Classification	Manufacturer	Batch #	Composition	Solvent	Classification	Manufacturer	Batch #
A	0.19-3.3 µm Zircony and Silica	Bis-GMA and UDMA	Hybrid	3M, Saint Paul, Minnesota, EUA	9UW; N155323; N148000	UDMA, TEGDMA, TMPT-MA, MHP, HEMA, and Zirconia nanoparticles	Water	Self-etch	3M, Saint Paul, Minnesota, USA	915900548a
E+	Filtek™					Adper SE PLUS™				
	Particle type and size	Matrix	Classification	Manufacturer	Batch #	Composition	Solvent	Classification	Manufacturer	Batch #
X	0.02 - 3.0 µm Silica, BABG, BAFG	Bis-EMA and TEGDMA	Nano-hybrid	Dentsply, York, Pennsylvania, USA	130648B; 128995B; 133469B	UDMA, TEGDMA, TMPT-MA, MHP, HEMA, and Zirconia nanoparticles	Water	Etch-and-rinse	Dentsply, York, Pennsylvania, USA	915900548

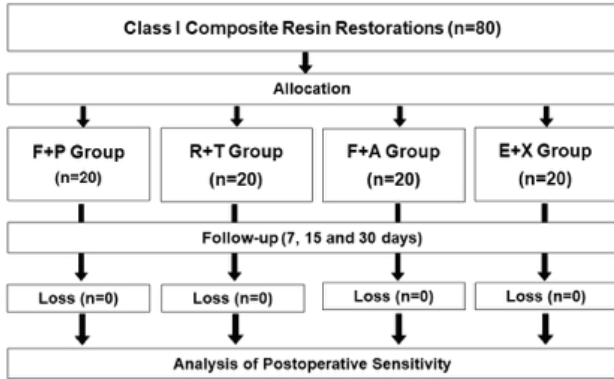


Figure 1 - Study flowchart.

Inclusion criteria were patients over 21 years of age and in need of restorative treatments on the occlusal surfaces of at least four posterior teeth and the antagonistic teeth should be healthy or satisfactorily restored. Patients with dental elements antagonistic to non-healthy restorations, missing or not satisfactorily restored, restored with ceramic material and with removable denture were excluded.

Detailed anamnesis and clinical examination were performed. Before starting the restorative procedures, the patients were instructed regarding diet and oral hygiene. All the patients who agreed to participate in the study signed the consent form. All clinical procedures were performed by a single calibrated operator, who was blind to the clinical procedure. A previous pilot study was performed to ensure operator calibration. The patient was also unaware of the materials used in each restoration.

The restorative procedures were carried out after local anesthesia and rubber dam isolation. Color match was performed under natural light by placing and curing an increment of resin composite on the tooth crown. Cavity preparations were limited to the removal of affected dentin [19-21] and were performed with #1014, #1015 and #1046 diamond burs (SSWhite, Juiz de Fora, Minas Gerais, Brazil) at high speed under copious water cooling and #1/2, #1, #2 and #3 (KG Sorensen, Cotia, São

Paulo, Brazil) in low speed. The diamond burs were discarded every five preparations.

After cavity preparation and rubber dam isolation of the operative field, prophylaxis with pumice (SSWhite, Juiz de Fora, Minas Gerais, Brazil) and water with the aid of a Robinson brush (KGSorensen, Cotia, São Paulo, Brazil) was performed. The cavities were washed and dried. Pulp capping procedures followed the guidelines of the Brazilian Group of Operative Dentistry Professors [22]. The restorative procedures followed the recommendations of the manufacturers regarding the use of the adhesive system and the resin composite (Table II). A Radium-call LED curing unit (SDI, Bays water, Victoria, Australia) was used for all photo polymerization procedures.

Table II - Restorative procedures according to groups.

F + P	<ol style="list-style-type: none"> 1. Enamel etching for 15 seconds 2. Washing and drying the cavity 3. Active application of the primer for 15 seconds 4. Light-curing for 10 seconds 5. Active application of the adhesive system followed by air jet 6. Light-curing for 10 seconds 7. Incremental application (2mm each) of the composite resin 8. Light-curing for 40 seconds (each increment)
R + S	<ol style="list-style-type: none"> 1. Cavity etching for 20 seconds 2. Washing and drying the cavity 3. Application of the adhesive for 15 seconds; 4. Light-curing for 10 seconds; 5. Incremental application (2mm each) of the composite resin 6. Light-curing for 20 seconds (each increment);
P + A	<ol style="list-style-type: none"> 1. Enamel etching for 15 seconds 2. Washing and drying the cavity 3. Application of liquid A 4. Application of liquid B and wait for the red color disappear 5. Light-curing for 10 seconds 6. Adhesive air-drying 7. Application of liquid B 8. Air-drying 9. Light-curing for 10 seconds 10. Incremental application (2mm each) of the composite resin 11. Light-curing for 20 seconds (each increment)
E + X	<ol style="list-style-type: none"> 1. Cavity etching for 20 seconds 2. Washing and drying the cavity 3. Application of the adhesive 4. Air-drying and light-curing for 10 seconds 5. Incremental application (2mm each) of the composite resin 6. Light-curing for 20 seconds (each increment)

After the restorations were completed, occlusal analysis was performed and interferences were removed with #2200 and #2112 diamond burs (KG Sorensen, Cotia, and São Paulo, Brazil). After 24 hours, finishing and polishing of the restorations were carried out with diamond burs, Enhance finishing points (Dentsply, York, Pensilvânia, USA) and polishing paste (Diamond – FGM, Joinville, Santa Catarina, Brazil).

After 7, 15 and 30 days, the patients were asked about the postoperative sensitivity associated with the restored teeth using a 11-point verbal numeric scale [23], which, when existing, was classified according to the intensity and the type (spontaneous or provoked) [24,25].

Normal data distribution was verified, and statistical analysis was carried out using the SPSS software ver. 22.0 (IBM, Armonk, NY, USA). Data are presented as mean \pm standard deviation (SD). Pearson's chi-square and Fisher's exact tests were used to verify differences between groups regarding age and sex, respectively. Student's t-test was used to verify differences in postoperative sensitivity between shallow and deep cavities. The choice of the F test (ANOVA) was due to the absence of alternative techniques (non-parametric test type) for the comparison of repeated measures and its robustness in relation to the absence of normality or heterogeneity of variances. A significance level of 5% was used for all statistical analysis.

RESULTS

The prevalence of postoperative sensitivity was approximately 6% of the total sample. Groups F + P and F + A had a sensitivity of 15% and 10% respectively. Patients in groups R + T and E + X did not report postoperative sensitivity.

Table III shows the age and sex according to the group. In the total group, the highest frequency corresponded to patients aged 26 to 29 years (40.0%), followed by those aged 30 or over (35.0%) and 20 to 25 years (25.0%). The majority (80.0%) of the patients were female.

Postoperative sensitivity according to evaluation time is presented in table IV. Sensitivity decreased with evaluation time. In 7-day evaluation, there was no reported sensitivity in the Evolux™ group (0.00), 0.25 in the ROK™ and varied from 0.75 to 0.90 for P90™ and P60™. In 15 days and 30 days, P90™ and ROK™ presented no sensitivity and the highest mean (0.45) was recorded for P60™. The average sensitivity increased with evaluation time for Evolux™ whereas in other groups, there was a reduction from 7 to 15 days ($p > 0.05$).

Considering cavity deep (Table V), postoperative sensitivity were slightly higher in medium/deep cavities in 7 and 15 days evaluation. Postoperative sensitivity decreased with the evaluation time among those with medium/deep cavity while there was a reduction in the evaluation from 7 to 15 days and a small increase from 15 to 30 days ($p > 0.05$) in teeth with shallow cavities.

Table VI shows the presence of no postoperative sensitivity in cavities with less than 1/3 in any of the evaluations. In the evaluations performed in 7 and 15 days, no postoperative sensitivity was reported in cavities with 1/3 of the tooth extension. In any of the evaluations, the averages of postoperative sensitivity were higher in cavities with more than 1/3 of tooth extension ($p > 0.05$).

Table III - Age and sex according to group

	Group										p-value
	F+P		R+T		P+S		E+P		Total		
	n	%	n	%	N	%	N	%	N	%	
Total	20	100	20	100	20	100	20	100	80	100	
• Age											
20–25	5	25	5	25	5	25	5	25	20	25	100 ⁽¹⁾
26–29	8	40	8	40	8	40	8	40	32	40	
≥30	7	35	7	35	7	35	7	35	28	35	
• Sex											
Male	4	20	4	20	4	20	4	20	16	20	100 ⁽²⁾
Female	16	80	16	80	16	80	16	80	64	80	

(1): Pearson's chi-squared test; (2): Fisher's exact test

Table IV - Age and sex according to group.

	F+P	R+T	P+S	E+	p-value*
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
7 days	0.75 ± 1.83	0.25 ± 1.12	0.90 ± 2.77	0.00 ± 0.00	0.332
15 days	0.00 ± 0.00	0.00 ± 0.00	0.45 ± 1.39	0.15 ± 0.67	0.220
30 days	0.00 ± 0.00	0.00 ± 0.00	0.10 ± 0.31	0.40 ± 1.79	0.460
p-value**	0.083	0.330	0.163	0.330	
Differences					
7 – 15 days	0.75 ± 1.83	0.25 ± 1.12	0.45 ± 1.39	-0.15 ± 0.67	0.190
7 – 30 days	0.75 ± 1.83	0.25 ± 1.12	0.80 ± 2.46	-0.40 ± 1.79	0.155
15 – 30 days	0.00 ± 0.00	0.00 ± 0.00	0.35 ± 1.09	-0.25 ± 1.12	0.122

*ANOVA F-test; **F-Statistic from repeated measures ANOVA.

Table V - Postoperative sensitivity according to cavity deep and evaluation time.

Evaluation	Cavity Deep		p-value*
	Shallow	Medium/Deep	
	Mean ± SD	Mean ± SD	
7 days	0.45 ± 1.67	0.52 ± 1.95	0.876
15 days	0.13 ± 0.68	0.19 ± 0.96	0.776
30 days	0.17 ± 1.10	0.04 ± 0.19	0.538
p-value**	0.227	0.180	
Differences	0.32 ± 1.41	0.33 ± 1.21	0.969
7 – 15 days	0.28 ± 1.96	0.48 ± 1.78	0.660
7 – 30 days	-0.04 ± 0.81	0.15 ± 0.77	0.326

*Student's t-test; **F-Statistic from repeated measures ANOVA.

Table VI - Postoperative sensitivity according to cavity extension and evaluation time.

Evaluation	Cavity Extension			p-value*
	< 1/3	= 1/3	> 1/3	
	Mean ± SD	Mean ± SD	Mean ± SD	
7 days	0.00 ± 0.00	0.42 ± 1.44	0.67 ± 2.12	0.368
15 days	0.00 ± 0.00	0.00 ± 0.00	0.24 ± 0.99	0.398
30 days	0.00 ± 0.00	0.00 ± 0.00	0.20 ± 1.15	0.623
p-value**		0.339	0.135	
Differences				
7 – 15 days	0.00 ± 0.00	0.42 ± 1.44	0.43 ± 1.55	0.485
7 – 30 days	0.00 ± 0.00	0.42 ± 1.44	0.47 ± 2.31	0.655
15 – 30 days	0.00 ± 0.00	0.00 ± 0.00	0.04 ± 1.02	0.976

*ANOVA F-test; **F-Statistic from repeated measures ANOVA.

DISCUSSION

From the patient's point of view, a higher postoperative sensitivity would be an undesired outcome [26]. The objective of present study was to evaluate the presence of postoperative sensitivity in posterior teeth restored with different types of resin composites and adhesive systems as well as the influence of the depth and extension of the dental cavity.

We observed that the materials used, depth and extension of the Class I cavities promoted similar response regarding postoperative sensitivity. This was observed in other study [27]. In addition, a systematic review and meta-analysis performed to evaluate the risk and intensity of postoperative sensitivity in posterior resin composites restorations bonded with self-etch and etch-and-rinse adhesives showed that the type of adhesive strategy for posterior resin composites restorations does not influence the risk and intensity of postoperative sensitivity [8].

It is the responsibility of dental professionals to inform their patients that a treatment of a tooth can cause postoperative sensitivity [14]. 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 [14].

A high prevalence of postoperative sensitivity was reported in 33% of 456 teeth restored [28]. In other study, 47% of 104 restorations in resin composites presented postoperative sensitivity [15]. In addition, no postoperative sensitivity has been found in other study [29]. In the present study, 80 teeth were restored by one operator and approximately 6% of the total sample, presented postoperative sensitivity. The differences found might be due to the variation of the resin composites and adhesive systems as well as the methodologies of the studies.

The adhesive systems and resin composites resins selected for this study present different

compositions. These differences led to specific protocols for use as described in materials and methods. In addition, these differences could lead to different levels of postoperative sensitivity reported by patients [9,30,31].

It was reported that the depth of the cavity represents a relevant factor for the emergence of postoperative sensitivity [11]. However, in the present study, the results revealed that cavity depth and extension did not prove to be a relevant factor for postoperative sensitivity. This corroborates a previous study [12]. It has been shown, however, that deeper cavities presents more postoperative sensitivity compared to shallower cavities [26,32]. The differences found may be due to the different materials and methodological approaches [33].

The magnitude of polymerization shrinkage may influence the degree of postoperative sensitivity reported by patients [1,34]. A meta-analysis of the literature to assess the clinical behavior of restorations performed with low polymerization shrinkage resin composite in comparison with traditional methacrylates-based resin composite, showed that methacrylates-based composites presented significantly better results than resin composites containing modified monomers [35]. In the present study, all cavities were of Class I type, so we opted for the incremental insertion technique, to minimize the effects of polymerization shrinkage. The purpose of the incremental techniques is to minimize the stress generated by polymerization contraction, inserting resin layers in the cavity and reducing the bonded areas [36,37]. As a result, a lower C-factor allows the resin to flow at the free surfaces [38].

The results, in the present study, showed no difference between the groups ($p > 0.05$), which had resin composites based on methacrylate (ROK™, Filtek P60™ and Evolux™) and silorane (P90™). The polymerization of resin composites produces stress [39,40]. This, however, may not represent an effective threat for postoperative sensitivity, as long as the incremental insertion technique is respected [41-43]. Controversially,

the use of a single increment of new bulk-fill material, even in deep cavities, did not generate more postoperative sensitivity when compared to its use in an incremental filling technique [44].

According to the manufacturers' recommendation for self-etching adhesives, a preliminary stage of enamel conditioning was carried out, which did not compromise the performance of such systems, since in the present study, the results revealed that there was no statistically significant difference between the groups that used total or self-etching adhesive systems. This finding may be attributed to the careful attention to the manufacturers' recommendations [6,45-47]. In addition, the risk and intensity of spontaneous postoperative sensitivity was shown to not be affected by the adhesive strategy or the filling technique in posterior composite restorations [48].

The selection of patients for the present research had as inclusion criteria the need for restorative treatment in at least four teeth, so each tooth received a type of resin composite and adhesive system. The purpose of this is that each patient became his own control, as the teeth were subject to the same environmental conditions [49,50].

To measure the postoperative sensitivity, a Visual Analog Scale (VAS) was used. The VAS is an instrument that measures subjective characteristics or attitudes that cannot be directly measured [51]. Thus, the presence of postoperative sensitivity may be influenced by the potential for aggression of the substances used as well as the individual differences in the subjective experience of pain [52]. Even though the analyzes of the results appear very promising, further clinical studies are needed to assess long-term postoperative sensitivity of the associations between the adhesive systems and resin composites used.

CONCLUSION

The combined resin composites and adhesive systems, depth and extension of the

Class I cavities promoted similar response regarding postoperative sensitivity in this limited study conditions.

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