Research Article

Dentin moisture does not influence postoperative sensitivity in posterior restorations: A double-blind randomized clinical trial

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Abstract: Purpose: This double-blind, randomized clinical trial evaluated the influence of dentin moisture on postoperative sensitivity (POS) in posterior restorations using a simplified etch-and-rinse adhesive, until 12 months of clinical service. **Methods:** 90 restorations were inserted in 45 patients to treat carious lesions or to replace existing posterior restorations with a depth ≥ 3 mm. After cavity preparation, the simplified etch-and-rinse adhesive (Adper Single Bond 2) was applied on dry or wet dentin followed by a bulk-fill resin composite (Filtek Bulk Fill) under rubber dam isolation. The patient's spontaneous and stimulated POS was evaluated at baseline and after 7 days, 6 months, and 12 months of clinical evaluation. The secondary parameters (marginal discoloration, marginal adaptation, fracture and recurrence of caries) were evaluated by World Dental Federation (FDI) criteria after 7 days, 6 and 12 months of clinical evaluation. **Results:** No significant spontaneous and stimulated POS was observed when dry and wet dentin were compared (P> 0.05). A significant and higher risk of spontaneous POS (18.6%; 95% CI 9.7 to 32.6) occurred up to 48 hours after restoration placement for both groups when compared to all evaluation times (P< 0.03). However, the intensity of POS was mild at up to 48 hours with a difference between the dry and wet dentin groups (P> 0.79). When secondary parameters were evaluated, no significant difference between the groups were observed (P> 0.05). (*Am J Dent* 2020;33:206-212).

Clinical significance: The moisture level of the dentin substrate in posterior restorations does not influence POS in bulk-fill resin composite posterior restorations when associated with an etch-and-rinse ethanol-based adhesive system.

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Introduction

The use of direct resin composites in posterior teeth has increased worldwide, mainly because of the improved durability of direct composite resin restorations.[1,2] However, postoperative sensitivity (POS) after posterior restorations with resin composite still remains a challenge in dentistry.[3,4] Clinical studies indicate that 30% of the population has reported POS after posterior resin composite treatment in posterior teeth, which is still a concern[3-10] because the literature contains no consensus on the possible risk factors for its occurrence.[11]

One of the most plausible hypotheses is related to the etch-and-rinse adhesive system used in association with the resin composite. When dentin is etched and rinsed, the smear layer is removed, and the dentin tubules are opened, increasing the dentin's permeability and the hydraulic conductance of the dentin aperture.[12] After that, it is necessary to apply an adhesive system. Several studies have shown that incomplete monomer infiltration may occur in the demineralizing dentin, leading to voids in the hybrid layer.[13] These non-filled spaces may allow dentin fluid movement,[14] especially under occlusal stress and temperature changes. This, in turn, sensitizes the nerve endings in the dentin tubules, which may cause POS.[15]

However, as long as the clinician keeps the dentin fully hydrated during the adhesive procedure, the dentin matrix will not collapse, and free space will be available for resin infiltration.[16-19] Therefore, better formation of the hybrid layer will occur, with less propensity to POS.[12] This is called the wet bonding technique, which has been used for more than 25 years to maintain adequate moisture for an etch-and-rinse adhesive.[17]

Unfortunately, the wet bonding technique is not easy to perform, mainly because of several factors, such as the adhesive solvent composition, operator skill, solvent drying time and distance can affect the degree of dentin moisture.[17-23] On the other side, until now, no clinical studies have shown any significant improvement in clinical parameters when etch-and-rinse adhesives were applied in the wet vs. dry conditions.[24-30] However, all previously published clinical trials were performed using non-carious cervical lesions. Since the dentin wetness and permeability have greater regional variability in occlusal dentin (posterior restorations) than in buccal dentin (non-carious cervical lesions),[31] it is important to evaluate how the degree of dentin moisture (dry or wet) affects the clinical performance (POS) of posterior resin composite restorations.

Thus, this double-blind, randomized clinical trial evaluated the influence of dentin moisture on spontaneous and stimulus POS in posterior restorations, using a simplified etch-and-rinse adhesive after 48 hours, 7 days, and 6 and 12 months. Also, the marginal discoloration, marginal adaptation, fracture and recurrence of caries were evaluated after 6 and 12 months by World Dental Federation (FDI) criteria. The null hypotheses were: (1) dentin moisture does not influence the spontaneous and stimulus POS evaluated at different times (at 48 hours, 7 days and 6 and 12 months), when compared to a simplified etch-and-rinse adhesive system used on dry dentin, and (2)

dentin moisture does not influence the other clinical parameters evaluated (marginal staining, fracture, marginal adaptation and the recurrence of caries) at different times (6 and 12 months), when compared to a simplified etch-and-rinse adhesive system used on dry dentin.

Materials and Methods

Ethical approval and protocol registration - The local ethics committee on involving human subjects reviewed and approved the protocol and consent form for this study (protocol #2.583.973). Written informed consent was obtained from all participants prior to starting the treatment. The experimental design followed the Consolidated Standards of Reporting Trials (CONSORT) statement.[32] This was a randomized, double-blind clinical trial registered in the Brazilian Clinical Trials Registry (#RBR-69d7cz). The study was carried out at the State University of Ponta Grossa from June 2018 to December 2018. All of the participants were informed about the study's nature and objectives, but they were not aware of which tooth received the specific treatments under evaluation.

Participant recruitment - Subjects were recruited as they sought treatment at the clinics of the School of Dentistry (State University of Ponta Grossa). These procedures were performed by two experienced dentists (called examiners) not involved in any part of the restorative phase of the clinical study. Those who qualified for the study were recruited in the order in which they reported for the screening session, thus forming a convenience sample. Participants were recruited through written advertisements placed on the university's walls.

Sample size - The sample size calculation was based on the absolute risk of spontaneous POS after posterior resin composite restorations. According to the literature, the risk of POS was around 30% in deep and large restorations.[7,9-11] Using $\alpha = 0.05$, a power of 80% and a two-sided test, the minimal sample size was 45 restorations in each group (considering a 20% dropout rate) in order to detect a 20% difference between groups when applying the adhesive to dry dentin.

Eligibility criteria - 63 participants were examined to evaluate if the subjects met the inclusion and exclusion criteria (Figure). The evaluations were performed using an intra-oral mirror, an explorer and a periodontal probe. The participants had to be in good general health, be at least 18 years-old, present at least 20 teeth under occlusion and present at least two carious lesions and/or have indications of replacement restoration (fracture, secondary caries, temporary restoration) in different hemiarches with a depth $\geq$ 3 mm, which was diagnosed using an interproximal radiograph.

Participants with dental prostheses, extremely poor oral hygiene, severe or chronic periodontitis, severe bruxism, parafunctional habits, or continuous use of medication that may alter the perception of pain (analgesic, anti-inflammatory) as well as patients undergoing bleaching treatment and pregnant patients were excluded. All of the participants signed an informed consent form before being enrolled in the study. Based on pre-established criteria, 45 subjects who volunteered for this study were selected (Figure).

Randomization sequence generation, allocation concealment and blinding - The within-subject randomization process was performed u sing http://www.sealedenvelope.com by a staff member who was not involved in the research protocol. Details of the allocated groups were recorded on cards contained in sequentially numbered, opaque, sealed envelopes. These were prepared by a staff member who was not involved in any of the phases of the clinical trial. The allocation assignment was revealed by opening the envelope only on the day of the restorative procedure, which guaranteed the concealment of the random sequence in order to prevent selection bias. The operator who implemented the interventions was not blinded to the procedure, mainly because they needed to know details regarding the restorative procedures. However, the participants and examiners were blinded to the group assignment.

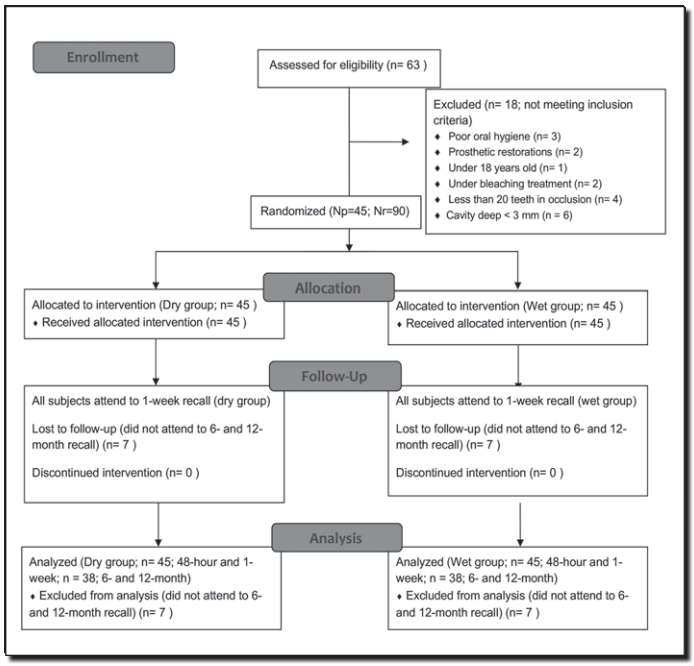

Figure. Participant flow diagram at the different phases of the study design.

Baseline characteristics of the selected teeth and clinical evaluation before restorative procedures - Two examiners, the same who were responsible for the subject recruitment, carried out the clinical evaluation before restorative procedures. The features of the posterior restorations were evaluated prior to the restorations' placement. Features such as the presence of antagonist and attrition facets were observed and recorded. The subjects were assessed for their risk of caries and parafunctional habits such as bruxism, estimated by means of clinical and sociodemographic information, taking into account incipient caries lesions, caries history and parafunctional habits.

Spontaneous preoperative sensitivity was evaluated prior to examination, as well as preoperative sensitivity to different stimuli (air, cold, heat, vertical and horizontal touch). To measure sensitivity to air, air-drying was applied for 10 seconds from a dental syringe placed 2 cm from the tooth surface; vertical and horizontal sensitivity were measured with a mirror cable; cold was stimulated by applying a swab with Endo Ice[a] to the labial surface in the cervical region of the restored tooth; and heat stimulation was applied to the tooth surface with a gutta-percha stick.[b,8]

For spontaneous preoperative sensitivity alone, the intensity of tooth sensitivity was also evaluated through the Visual Analogue Scale (VAS) and the NRS (Numerical Rating Scale). The VAS scale consists of a 10 cm linear scale with the words

"no pain" at one end and "unbearable pain" at the other. The NRS consists of five verbal points (0= none and 4= severe) with 0 meaning no pain and 4 meaning severe pain.

Interventions: Calibration and restorative procedure - Three trained and calibrated operators, not involved in the previous evaluation of the patients, carried out the restorative procedures. For calibration, the study director placed one restoration of each group in order to identify all steps involved in the protocol. Then, three operators placed another four restorations for each group in a clinical setting, under the study director's supervision. Any discrepancies in the restorative protocol were identified and discussed with the operators prior to starting the study. At this point, the operators were considered calibrated to perform the restorative procedures. The calibrated operators restored all teeth under the study director's supervision.

The interventions were standardized by a detailed protocol, briefly summarized below. A preliminary dental prophylaxis of the tooth surface was performed with pumice and water in a rubber cup, to remove the salivary pellicle and any remaining dental plaque, followed by rinsing and drying. Using a shade guide, the proper shade of the resin composite was determined. Local anesthesia was applied with a 3% mepivacaine solution (Mepisv[c]); all restorations were placed under rubber dam isolation. The operators did not prepare any additional retention or bevel in the cavities.

All subjects received a minimum of two restorations, one from each experimental group, in different cavities that were previously selected according to the inclusion criteria. The cavity dimensions in millimeters (height, width, and depth) was measured with a periodontal probe (#6 Satin Steel Handled[d]). The depth was measured in the proximal (Class II) or occlusal (Class I) cavity box after finishing the cavity preparation. The cavity design was performed using a spherical diamond bur (#1013-1017[e]) mounted in a high-speed handpiece with air-water spray. It was only applied to remove defective restorations or eliminate carious tissue (caries-infected dentin). No liner or base was used. To restore Class II cavities, a sectional matrix system (Palodent[b]) was preferentially used. However, circumferential matrix systems were used when good adaptation could not be obtained with the sectional matrix system.

Then, 34% phosphoric acid (Scotchbond Universal Etchant[f]) was applied for 15 seconds to the dentin/enamel, followed by rinsing with a dental syringe for 10 seconds. Following that, in the dry dentin groups, all of the dentin surface was dried for 10 seconds with 2 cm between the tip of the air syringe and the dentin surface. At the end, the dentin surface was completely dry, without any signs of moisture. On the other hand, in the wet dentin groups, only the excess water on the dentin surface was removed using slight air-drying for 2-4 seconds with 2 cm between the tip of the air syringe and the dentin surface. At the end, the entire dentin surface should have been shiny since moisture was visible.[12]

The Adper Single Bond 2[f] adhesive was shaken, and a small drop of it was placed on a microbrush.[g] Following that, the microbrush was rubbed onto the surface of the dentin under manual pressure (equivalent to at least 50 g), followed by thinning with gentle air-drying for 5 seconds. Then, the entire surface was light-cured (Radii Cal[h]) for 10 seconds (1,000 mW/cm^2). The resin composite Bulk Fill[e] was used in a single increment and photoactivated[h] for 30 seconds (1,000 mW/cm^2) in the majority of the cavities. When the cavities were deeper than 4 mm, the second increment was inserted and photo-activated as previously described (30 seconds; 1,000 mW/cm^2). The light-curing output was checked daily, before starting the restorative procedure of each patient. After the restorations were finished, the occlusal adjustment was carried out, followed by finishing and final polishing with fine-grained FF diamond tips and polishing with rubber cups (Astropol[i]).

Examination after restorative procedure - Two examiners, the same persons who were responsible for the patient recruitment and clinical evaluation before restorative procedure, carried out the clinical evaluation after restorative procedure. Spontaneous POS was the primary clinical outcome analyzed and was assessed up to 48 hours and after 7 days, 6 months and 12 months using the VAS and NRS, as previously described. The stimulated POS was also evaluated (secondary outcomes). This was performed after 7 days, 6 months and 12 months. At each time period, the sensitivity caused by air application, vertical and horizontal percussion and cold and heat stimulation were evalu-ated, as described in the initial evaluation. The final values of spontaneous POS were divided into two categories: the percen-tage of patients who reported POS at least once during treat-ment (absolute risk) and overall POS intensity after 48 hours, 7 days, and 6 and 12 months. Also, during return visits, clinical outcomes such as marginal staining, fracture, marginal adaptation and the recurrence of caries were evaluated using FDI criteria at 6 and 12 months after the procedure.

Statistical analysis - The statistician was blinded to the study groups, and the statistical analyses followed the intention-to-treat protocol according to CONSORT suggestions.[32] This protocol included all participants in their originally randomized groups, even those who were unable to meet their scheduled recall visits. This approach was more conservative and less open to bias.

Participants who experienced at least one event of POS at each evaluation time (after 48 hours, 7 days, and 6 and 12 months) were considered as having POS. The risk of spontaneous and stimulated (by air, cold, heat, horizontal and vertical percussion) POS among the groups was compared using the chi-square test and Fisher exact test.

The intensity of spontaneous POS at each evaluation time (7 days and 6 and 12 months) was evaluated using the Mann-Whitney test (VAS) and two-way ANOVA and Tukey tests (NRS). Additionally, the risks of POS according to the characteristics of dental arches and cavities were compared using the chi-square test. Each item was statistically analyzed, as was each overall parameter (FDI criteria). The differences in the ratings of the two groups and each group at baseline and after 6 and 12 months were tested with the Wilcoxon rank-sum test and repeated measures analysis of variance by rank ($\alpha = 0.05$). In all of the statistical tests, the alpha was set at 5% (Statistica[j] for Windows 7.0).

Results

Characteristics of the participants and cavities - The experimental protocols were implemented exactly as planned, and no modifications were made. The Figure depicts the participant flow diagram at the different phases of the study design.

Table 1. Characteristics of the subjects, dental arches and cavities per group.

Characteristic	Number of restorations	
Gender		
Male	16	
Female	29	
Age distribution, years		
20-29	28	
30-39	7	
40-49	6	
>49	4	
Characteristics of dental arches and cavities	Number of restorations	
Presence of antagonist	Dry dentin	Wet dentin
Yes	45	45
No	0	0
Attrition facet		
Yes	3	3
No	42	42
Arc distribution		
Maxillary	21	23
Mandibular	24	22
Cavity depth		
3 mm	10	13
4 mm	25	21
>4 mm	10	11
Black classification		
I	35	32
II	10	13
Number of restored surfaces		
1	33	30
2	12	11
3	0	4
4	0	0
Reasons for restoration		
Marginal fracture	1	0
Esthetic reasons	17	20
Marginal discoloration	0	1
Bulk fracture	0	0
Primary/secondary caries lesion	28	23

A total of 29 women and 16 men participated in this study. The mean age of the participants was 34 ± 10.5 years. Ninety restorations were placed, 45 for each group. The distribution of the restorations was 67 Class I and 23 Class II cavities (Table 1). Table 1 shows the homogeneity of the cavity characteristics between the study groups. Two participants did not attend the 48-hour and 7-day recalls, and two other participants did not attend the 6- and 12-month recalls.

Postoperative sensitivity evaluation - Only one subject reported spontaneous POS who also had preoperative sensitivity. No significant spontaneous POS was observed when dry and wet dentin was compared (Tables 2-4) The same occurred with stimulated sensitivity (data not shown). A significant and higher risk of spontaneous POS (18.6%; 95% CI 9.7 to 32.6; Table 2) occurred up to 48 hours after restoration placement for both groups when compared to all evaluation times (Table 3; $P< 0.03$). However, the intensity of spontaneous POS was mild at up to 48 hours, as measured by the VAS and NRS scales, with a statistically insignificant difference between the dry and wet dentin groups (Table 3; $P> 0.79$).

None of the participants reported spontaneous POS for any restorations after 1 week nor after 6 or 12 months. Some of the restorations showed stimulus pre- and postoperative sensitivity with no statistically significant difference when comparing dry to wet dentin (Tables 2-4). Notably, none of the subjects needed an analgesic drug to reduce their POS.

When the cavity characteristics were evaluated, the types of cavities and the numbers of surfaces were not statistically significant (Table 4; $P= 0.33$ and $P= 0.1$, respectively). Additionally, the cavity depth did not show any significant difference (Table 4; $P= 0.51$)

Other clinical parameters - Seven restorations showed small marginal discrepancies after the 12-month recall, with no statistical difference between the dry and wet dentin groups (Table 5; $P= 1.0$). Four restorations showed some marginal fractures after the 12-month recall, with no statistical difference between the groups (Table 5; $P= 0.61$). Fourteen restorations, showed some marginal discolorations after the 12-month recall. Once again, no statistical difference between the dry and wet dentin groups was observed (Table 5; $P= 0.55$). No restorations had recurring caries at the 12-month recall (Table 5).

Discussion

In the present randomized clinical trial, the POS of restorations placed using the bulk-fill resin composite associated with a simplified ethanol-based etch-and-rinse adhesive applied in wet and dry dentin was evaluated. The results showed that keeping the demineralizing dentin wet or dry did not significantly increase the spontaneous and provoked POS in resin composite posterior restorations, which leads to accepting the first null hypothesis. Also, no significant difference was observed when wet and dry dentin conditions were compared after 6 and 12 months of clinical evaluation, in terms of other clinical parameters (marginal staining, fracture, marginal adaptation and recurrence of caries) were compared, which leads to accepting the second null hypothesis.

Unfortunately, the effects of drying etched dentin in a clinical situation have been poorly reported over the last 25 years.[24-30] Perdigão et al[24,33] authored the first clinical study showing no clinical differences after 6 and 18 months due to substrate moisture when non-carious cervical lesions were restored. They speculated that the dentin was hypermineralized by sclerosis due to tubule occlusion by mineral salts.[34] As a result, acids on the dentin surface may not expose collagen upon etching, preventing adequate resin tag and hybrid layer formation.[35,36]

Based on the reasons for the teeth being restored, it is possible to speculate that the remaining occlusal dentin in the present study could be also considered a sclerotic dentin. The pulp responds to the carious process or to multiple injuries (bur, temperature, etc.) either by completely blocking the lumen of the dentin tubule or by decreasing the in tubule's diameter.[31] All of these pathological processes significantly decrease the intrinsic moisture of occlusal dentin. Therefore, leaving the dentin moist may not be clinically relevant, as the collapse of collagen upon drying may not occur in etched sclerotic dentin.[31,37]

Several in vitro studies have also shown that the immediate and long-term bonding of simplified adhesive can be improved by rubbing the adhesive onto the demineralized dentin surface, even if the dentin was kept dry.[24-30] Zander-Grande et al[25] showed that dentin moisture seemed unimportant to the retention of etch-and-rinse adhesives, as long as the adhesives have been vigorously rubbed onto the dentin surface. The me-

Table 2. Number of subjects with spontaneous tooth sensitivity/total during 12 months of follow-up, as well as the absolute risk.

Time assessment		Dry dentin		Wet dentin		P value*
		Number of subjects with POS/total	Absolute risk (95%CI)	Number of subjects with POS/total	Absolute risk (95%CI)	
Pre-operative	Baseline	8/45	17.8 (9.29-31.33)	8/45	17.8 (9.29-31.33)	1.0
	Up to 48 hours	8/43	18.6 (9.74-32.62)	8/43	18.6 (9.74-32.62)	1.0
Postoperative						
	1 week	0/43	0 (0.00-0.82)	0/43	0 (0.00-0.82)	1.0
	6 months	0/41	0 (0.00-0.85)	0/41	0 (0.00-0.85)	1.0
	12 months	0/40	0 (0.00-0.87)	0/40	0 (0.00-0.87)	1.0

* Chi-square test and Fisher exact test.

Table 3. Intensity of spontaneous postoperative sensitivity experienced by the subjects during 7 days of follow-up.

Time assessment	Visual Analogue Scale*		Numerical Rate Scale**	
	Dry dentin	Wet dentin	Dry dentin	Wet dentin
Up to 48 hours	3.5 (2-5) A	3.0 (2-5) A	2.9 (2.1) a	3.0 (2.3) a
1 week later	0 (0-0) B	0 (0-0) B	0.0 (0.0) b	0.0 (0.0) b

* Median and interquartile range; Similar capital letters means medians statistically similar (Mann-Whitney's test; P> 0.05).
** Mean and standard deviation; Similar lower-case letters means statistically similar (Tukey's test; P> 0.05).

Table 5. Number of evaluated restorations for dry and wet dentin classified according to the World Dental Federation (FDI) criteria.

FDI criteria	Score*	Baseline		6 months		12 months		FDI criteria	Score*	Baseline		6 months		12 months	
		Dry	Wet	Dry	Wet	Dry	Wet			Dry	Wet	Dry	Wet	Dry	Wet
Marginal adaptation	VG	45	45	41	40	37	36	Fractures	VG	45	45	40	39	39	37
	GO	--	--	0	1	3	4		GO	--	--	1	2	1	3
	SS	--	--	--	--	--	--		SS	--	--	--	--	--	--
	UN/PO	--	--	--	--	--	--		UN/PO	--	--	--	--	--	--
Marginal staining	VG	45	45	38	38	33	33	Caries recurrence	VG	45	45	41	41	40	40
	GO	--	--	2	2	4	5		GO	--	--	--	--	--	--
	SS	--	--	1	1	3	2		SS	--	--	--	--	--	--
	UN/PO	--	--	--	--	--	--		UN/PO	--	--	--	--	--	--

* VG for clinically very good; GO for clinically good; SS for clinically sufficient/satisfactory; UN for clinically unsatisfactory and; PO for clinically poor.

Table 4. Number of subjects (%) who experienced spontaneous postoperative sensitivity up to 48 hours follow-up according to the characteristics of dental arches and cavities.

Characteristics	Number of sensitive teeth (%)		P-value*
	No	Yes	
Cavity depth			
3 mm	18 (78)	5 (22)	0.51
4 mm or more	57 (85)	10 (15)	
Black cavity			
Class I	54 (80.59)	13 (19.40)	0.33
Class II	21 (91.3)	2 (8.69)	
Number of restored surfaces			
1 + 2	71 (82.55)	15 (17.44)	1
3 + 4	4 (100)	0 (0)	

* Chi-square test.

chanical pressure applied to the demineralized dentin surface during vigorous rubbing might compress the collapsed collagen network like a sponge. As the pressure is relieved, the compressed collagen expands, and the adhesive solution may be drawn into the collapsed collagen mesh.[20] However, it is worth mentioning that the dentin was not over-dry during the adhesive application. After drying procedures, the dentin was visibly dry, with no signs of moisture.

After 1 week and after 6 and 12 months of clinical evaluation, the spontaneous and provoked POS was very low, as previously demonstrated in a recent study[10] and also in a systematic review of clinical studies[38] indicating that POS generated immediately after placement of a restoration appears to be the result of trauma produced by restorative procedures.[10]

In the present study, two different scales to measure the intensity of POS were used: Visual Analogue Scale (VAS) and the Numerical Rating Scale (NRS). In fact, Reis et al,[38] in a systematic review of clinical studies, concluded that there is a great variation among the way researchers assess the POS in posterior restorations. This leads to a difficulty in comparing intensity of POS between different studies. Therefore, if in the same study, both scales are used, comparison with different clinical studies may be possible.

Regarding the characteristics of the cavities, the risk of spontaneous POS was correlated with the complexity of the restoration, as was previously observed in several studies.[3,7,9] Class II cavities or cavities with three or four surfaces showed more POS when compared with Class I cavities or cavities with one or two surfaces. Cavity size can make Class I and II composite restorations more susceptible to clinical failure.[3,7,9] The incidence of POS in Class II cavities was higher than in other cavity preparations, and the increased amount of destruction of dental structure found in Class II cavities is a determinant factor in the occurrence of POS.[7,10]

According to the results of previous studies,[6,39] cavity depth is not a factor for increasing spontaneous POS. As bulk-fill composite resin was used to restore all of the cavities, only pa-

tients with a minimum cavity depth of 3 mm were included in the present study. Therefore, most of the cavities restored in the current study had a depth from 3 to 5 mm, which was probably responsible for the similarity of the results when cavity depth was evaluated. For instance, in a recently published study,[39] the authors included cavity sizes of 2 mm or higher, which may have caused the lower POS incidence in shallow cavities when compared to in deep cavities.

The present study had some limitations. Only an ethanol solvent-based adhesive was evaluated. Yet, different solvents are available with different commercial adhesives in the market. For instance, due to the higher vapor pressure of acetone, about four times as high as that of ethanol, it is mainly applied with etch-and-rinse adhesives.[40] Therefore, future clinical studies should apply acetone-based adhesives to dry and wet dentin.

It worth to mentioning that the present study was conducted in an ideal scenario (a university setting), in which calibrated and experienced operators placed the restorations using rubber dam isolation, which could be reported as an additional moisture control. Future clinical studies evaluating the same hypothesis but in a practice-based scenario need to be performed.

In conclusion, dentin moisture did not influence POS in bulk-fill resin composite posterior restorations when used with an etch-and-rinse ethanol-based adhesive system.

a. Maquira, Maringá, Paraná, Brazil.
b. Dentsply Caulk, Milford, DE, USA.
c. Nova DFL, Rio de Janeiro, RJ, Brazil.
d. Hu-Friedy Manufacturer, Chicago, IL, USA.
e. KG Sorensen, Barueri, SP, Brazil.
f. 3M Oral Care, St. Paul, MN, USA.
g. FGM Prod. Odont., Joinville, SC, Brazil.
h. SDI, Victoria, Australia.
i. Ivoclar Vivadent, Schaan, Liechtenstein.
j. StatSoft Inc., Tulsa, OK, USA.

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