



Levantamento dos protocolos dos dentistas em relação aos procedimentos de Adesão

Survey on protocols focused on adhesion procedures adopted by dentists

Levantamiento de protocolos de odontólogos en relación a los procedimientos de Adhesión

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RESUMO

Objetivo: Avaliar os protocolos relacionados aos procedimentos adesivos praticados pelos cirurgiões-dentistas atuantes do estado do Espírito Santo (ES) por meio da aplicação de questionários. **Métodos:** Odontólogos atuantes do Espírito Santo foram convidados a responder um questionário virtual que abordou questões relacionadas à sua prática clínica adesiva rotineira. As respostas obtidas foram tabuladas para análise descritiva e comparadas baseadas no índice de sucesso/insucesso em procedimentos restauradores relatados pelos profissionais e no conhecimento sobre o conceito de adesão. Os dados passaram por análise estatística utilizando o teste qui-quadrado ou exato de Fisher, dependendo do caso. **Resultados:** 118 profissionais responderam o questionário. Destes, em relação ao índice de sucesso/insucesso, cerca de 83,9% relataram baixo índice de insucesso em seus procedimentos restauradores, enquanto 16,1% apresentaram alto índice de insucesso, contudo, alguns passos dos procedimentos adesivos não foram respondidos da maneira como a literatura sugere. Sobre o conhecimento acerca do conceito de adesão, 95,8% relataram conhecer o conceito e apenas 4,2% relataram não conhecer. **Conclusão:** Conclui-se que, apesar do baixo índice de insucesso e conhecimento sobre adesão relatados pelos profissionais, o conhecimento sobre os protocolos dos procedimentos adesivos de cirurgiões dentista do ES foi baixo.

Palavras-chave: Adesivos Dentinários, Resinas Compostas, Coleta de Dados.

ABSTRACT

Objective: The aim of the current study is to assess protocols focused on adhesive procedures practiced by dentists who work in Espírito Santo State (ES), based on questionnaire application. **Methods:** Dentists working in ES were invited to complete a virtual questionnaire about adhesion procedures associated with their clinical practice. Participants' responses were tabulated for descriptive analysis purposes and compared to each other,

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based on the success/failure rate in restorative procedures reported by these professionals and on their understanding about the concept of adhesion. Collected data were subjected to statistical analysis based on using the Chi-square or Fisher's exact test, depending on the case. **Results:** One hundred and eighteen (118) professionals completed the questionnaire. Approximately 83.9% of them reported low failure rate in their restorative procedures, whereas 16.1% reported high failure rate. Moreover, 95.8% of participants reported to know the concept of adhesion, whereas only 4.2% reported not know it. **Conclusion:** It is possible concluding that, despite the low rate of failure in, and knowledge about, adhesion reported by the herein interviewed professionals, their knowledge about protocols on adhesive procedures to be adopted by dentists in ES remains incipient.

Keywords: Dentin-Bonding Agents, Composite Resins, Data Collection.

RESUMEN

Objetivo: Evaluar los protocolos relacionados con los procedimientos adhesivos practicados por odontólogos que actúan en el estado de Espírito Santo (ES) a través de la aplicación de cuestionarios. **Métodos:** Se invitó a los odontólogos que trabajaban en Espírito Santo a responder un cuestionario virtual que abordaba preguntas relacionadas con su práctica clínica habitual de adhesivos. Las respuestas obtenidas fueron tabuladas para análisis descriptivo y comparadas con base en la tasa de éxito/fracaso en los procedimientos restaurativos relatada por los profesionales y el conocimiento sobre el concepto de adherencia. Los datos se analizaron estadísticamente mediante la prueba de chi-cuadrado o exacta de Fisher, según el caso. **Resultados:** 118 profesionales respondieron el cuestionario. En cuanto a la tasa de éxito/fracaso, alrededor del 83,9 % reportó una baja tasa de fracaso en sus procedimientos restaurativos, mientras que el 16,1 % tuvo una alta tasa de fracaso, sugiere la literatura. En cuanto al conocimiento sobre el concepto de adherencia, el 95,8% refirió conocer el concepto y solo el 4,2% refirió no conocer. **Conclusión:** Se concluye que, a pesar de la baja tasa de fallas y conocimientos sobre adhesión informados por los profesionales, el conocimiento sobre los protocolos de procedimientos adhesivos de los odontólogos en ES fue bajo.

Palabras clave: Recubrimientos Dentinarios, Resinas Compuestas, Recolección de Datos.

INTRODUCTION

Adhesive procedures account for the majority of dental clinics' routine practice, and with the increase in dental restorations for aesthetic and minimally invasive purposes, Adhesive Dentistry has had to develop quickly, resulting in various dental adhesives emerging in the dental market. Additionally, the success of adhesive dentistry is influenced by several factors, such as the way associated materials are used, and the operator's skills and knowledge to perform the treatment. These factors can compromise restorative treatment success and lead to adhesive failures. Therefore, professionals' knowledge about adhesive procedures is deficient. Despite the significant number of clinical studies about different dental materials available in the literature, dentists have a hard time updating themselves. Their difficulty and negligence lie in the fact that they do not access information based on scientific evidence and user handbooks provided by manufacturers (MATOS AB, et al., 2017; ALTHAQAFI KA, et al., 2020; PERDIGÃO J, 2020).

Adhesion in dentistry has been described since 1951 when a group of researchers used the GMDP (glycerophosphate dimethacrylate) monomer to bond acrylic resin to dental substrate. Later on, in 1955, Michael Buonocore revolutionized Restorative Dentistry by introducing the acid etching technique to be applied to the tooth structure to demineralize hydroxyapatite crystals and create sites on the tooth surface to enable the effective adhesion of resin monomers. Another revolution in Adhesive Dentistry was in 1982 when Nakabayashi described the hybrid layer (BEDRAN-RUSSO A, et al., 2017; PERDIGÃO J, 2020; MEERBEEK BV, et al., 2020; AHMED MH, et al., 2020; PERDIGÃO J, et al., 2021).

Adhesives were classified according to their generation, but due to confusion, they are now classified according to how they interact with the smear layer. Thus, there are three types of adhesive systems: the

conventional system, which can be three steps or two steps, the self-etching system, two steps or one step, and the universal system. The conventional system depends on the use of phosphoric acid separately to remove the smear layer, and enamel and dentin demineralization occurs. The self-etching system is the adhesive system that does not use the acid etching step, so there will be acidic monomers in the primer solution of this system, making it an acidic solution. Universal adhesives were the last adhesives to be launched on the dental market, and they are single-bottle, composed of an acidic primer, adhesive, and functional monomers, which is the main difference between universal and self-etching adhesives (BEDRAN-RUSSO A, et al., 2017; PERDIGÃO J, et al., 2021).

The main challenge faced by adhesive dentistry is promoting efficient adhesion on dental substrates of different natures. Enamel has approximately 96% mineral content, whereas dentin has 70% mineral content and 20% organic material, in addition to water. Furthermore, with increasing depth in the dentin, there will be an increase in the number of dentinal tubules present in the dentin surrounding the dental pulp. Given this difference, dentin bonding should be done more carefully, since collagen fibers' collapse can lead to bond failure. Thus, there are two adhesion types: mechanical and chemical. Mechanical adhesion refers to the creation of micro-retentions in the mineral tissue to promote the microporosities where resin tags will be formed and adhere through mechanical interlocking. These micro-retentions can be mechanically achieved through cavity preparation and chemically achieved through acid conditioning. Chemical adhesion is performed using chemical bonds of specific functional monomers capable of joining hydroxyapatite calcium ions to the synthetic material - this adhesion type is the ideal one to be used in dentin (MATOS AB, et al., 2017; MEERBEEK BV, et al., 2020; PERDIGÃO J, et al., 2021; BEDRAN-RUSSO A, et al., 2017; NARGARKAR S, et al., 2019).

Therefore, the aim of the current study was to assess the protocols on adhesive procedures practiced and adopted by dentists who work in Espírito Santo State based on questionnaire application and the comparison between the observed results.

METHODS

The study protocol was approved by the Ethics Committee on Human Research of Faculdade Unificadas Doctum de Teófilo Otoni - FUTO (5.151.412 and CAAE 50882121.3.0000.8747). The current research was carried out based on the application of a questionnaire to 300 dentists (convenience sample) who were enrolled in the Regional Council of Dentistry, Espírito Santo State's section (CRO-ES), and who work in the aforementioned state.

Data collection instrument comprised a questionnaire that was digitally prepared based on using Google Forms (Google Inc., Mountain View, CA, USA), with CRO-ES's support, and sent to registered dentists in the form of 'hidden list'. In addition to the questionnaire, the digital file included the Free and Informed Consent Form to be signed by professionals who agreed to participate in the study, before they digitally filled out the questionnaire.

Inclusion criteria comprised professionals, who were regularly enrolled in the Regional Dentistry Council of Espírito Santo State, who worked in the aforementioned state and who provided the written consent. And the exclusion criteria comprised professionals who did not work in Espírito Santo State; participants' withdrawal from the study and non-fully completed questionnaires.

The questionnaire applied to the investigated dentists was sent to the CRO-ES, which, in its turn, sent it to registered professionals by direct mail. All 118 properly completed questionnaires - i.e., the ones that did not show unanswered questions - were analyzed. Participants were not identified at any time during the research or in the results' presentation.

Data extracted from all fully completed questionnaires were organized in the form of tables to enable properly performing statistical analysis, based on the desired comparison, namely: results' comparison between specialties and based on clinical experience (based on the number of years of professional experience, after Dental Surgeons' certification).

The questionnaire titled " Survey on protocols focused on adhesion procedures adopted by dentists in Espírito Santo State" comprised 17 objective questions, questions addressing the routine adhesive practice, as well as questions focused on identifying protocols adopted by dentists (**Supplementary File**). Data collected through the application of the aforementioned questionnaire were tabulated in Microsoft Excel® in order to be analyzed. Analyses were performed based on the following comparative parameters: restoration success rate and years of professional experience. Chi-square or Fisher's exact test was applied, depending on the case, at 5% significance level ($p < 0.05$). Multifactorial analysis of variance (ANOVA) was used to compare variables. Tukey's post-test was used whenever multiple comparisons were necessary. All statistical analyses adopted 5% significance level and 95% confidence interval. IBM SPSS Statistics 19 (IBM Company, Armonk, NY, USA) was the statistical software used in the analyses.

RESULTS

In total, 118 responses to the electronically applied questionnaire were collected. Participants' mean age was 36.5 years and their mean professional activity time was 12.1 years. Demographic data representative of the sample are shown in **Table 1**.

Table 1 - Demographic data associated with sample featuring.

Demographic features	Categories	N	%
Has specialty	Yes	71	60.2%
	No	47	39.8%
Operating time	0-5 years	46	39.9%
	6-15 years	29	24.5%
	More than 15 years	43	36.4%
Gender	Female	86	72.9%
	Male	32	27.1%
Workplace	Private office	103	71.5%
	Basic Health Unit (BHU)	24	16.6%
	Popular Clinic	13	9%
	Hospital	4	2.7%
Age	20-35 years old	59	50%
	36-45 years old	31	26.2%
	Older than 45 years	28	23.7%

Source: Rodrigues LS, et al., 2023.

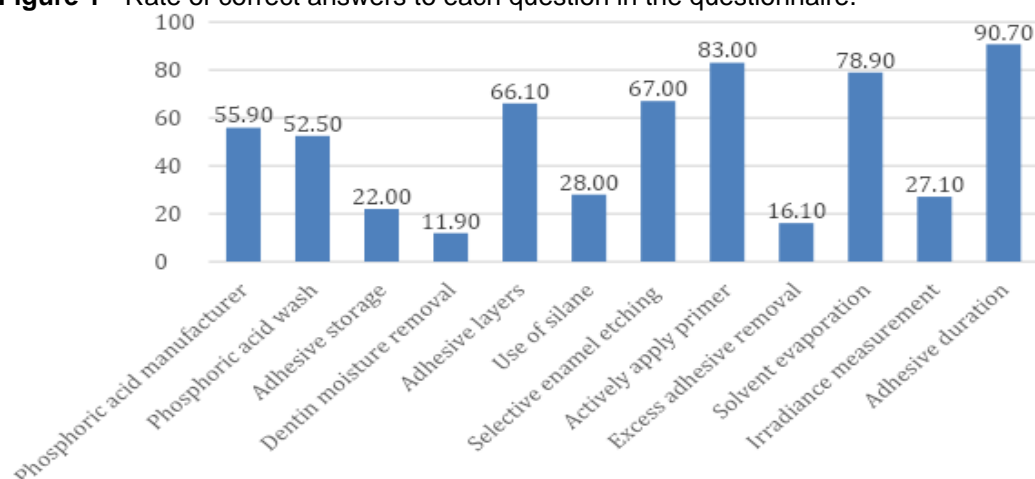
Variables included in the current study are described in **Table 2**. These variables represent the questions used in the questionnaire, in order to identify the protocols adopted by dentists. The questions discussed the routine adhesive practice, such as phosphoric acid manufacturer, phosphoric acid wash, adhesive storage, dentin moisture removal, adhesive layers, use of silane, selective enamel etching, actively apply primer, excess adhesive removal, solvent evaporation, irradiance measurement and adhesive duration.

Table 2 - Descriptive analysis of variables included in the current study.

Outcome variables	Categories	N	%
Isolation type	Relative	89	75.4%
	Absolute	29	24.6%
Restoration failures	Rarely	86	72.9%
	Never	13	11.0%
	Often	3	2.5%
	Sometimes	16	13.6%
Has Specialty	Yes	71	60.2%
	No	47	39.8%
Worries about phosphoric acid manufacturer	Yes	66	55.9%
	No	52	44.1%
Phosphoric acid washing method	Air and water spray	62	52.5%
	Just water	56	47.5%
Adhesive storage location	Closet (drawer)	92	77.9%
	Refrigerator	26	22%
Moisture removal from dentin	Absorbent paper	14	11.8%
	Triple syringe air	77	65.3%
	Cotton	27	22.9%
Number of applied adhesive layers	Two	78	66.1%
	One	37	31.4%
	More than two	3	2.5%
Do you use the silane found in universal adhesives?	Yes	85	72%
	No	33	28%
Do you selectively etch enamel at the time to use self-etching adhesive?	Yes	79	66.9%
	No	39	33.1%
Do you actively apply primer?	Yes	98	83.1%
	No	20	16.9%
Do you wait for the primer solvent to evaporate?	Yes	93	78.8%
	No	25	21.2%
How do you remove excess adhesive?	Dry microbrush	21	17.7%
	Air jet	97	82.2%
Do you frequently measure the irradiance of the light curing device?	Always	16	13.6%
	Never	51	43.2%
	Rarely	35	29.7%
	Sometimes	16	13.6%
How long does the adhesive often last and for how long is it used, after its container is opened?	6 months	61	51.7%
	2 months	46	39%
	12 months	10	8.5%
	More than 1 year	1	0.8%
Do you know the concept of adhesion?	Yes	113	95.8%
	No	5	4.2%
Professional career time	0-5 years	46	39.9%
	6-15 years	29	24.5%
	More than 15 years	43	36.4%
What do you notice the most about failures in adhesive restorations?	Marginal pigmentation	40	33.9%
	Restoration fracture/decementing	65	55%
	Others	13	11%
What adhesive systems do you have in your workplace?	Conventional two-step system	58	36%
	Conventional three-step system	5	3.1%
	Two-step self-etching system	15	9.3%
	One-step self-conditioning system	27	16.7%
	Universal	53	32.9%
Gender	Female	86	72.9%
	Male	32	27.1%
Workplace	Private office	103	71.5%
	Basic Health Unit (BHU)	24	16.6%
	Popular Clinic	13	9%
	Hospital	4	2.7%
Age	20-35 years old	59	50%
	36-45 years old	31	26.2%
	Older than 45 years	28	23.7%

Source: Rodrigues LS, et al., 2023.

Figure 1 - Rate of correct answers to each question in the questionnaire.



Source: Rodrigues LS, et al., 2023.

Table 3 - Comparison between failure data and other variables.

Variables	Success		Failure		p-value
	N	%	N	%	
Isolation type					
Relative	72	80.9	17	19.1	0.120
Absolute	27	93.1	2	6.9	
Worries about phosphoric acid manufacturer					
Yes (correct answer)	56	84.9	10	15.1	0.752
No (incorrect answer)	43	82.7	9	17.3	
Phosphoric acid washing					
Air and water spray (correct answer)	50	80.7	12	19.3	0.521
Just water (incorrect answer)	49	87.5	7	12.5	
Adhesive storage location					
Refrigerator (correct answer)	24	82.3	2	7.7	0.368
Closet/drawer (incorrect answer)	75	81.5	17	18.5	
Moisture removal from dentin					
Absorbent paper (correct answer)	13	92.9	1	7.1	0.611
Triple syringe air/ cotton (incorrect answer)	23	56.1	18	43.9	
Number of applied adhesive layers					
Two (correct answer)	64	82.1	14	17.9	0.446
One/More than two (incorrect answer)	35	87.5	5	12.5	
Do you use the silane found in universal adhesives?					
No (correct answer)	27	81.8	6	18.2	0.702
Yes (incorrect answer)	72	84.7	13	15.3	
Do you selectively etch enamel at the time to use self-etching adhesive?					
Yes (correct answer)	66	83.5	13	16.5	0.882
No (incorrect answer)	33	84.6	6	15.4	
Do you actively apply primer?					
Yes (correct answer)	84	85.7	14	14.3	0.235
No (incorrect answer)	15	75	5	25	
Do you wait for the primer solvent to evaporate?					
Yes (correct answer)	77	82.8	16	17.2	0.530
No (incorrect answer)	22	88	3	12	
How do you remove excess adhesive?					
Dry microbrush (correct answer)	16	84.2	3	15.8	0.906
Air jet (incorrect answer)	83	83.8	16	16.2	
Do you frequently measure the irradiance of the light curing device?					
Always/Sometimes (correct answer)	28	87.5	4	12.5	0.516
Rarely/Never (incorrect answer)	71	82.6	15	17.4	
How long does the adhesive often last and for how long is it used, after its container is opened?					
6/2 months (correct answer)	89	83.2	18	16.8	0.506
12 months/More than 1 year (incorrect answer)	9	81.8	2	18.2	
Professional career time					
0-10 years	44	81.2	13	22.8	0.111
More than 10 years	55	90.2	6	9.8	

Source: Rodrigues LS, et al., 2023.

In total, 99 (83.9%) of participants reported a low failure rate in their restorations (72.9% - rarely; 11.0% - never), whereas 19 participants reported a high failure rate in these procedures (2.5% - frequently; 13.6% - sometimes). Some questions in the questionnaire had a correct answer and the success rate of each one of them is shown in **Figure 1**. In total, 99 (83.9%) of participants reported a low failure rate in their restorations (72.9% - rarely; 11.0% - never), whereas 19 participants reported a high failure rate in these procedures (2.5% - frequently; 13.6% - sometimes). Some questions in the questionnaire had a correct answer and the success rate of each one of them is shown in **Figure 1**. In total, 113 professionals (95.8%) reported to know the concept of adhesion, whereas only 5 (4.2%) of them reported to not know it. **Table 4** presents the comparison between knowledge data on the concept of adhesion and other variables associated with professionals' conduct.

Table 4 - Comparison between knowledge data on the concept of adhesion and other variables.

Variables	Know the concept		Do not know the concept		p-value
	N	%	N	%	
Worries about phosphoric acid manufacturer					
Yes (correct answer)	63	95.4	3	4.6	0.851
No (incorrect answer)	50	96.1	2	3.9	
Phosphoric acid washing					
Air and water spray (correct answer)	59	95.2	3	4.8	0.916
Just water (incorrect answer)	54	96.4	2	3.6	
Adhesive storage location					
Refrigerator (correct answer)	87	94.6	5	5.4	0.461
Closet/drawer (incorrect answer)	26	100	0	0	
Moisture removal from dentin					
Absorbent paper (correct answer)	14	100	0	0	0.704
Triple syringe air/ cotton (incorrect answer)	99	95.2	5	4.8	
Number of applied adhesive layers					
Two (correct answer)	75	96.1	3	3.9	0.768
One/ More than two (incorrect answer)	38	95	2	5	
Do you use the silane found in universal adhesives?					
No (correct answer)	32	97.0	1	3.0	0.685
Yes (incorrect answer)	81	95.3	4	4.7	
Do you selectively etch enamel at the time to use self-etching adhesive?					
Yes (correct answer)	75	95.0	4	5.0	0.526
No (incorrect answer)	38	97.4	1	2.6	
Do you actively apply primer?					
Yes (correct answer)	94	95.9	4	4.1	0.853
No (incorrect answer)	19	95.0	1	5.0	
Do you wait for the primer solvent to evaporate?					
Yes (correct answer)	89	95.7	4	4.3	0.947
No (incorrect answer)	24	96.0	1	4.0	
How do you remove excess adhesive?					
Dry microbrush (correct answer)	18	94.7	1	5.3	0.952
Air jet (incorrect answer)	95	95.9	4	4.1	
Do you frequently measure the irradiance of the light curing device?					
Always/Sometimes (correct answer)	31	96.9	1	3.1	0.714
Rarely/Never (incorrect answer)	82	95.3	4	4.7	
How long does the adhesive often last and for how long is it used, after its container is opened?					
6/2 months (correct answer)	102	95.3	5	4.7	0.464
12 months/More than 1 year (incorrect answer)	11	100	0	0	

Source: Rodrigues LS, et al., 2023.

DISCUSSION

Adhesion procedures account for most routine practices adopted by dental clinics. Analyzing professional adhesion procedure protocols is extremely important to enable the establishment of necessary changes and reduce adhesive failures in daily clinical restorative procedures. Thus, the current research was carried out to assess knowledge about, and protocols for, adhesive procedures practiced by dentists working in Espírito Santo State, Brazil. Based on questionnaire application, it was observed that most participants reported a low failure rate in their restorative procedures (83.9%), whereas few professionals (4.2%) reported not knowing

the concept of adhesion. On the other hand, questions about adhesive storage, dentin moisture removal, use of silane, excess adhesive removal, and curing light device-irradiance measurement were the ones recording the lowest precision rate.

Despite the low failure rate reported by dentists, some adhesive procedure protocols have shown divergence from what is suggested in the scientific literature. With respect to operative field isolation, participants reported preferring relative isolation; however, Jurado CA, et al. (2021) have emphasized the importance of using a rubber dam to keep the operative field aseptic, to protect adhesion areas from saliva, as well as to prevent patients from inhaling toxic materials, because the presence of contaminants has an unsuccessful negative impact on the adhesive process. In addition, Wang Y, et al (2016) have concluded that rubber dam leads to a lower failure rate in direct restorations. Based on the results of the present study, approximately 75.4% of participants are not aware of this information.

Phosphoric acid has been used to promote microretention in dental tissue and resin tags' formation through dental adhesives since the introduction of the acid etching technique by Buonocore, which is the ideal mechanism for mechanical adhesion. Accordingly, 55.9% of the herein investigated professionals were concerned with the commercial brand of phosphoric acid, and 52.5% of them reported washing off phosphoric acid based on using air and water spray.

Zhu J, et al. (2014) reported that phosphoric acid washing must be carried out with the aid of air and water spray, from 15 to 30 seconds, and they also stated that this critical step must be carried out carefully, since complete phosphoric acid removal, as well as the removal of any residue produced by conditioning, must be ensured. The literature reports another problem, the over-etching of dentin with phosphoric acid, since demineralization by acid would be greater than infiltration by monomers, leaving the deepest portion of collagen exposed. These fibers undergo hydrolysis, which compromises adhesion (MEERBEEK BV, et al., 2020; PERDIGÃO J, et al., 2021).

Adhesive systems' storage is an important aspect to prevent their extraoral degradation since it can compromise both the effectiveness and the stability of the adhesion process. Iliev G, et al. (2021) conducted a literature review about the storage of universal adhesive systems and reported that incorrect storage on shelves and drawers can impair monomers' polymerization and degrade adhesive formulation components.

Iliev G, et al. (2021) recommended storing adhesive materials in refrigerators, where temperature and humidity conditions are controlled to reduce their degradation. Approximately 78% of professionals who participated in the current survey stored their adhesive systems in cabinets and drawers. Accordingly, adhesive system storage and use time also affect the dentin-adhesive interface. According to Anchieta RB, et al. (2015), degradation takes place at the dentin-adhesive interface when adhesive systems are stored for 12 months, and the intensity of this degradation can change depending on the adopted adhesive system type. Most professionals (90.7%) investigated in the present study reported that their adhesive system often lasts and is used from 2 to 6 months after their container is opened.

Moisture removal from dentin is a delicate procedure applied after dentin acid conditioning, since the dentin substrate must remain moist to enable the functional monomers of adhesive systems to penetrate this collagen network and to prevent collagen fibers from collapsing. Most (88.9%) investigated professionals used an air jet and cotton to remove excess moisture from dentin. However, Cardoso GC, et al. (2019) used absorbent paper as the standard technique to remove moisture from dentin in their study. In addition, the way the primer is applied to the dentin surface is an extremely relevant factor capable of affecting adhesive performance. According to Meerbeek BV, et al. (2020), the active application form enables monomers' infiltration and promotes intense interaction between adhesive system monomers and dentin collagen fibers. Most interviewed professionals (83%) actively applied the adhesive.

Primer application on dentin is critical as it stabilizes the collagen network and removes excess water, which also increases surface free energy, preparing it for adhesive application. The evaporation time is an aspect widely addressed in the literature. According to Perdigão J et al. (2020), the formulation of universal adhesives comprises approximately 20% water. Moreover, most manufacturers only recommend a 5-second evaporation

of this solvent. However, the recommended time is not enough to get satisfactory results. Thus, it is necessary to extend it from 15 to 30 seconds. In the present research, 78.9% of professionals reported carrying out the solvent evaporation procedure.

The infiltration of resin monomers from the adhesive system into dentin collagen fibers is one of the main factors enabling good adhesion. This factor is associated with adhesive layer thickness. According to Hueb de Menezes FC et al. (2013), an excessively thick adhesive layer can impair bond strength and lead to postoperative sensitivity. In total, 66.1% of the investigated professionals reported applying two adhesive layers. Hirokane E et al. (2021) have also stated that the double layer increases universal adhesives' bond strength. A thin and uniform layer is ideal to enable monomers' infiltration throughout the dentinal collagen network to protect and strengthen these fibers.

To achieve a thin and uniform layer, the literature recommends using a dry microbrush before polymerization to remove the excess (BEDRAN-RUSSO A, et al., 2017). The investigated professionals reported using a triple syringe air jet to remove excess adhesive. However, according to Hueb de Menezes FC, et al. (2013), this practice can compromise bond quality since air jet application incorporates oxygen into the adhesive layer, compromising polymerization and adhesion to the substrate.

Only 16.1% of participants reported removing excess adhesive based on using a dry microbrush. Hueb de Menezes FC, et al. (2013) reported that using a dry microbrush to remove excess adhesive leads to adhesion values higher than those observed for air jet applications. A dry microbrush promotes a thinner and more uniform layer due to its absorption capacity, since adhesive excess has a negative influence on bond strength.

The self-etching adhesive was introduced in the market to enable operators to reduce the number of steps in restoration procedures since the acidic monomer is inserted in its composition. According to the literature, using self-etching adhesive on enamel does not promote proper demineralization because the amount of mineral in it is higher than that in dentin.

Matos AB, et al. (2017) reported that selective etching application on enamel before using self-etching adhesives is critical to enable the successful self-etching protocol application. Approximately 33% of the investigated professionals did not perform selective enamel etching before using the self-etching system. According to Bedran-Russo A, et al. (2017), selective enamel etching has improved the clinical performance of self-etching adhesives (GIANNINI M, et al., 2015; PERDIGÃO J, 2020).

Silane is the essential agent that enables adhesion of glass-ceramics. The evolution of adhesive systems has reduced the number of operative steps in restoration processes by introducing universal adhesives that contain functional monomers such as the 10-MDP molecule and silane. However, the results of the study indicate that 72% of participants reported using silane found in universal adhesives, which is not in compliance with the study by Melo LA, et al. (2019).

Their systematic review suggested that silane and the adhesive should be applied separately to enable effective adhesion because silane found in universal adhesives loses its bond strength effectiveness. This happens because silane in acidic adhesives presents an unstable molecule and altered pH, making it inefficient in this system. Only 27.1% of participants often measured the irradiance of the light-curing device.

Resin materials and adhesive systems have replaced amalgam restorations in restorative treatments. Most of these adhesive materials have photoinitiators in their formulation, requiring optical radiation absorption, making LED photo activators the most effective light sources to be used for this purpose. The required irradiance depends on the features of the used material.

This irradiance must be higher than 400mW/cm², and its exposure time can range from 100s to 5s. Low irradiance or very short exposure time can lead to inadequate restoration polymerization and negatively affect the success of restoration procedures. It is important to periodically check the light-curing devices since their use time and frequency, as well as disinfection procedures performed in them, can decrease their performance and reduce the light output of the tip. Dentists should use updating resources such as taking short courses and reading articles to help reduce their clinical failures and improve their knowledge about adhesive protocols.

The limitations observed in the current study lie in its sample size, which does not correspond to the number of dentists enrolled in the Regional Council of Dentistry of Espírito Santo State (CRO-ES), as well as the use of a virtual environment, which does not promote accurate answers since it enables participants to search for answers on the internet at any time. Despite these limitations, the current study has shown extreme clinical importance in encouraging professionals working in the dentistry field to improve their knowledge about adhesive system protocols and base their clinical practice on scientific evidence.

CONCLUSION

Despite the low rate of failure and the knowledge about adhesion reported by the professionals investigated herein, dentists working in Espírito Santo State have shown poor knowledge about adhesive procedure protocols. However, accumulated experience based on the number of years of practicing the profession and performing a specialty was related to success in adhesive procedures. Therefore, the limitations of the study must be considered in relation to the results, as well as the sample size and the virtual environment. The professionals must improve their technique and knowledge about dental adhesion through courses and lectures based on scientific evidence to reduce the rate of adhesive failures in daily clinical restorative procedures.

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