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# Knowledge and Attitudes of Dentists toward Adhesive System Selection: A Cross-sectional Study from Palestine

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ABSTRACT

**Aim:** The aim of this study was to determine the attitudes and knowledge of dentists in Palestine toward selecting adhesive agents for different clinical procedures and to investigate whether the time of clinical practice influences their choices. **Materials and Methods:** A questionnaire was randomly sent by e-mail to 500 dentists registered with the Palestinian Dental Association. The questionnaire consisted of nine close-ended questions. The first two questions focused on demographics, whereas the other questions aimed to evaluate the respondents' knowledge toward selecting adhesive agents for different restorative procedures. **Statistical Test Used:** Statistical analysis was carried out using the Statistical Package for the Social Sciences software, version 16.0 (IBM, Armonk, New York). Descriptive analysis was obtained and the frequency of distribution was calculated in percentages. Nonparametric chi-square test was used to analyze the difference in the distribution of the preference of different bonding choices overall for every treatment scenario. Fisher's exact test with the Monte Carlo method was used to verify the association between the adhesive agent of choice and years of experience. **Results:** The response rate was 74%. The respondents' choices were significantly different in all suggested treatment procedures ( $P < 0.05$ ). A correlation was found between time since graduation and the choice of adhesive agent ( $P < 0.05$ ). **Conclusion:** Irrespective of restorative treatment scenario, respondents' selection of adhesive agents diverged from recommendations made by the literature. Further efforts should be made to improve the level of knowledge of general dentists on this topic.

**KEYWORDS:** Attitudes, dental materials, dentin bonding agents, resin composites, restorative dentistry

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## INTRODUCTION

Improvements in dental adhesive technology have extensively influenced modern restorative dentistry. In addition to direct resin restorations of teeth compromised by fractures, carious or non-carious lesions, adhesives enable several other procedures, such as bonding of indirect restorations, intra-radicular posts and orthodontic brackets, repair of failed restorations, control of dentin hypersensitivity, and correction of aesthetic impairments.

Dental adhesives have been classified using several methods: generation, solvent type, mechanism of smear layer removal, and number of clinical steps. The concept of generation refers to “when” and in “what order” this type of adhesive was developed by the dental industry.<sup>[1]</sup> For a variety of reasons, the classification based on generations (first through

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seventh) is problematic and not straightforward; the generations overlap and the classification system gets confusing because of the vast supply and turnover of adhesives. The other problem of referring to adhesive systems by generation is the wrong association that as we go higher up in generations the better the adhesive system would be.

A classification of adhesive systems reflecting their approach to the removal of the smear layer rather than “generation” has been proposed.<sup>[2]</sup> Dental adhesives accordingly can be grouped into two major types: (1) etch-and-rinse adhesives and (2) self-etching adhesives. Etch-and-rinse adhesives remove the smear layer from the enamel surface and demineralize the superficial hydroxyapatite to reveal the enamel prisms. On dentin, the acid demineralizes the superficial hydroxyapatite and removes the smear layer and smear plugs to expose the collagen fibrils of the dentinal matrix and open the dentinal tubules. Self-etch systems use a non-rinsing solution of acidic monomers to dissolve and incorporate the smear layer into the hybrid layer rather than removing it complete.<sup>[3]</sup>

In the most commonly used classification method, adhesives are grouped according to the number of clinical steps involved in the adhesion procedure. Etch-and-rinse adhesive systems are grouped into “three-step” or “two-step” adhesives. The three-step system includes a separate etchant, primer, and bonding resin applied consecutively. In the two-step systems, etching is followed by the application of a combined primer and bonding resin.

Self-etch adhesives may be two- or one-step systems: in two-step self-etch adhesive systems, a combined etching and primer agent (simultaneously “condition” and “prime” the dental substrate) is applied on enamel and dentin and air dried, followed by the application and polymerization of a bonding resin. The one-step self-etch adhesives combine etching, primer, and bonding resin in a single application (all-in-one). Some one-step systems require mixing materials from two or more bottles before being applied as one-step agents on the enamel or dentine. The two-step etch-and-rinse and one-step self-etching adhesives are considered simplified versions of their multistep counterparts (three-step etch-and-rinse and two-step self-etching adhesives) introduced to simplify the clinical procedures of adhesive application, hence reducing clinical time.

The wide variety of bonding agents currently available makes it difficult for clinicians to choose the best adhesive in terms of material and technique, especially

when different clinical situations are considered. There is a lack of studies evaluating the attitudes and practice of dentists toward the selection of adhesive agents. The attitudes of dentists toward the use and selection of adhesive agents in Palestine have not been studied; hence, the aim of this study was to determine the attitudes and practice of dentists in Palestine toward choosing dentine adhesive agents for different clinical procedures and to investigate whether the time since graduation influences these options for each procedure.

## MATERIALS AND METHODS

This is an observational cross-sectional study that was carried out from April 2018 to August 2018 among registered dental practitioners in Palestine. A questionnaire was designed, validated, and distributed by e-mail to 500 randomly selected general dentists from a list of those registered with the Palestinian Dental Association before March 2018. Prior to the formal survey, a pilot study was performed among 20 general practitioners to verify suitability. After evaluating the responses, the questionnaire was considered appropriate and used as the final version in this survey. Among the 500 dentists who were invited to participate in the online survey, 370 completed the questionnaire. The questionnaire consisted of nine close-ended questions. The first two were about the respondent’s gender and years since graduation. The other seven questions aimed to evaluate the respondents’ knowledge toward the choice of adhesive agents in combination with auto- or dual-cured composites, anterior and posterior composite restorations, fiber posts, fissure sealants, primary teeth, and in non-cariou cervical lesions. Each question had four answer options available to the respondents to choose from “etch and rinse (three steps),” “etch and rinse (two steps),” “self-etch (two steps),” and “self-etch (all-in-one).”

## STATISTICAL ANALYSIS

All statistical analysis was carried out using the Statistical Package for the Social Sciences software, version 16.0 (IBM, Armonk, New York). Descriptive analysis was obtained and the frequency of distribution was calculated in percentages. Chi-square tests were used to verify the association between gender and adhesive agent of choice. Nonparametric chi-square test was used to analyze the difference in the distribution of the preference of different bonding choices overall for every treatment scenario. In addition, Fisher’s exact test with the Monte Carlo method was used to verify the association between the adhesive agent of choice and years of experience. The confidence level was 95%

and the  $P$  value for statistical significance was set at  $<0.05$ .

## RESULTS

Among the 500 dentists solicited for the survey, 370 dentists responded for a rate of 74%. The losses and refusals were mainly due to the lack of questionnaire return or failure to sign in the informed consent. The 370 respondents consisted of 203 (45%) men and 167 (55%) women. Considering time since graduation, 159 (42.9%) of the respondents had 5 years or less since graduation, 136 (36.75%) had 6–9 years since graduation, 61 (16.48%) had 10–15 years since graduation, and 14 (3.78%) had more than 10 years since graduation. The distribution of the 370 respondents with regard to gender and time since graduation is shown Table 1. When asked about the adhesive agent they preferred in combination with various restorative procedures, the respondents' choices were significantly different in all suggested treatment procedures ( $P < 0.05$ ). Except for the bonding to primary teeth where there was no significant association between gender and preference of adhesive agents when bonding to primary teeth ( $P = 0.208$ ), a significant association was present between gender and the preferred adhesive agent chosen for all restorative procedures ( $P < 0.05$ ) [Table 2]. A correlation was found between time since graduation and the choice of adhesive agent ( $P < 0.05$ ) for all restorative procedures [Table 3].

## DISCUSSION

Adhesive dentistry is a rapidly evolving discipline. It is important to understand and critically analyze attitudes and practices of dental practitioners who deal with dental materials and techniques in order to make appropriate amendments and alterations where needed. This study aimed to determine the attitudes and knowledge of dentists in Palestine toward selecting adhesive agents for different clinical procedures.

When asked about the adhesives they prefer in association with self- or dual-cured resin composites, 35% of the respondents opted for the two-step etch-and-rinse adhesives, whereas 25.13% preferred the one-step (all-in-one) self-etch adhesives. Simplified versions of adhesive agents (the two-step etch and rinse, and

the one-step self-etch) are incompatible with self- or dual-cured resin composites.<sup>[4-7]</sup> The incompatibility is due to the interaction between the residual acidic monomers from the adhesive oxygen-inhibited layer and the binary peroxide-amine system, which interferes with the polymerization process and the bond strength of chemically cured composites.<sup>[8-10]</sup> It seems that 38% of the respondents seem to be unaware of this incompatibility.

Similarly, as in the self- or dual-cured resin composites scenario, a high percentage of the respondents (78%) preferred simplified adhesives in combination with dual-cured cements and fiber posts without noting the incompatibility.<sup>[7,4]</sup> Three-step etch-and-rinse adhesive systems are reported superior to two-step etch-and-rinse and self-etch adhesive systems<sup>[11-13]</sup> due to the fact that bonding to intraradicular dentin is different from that to coronal dentin because of the intrinsic substrate modifications caused by the use of irrigants, cements, and other endodontic filling materials.

Restorations of the non-carious cervical lesions may represent one of the least durable restorations with a high index retention loss, marginal discoloration, and marginal adaptation.<sup>[14-16]</sup> This might be due to the modified histology of the affected dental structure that presents hyper-mineralized dentin and denatured collagen, not ideal for the bond stability in general. Hence, the success of non-carious cervical lesions' restorations has intimate relation with the adhesive system applied. The results of this study showed that 68% of the respondents opted for simplified adhesives (two-step etch-and-rinse adhesives [13%] and one-step [all-in-one] self-etch adhesives [55%]) for restoring non-carious cervical lesions. The results of this study differ from those reported in the study of Modena *et al.*,<sup>[17]</sup> who investigated the restorative practices of non-carious cervical lesions by a group of Brazilian dentists from the state of Rio de Janeiro. The study reported that the two-step etch-and-rinse system was the most common (88.1%) adhesives selected by the respondents. The study also reported that 6.8% of the respondents chose one-step self-etch adhesives.

One-step self-etch adhesives produce relatively low bond strength values and inferior marginal adaptation to both enamel and dentin as compared to two-step self-etch or

**Table 1: Distribution of respondents according to years since graduation**

Gender	0–5 years		6–9 years		10–15 years		>15 years		Total
	No.	%	No.	%	No.	%	No.	%	
Female	83	52.2	66	48.5	50	82	4	28.6	203(45%)
Male	76	47.8	70	51.5	11	18	10	71.4	167 (55%)
	159	42.9	136	36.75%	61	16.48%	14	3.78	

**Table 2: Adhesive agent selected for a given restorative procedure**

	Female			Male			P value	Total (%)
	N	R (%)	Col(%)	N	R (%)	Col(%)		
Adhesive agent selected for self/dual cure composites								
E&R (three steps)	50	(50.0)	(24.6)	50	(50.0)	(29.9)		100 (27)
E&R (two steps)	49	(38.0)	(24.1)	80	(62.0)	(47.9)		129 (34.8)
SE (two steps)	31	(64.6)	(15.3)	17	(35.4)	(10.2)		48 (12.97)
SE (all-in-one)	73	(78.5)	(36.0)	20	(21.5)	(12.0)	<0.001*	93 (25.13)
P value								<0.001**
Adhesive agent selected for the adhesive cementation of fiber posts using dual cure luting resin cements								
E&R (three steps)	39	(69.6)	(19.2)	17	(30.4)	(10.2)		56 (15.1)
E&R (two steps)	27	(36.5)	(13.3)	47	(63.5)	(28.1)		74 (20)
SE (two steps)	22	(50.0)	(10.8)	22	(50.0)	(13.2)		44 (11.9)
SE (all-in-one)	115	(58.7)	(56.7)	81	(41.3)	(48.5)	0.001*	196 (52.9)
P value								<0.001**
Adhesive agent selected for the adhesive restoration of non-carious cervical lesions								
E&R (three steps)	24	(64.9)	(11.8)	13	(35.1)	(7.8)		37 (10)
E&R (two steps)	26	(54.2)	(12.8)	22	(45.8)	(13.2)		48 (13)
SE (two steps)	60	(74.1)	(29.6)	21	(25.9)	(12.6)		81 (21.9)
SE (all-in-one)	93	(45.6)	(45.8)	111	(54.4)	(66.5)	<0.001*	204 (55.1)
P value								<0.001**
Adhesive agent selected for anterior composite restorations								
E&R (three steps)	26	(41.3)	(12.8)	37	(58.7)	(22.2)		63 (17)
E&R (two steps)	117	(70.1)	(57.6)	50	(29.9)	(29.9)		167 (45.1)
SE (two steps)	9	(24.3)	(4.4)	28	(75.7)	(16.8)		37 (10)
SE (all-in-one)	51	(49.5)	(25.1)	52	(50.5)	(31.1)	<0.001*	103 (27.8)
P value								<0.001**
Adhesive agent selected for posterior composite restorations								
E&R (three steps)	22	(42.3)	(10.8)	30	(57.7)	(18.0)		52 (14)
E&R (two steps)	87	(57.2)	(42.6)	65	(42.8)	(38.9)		152 (41)
SE (two steps)	15	(40.5)	(7.4)	22	(59.5)	(13.2)		37 (10)
SE (all-in-one)	80	(61.5)	(39.2)	50	(38.5)	(29.9)	0.028*	130 (35)
P value								<0.001**
Adhesive agent selected for primary teeth								
E&R (three steps)	41	(58.6)	(20.2)	29	(41.4)	(17.4)		70 (19.1%)
E&R (two steps)	59	(53.2)	(29.1)	52	(46.8)	(31.1)		11 (30%)1
SE (two steps)	28	(68.3)	(13.8)	13	(31.7)	(7.8)		41 (11.1%)
SE (all-in-one)	75	(50.7)	(36.9)	73	(49.3)	(43.7)	0.208*	148 (40%)
P value								<0.001**
Adhesive agent selected for fissure sealants								
E&R (three steps)	6	(13.6)	(3.0)	38	(86.4)	(22.9)		44(11.9%)
E&R (two steps)	70	(47.3)	(34.5)	78	(52.7)	(47.0)		148(40%)
SE (two steps)	33	(75.0)	(16.3)	11	(25.0)	(6.6)		44(11.9%)
SE (all-in-one)	94	(70.7)	(46.3)	39	(29.3)	(23.5)	<0.001*	133(35.9%)
P value								<0.001**

E&amp;R = etch and rinse, SE = self-etch

\* Chi-square test

\*\* Nonparametric chi-square

etch-and-rinse systems.<sup>[18-22]</sup> A systematic review on the clinical effectiveness of adhesive agents used to restore cervical non-carious lesions concluded that three-step

etch-and-rinse adhesives and two-step self-etch adhesives showed a clinically reliable and predictably good clinical performance and that the clinical effectiveness of

**Table 3: Association between the preference of adhesive agent for a given restorative procedure and years since graduation**

	0-5 years				6-9 years				10-15 years				>15 years				P value
	N	R (%)	Col(%)	Col(%)	N	R (%)	Col(%)	Col(%)	N	R(%)	Col(%)	Col(%)	N	R	Col(%)	Col(%)	
Association between the preference of adhesive agent for self/dual cure composites and years since graduation																	
E&R (three steps)	55	(55.0)	(34.6)	(11.0)	15	(15.0)	(11.0)	(42.6)	26	(26.0)	(42.6)	(23.5)	4	(4.0)	(23.5)	(23.5)	<0.001*
E&R (two steps)	44	(34.1)	(27.7)	(51.5)	70	(54.3)	(51.5)	(21.3)	13	(10.1)	(21.3)	(11.8)	2	(1.6)	(11.8)	(11.8)	
SE (two steps)	21	(41.2)	(13.2)	(8.8)	12	(23.5)	(8.8)	(23.0)	14	(27.5)	(23.0)	(23.5)	4	(7.8)	(23.5)	(23.5)	
SE (all-in-one)	39	(41.9)	(24.5)	(28.7)	39	(41.9)	(28.7)	(13.1)	8	(8.6)	(13.1)	(41.2)	7	(7.5)	(41.2)	(41.2)	
Association between the preference of adhesive agent for cementing fiber posts and years since graduation																	
E&R (three steps)	7	(12.5)	(4.4)	(19.9)	27	(48.2)	(19.9)	(34.4)	21	(37.5)	(34.4)	(7.1)	1	(1.8)	(7.1)	(7.1)	
E&R (two steps)	46	(62.2)	(28.9)	(14.7)	20	(27.0)	(14.7)	(.0)	0	(.0)	(.0)	(57.1)	8	(10.8)	(57.1)	(57.1)	
SE (two steps)	11	(25.0)	(6.9)	(15.4)	21	(47.7)	(15.4)	(18.0)	11	(25.0)	(18.0)	(7.1)	1	(2.3)	(7.1)	(7.1)	
SE (all-in-one)	95	(48.5)	(59.7)	(50.0)	68	(34.7)	(50.0)	(47.5)	29	(14.8)	(47.5)	(28.6)	4	(2.0)	(28.6)	(28.6)	
Association between the preference of adhesive agent for non-carious cervical restorations and years since graduation																	
E&R (three steps)	12	(32.4)	(7.5)	(12.5)	17	(45.9)	(12.5)	(6.6)	4	(10.8)	(6.6)	(28.6)	4	(10.8)	(28.6)	(28.6)	
E&R (two steps)	9	(18.8)	(5.7)	(14.7)	20	(41.7)	(14.7)	(27.9)	17	(35.4)	(27.9)	(14.3)	2	(4.2)	(14.3)	(14.3)	
SE (two steps)	26	(32.1)	(16.4)	(22.8)	31	(38.3)	(22.8)	(34.4)	21	(25.9)	(34.4)	(21.4)	3	(3.7)	(21.4)	(21.4)	
SE (all-in-one)	112	(54.9)	(70.4)	(50.0)	68	(33.3)	(50.0)	(31.1)	19	(9.3)	(31.1)	(35.7)	5	(2.5)	(35.7)	(35.7)	
Association between the preference of adhesive agent for anterior composite restorations and years since graduation																	
E&R (three steps)	27	(42.9)	(17.0)	(14.7)	20	(31.7)	(14.7)	(18.0)	11	(17.5)	(18.0)	(35.7)	5	(7.9)	(35.7)	(35.7)	
E&R (two steps)	70	(41.9)	(44.0)	(61.0)	83	(49.7)	(61.0)	(16.4)	10	(6.0)	(16.4)	(28.6)	4	(2.4)	(28.6)	(28.6)	
SE (two steps)	10	(27.0)	(6.3)	(14.7)	20	(54.1)	(14.7)	(8.2)	5	(13.5)	(8.2)	(14.3)	2	(5.4)	(14.3)	(14.3)	
SE (all-in-one)	52	(50.5)	(32.7)	(9.6)	13	(12.6)	(9.6)	(57.4)	35	(34.0)	(57.4)	(21.4)	3	(2.9)	(21.4)	(21.4)	
Association between the preference of adhesive agent for posterior composite restorations and years since graduation																	
E&R (three steps)	17	(32.7)	(10.7)	(14.7)	20	(38.5)	(14.7)	(19.7)	12	(23.1)	(19.7)	(21.4)	3	(5.8)	(21.4)	(21.4)	
E&R (two steps)	55	(36.2)	(34.6)	(51.5)	70	(46.1)	(51.5)	(41.0)	25	(16.4)	(41.0)	(14.3)	2	(1.3)	(14.3)	(14.3)	
SE (two steps)	3	(8.1)	(1.9)	(19.9)	27	(73.0)	(19.9)	(6.6)	4	(10.8)	(6.6)	(21.4)	3	(8.1)	(21.4)	(21.4)	

Table 3: Continued

	0-5 years			6-9 years			10-15 years			>15 years			P value
	N	R (%)	Col(%)	N	R (%)	Col(%)	N	R (%)	Col(%)	N	R	Col(%)	
SE (all-in-one) Association between the preference of adhesive agent for primary teeth and years since graduation	84	(65.1)	(52.8)	19	(14.7)	(14.0)	20	(15.5)	(32.8)	6	(4.7)	(42.9)	<0.001*
E&R (three steps)	23	(32.9)	(14.5)	32	(45.7)	(23.5)	12	(17.1)	(19.7)	3	(4.3)	(21.4)	
E&R (two steps)	77	(69.4)	(48.4)	14	(12.6)	(10.3)	18	(16.2)	(29.5)	2	(1.8)	(14.3)	
SE (two steps)	10	(24.4)	(6.3)	15	(36.6)	(11.0)	12	(29.3)	(19.7)	4	(9.8)	(28.6)	
SE (all-in-one) Association between the preference of adhesive agent for fissure sealants and years since graduation	49	(33.1)	(30.8)	75	(50.7)	(55.1)	19	(12.8)	(31.1)	5	(3.4)	(35.7)	<0.001*
E&R (three steps)	12	(26.7)	(7.5)	23	(51.1)	(16.9)	6	(13.3)	(9.8)	4	(8.9)	(28.6)	
E&R (two steps)	62	(41.9)	(39.0)	61	(41.2)	(44.9)	21	(14.2)	(34.4)	4	(2.7)	(28.6)	
SE (two steps)	13	(29.5)	(8.2)	14	(31.8)	(10.3)	15	(34.1)	(24.6)	2	(4.5)	(14.3)	
SE (all-in-one)	72	(54.1)	(45.3)	38	(28.6)	(27.9)	19	(14.3)	(31.1)	4	(3.0)	(28.6)	0.001*

E&R = etch and rinse, SE = self-etch

\* Fisher's exact test

two-step etch-and-rinse adhesives was less favorable, whereas an inefficient clinical performance was noted for the one-step self-etch adhesives.<sup>[23]</sup>

Failures in anterior composite restorations are related to aesthetics. Anterior composite restorations bonded with self-etch adhesives have a higher prevalence of marginal staining than restorations accompanied with etch and rise enamel etching.<sup>[16]</sup> Thirty-seven percent of the respondents preferred simplified adhesives (two-step etch-and-rinse adhesives [45%] and one-step [all-in-one]) [28%] self-etch adhesives). The results of this study differ from the results of a study that assessed technical preferences of 276 general dental practitioners in Southern Brazil when placing anterior composites. The survey reported that 1.8% and 2.53% of the respondents chose two-step self-etch and one-step (all-in-one) adhesives, respectively.<sup>[24]</sup> Self-etch adhesive agents produce a very shallow enamel etching, with reduced microporosities for resin infiltration,<sup>[25,26]</sup> which in turn may eventually cause marginal discoloration.

Contrary to anterior composite restorations, failures due to aesthetic reasons are rarely reported in studies on posterior composite resin restorations. Forty-one percent of the respondents reported using two-step etch-and-rinse, 14% the three-step etch-and-rinse, 10% two-step self-etch, and 35% one-step (all-in-one) self-etch adhesives. The results of our study were close to those of the study of Blum *et al.*,<sup>[27]</sup> who reported that 60% of the respondents to their survey in the UK used two-step etch-and-rinse system, whereas 10% used a two-step self-etch adhesives when restoring posterior teeth with resin composite. Studies report that the bonding strategy does not influence the clinical performance of posterior composite restorations.<sup>[28-33]</sup> Yet, using two-step self-etching adhesives ensure simplified clinical application and reduced operator sensitivity by eliminating the need to etch dentine with phosphoric acid. Nevertheless, a concern with the bonding process for self-etching adhesives is how to best maximize the bond to enamel without compromising the bond to dentine. A separate application of phosphoric acid to enamel prior to self-etching adhesive application will significantly improve the bond to enamel and ensure better marginal adaptation and less surface and marginal staining.

Selection of an appropriate adhesive agent in pediatric dentistry is influenced by the application time, technique sensitivity, number of steps, and patient behavior/age. The selection is also influenced by the differences in the microstructure and composition of primary and permanent teeth. Compared to the permanent dentin, the inorganic content of intratubular primary dentin is

less. The number of dentinal tubules is lower, resulting in less surface moisture and increased susceptibility of the primary dentin to decalcification.<sup>[34,35]</sup> In this regard, the self-etch adhesive systems may offer the advantage of limited decalcification of the primary dentin.<sup>[36]</sup> Ebrahimi *et al.*<sup>[37]</sup> systemically reviewed the *in vitro* studies on dentin bond strength of etch-and-rinse and self-etch adhesives to primary teeth. Their meta-analysis showed that the application of the two-step self-etch adhesives performs well when used for primary dentin and can be used to save time in pediatric dentistry.<sup>[37]</sup> In this study, only 11.1% opted for two-step self-etch adhesives, whereas 70% opted for simplified versions of adhesives (40% one-step [all-in-one] self-etch adhesives and 30% two-step etch-and-rinse adhesives).

Pit and fissure sealant is effective in preventing occlusal caries, which is further substantiated by evidence.<sup>[38-40]</sup> The use of adhesive agents beneath fissure sealants can increase their retention.<sup>[41,42]</sup> When adhesive systems are used with fissure sealants, etch-and-rinse systems are preferable.<sup>[41,42]</sup> Forty percent and twelve percent of respondents used two-step and three-step etch-and-rinse adhesives, respectively, whereas 35.9% of the respondents opted for one-step (all-in-one) self-etch adhesives.

The results of this study suggest that respondents prefer simplified versions of adhesive agents as alternatives to their technique sensitive, time-consuming multistep counterparts (three-step etch-and-rinse and two-step self-etch adhesives). The vast majority of respondents selected one-step (all-in-one) self-etch and two-step etch-and-rinse adhesives where simplification in the clinical technique and ease of use are warranted. These findings were in agreement with those obtained by McFadzean *et al.*,<sup>[43]</sup> who investigated which dentine-bonding systems were most widely used by a random sample of dentists in the East of Scotland and what influenced the dentists' choice when buying or using a particular bonding agent. Two-step etch-and-rinse followed by one-step self-etch adhesives were reported as the most popular. Availability and ease of use were reported by respondents as the most popular reasons for choosing an adhesive agent.

Several surveys reported that "years of experience" is an important dentist-related factor regarding clinical diagnosis, material selection, and treatment strategy.<sup>[24,43-45]</sup> In this study, time since graduation had a significant influence relative to the type of adhesive agent selected by the respondents. This study shows that dentists who had 10–15 years of clinical experience had a stronger inclination to "better choices" that met recommendations by the literature.

This might indicate that dentists in this category might have a better understanding of adhesive dentistry, better clinical experience, and better access to newly marketed materials. However, those with more than 15 years since graduation opted for adhesive agents that deviated the most from the recommendations made by the literature. Dentists within this category probably attended dental schools when the nature and extent of the adhesive techniques and materials taught were limited.

The limitations of this study should be considered when interpreting the results. The use of questionnaires in cross-sectional surveys and the sampling methodology are major limitations. However, a questionnaire can be very useful to evaluate how dentists are working in their offices and to assess how updated they are in relation to recent advances in material development and techniques. A comparative assessment of all aspects of our results with that of similar previous studies was not always possible due to differences in questions and answer choices.<sup>[17,24,27,43,44]</sup>

To the best of our knowledge, this was the first study to assess the attitudes and knowledge toward choosing adhesive systems among dentists in Palestine. The implication of the study might raise attention and encourage changes in the dental curriculum taught at dental faculties to allow more focus on practical and clinical aspects of the use of adhesive systems. The findings may also help sensitize continuous education programs regarding the topic of dental adhesives and their applications in the daily practice of general dentists. Regular Continuing Dental Education programs need to be programmed carefully in order to update practitioners.

## CONCLUSION

Assessing dentists' knowledge is one way to measure their performance. This study showed that the overall knowledge and attitudes of dentists in Palestine toward choosing the proper adhesive agent for a given clinical scenario are inconsistent with the recommendations made in the literature. The respondents' choices were significantly different in all suggested treatment procedures. In general, dentists opted for the simplified adhesives (two-step etch-and-rinse and one-step (all-in-one) adhesives). A correlation was found between time since graduation and the choice of an adhesive agent. The results of this study might be used as baseline data for future amendments and alterations in undergraduate and continuous education curricula.

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**CONFLICTS OF INTEREST**

There are no conflicts of interest.

**AUTHOR CONTRIBUTIONS**

Naji Ziad Arandi: study conception, data collection, data acquisition and analysis, data interpretation, manuscript writing. Mohammad Thabet: data collection, data acquisition and analysis, data interpretation.

**ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT**

This research project was approved by the IRB Committee of the Faculty of Dentistry, The Arab American University.

**DATA AVAILABILITY STATEMENT**

Available on request from (Dr. Naji Arandi, arandi@gmail.com).

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