Research Article

The role of knowledge and practice in orthodontists' attitudes towards bonding materials and techniques

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Abstract: Background: The materials and techniques of orthodontic bonding systems remain a pivotal concern in orthodontic research. This issue is further complicated by orthodontists' preferences. To assess the effect of knowledge and practice on the attitudes of orthodontists towards bonding materials and techniques. Methods: A cross-sectional, questionnaire-based study was conducted using Google Forms. The questionnaire comprised 17 multiple-choice questions that targeted orthodontists' awareness, knowledge, and attitude towards bonding materials. It was distributed via email or social networking platforms to specialist Iraqi orthodontists. Results: A total of 176 participants responded with nearly equal representation between the sexes. The majority of respondents (approximately 70%) held an M.Sc. degree, and slightly more than half the sample worked in both governmental and private clinics. All participants were aware of the etch and rinse adhesive system, and the majority used it with light curing as the activation method. The effect of academic degrees and place of work was evident in some responses related to the selection and management of bonding adhesive. Conclusions: The orthodontists preferred the traditional etch and rinse technique to minimise bracket loss and maintain treatment flow. The self-etch primer system was the preferred option when prioritising safety, time efficiency, reduced technique sensitivity, and aerosol reduction. Clinical choices may be significantly shaped by skills and information from initial training, despite the available evidence-base. Future decision-making should prioritise leveraging scientific evidence effectively.

Keywords: Orthodontic bonding, orthodontic adhesives, Orthodontists' attitudes, Orthodontists' knowledge, Orthodontists' skill.

Introduction

Bonding or adhesion is an essential step in orthodontic treatment [1]. Orthodontic adhesives consist of three basic components: etchant, primer, and adhesive resin [2]. These adhesives are categorised based on the adhesion mechanism into two main systems: the etch-and-rinse (EAR) system and the self-etch primer (SEP) system. The key differences between the two adhesive systems lie in their acid component, application protocols, and interfacial ultrastructures [3].

Advances in the field of adhesion have resulted in the development of new materials with improved properties. Recently, enamel conditioning with SEP, including universal adhesives, has attracted interest in orthodontic bonding. These materials simplify the bonding process by etching and priming the enamel surface in a single step, addressing the increasing demand for more convenient and less technique-sensitive materials [4, 5].

On the other hand, orthodontists use different adhesive paste materials, including composite resins, glass-ionomer cement, and resin-modified glass-ionomer cement. Among these, resin composites are the most popular owing to their superior adhesion and mechanical properties and favourable handling characteristics [5, 6].

Despite significant advancements in orthodontic bonding systems, fixing brackets to enamel remains a critical issue in orthodontic research and continues to be a primary focus of numerous studies. Such research includes evaluating the physical and mechanical properties of the primer or resins used for direct bracket bonding, short- and long-term bond strength, and assessing the condition and appearance of the enamel after debonding [7-11]. On the other hand, numerous research studies focused on combining the bonding material with remineralizing or antibacterial additives, aiming to enhance their therapeutic and clinical performance [7,10,12-17].

The orthodontist might choose one product over another depending on marketing, habits learnt during dental education, personal clinical practice, or exposure to various information pools [18]. However, limited research exists on how these factors shape the orthodontist's attitude toward bonding techniques in clinical application. Therefore, this study aimed to assess the effect of knowledge and practice on the attitudes of orthodontists towards bonding materials and techniques. The null hypothesis is that there is no significant difference in attitudes toward bonding techniques and materials among orthodontists with varying levels of knowledge or different practice settings.

Materials and Methods

This study utilised a cross-sectional, questionnaire-based survey. The authors developed a questionnaire to assess orthodontists' beliefs regarding the impact of different bonding techniques and materials on achieving a successful, robust, and safe bonding procedure. The questionnaire comprised 17 multiple-choice questions, which were piloted on five orthodontists and revised accordingly. The first three questions gathered sociodemographic information on the individual orthodontist, including gender, academic degree, and the type of sector where the orthodontist was practising. The remaining 14 questions assessed the awareness, knowledge, and behavioural variations among Iraqi orthodontists toward bonding materials.

The questionnaire was distributed to participants via e-mail or social networking platforms, such as Telegram. Each e-mail and message explained the survey objectives and included a link to the Google Forms platform where respondents could complete the questionnaire. Participant were allowed to submit their responses only once, and anonymity was maintained throughout the study.

Orthodontic specialists eligible to participate in this study were active members of the Iraqi Orthodontic Society, which comprises 500 members. The sample size was calculated to ensure adequate representation of the total sample population. The estimated sample size for the orthodontists was determined to be 176 at an 80% confidence interval, 5% margin of error, and 0.5 sample proportion. The survey was conducted over three months, from March to May 2024. The questionnaire was initially sent to 300 orthodontists. After one month, a follow-up reminder was sent to those who had not responded, aiming to increase the response rate. To mitigate dropout, and ensure the required sample was achieved, the Google Form was set to accept responses until meeting the target.

Once responses were collected, data description, analysis, and presentation were conducted using the Statistical Package for Social Science (SPSS version 26, Chicago, IL, USA). Descriptive statistics were used to calculate the counts and percentages of respondents favouring each option of survey questions. Chi-square and Fisher's exact tests were used to evaluate the significance of the relationship between sociodemographic factors and the subsequent questions. The level of significance was set at $p<0.05$.

Results

A total of 176 responses were collected through the Google Form. The participation of genders was almost equal (male: 52.27%, female: 47.73%). Among the participants, the majority held an M.Sc. degree (69.89%), while the smallest proportion had a diploma/certificate qualification (3.98%). More than half of the participants (52.27%) worked simultaneously in private and public or governmental clinics; those who worked solely in private clinics constituted 35.8%, and the remainder worked exclusively in public clinics (Table 1).

Table 1: The sociodemographic distribution of the participants expressed in numbers and percentages of the total sample.

Sociodemographic factors	Distribution	Gender				Total	
		Female		Male			
		N	%	N	%	N	Total %
Academic Degree	**Diploma/Certificate.**	3	1.70%	4	2.27%	7	3.98%
	Ph.D.	14	7.95%	32	18.18%	46	26.14%
	M.Sc.	67	38.07%	56	31.82%	123	69.89%
Practice setting	**Both**	46	26.14%	46	26.14%	92	52.27%
	Private dental center or	21	11.93%	42	23.86%	63	35.80%
	Public dental clinic	17	9.66%	4	2.27%	21	11.93%
	Total	84	47.73%	92	52.27%	176	100.00%

Participants' awareness of available bonding systems was variable. While all participants were aware of the EAR system, less than 60% were aware of the SEP system, and the majority of the participants were less aware of the other bonding systems (Figure 1).

The number and percentage of participants' responses to each option are presented in Tables 2, 3, 4, and 5 categorised by academic degree and practice setting. Table 6 summarises the statistical analysis.

The majority of orthodontists, irrespective of their academic degree or place of work, used EAR adhesive systems with light-curing as the activation method (Table 2). The majority preferred medium viscosity for the consistency with fluoride release over other types.

When the knowledge of participants was tested, most participants indicated that the EAR adhesives (primer) system would provide the higher shear bond strength (Table 3). Nonetheless, there was a significant difference between academic degrees as more participants with M.Sc. degree responded "I don't know" (Table 6).

A SEP ranked first in responses about the system that could provide safer debonding (32.9%) followed by Universal adhesives (primer) system in self-etching mode (21%), and then "I don't know" (19.8%) (Table 3). There was a statistically significant difference (p= 0.006) when the responses were compared across different academic degrees (Table 6). There were two main differences: the first was regarding whether EAR is the safest, which was higher in M.Sc. degree holders, and the second involved the option that there was "no difference" among the adhesive types, which was higher in Ph.D. degree holders. A statistically significant difference was also observed when comparing responses based on the place of work (p= 0.001). Notably, the response "I don't know" was more frequent among orthodontists working in private dental clinics/centres (11.36%). In contrast, the response "self-etching primer system" was more common among practitioners who worked in both private and public settings (21.02%), and less frequent among those who worked in public dental centres (1.14%). The preference for the EAR system was higher than the expected count for practitioners working in public dental clinics.

When the satisfaction regarding the time consumed by using the different bonding systems was investigated, the majority selected the SEP system (Table 4).

For bonding in a wet field, the responses were distributed among the five options (across all academic degrees and places of work), with the highest proportion responding "I don't know" (28.9%). The other responses were in the following descending order: SEP (21%), EAR adhesive (14.7%), no difference (13.0%), universal adhesive in self-etching mode (12.5%), and universal adhesive in EAR mode (9.6%) (Table 4). A statistically significant difference (p=0.046) was detected when responses were compared

across different academic degrees (Table 6), with higher "I don't know" responses from holders of master's degrees (24.43%), while Ph.D. holders responded mainly with the SEP system (9.66%) (Table 4).

Regarding the factor that has the greatest effect on the bond strength of light-cured acrylic, most respondents indicated that the type of bonding system plays the most significant role (Table 4). Those working in both public and private clinics responded at a significantly higher count for the time of curing compared to workers in public clinics (2 vs 5).

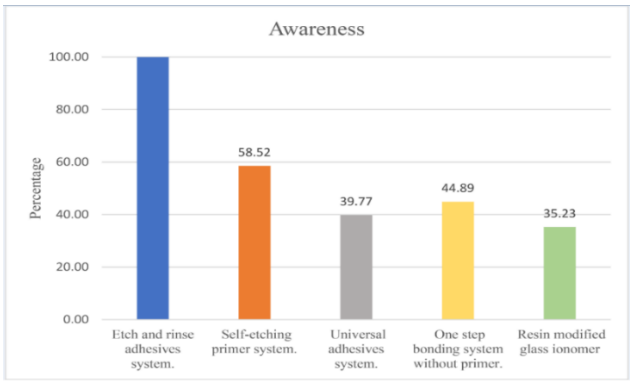

Figure 1: Participants' awareness of different types of available bonding systems

Table 2: Participants' knowledge of adhesive properties: Counts and Percentages by Academic Degree and Practice Setting

	Academic Degree				Practice Setting	
	Diploma/ Certificate	M.Sc.	Ph.D.	Both	Private dental clinic	Public dental clinics
What kind of bonding adhesive (primer) system do you use?						
Etch and cementing without bonding	0 (0%)	0 (0%)	1 (0.57%)	1 (0.57%)	0 (0%)	0 (0%)
Etch and rinse adhesives (primer) system.	5 (2.84%)	80 (45.45%)	32 (18.18%)	56 (31.82%)	48 (27.27%)	13 (7.39%)
Self-etching primer system.	0 (0%)	7 (3.98%)	6 (3.41%)	9 (5.11%)	2 (1.14%)	2 (1.14%)
Universal adhesives (primer) system in etch and rinse mode.	2 (1.14%)	35 (19.89%)	6 (3.41%)	25 (14.2%)	12 (6.82%)	6 (3.41%)
Universal adhesives (primer) system in self-etching mode.	0 (0%)	1 (0.57%)	1 (0.57%)	1 (0.57%)	1 (0.57%)	0 (0%)
What is the activation method of your adhesive?						
Chemical-cured.	0 (0%)	1 (0.57%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)
Light-cured.	7 (3.98%)	122 (69.32%)	44 (25%)	91 (91%)	63 (35.8%)	19 (19%)
No-Mix.	0 (0%)	0 (0%)	2 (2%)	1 (1%)	0 (0%)	1 (1%)
What consistency of the adhesive paste would you prefer?						
High viscosity.	1 (0.57%)	19 (10.8%)	6 (3.41%)	18 (10.23%)	6 (3.41%)	2 (1.14%)
Low viscosity (e.g. flowable composite)	0 (0%)	5 (2.84%)	0 (0%)	0 (0%)	2 (1.14%)	3 (1.7%)
Medium viscosity.	6 (3.41%)	99 (56.25%)	40 (22.73%)	74 (42.05%)	55 (31.25%)	16 (9.09%)
If you were offered different types of adhesives, what type would you prefer regarding fluoride content.						
Any type	1 (0.57%)	27 (15.34%)	7 (3.98%)	21 (11.93%)	11 (6.25%)	3 (1.7%)
Fluoride releasing.	5 (2.84%)	84 (47.73%)	33 (18.75%)	60 (34.09%)	48 (27.27%)	14 (7.95%)
Non-fluoride releasing.	1 (0.57%)	12 (6.82%)	6 (3.41%)	11 (6.25%)	4 (2.27%)	4 (2.27%)

Table 3: Participants' knowledge of adhesive performance: Counts and Percentages by Academic Degree and Practice Setting

	Academic Degree				Practice Setting	
	Diploma/ Certificate	M.Sc.	Ph.D.	Both	Private dental clinic	Public dental clinics
According to your opinion, which bonding system can give higher bond strength?						
Etch and rinse adhesives (primer) system.	5 (2.84%)	56 (31.82%)	28 (15.91%)	45 (25.57%)	35 (19.89%)	9 (5.11%)
I don't know	1 (0.57%)	20 (11.36%)	0 (0%)	6 (3.41%)	12 (6.82%)	3 (1.7%)
No difference.	0 (0%)	8 (4.55%)	4 (2.27%)	8 (4.55%)	2 (1.14%)	2 (1.14%)
Self-etching primer system.	1 (0.57%)	2 (1.14%)	2 (1.14%)	3 (1.7%)	0 (0%)	2 (1.14%)
Universal adhesives (primer) system in etch and rinse mode.	0 (0%)	35 (19.89%)	12 (6.82%)	28 (15.91%)	14 (7.95%)	5 (2.84%)
Universal adhesives (primer) system in self-etching mode.	0 (0%)	2 (1.14%)	0 (0%)	2 (1.14%)	0 (0%)	0 (0%)
According to your opinion, which bonding system can give safer debonding (with minimal enamel damage)?						
Etch and rinse adhesives (primer) system.	0 (0%)	28 (15.91%)	2 (1.14%)	13 (7.39%)	9 (5.11%)	8 (4.55%)
I don't know.	4 (2.27%)	24 (13.64%)	7 (3.98%)	11 (6.25%)	20 (11.36%)	4 (2.27%)
No difference.	0 (0%)	14 (7.95%)	13 (7.39%)	16 (9.09%)	8 (4.55%)	3 (1.7%)
Self-etching primer system.	2 (1.14%)	37 (21.02%)	19 (10.8%)	37 (21.02%)	19 (10.8%)	2 (1.14%)
Universal adhesives (primer) system in etch and rinse mode.	1 (0.57%)	9 (5.11%)	1 (0.57%)	6 (3.41%)	1 (0.57%)	4 (2.27%)
Universal adhesives (primer) system in self-etching mode.	0 (0%)	11 (6.25%)	4 (2.27%)	9 (5.11%)	6 (3.41%)	0 (0%)

Table 5 shows the participants' attitude to adhesives. There was no statistically significant difference regarding participants' attitudes toward adhesives (Table 6). Participants' attitudes toward reducing aerosol by using a self-etching bonding system were positive; around 75% of the participants thought that it was somewhat or highly related. More than half the participants were very satisfied with the bonding system they already use. More than a third of the participants were satisfied, while only one response was "somewhat dissatisfied". There was a positive trend toward conserving enamel structure with more than one third of responses in this regard, while less than a third aimed toward increased bond strength if they were to replace their current bonding. The rest of the responses were distributed among decreasing bonding steps, increased patient comfort (15.9%), decreased time for bonding procedure (13.1%), and finally, about 7% were looking for a bonding system with decreased remnant adhesive at the debonding step. Randomized clinical trials and meta-analysis had comparable weight to personal opinion when deciding for a specific bonding system, which accounted for around 60% of the responses. The second influential matter was the opinion of experts with around one quarter of responses. Less than 5% reported that they rely on commercial advertisement and social media platforms.

Table 4: Participants' knowledge of bonding technique considerations: Counts and Percentages by Academic Degree and Practice Setting

	Academic Degree				Practice Setting	
	Diploma/ Certificate	M.Sc.	Ph.D.	Both	Private dental clinic	Public dental clinics
According to your opinion, which bonding system can be more satisfying regarding the time consumed in orthodontic bonding procedure?						
Etch and rinse adhesives (primer) system.	1 (0.57%)	19 (10.8%)	8 (4.55%)	12 (6.82%)	13 (7.39%)	3 (1.7%)
I don't know.	0 (0%)	4 (2.27%)	2 (1.14%)	2 (1.14%)	3 (1.7%)	1 (0.57%)
No difference.	0 (0%)	12 (6.82%)	5 (2.84%)	11 (6.25%)	4 (2.27%)	2 (1.14%)
Self-etching primer system.	3 (1.7%)	54 (30.68%)	21 (11.93%)	41 (23.3%)	24 (13.64%)	13 (7.39%)
Universal adhesives (primer) system in etch and rinse mode.	1 (0.57%)	9 (5.11%)	0 (0%)	7 (3.98%)	2 (1.14%)	1 (0.57%)
Universal adhesives (primer) system in self-etching mode.	2 (1.14%)	25 (14.2%)	10 (5.68%)	19 (10.8%)	17 (9.66%)	1 (0.57%)
According to your opinion, which bonding system can produce satisfactory bonding in a wet field?						
Etch and rinse adhesives (primer) system.	0 (0%)	19 (10.8%)	7 (3.98%)	15 (8.52%)	8 (4.55%)	3 (1.7%)
I don't know.	2 (1.14%)	43 (24.43%)	6 (3.41%)	21 (11.93%)	24 (13.64%)	6 (3.41%)
No difference.	1 (0.57%)	17 (9.66%)	5 (2.84%)	14 (7.95%)	6 (3.41%)	3 (1.7%)
Self-etching primer system.	2 (1.14%)	18 (10.23%)	17 (9.66%)	24 (13.64%)	11 (6.25%)	2 (1.14%)
Universal adhesives (primer) system in etch and rinse mode.	1 (0.57%)	12 (6.82%)	4 (2.27%)	7 (3.98%)	6 (3.41%)	4 (2.27%)
Universal adhesives (primer) system in self-etching mode.	1 (0.57%)	14 (7.95%)	7 (3.98%)	11 (6.25%)	8 (4.55%)	3 (1.7%)
According to your opinion, which factor has greater effect on the bond strength of light-cured composite?						
Applying pumice slurry before bonding.	0 (0%)	17 (9.66%)	7 (3.98%)	16 (9.09%)	6 (3.41%)	2 (1.14%)
Intensity of Light curing.	0 (0%)	17 (9.66%)	11 (6.25%)	17 (9.66%)	9 (5.11%)	2 (1.14%)
The type of brackets	2 (1.14%)	14 (7.95%)	4 (2.27%)	8 (4.55%)	11 (6.25%)	1 (0.57%)
The type of the bonding system.	3 (1.7%)	67 (38.07%)	21 (11.93%)	49 (27.84%)	31 (17.61%)	11 (6.25%)
Time of curing.	2 (1.14%)	8 (4.55%)	3 (1.7%)	2 (1.14%)	6 (3.41%)	5 (2.84%)

Table 5: Participant Attitudes Toward Adhesives: Counts and Percentages by Academic Degree and Practice Setting.

	Academic Degree			Practice Setting		
	Dip./ Cert.	**M.Sc.**	**Ph.D.**	**Both**	**Private dental clinic**	**Public dental clinics**
The aerosol produced during bonding procedure can be minimized when self-etch system is used, how much would you consider that in high-risk cross infection situation (as in pandemic corona virus or tuberculosis)						
Neutral.	1 (0.57%)	20 (11.36%)	9 (5.11%)	14 (7.95%)	15 (8.52%)	1 (0.57%)
Not related	1 (0.57%)	14 (7.95%)	2 (1.14%)	8 (4.55%)	7 (3.98%)	2 (1.14%)
Somewhat related.	3 (1.7%)	60 (34.09%)	15 (8.52%)	45 (25.57%)	25 (14.2%)	8 (4.55%)
Strongly related.	2 (1.14%)	29 (16.48%)	20 (11.36%)	25 (14.2%)	16 (9.09%)	10 (5.68%)
Please rate your overall satisfaction with the bonding system you use						
Neutral.	0 (0%)	19 (10.8%)	6 (3.41%)	15 (8.52%)	7 (3.98%)	3 (1.7%)
Somewhat dissatisfied.	0 (0%)	0 (0%)	1 (0.57%)	0 (0%)	1 (0.57%)	0 (0%)
Somewhat satisfied.	4 (2.27%)	40 (22.73%)	16 (9.09%)	28 (15.91%)	19 (10.8%)	13 (7.39%)
Very satisfied.	3 (1.7%)	64 (36.36%)	23 (13.07%)	49 (27.84%)	36 (20.45%)	5 (2.84%)
You will replace your current bonding system if the newer system has:						
Decreased bonding steps and enhanced patient comfort.	0 (0%)	20 (11.36%)	8 (4.55%)	16 (9.09%)	9 (5.11%)	3 (1.7%)
Decreased remnant adhesive at the debonding step.	0 (0%)	11 (6.25%)	2 (1.14%)	6 (3.41%)	6 (3.41%)	1 (0.57%)
Decreased time needed for bonding procedure.	0 (0%)	14 (7.95%)	9 (5.11%)	13 (7.39%)	9 (5.11%)	1 (0.57%)
Increased bonding strength further than what you have currently.	3 (1.7%)	39 (22.16%)	8 (4.55%)	25 (14.2%)	16 (9.09%)	9 (5.11%)
Increased enamel safety.	4 (2.27%)	39 (22.16%)	19 (10.8%)	32 (18.18%)	23 (13.07%)	7 (3.98%)
What is the level of clinical evidence you relied on in choosing the bonding system you currently use?						
Case report, in vitro studies, retrospective clinical studies.	1 (0.57%)	15 (8.52%)	3 (1.7%)	8 (4.55%)	8 (4.55%)	3 (1.7%)
Commercial advertisement or encouragement from different social media	0 (0%)	6 (3.41%)	2 (1.14%)	3 (1.7%)	2 (1.14%)	3 (1.7%)
Opinion of other experts.	4 (2.27%)	31 (17.61%)	9 (5.11%)	21 (11.93%)	18 (10.23%)	5 (2.84%)
Personal opinion.	2 (1.14%)	36 (20.45%)	14 (7.95%)	29 (16.48%)	17 (9.66%)	6 (3.41%)
Randomized clinical trial, multiple clinical trials, Meta-analysis.	0 (0%)	35 (19.89%)	18 (10.23%)	31 (17.61%)	18 (10.23%)	4 (2.27%)

Table 6: The results of Chi-square and Fischer exact test between the different groups

	Questionnaire item	P-Value	
		Academic degree	Practice Setting
1.	**What kind of bonding adhesive (primer) system do you use?**	0.150	0.490
2.	**What is the activation method of your adhesive?**	0.180	0.038*
3.	**What consistency of the adhesive paste would you prefer?**	0.686	0.009*
4.	**If you were offered different types of adhesives, what type would you prefer regarding fluoride content?**	0.797	0.383
5.	**According to your opinion, which bonding system can give higher bond strength?**	0.013*	0.087
6.	**According to your opinion, which bonding system can give safer debonding (with minimal enamel damage)?**	0.006*	0.001*
7.	**According to your opinion, which bonding system can be more satisfying regarding the time consumed in orthodontic bonding procedure?**	0.749	0.316
8.	**According to your opinion, which bonding system can produce satisfactory bonding in a wet field?**	0.046*	0.479
9.	**According to your opinion, which factor has greater effect on the bond strength of light-cured composite?**	0.222	0.035*
10.	**The aerosol produced during bonding procedure can be minimized when self-etch system is used, how much would you consider that in high-risk cross infection situation (as in pandemic corona virus or tuberculosis):**	0.136	0.273
11.	**Please rate your overall satisfaction with the bonding system you use**	0.521	0.049
12.	**You will replace your current bonding system if the newer system has:**	0.309	0.898
13.	**What is the level of clinical evidence you relied on in choosing the bonding system you currently use?**	0.387	0.516

* Statistically significant differences when the P value is less than 0.05.

Discussion

Various orthodontic bonding techniques and materials have been developed but there remains no consensus regarding the optimal system. Many systematic reviews and meta-analyses have concluded that there is insufficient evidence to recommend one enamel conditioning system, bonding technique, or material over another [19-21]. In the absence of conclusive evidence, the choice of bonding technique in an orthodontic practice is governed by the orthodontist's preference [22]. Therefore, it is crucial to explore orthodontists' expectations regarding the available bonding techniques and materials and understand how they interpret the available evidence in their clinical choices.

Here, to understand the underlying factors affecting orthodontic clinical choices, we determined the effect of sociodemographic categories on treatment choices. This study had a comparable proportion of female and male participants, reflecting an almost equal gender distribution within the Iraqi Orthodontic Society. Unsurprisingly, all participants, regardless of their sociodemographic classes, were aware of the EAR system, and they used this system with light-curing as the primary activation method. This may be because the phosphoric acid-etch bonding technique's ability to produce high bond strength and a reliable seal, thus protecting against degradation [23, 24]. Additionally, this may stem from the participants' educational background emphasising the EAR system as the standard bonding technique. Among other types, the SEP system was the next most recognised by orthodontists. These findings align with the tendency of practitioners to adopt specific techniques or materials according to their chronological development. The two-step EAR system is the traditional technique used for orthodontic bonding; however, a new era of SEP may be just around the corner, as the accumulated evidence does not provide a reason to favour the use of EAR over SEP regarding bracket failure rates [19, 20]. In contrast, universal adhesives were the least preferred, which might be related to the struggle

the practitioners still face in selecting the appropriate etching mode to optimise adhesive performance in clinical practice [25].

The vast majority of orthodontists chose the light-curing method over others, a finding that might be related to the unique advantage of allowing sufficient working time for accurate bracket positioning, which is essential in modern orthodontic practice. Interestingly, the dental practice setting seems to have a significant impact on orthodontist choice, as some practitioners working in public clinics disclosed a preference for chemical-cured systems. This may be attributed to the high workflow in public settings, which requires faster bonding methods to manage time constraints efficiently.

Most orthodontists preferred medium viscosity over other types, likely because of its consistency. The flowability of orthodontic adhesive is essential for achieving proper enamel wetting and penetration into the micromechanical retentive areas created during the etching step, ensuring good bracket retention. In contrast, low-viscosity materials may lead to bracket slippage before the final curing of the bracket, which jeopardises the accurate positioning of the bracket [26]. Notably, there was a significant influence of the clinical setting with a higher preference for medium viscosity by orthodontists working in private settings, which might be attributed to the higher flexibility in selecting a particular material in their practice.

When it comes to fluoride content, the practitioners predominantly selected fluoridated adhesives, irrespective of any sociodemographic factors. This could reflect their desire to control the enamel demineralisation commonly associated with fixed orthodontic appliances. Fluoride-mediated remineralisation strategies serve as the cornerstone of managing orthodontically induced white spot lesions. By incorporating fluoridated compounds into orthodontic adhesives, orthodontists can enhance enamel protection in areas adjacent to brackets while reducing the reliance on patient compliance [27].

Enamel treatment using the EAR technique was identified as the system providing the strongest bond strength, which is consistent with its status as the gold standard for enamel conditioning [4]. Interestingly, the M.Sc. respondents displayed hesitation in selecting a specific system, which may originate from the limited comparative knowledge of bonding systems or relying on inconclusive evidence regarding the bond failure of different systems [20, 28].

Regarding enamel safety, the SEP system was recognised as the safest bonding strategy. This aligns with the previous question, as the benefit of robust orthodontic attachment of the EAR technique is not without increased risk of enamel damage [29]. Notably, respondents with higher academic degrees better recognised this effect, demonstrating a higher awareness of this issue and highlighting the impact of educational level on clinical decision-making. Practitioners in different dental settings exhibited no specific preference patterns, confirming the ongoing need to strengthen evidence-based practice.

When evaluating chairside time, the SEP system was preferred, which is logical because SEP eliminates the rinsing step and simplifies the bonding procedure, making it more user-friendly. This preference is influenced equally by personal experience and evidence from earlier studies [30].

With respect to the wet environment, system selection was inconsistent, with no clear trends or preferences observed across practice settings. However, respondents with a with higher academic level (Ph.D. holders) demonstrated a significant preference for SEP, which appears to be beneficial in a moist environment owing to the aqueous compositions of the primer [31, 32]. Conversely, the EAR system is technique sensitive in moist environments [4, 33].

Regardless of sociodemographic factors, most orthodontists specified the bonding system as the primary determinant of bond strength when using light-cured adhesives. Interestingly, orthodontists working in both public and private clinics reported a much lower emphasis on curing time compared to workers in public clinics. This discrepancy underscores the complexities in this area of research, [24, 34] where personal opinion may affect clinical choices.

The participants demonstrated a positive attitude toward reducing aerosols by using a self-etching bonding system, which could further enhance the preference for such a system [35] because of its safety, time efficiency, and reduced wet sensitivity, as highlighted in the previous questions. Overall, the orthodontists expressed satisfaction with their current bonding experience. However, their primary concern was ensuring the safety of enamel, which encompasses minimising risks such as demineralisation, discolouration, cracking, or damage during or after bonding [7, 10].

Although orthodontists in this study selected a variety of bonding systems to satisfy specific clinical objectives, there was a clear predilection towards the traditional EAR technique with a strong bond strength to preclude the possibility of bracket failure, which might consequently disturb the orthodontic treatment flow. This preference also suggests a knowledge gap among orthodontists concerning the relationship between the higher bond strength offered by this system and the potential enamel damage [29].

The study findings provide sufficient evidence to reject the null hypothesis. This study provides an opportunity for orthodontists to reevaluate their clinical choices in light of different levels of knowledge and practice settings and to critically compare their preferences based on different sociodemographic factors.

The findings of this study are subjected to the inherent limitations of questionnaire-based studies. The accuracy of the results might be affected by the level of accuracy of the respondents, who might interpret the questions differently. Moreover, the information recruited from questionnaires cannot mimic the depth and detail that can be obtained via interviews or direct clinical evaluation. However, questionnaires are consistent and user-friendly instruments for assessing attitude, awareness, and knowledge. In addition, according to the sample size estimation, the sample size for this study has sufficient power to test the study objectives. Furthermore, in addition to recruiting participants with different academic degrees, the study also recruited orthodontists working in different clinical sectors, which enhanced the diversity of the sample and contributed to the generalisability of the findings.

Conclusion

Orthodontists demonstrated a preference for the traditional EAR technique to reduce the risk of bracket loss, which could interfere with the orthodontic treatment flow. In contrast, the SEP system was the most satisfactory option when prioritising safety, time efficiency, reduced technique sensitivity, and aerosol-reducing properties. The findings of this study suggest that orthodontists' clinical choices are still significantly shaped by the skills and information acquired during their preliminary education, despite the availability of unbiased, evidence-based options. There is a need for better integration of robust scientific evidence in future clinical decision-making to optimise bonding system selection and treatment outcomes.

Conflict of interest

The authors have no conflicts of interest to declare.

Author contributions

NMG, ASK, and YAY; study conception and design, data collection. NMG, ASK, YAY, AII, and DRB; methodology. NMG, ASK, and YAY; statistical analysis and interpretation of results. NMG; Writing – review. ASK; editing. AII and DRB; Supervision. All authors reviewed the results and approved the final version of the manuscript to be published.

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Informed consent

Informed consent was obtained from all individuals (or their guardians) who participated in this study.

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دور المعرفة والممارسة في توجهات اختصاصيي تقويم الأسنان تجاه مواد وتقنيات اللصق التقويمي

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المستخلص:

الأهداف: تقييم تأثير المعرفة والممارسة على توجهات اختصاصيي تقويم الأسنان تجاه مواد وتقنيات لصق الحاصرات التقويمية. الطرق: أُجريت دراسة مقطعية قائمة على الاستبيان باستخدام نماذج جوجل. تضمن الاستبيان 18 سؤالًا متعدد الخيارات لقياس وعي أخصائيي تقويم الأسنان ومعرفتهم وتوجهاتهم فيما يخص مواد اللصق التقويمي. وُزع الاستبيان عبر البريد الإلكتروني أو منصات التواصل الاجتماعي على اختصاصيي تقويم الأسنان العراقيين. النتائج: مجموع المشاركين في الدراسة 176 اختصاصيا بتوزيع متساوٍ تقريبًا بين الجنسين، وكان أغلب المشاركين (نحو 70%) حاصلين على درجة الماجستير، وأكثر من نصف المشاركين عملوا في الوقت ذاته في عيادات خاصة ومراكز حكومية. أظهر جميع المشاركين معرفة بنظام "التحضير بالتحفير والغسل" للصق، واستخدمه الأغلبية مع تفعيل المعالجة الضوئية. ظهر تأثير الدرجات العلمية ومكان العمل في بعض الاستجابات المتعلقة باختيار وإدارة مواد اللصق. الاستنتاجات: فضّل اختصاصيو تقويم الأسنان تقنية "لتحفير والغسل" التقليدية لتقليل فقدان الحاصرات والحفاظ على سير العلاج. بينما كان نظام "التحضير الذاتي" الخيار المفضل عند التركيز على السلامة، وكفاءة الوقت، وتقليل الحساسية التقنية، والحد من الانتشار الجوي. قد تتشكل الخيارات السريرية بشكل كبير من المهارات والمعلومات المكتسبة خلال التدريب الأولي، رغم الأدلة المتاحة. يجب أن تركز القرارات المستقبلية على الاستفادة الفعالة من الأدلة العلمية.