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ORIGINAL ARTICLE

Attitude and awareness of dentist towards resin bonded bridges in Saudi Arabia

Fahim Ahmed Vohra [a,*], **Muhammed Ayedh Al-Qahtani** [b]

[a] *Prosthetic Dental Science (SDS), College of Dentistry, King Saud University, PO Box 60169, Riyadh 11545, Saudi Arabia*
[b] *SDS Department, College of Dentistry, King Saud University, PO Box 60169, Riyadh 11545, Saudi Arabia*

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Abstract *Statement of the problem:* Resin bonded bridges (RBBs) offer a conservative approach to tooth replacement. However, the use of this treatment option has been limited. Therefore, the aim of this study was to assess the knowledge and attitude of dentists in Saudi Arabia, including general dental practitioners (GDPs) and prosthodontic and restorative specialists (SPs), toward RBBs.

Methods: In this cross-sectional study, questionnaires designed to survey knowledge of RBB performance factors were distributed to GDPs and SPs (n = 400). Specifically, opinions of GDPs and SPs regarding clinical, mechanical, technique- and patient-dependent performance factors of RBBs were obtained. Average significance and Chi-square tests were used to identify the frequency, pattern, and significance of the response variables identified.

Results: A majority (65.3%) of the subjects reported using RBBs in less than 10% of their prosthodontic cases. The most common reason for the limited clinical application of RBBs was perceived poor retention (23.45%). In addition, SPs regarded the influence of enamel structure, number of pontics, cement type, RBB design, and surface treatment as "very significant" factors with respect to RBB survival. Overall, a statistically significant difference was observed between the responses of GDPs and SPs regarding their knowledge of performance factors for RBBs.

Conclusion: In comparison to SPs, GDPs reported greater disagreement with current standards for RBB success factors. Moreover, 60% of SPs and 71% of GDPs used RBBs for less than 10% of their prosthodontic cases. Therefore, continuing education opportunities are needed for practicing dentists, and undergraduate students need to receive greater exposure to the clinical application of RBBs.

1. Introduction

Treatment options for missing teeth can include the absence of treatment and acceptance of the resulting space, orthodontic therapy to redistribute the space, or prosthetic tooth replacement (Robertsson and Mohlin, 2000; Jepson et al., 2003). Resin bonded bridges (RBBs) offer a conservative and cost-effective approach to the restoration of space compared to conventional bridgework (Cheung et al., 2005). Specifically,

* Corresponding author. Tel.: +966 532911056.
E-mail addresses: fahimvohra@yahoo.com (F.A. Vohra), drm212@hotmail.com (M.A. Al-Qahtani).
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RBBs allow for the preservation of tooth structure, treatment reversibility (when RBBs are used as a provisional restoration), minimal catastrophic failure and loss of abutment, preservation of pulp vitality, minimal soft tissue interaction, ease of retrievability (Djemal et al., 1999; Ibbetson, 2004; Pjetursson et al., 2008; Howard-bowles et al., 2011; Miettinen and Millar, 2013). Moreover, with an increasing emphasis on conservation of oral tissues in recent years, awareness of RBBs as a definitive treatment option has also increased. However, since their introduction, the main concern regarding RBBs has been the potential for higher debonding rates and decreased longevity (Creugers et al., 1997). Despite this, accumulating scientific evidence indicates that they are effective alternatives to conventional bridges, and have been used to achieve long-term success and patient satisfaction (Boyer et al., 1993; Wood et al., 1996; Creugers and De Kanter, 2000; Ketabi et al., 2004; Botelho et al., 2006).

In a systematic review of survival and complication rates for RBBs over a five-year period that was conducted by Pjetursson et al. (2008), an estimated survival rate of 87.7% was reported. Clinical success rates ranging from seven to nine years have also been reported, provided that vital success factors are respected (Djemal et al., 1999; Garnett et al., 2006; Pjetursson et al., 2008). Specifically, the clinical performance of RBBs has been found to depend on factors that can be classified as: patient-related (e.g., saddle span, location, remaining enamel, and parafunction), design-related (e.g., retainer type, thickness, connector height), and technique-related (e.g., cement, retainer treatment, and isolation method) (Djemal et al., 1999).

Established standards (Garnett et al., 2006; Miettinen and Millar, 2013) related to the design and retainers of RBBs for clinical success include: increased longevity for cantilever designs (van Dalen et al., 2004; Kern, 2005), maximum enamel coverage by retainers, sandblasted and non-perforated retainers, and nickel chromium alloy framework (Djemal et al., 1999). Furthermore, a minimum retainer thickness of 0.7 mm and a minimum connector height of 2 mm have been recommended (Smyd, 1961; Ibrahim et al., 1997). In addition, none or minimal tooth preparation with preservation of enamel thickness has been associated with respectable survival rates (Botelho, 2000; Ibbetson, 2004). While the use of resin-based cements (RBC) with rubber dam isolation is also a well-recognized method, the particular type of RBC that should be used has been difficult to establish (Djemal et al., 1999). Thus, knowledge and application of vital performance factors for RBBs are key to the successful application of RBBs as a definitive treatment option.

The teaching and training of undergraduates and postgraduates regarding RBBs is reflected in the clinical attitudes and clinical application of this restoration method by general dental practitioners (GDPs) and prosthodontics and restorative specialists (SPs). It is hypothesized that RBBs are not widely performed in clinical practice due to concerns regarding the reliability of this treatment. While this uncertainty among clinicians may be multifactorial, if the reasons for this uncertainty can be identified and addressed, more effective use of RBBs may be achieved. Correspondingly, it is important to estimate the clinical use of RBBs in Saudi Arabia and to evaluate awareness of the factors needed to successfully perform RBBs. As a result, reasons for the limited application of these restorations may be ascertained. To date, there have been no reports to evaluate the attitudes and knowledge of RBB performance factors between GDPs and SPs. Hence, the aim of this study was to assess perceptions and knowledge of essential performance factors for RBBs by GDPs and SPs in Saudi Arabia.

2. Materials and methods

This cross-sectional study was conducted among GDPs and SPs in Saudi Arabia. The former graduated as dentists and had completed at least one-year of an internship. The SPs involved in this study had completed a postgraduate specialist program in prosthodontic and restorative dentistry. Participants also had to be currently engaged as a dental practitioner and/or have a teaching position. Contact details for the enrolled clinicians were obtained from the office of the Saudi Dental Society. Although a sample size of 350 was considered sufficient for statistical analysis, the potential for non-responding participants was anticipated, and the sample size enrolled was 400. Stratified random sampling was performed to select study participants, and GDPs and SPs were considered two distinct strata. The ethics committee of the College of Dentistry Research Centre (King Saud University) approved the study protocol (Ref No. FR 0023). A structured, self-administered questionnaire composed of twenty questions was attached to a study description and a consent for participation form. These packets were either emailed (n = 190) or hand delivered (n = 210). To maximize the responses obtained, participants were reminded to return their questionnaires three weeks and six weeks after the questionnaires were distributed.

The first part of the questionnaire consisted of questions related to a clinician's area of expertise, years of experience, and the percentage of RBBs performed in their clinical prosthodontic/restorative practice. The second part of the questionnaire comprised of fifteen close-ended, multiple-choice questions which were designed to extract the opinion and understanding of the respondent regarding performance factors for RBBs. In particular, the questions were related to clinical indications, prosthesis design, retainer type and dimensions, retainer surfaces, tooth preparation, desired cements, and clinical technique. The last part of the questionnaire contained a single table grid question that was designed to identify the participants' opinions regarding the significance level of vital factors related to the clinical success of RBB therapy. These factors included: remaining abutment enamel, area of the mouth where the RBB is placed, number of missing teeth to be replaced, RBB design, type of retainer, retainer surface treatment, connector height, retainer thickness, tooth preparation, cement type, and use of RD during cementation. The respondents could provide scores ranging from one to five, with a score of one indicating a factor is very insignificant, and a score of five indicating a factor was very significant. Factors designated as insignificant, neutral, and significant received scores 2–4, respectively.

A single investigator analyzed all of the returned questionnaires. Average significance was determined to identify the frequency, pattern, and significance of the response variables identified (e.g., performance factors for RBBs). Using the Statistical Package for Social Sciences (SPSS) version 17 (Chicago, Illinois, USA), Chi-square tests were used to compare the responses of GDPs and SPs for each question in regard to the response options. A p-value less than 0.05 was considered statistically significant.

Table 1 Numerical summary of participant responses to survey questions.

Question No.	Question	Response options	SPs (%)	GDPs (%)	Chi-squared	*p*-Value
1	For what percentage of your tooth replacement cases have RBBs employed?	< 10%	59.33	70.98	5.081	0.165
		10–20%	30.00	24.07		
		21–30%	8.00	4.93		
		31–40%	2.66	0		
2	How long have you been practicing dentistry?	< 5 years	10.66	11.11	0.117	< 0.943
		5–10 years	40.01	41.97		
		> 10 years	49.33	46.92		
3	What type of restoration do you consider RBBs provide?	Permanent	25.33	16.04	7.094	0.0288
		Provisional	21.33	43.20		
		Both	53.33	40.74		
4	Does the amount of remaining enamel affect the success of RBBs?	Yes	98.66	82.71	15.073	0.0001
		No	1.335	17.28		
5	In which area of the mouth are RBBs the most successful?	Ant Max.	59.13	59.61	7.594	0.107
		Ant Mand.	27.95	18.26		
		Post Max.	2.15	6.70		
		Post Mand.	1.07	5.76		
		No effect	9.67	9.61		
6	How many missing teeth should be replaced for maximum longevity of a RBB?	One	61.33	61.33	0.484	0.9223
		Two	30.66	28.86		
		Three	2.66	4.94		
		Four	5.33	5.40		
7	Which RBB design provides maximum longevity?	Fixed–fixed	77.33	85.18	6.218	0.0446
		Cantilever	18.66	7.400		
		Does not affect	4.0	7.4		
8	Which RBB retainer provides maximum longevity?	Perforated	17.33	58.02	36.623	< 0.0001
		Non-perforated	60.00	25.92		
		Both are equal	22.66	16.04		
9	Does retainer surface treatment increase RBB longevity?	Yes	100	86.41	14.491	0.0001
		No	0	13.5		
10	Does connector height affect longevity?	Yes	90.66	92.59	0.243	0.622
		No	9.33	7.40		
11	What is the optimum height for a connector?	1 mm	5.33	3.70	8.204	0.041
		2 mm	24.0	35.8		
		3 mm	46.6	43.2		
		4 mm	24.00	17.28		
12	Does preparing teeth for retentive features improve longevity?	Yes	78.66	87.65	2.886	0.089 ns
		No	21.33	12.34		
13	Which cement type provides maximum longevity?	RBC	100	82.71	18.916	< 0.001
		GIC	0	17.28		
14	Does the use of rubber dam improve longevity?	Yes	93.33	71.60	16.335	< 0.001
		No	6.660	28.39		
15	Does thickness of a retainer affect longevity?	Yes	69.33	77.77	1.831	0.176
		No	30.66	22.22		
16	What is an optimum thickness for a retainer?	0.3 mm	18.66	13.58	6.632	0.084
		0.5 mm	44.00	43.20		
		0.7 mm	26.66	19.75		
		1.0 mm	10.66	23.45		
17	Which type of occlusion RBBs are the most successful?	Class I	50.66	55.55	6.069	0.108
		Class II	10.66	19.75		
		Class III	10.66	7.400		
		Has no effect	28.00	17.28		

SPs: prosthodontic and restorative specialists, GDPs: general dental practitioners, RBBs: resin bonded bridges, Ant: anterior, Max: maxilla, Mand: mandible, Post: posterior, RBC: resin based cement, GIC: Glass ionomer cement.

3. Results

Of the 400 questionnaires that were distributed, 312 were returned (78% response rate). The response rate for the SPs was 75% (150/200) and for the GDPs it was 81% (162/200). Both groups had comparable clinical experience ($p = 0.943$) (Table 1). For 60% of the SPs and 71% of the GDPs, RBBs were performed for less than 10% of the available prosthodontic cases. In addition, the majority of SPs

(53.33%) considered RBBs as both a permanent and provisional restoration, compared with 43.2% of GDPs who regarded RBBs only as a provisional option ($p = 0.02$). Of the fifteen questions related to RBB performance factors, responses to eight of these questions (53%) were found to significantly differ between the SP and GDP groups.

Regarding design and mechanical factors associated with RBBs (Table 1), more than 75% of both the SPs and GDPs selected fixed–fixed as the most successful RBB design. However, 18.66% of SPs opted for cantilevers, thereby resulting in a significant difference in opinion between the two groups ($p = 0.04$). For 60% of SPs, non-perforated retainers were associated with the clinical success of RBBs. In contrast, 58% of GDPs associated perforated retainers with better RBB performance. However, all of the SPs (100%) and a majority of the GDPs (86.41%) agreed that retainer surface treatment improves longevity ($p < 0.001$). The optimum connector height selected by SPs (46.6%) and GDPs (43.2%) was 3 mm, followed by 2 mm ($p = 0.04$). For optimum retainer thickness, 0.5 mm was the most common choice (SPs, 44%; GDPs, 43.2%; $p = 0.084$), followed by 0.7 mm (26.66%) according to SPs and 1.0 mm (23.45%) according to GDPs. In addition, 30.66% of SPs and 22.22% of GDPs did not consider retainer thickness a factor that influenced RBB longevity. However, for both groups (SPs and GDPs), 61.33% preferred that only one tooth should be replaced by a RBB, while ~30% favored the use of two pontics ($p = 0.922$).

Regarding patient- and technique-related factors (Fig. 1), a majority of the SPs (98.66%) and GDPs (82.71%) accepted that remaining enamel structure influences the performance of RBBs although, 17.28% of the GDPs reported the contrary. In contrast, a greater percentage of GDPs (87.65%) responded that tooth preparation improves RBB performance compared to SPs (78.66%). The anterior maxilla was considered the most favorable location for achieving a successful RBB (SP, 59.13%; GDP, 59.61%), followed by the anterior mandible (SP, 27.95%; GDP, 18.26%). Class I was also the most preferred jaw relation (SP, 50.66%; GDP, 55.55%), although 28.0% of SPs and 17.3% of GDPs believed that occlusal classification does not influence RBB performance. A total of 17.28% of GDPs selected glass ionomer cement (GIC) as their first choice for RBB cementation, while all of the SPs (100%) and a majority of GDPs (82.71%) preferred RBC. However, regarding the principle that RD use improves RBB longevity, 93.33% of SPs agreed and 28.39% of GDPs disagreed ($p = 0.001$).

Perceived reasons for the limited clinical application of RBBs that was reported included poor retention, technique sensitivity, inferior knowledge and understanding of RBBs, and poor undergraduate training (Table 2). The average significance values assigned to RBB performance factors are presented in Figs. 2a and b. According to the SP group, "very significant" factors included: remaining enamel structure, number of pontics, cement type, RBB design, and retainer surface treatment (Fig. 2a, significance average was >4). In contrast, the GDP group only considered the number of pontics to be a "very significant" factor, yet all of the factors surveyed were considered "significant" by this group (Fig. 2a, significance average was >3). Overall, remaining enamel structure, number of pontics, and cement type received the most "very significant" responses, while retainer thickness, type of retainer, retainer surface treatment, and connector height received the most "significant" responses (Fig. 2b).

4. Discussion

This study presents a unique comparison of data designed to evaluate the knowledge and perception of factors related to the successful clinical performance of RBBs between GDPs and SPs in Saudi Arabia. The overall response rate for the questionnaire distributed was 78% (75% for SPs and 81% for GDPs). In comparison, the response rate for paper surveys was previously reported to be 50–55% (Baruch and Brooks, 2008). The higher than average response observed in the present study is attributed to the multiple reminders that were distributed to participants, a method previously reported to improve response rates (Dommeyer et al., 2004). Of the respondents, 49.33% of the SPs and 46.92% of the GDPs had more than ten years of clinical experience. Due to the statistical similarity of this clinical experience ($p = 0.943$), an effective comparison of the available data sets was performed.

A majority of the SP and GDP groups (60% and 71%, respectively) used RBBs for less than 10% of the prosthodontic cases in their clinical practice. Low levels of confi-

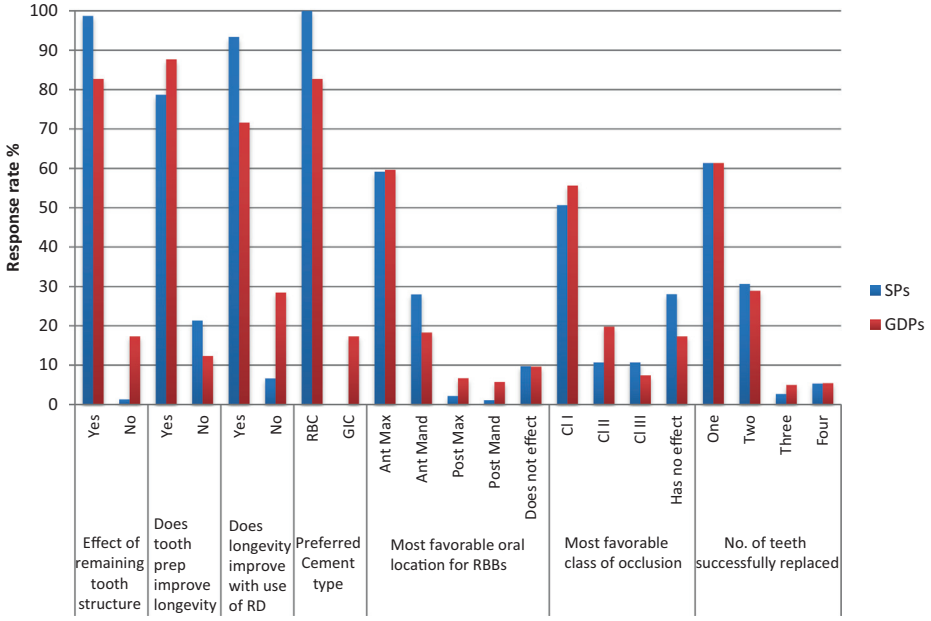

Figure 1 Comparison of response rates regarding patient- and technique-related performance factors for RBBs. GDPs: general dental practitioners, SPs: prosthodontic and restorative specialists, RD: rubber dam, RBC: resin-based cement, GIC: glass ionomer cement, Ant: anterior, Max: maxilla, Mand: mandible, Post: posterior, Cl: class.

Table 2 Participants' reasons for limited usage of RBBs in their practice ($N = 312$).

	Poor retention	Technique sensitive	Inadequate knowledge	Poor exposure during training	Poor laboratory support	Compromised esthetics	Limited financial gain	Chi Square	P value
Specialist (SP)*	25.00	17.07	20.37	15.24	12.19	4.87	4.87	2.629	0.853
General Dental Practitioner (GDP)	21.91	20.73	15.73	18.53	12.92	7.30	2.80		

* Prosthodontic and restorative specialist.

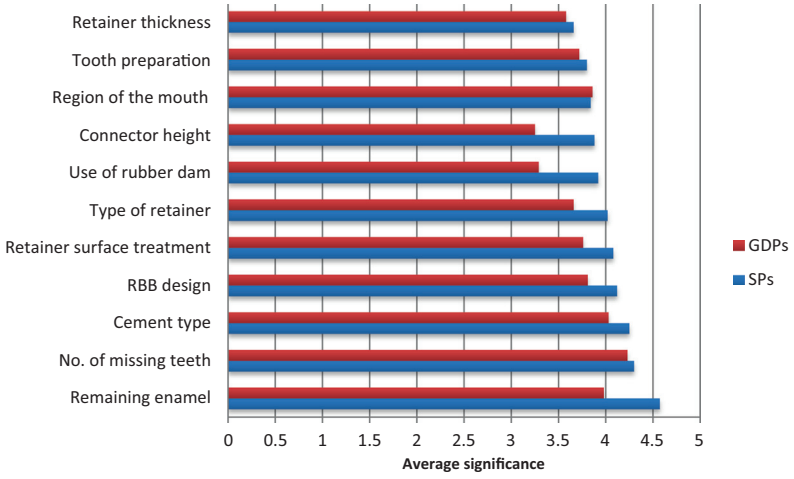

Figure 2a Comparison of the RBB performance factors perceived to be significant. GDPs: general dental practitioners, SPs: prosthodontic and restorative specialists.

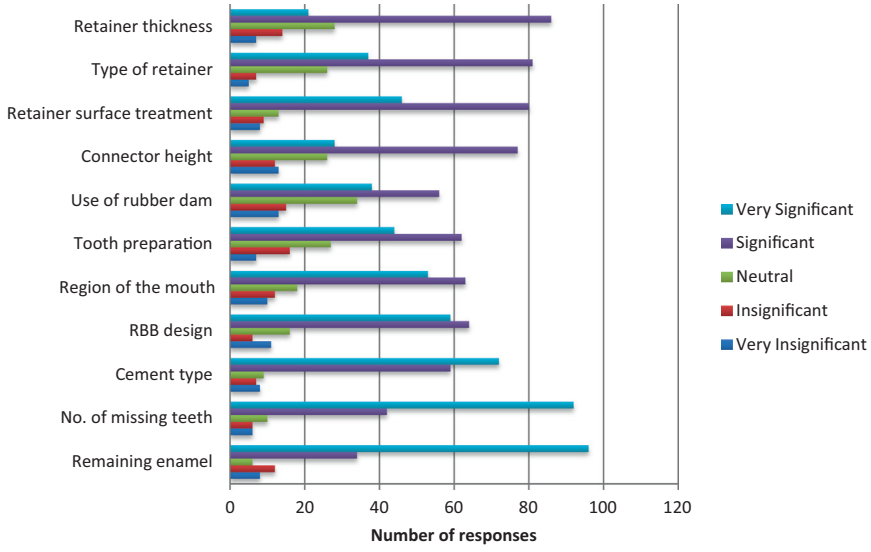

Figure 2b Summary of participant responses related to the significance of RBB performance factors.

dence in performing these restorations and pessimism regarding the longevity of RBBs were reasons given for the limited use of RBBs. For example, 21.33% of SPs and 43.2% of GDPs classified RBBs as only a provisional restoration, and not as a definitive restoration. This may be due to an early RBB survival study that reported high debond rates (poor retention) (Boening, 1996). However, with improved understanding of biomechanics and advances in adhesive bonding and materials, the reported success rates have increased. For example, in a recent systematic review, survival rates for RBBs were found to be 87.7% compared with 90% for conventional bridges over a period of five years (Pjetursson et al., 2008). It is accepted that adhesive bonding of a RBB warrants strict isolation and a meticulous enamel bonding technique, since these factors have been found to directly impact the prognosis of RBBs (Audenino et al., 2006). Hence, RBBs may not innately lack retention. Rather, poor understanding and execution by clinicians may be responsible for compromised clinical performance of these bridges.

A fixed–fixed (FF) design was the preferred choice for both groups of respondents, with only 18.66% of SPs opting for a cantilever design. However, many dental professionals preferentially support the use of a cantilever due to differential abutment movement and partial retainer failure that has been associated with the FF design (Chan and Barnes, 2000; van Dalen et al., 2004; Kern, 2005). While the FF design can be used to gain surface area in cases involving short abutments and a long span, the FF choice in the present study is contrary to established facts. However, the success of a cantilever RBB is not straightforward, and informed case selection is a key to its successful application. In the present survey, Maryland (non-perforated) RBBs were associated with greater success according to the opinion of the SP group (60%), which is a perspective that is consistent with many other research reports (Bastos et al., 1991; Boyer et al., 1993). In contrast, 58% of the GDP group associated Rochette (Perforated)-type retainers with better performance. This indicates that GDPs may have an inaccurate impression of design-related RBB success factors. Regarding connector height, approximately 95% of respondents indicated that a height of 2 mm and above was optimal, and this is consistent with previously published standards (Ibrahim et al., 1997). Previous studies have also recommended 0.7 mm as a minimum retainer thickness (Smyd, 1961; Lin et al., 2003). In the present study, more than half of the respondents from each group selected less than 0.7 mm as an optimum thickness. However, it has been shown that the lesser the thickness of a retainer, the greater the chance that a framework may flex and debond (Smyd, 1961).

Except for 17.28% of GDP respondents, all subjects agreed that remaining tooth enamel affects the success of a RBB. For patients with tooth wear, hypodontia, and trauma, there tends to be less enamel available for resin bonding. As a result, the available bonding surface area is decreased, and in some cases, this can enhance debonding (Djemal et al., 1999). However, the notion that tooth preparation for RBBs improves retention remains controversial. While most authors recommend that tooth preparation is not needed or can be minimal (Botelho, 2000; Ibbetson, 2004), both SP and GDP respondents (a total of 82.69%) strongly expressed that tooth preparation increases RBB survival. Conversely, however, tooth preparation results in dentine exposure, which increases the potential for sensitivity and reduced bond strength.

Almost 60% of all respondents agreed that the anterior maxilla was the most successful site for a RBB, followed by the anterior mandible (SP, 27.95%; GDP, 18.26%). These results are consistent with those of previous studies (Boyer et al., 1993; Boening, 1996; De Rijk et al., 1996; Howard-Bowles et al., 2011). Surprisingly, however, 17.28% of GDPs associated GIC with improved RBB performance compared with RBC, which is contrary to popular belief. Bonding RBBs under isolation using RD is currently considered the gold standard, as it provides the best possible chance of survival (Audenino et al., 2006; Gilbert et al., 2010). However, 28.39% of GDP respondents did not report the use of RD for RBB cementation.

The most important performance factors for RBB were previously reported to include: patient selection, design, mechanical features, and clinical technique (Djemal et al., 1999). In the present study, SPs designated the following factors to be "very significant": remaining enamel structure, number of pontics, cement type, design, and retainer surface treatment. In contrast, the GDPs only reported the length of a span (e.g., number of pontics) as "very significant". In addition, designs with four or less units were regarded as more successful. However, the latter is related to an increased debonding risk due to the presence of more retainers, rather than the length of the span involved (Djemal et al., 1999). Overall, it was observed that GDPs considered most of the performance factors surveyed (e.g., design, restoration type, retainer type and thickness, occlusal classification, and cement type) to be important for RBBs. In contrast, SPs considered bridge design, retainer thickness, and occlusal classification to be important factors. However, both sets of factors are inconsistent with contemporary RBB standards.

5. Recommendations

With the aim of aligning GDPs and SPs in Saudi Arabia with contemporary concepts of RBB success and longevity, continued education and clinical training of existing GDPs and SPs is needed. Improved teaching and training of RBBs during their undergraduate education is also needed to familiarize future dentists with this prosthetic treatment option.

6. Conclusions

Within the limitations of the present study, the following observations were made:

- GDPs and SPs (prosthodontic and restorative) exhibit differences in their knowledge and understanding of the factors that affect the clinical performance of RBBs.
- Of the respondents for this study, 60% of SPs and 71% of GDPs used RBBs for less than 10% of the tooth replacement prosthodontic cases treated in their clinical practices. Poor retention was the most common reason given for not using RBBs.
- The GDPs surveyed reported greater disagreement with current standards for the following RBB success factors: bridge design, type of restoration, type of retainer, retainer thickness, classification of occlusion, and cement type.
- Regarding the successful application of RBBs, SPs regarded the following factors to be "very significant": enamel structure, number of pontics, cement type, RBB design, and retainer surface treatment.

Conflict of interest

The authors have no conflicts of interest to declare.

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