

# The Opinions and Practices of Saudi Arabian Dentists about Cervical Margin Relocation

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## ABSTRACT

**Aim:** The aim of this study was to assess the opinions and practices of different dentists about the cervical margin relocation (CMR) concept.

**Materials and methods:** A total of 432 general dentists, advanced general dentists (AGDs), periodontists, restorative dentists, and prosthodontists practicing in Saudi Arabia were approached in person or asked to complete an electronic survey (Google Forms) assessing demographic data and their opinions and practice of CMR. Differences between groups were assessed using the Chi-squared test, and binary regression models were constructed to identify predictors of opinions and practice of CMR.

**Results:** About half of the surveyed dentists practiced CMR when indicated, but many felt that it represents an invasion of the biological width and might affect crown survival. Participants had several, often concurrent concerns about CMR. The opinions and practices of CMR were influenced by several factors including educational degree, work setting, country of clinical training, years of experience, and speciality.

**Conclusion:** The relatively conservative attitude of dentists towards CMR is justifiable, as it is a relatively new concept with little long-term clinical data. Clinical trials with sufficient follow-up periods are now needed to evaluate outcomes from CMR to provide further confidence to dentists to implement the procedure.

**Clinical significance:** Deep proximal carious lesions extending subgingivally is a common clinical scenario. Assessing the opinion and practice of dentists towards conservative treatment with CMR provides the basis for encouraging practitioners to use the procedure both clinically and in clinical trials.

**Keywords:** Cervical margin relocation, Crown lengthening surgery, Deep margin elevation, Deep proximal carious lesions.

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## INTRODUCTION

Dietschi and Spreafico first introduced the concept of CMR—also known as deep margin elevation, coronal margin relocation, and proximal box elevation – in 1998.<sup>1,2</sup> The aim of CMR is to relocate a deep subgingival class II cavity margin into a more favorable supragingival location when rubber dam isolation is not possible. Preparing an extracoronary restoration on a relocated margin is easier, as moisture control and visibility are improved. In addition, CMR allows for a good marginal seal and optimal light curing due to the decrease in distance from the bottom of the cavity. Moreover, taking impressions is also easier, either conventionally or using intraoral optical scanners.

The first permanent molars emerge as early as 6 years of age,<sup>3</sup> which exposes the tooth to multiple caries attacks during life and possibly proximal carious lesions. There are many options for saving badly destroyed teeth, including crown lengthening surgery (CLS), post and core and extracoronary restoration, and intentional root canal treatment. However, if a tooth is hopeless early in life and extracted, this can lead to multiple adverse consequences including drifting of neighboring teeth into the space, overeruption of opposing teeth into the space, occlusal interferences, and bone loss.<sup>4</sup> In addition, early extraction of compromised first permanent molars can decrease the post extraction space and lead to the early eruption of the second and third molars, counterclockwise rotation of the occlusal plane, and lingual tipping of incisors.<sup>5</sup> To avoid such consequences, CMR can be a conservative means to save hopeless teeth until time has passed to allow definitive treatment.

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Deep carious lesions are challenging to restore. The challenges include the following: (i) A risk of jeopardizing the integrity of the epithelial attachment by violating the biologic width;<sup>6</sup> (ii) difficulty in subgingival margin preparation, impression making and isolation during impression, and cementation of the final crown if resin cement is used (inspection and accessibility issues);<sup>7</sup> (iii) difficulty in moisture control (saliva or blood) risking adequate bond strength;<sup>8</sup> and (iv) quality of bond to dentin/cementum is different to bonding to enamel. Nevertheless, a recent systematic review comparing the prognosis of teeth restored with crown lengthening surgery vs CMR found that although crown lengthening surgery successfully promoted the long-term survival of teeth, CMR offered a better survival ratio.<sup>9</sup> Another systematic review concluded that indirect restorations on teeth with CMR face a low rate of complications in the long term.<sup>10</sup> These findings are consistent with the recent findings of Bresser et al.,<sup>11</sup> who reported long term survival of teeth (95.9%)

restored with ceramic restorations following CMR over a period of 12 years. Furthermore, *in vitro* studies on CMR have also shown promising results.<sup>12-20</sup>

Although the relatively small amount of available clinical data seem to favor CMR, data on the opinions and practices of dentists about CMR are lacking. Understanding how dentists feel about the procedure and whether they use it in practice is important to identify gaps in perception and knowledge that might be addressed to encourage the use of CMR both clinically and in clinical trials. Indeed, subjective data from a questionnaire study are important, since even if the clinical data favor a particular practice, if there are real-world barriers to its implementation (outside the clinical trial context), it will struggle to gain traction. Therefore, the aim of this study was to assess the opinions and practices of a range of different dentists about the concept of CMR.

## MATERIALS AND METHODS

### Inclusion and Exclusion Criteria

The Research Ethics Committee, Faculty of Dentistry, King Abdulaziz University approved the study protocol (REC No. 10-12-19). Dental practitioners were general dentists, AGD, periodontists, restorative dentists, and prosthodontists practicing in Saudi Arabia. Both public and private sector workers and dentists with a range of clinical experience were included. Any other dental specialists and undergraduate dental students were excluded from the study.

### Sample Size Calculation

G\*Power software (HHM Düsseldorf) was used to perform *post hoc* calculation of the power of the Chi-squared test and multinomial logistic regression. For an  $\alpha = 0.05$ , an effect size of 0.3, a sample size of 432, and a maximum degree of freedom of 5, the power of the Chi-squared test was 99.9%. For multinomial logistic regression, for an  $\alpha = 0.05$ , a sample size of 432, and a two-tailed normal distribution, the power was calculated for each odds ratio mentioned in each characteristic.

### Data Collection

Survey questions were formulated after a literature review of CMR. Two specialists each of general dentists, prosthodontists, periodontists, restorative dentists, and AGD were approached and asked to complete the survey and provide feedback, which was used to adjust the survey questions as applicable. Two weeks later, the same dental practitioners were approached again to complete the survey to ensure reliability of the results.

Four-hundred and thirty-two dental practitioners were approached either in person or electronically (Google Forms) through emails and messages. Emails were sent to faculty members at Saudi universities, and the remaining participants were approached in person in dental hospitals and clinics. Prior to data collection, participants provided written informed consent after reading an information sheet about the study. Twenty-two questions were asked using the answer scale of agree, neutral, or disagree with a response rate of 74% in the following areas: (i) demographic data including gender, educational degree, country of clinical training, work setting (clinical or academic or both), years of experience, and specialty; (ii) knowledge about CMR (not reported here); (iii) opinion regarding CMR including whether it can be achieved successfully,

it can replace crown lengthening surgery, they would recommend it to colleagues, it is thought of as violation of biological width, it is easier to perform than crown lengthening surgery, and whether or not it influences crown survival; (iv) practice including how often they encountered a need for CMR, whether they performed the procedures themselves, whether they referred the case and why, the material used while performing the procedure, whether they followed up their patients and which parameters were checked, and any concerns about the concept.

### Statistical Analysis

Validity and reliability were tested prior to data collection. Twenty dental practitioners were approached in person and asked complete the survey and provide feedback. Reliability was also checked by completing the survey ten days later. Kappa statistics was calculated, and the survey was adjusted accordingly.

Statistical testing was performed using SPSS, v.20 (IBM Statistics, Armonk, NY). Descriptive statistics were calculated to describe the data, and the Chi-squared test was used to identify differences between categorical variables. Multinomial logistic regression was applied to assess predictors of opinion and practice. The null hypothesis was that gender, training country, work setting, years of experience and specialty have no effect on the opinion and practice of dentists about the CMR concept;  $p < 0.05$  was considered statistically significant.

## RESULTS

### Descriptive Statistics

Details of the study participants are shown in Table 1. Of 432 dentists, 223 (51.62%) were male and 209 (48.37%) were female. Two hundred and twenty (50.92%) held bachelor's degrees, while the remaining 212 (49.07%) held higher degrees including master's degrees, PhDs, and board certificates. Of those who responded, participants were graduates of Arabian and Asian countries (196/432; 45.4%) or European and North American countries (236/432; 54.6%). About half worked in clinical or academic settings (162/329; 49.2%) and the other half in combined clinical and academic roles (157/329; 50.8%). Experience ranged from 0 year for new graduates (155/432; 35.9%) to 1–10 years for experienced dentists (197/432; 45.6%); 18.5% had 11+ years of experience. Participants were general dentists (211/432; 48.8%), periodontists (61/432; 14.1%), restorative dentists (97/432; 22.5%), and prosthodontists (63/432; 14.6%). A total of 84% of dentists (365/432) had heard about CMR, while 15.5% (67/432) had not heard about the concept and were excluded from further questions.

### Opinions and Practice of Dentists about CMR

Details of dentists' responses to the survey are tabulated in Figure 1. A total of 50% of dentists (183/365) agreed that CMR can be achieved successfully, although opinion was equally divided between agreeing (33%) (120/365) and disagreeing (33%) (121/365) that CMR might replace crown lengthening surgery in the future; 34% (124/365) were neutral. Over half of participants (198/365) agreed that CMR is easier to perform than crown lengthening surgery, and 42% (153/365) said that they would recommend the procedure to fellow colleagues. However, 38% (138/365) of dental practitioners considered CMR to be a violation of biological width and 57% (207/365) felt that CMR might affect survival of extra-coronal restorations.

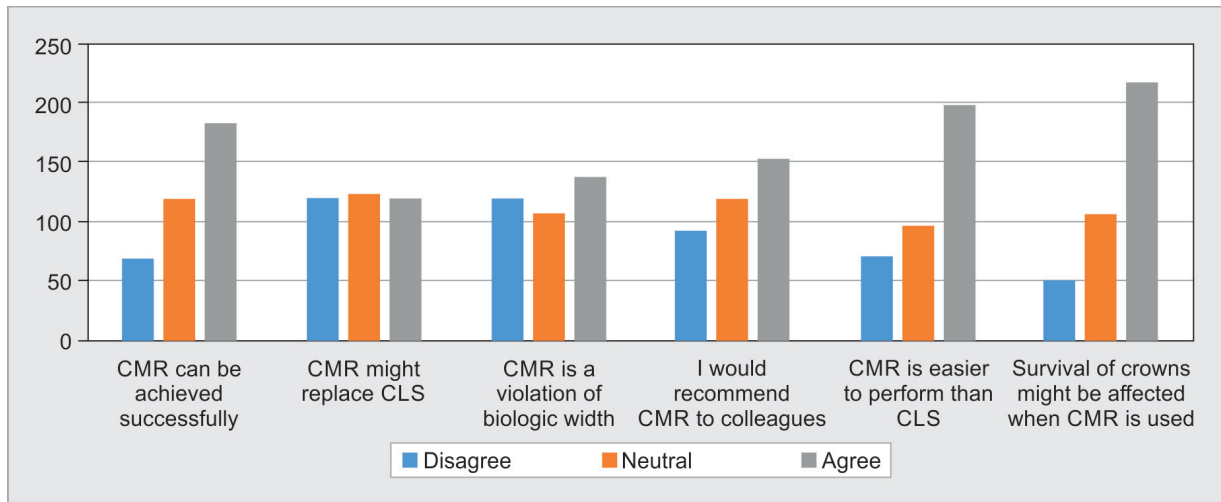


Fig. 1: Responses to survey data (opinion)

A total of 62% (130/209) of dentists had a need for CMR in their practice at least monthly, and 54.5% (114/209) of them performed CMR themselves. Of those who did not perform the procedure themselves, 77.9% (74/95) referred the patient: for margin relocation in 16.2% (12/74) of cases and to perform crown lengthening surgery or extraction in 83.8% (62/74) of cases. Dentists reported using composite, glass ionomer (GI), or composite and GI to elevate the deep gingival margin in 92.1% (105/114) of cases, while the remaining 7.9% (9/114) of cases elevated using amalgam.

A total of 43% (49/114) chose orthodontic extrusion and crown lengthening surgery to treat deep subgingival margins before placing indirect restorations, while 57% (65/114) chose CMR with direct restorations or extended the margin of the indirect restoration subgingivally.

Of all dentists participating in the survey, 57.9% (66/114) reported following up their patients after performing CMR and 75.8% (50/66) followed them up 1–6 months after the procedure. Parameters checked at follow-up included the bleeding index, gingival level, crown integrity, crown margin, and bone level. A total of 3% (2/66) of dentists reported an increased bleeding index, 9.1% (6/66) recession, 3% (2/66) fractured crowns, 10% (7/66) an open crown margin, and 9.1% (6/66) bone resorption.

Dentists' concerns about CMR ranged from isolation and inspection, marginal adaptation, microleakage, biologic width invasion, and insufficient availability of evidence about CMR. A total of 78% (52/66) had more than one concern about the procedure.

### Associations between Demographics, Opinions, and Practice of CMR

In univariable analysis, educational degree, work setting, years of experience, and specialty but not training country were associated with different opinions about CMR (Chi-squared test, all  $p < 0.05$ ) (Tables 1 to 3). In multivariable analysis, educational degree, work setting, years of experience, and specialty remained associated with opinion (Table 4). Specifically, prosthodontists were neutral to the idea that CMR affects crown survival than general dentists. Dentists working in clinical or academic settings were more likely to be neutral to the idea that CMR can be achieved successfully than dentists working in both academic and clinical settings, while restorative dentists were slightly more likely to agree that CMR can be achieved successfully than prosthodontists. The least

Table 1: Demographics of the study participants

Characteristic	Attribute	Frequency	%
Gender	Male	223	51.6
	Female	209	48.4
Educational degree	Bachelor	220	50.9
	Higher education	212	49.1
	No response	103	23.8
Training country	Arabian and Asian	196	45.4
	European or North American	133	30.8
	No response	103	23.8
Work setting	Clinical or academic	162	37.5
	Clinical and academic	167	38.7
	No response	103	23.8
Years of experience	0 year	155	35.9
	1–10 years	197	45.6
	11+ years	80	18.5
Specialty	General dentist	211	48.8
	Periodontist	61	14.1
	Restorative dentist or AGD	97	22.5
	Prosthodontist	63	14.6
Have you heard about DME?	Yes	365	84.5
	No	67	15.5

AGD, advanced general dentist

experienced dentists (newly qualified) were more likely to agree that CRM might replace crown lengthening surgery in the future and that CMR is considered a violation of biological width than the most experienced (11+ years) dentists. Restorative were more likely to recommend CMR to colleagues than prosthodontists.

Finally, in both univariable and multivariable analysis, specialty was associated with CMR practice, with restorative dentists more likely to perform CMR themselves than prosthodontists (Tables 2 and 4).

**Table 2:** Univariable analysis (Chi-squared test) of associations between demographic parameters and opinions and practice of CMR. Reference value is “disagree” unless otherwise indicated

	<i>Educational degree</i>	<i>Training country</i>	<i>Work setting</i>	<i>Years of experience</i>	<i>Specialty</i>
CMR can be achieved successfully	<0.0001*	0.388	0.019*	0.029*	<0.0001*
CMR might replace crown lengthening surgery (CLS) in the future	<0.0001*	0.106	0.186	<0.0001*	<0.0001*
CMR is considered a violation of the biological width	0.155	0.302	0.678	<0.0001*	0.08
I would recommend CMR to my colleagues	0.003*	0.124	0.186	0.16	0.000*
CMR is easier to perform than crown lengthening surgery	0.514	0.909	0.211	0.694	0.54
In your opinion, survival of crowns might be affected when CMR is used	0.859	0.117	0.681	0.092	0.664
If yes, did you perform the procedure yourself? (Yes)	0.778	0.727	0.36	0.381	<0.0001*
If no, did you refer? (Yes)	0.043*	0.108	0.144	0.123	0.334
Which material did you use to elevate the cervical margin? (amalgam with or without composite or GI, or with composite and GI)	0.838	0.676	0.105	0.437	0.089

\*Significant p-value

**Table 3:** Univariable analysis (Chi-squared test) of associations between demographics and opinions and practice of CMR

		<i>General dentist</i>		<i>Periodontist</i>		<i>Restorative dentist or AGD</i>		<i>Prosthodontist</i>		<i>p-value</i>
		<i>Frequency</i>	<i>%</i>	<i>Frequency</i>	<i>%</i>	<i>Frequency</i>	<i>%</i>	<i>Frequency</i>	<i>%</i>	
1. CMR can be achieved successfully	Disagree	16	25.4	17	27.0	13	20.6	17	27.0	<0.001*
	Neutral	54	45.4	21	17.6	26	21.8	18	15.1	
	Agree	104	56.8	10	5.5	48	26.2	21	11.5	
2. CMR might replace crown lengthening surgery	Disagree	40	33.1	24	19.8	30	24.8	27	22.3	<0.001*
	Neutral	60	48.4	13	10.5	34	27.4	17	13.7	
	Agree	74	61.7	11	9.2	23	19.2	12	10.0	
3. CMR is considered a violation of the biologic width	Disagree	50	41.7	12	10.0	35	29.2	23	19.2	0.080
	Neutral	60	56.1	11	10.3	24	22.4	12	11.2	
	Agree	64	46.4	25	18.1	28	20.3	21	15.2	
4. I would recommend CMR to my colleagues	Disagree	29	31.5	22	23.9	16	17.4	25	27.2	<0.001*
	Neutral	60	50.0	18	15.0	27	22.5	15	12.5	
	Agree	85	55.6	8	5.2	44	28.8	16	10.5	
5. CMR is easier to perform than crown lengthening surgery	Disagree	31	44.9	11	15.9	16	23.2	11	15.9	0.540
	Neutral	51	52.0	16	16.3	18	18.4	13	13.3	
	Agree	92	46.5	21	10.6	53	26.8	32	16.2	
6. In your opinion, survival of crowns might be affected when CMR is used	Disagree	24	47.1	5	9.8	16	31.4	6	11.8	0.664
	Neutral	50	46.7	17	15.9	26	24.3	14	13.1	
	Agree	100	48.3	26	12.6	45	21.7	36	17.4	

\*Significant p-value



**Table 4:** Multivariable analysis (multinomial logistic regression) of associations between demographic parameters and opinions and practice of CMR

Question	Response	Parameter	Significance	Odds ratio (95% CI)	Reference
CMR can be achieved successfully	Neutral	Clinical or academic	0.05	2.1 (1.0–4.6)	Clinical and academic
	Agree	Restorative dentist	0.03	3.1 (1.1–8.3)	Prosthodontist
CMR might replace crown lengthening surgery in the future	Agree	0 year	0.02	6.3 (1.3–31.0)	11+ years
CMR is considered a violation of the biological width	Agree	0 year	0.04	4.5 (1.1–18.5)	11+ years
	Agree	1–10 years	0.02	2.5 (1.2–5.2)	11+ years
I would recommend CMR to my colleagues	Neutral	General dentist	0.04	12.0 (1.1–126.8)	Prosthodontist
	Agree	Restorative dentist	<0.001	4.6 (1.8–11.8)	Prosthodontist
In your opinion, survival of crowns might be affected when CMR is used	Neutral	General dentist	<0.001	$1.9 \times 10^{-7}$ [[ $4.1 \times 10^{-8}$ ] – [ $8.9 \times 10^{-7}$ ]]	Prosthodontist
Did you perform the procedure yourself?	Yes	Restorative dentist	0.02	3.1 (1.2–7.7)	Prosthodontist
If no, did you refer?	Yes	Bachelor's degree	0	94,348,179.2	Higher education

CI, confidence interval

## DISCUSSION

Here we explored the opinions and practices about CMR of a cohort of dentists in Saudi Arabia. About half of dentists surveyed in Saudi Arabia practice CMR when indicated, but many dentists had several, often concurrent concerns about CMR. The opinion and practice of CMR was influenced by several factors including educational degree, work setting, country of clinical training, years of experience, and specialty.

Although the least experienced dentists agreed that CMR might replace crown lengthening surgery, they felt that CMR was a violation of biological width. This could be due to their lack of clinical experience performing complex treatments such as elevating a deep gingival margin. The educational degree of participants was predictive of their inclination to perform the elevation, with bachelor's degree holders more likely to refer their elevation cases than higher educational degree participants. This is consistent with Honey et al.,<sup>21</sup> who found that final year students were less confident in performing procedures they were less exposed to clinically and more confident performing simpler clinical procedures like scaling and polishing, applying fissure sealants, and providing oral hygiene instructions. The confidence levels of postgraduate students increases after graduation, and the primary reason for seeking postgraduate studies is a lack of clinical confidence;<sup>22</sup> indeed, after completing their studies, postgraduate students have been shown to have greater confidence in treating patients and offering different treatment options,<sup>23</sup> which might include CMR. Elevating a deep gingival margin is a complex and challenging procedure that requires consideration of many factors including moisture control (saliva and blood), visibility (deeper parts and interproximal obstruction), and tooth location (distal surfaces of molars are harder to reach and visualize). In addition, CMR is not a standard dental procedure taught to undergraduate dental students.

The participant's specialty was a predictor of their clinical behavior performing the elevation, with restorative dentists more likely to perform the elevation themselves than prosthodontists, which is unsurprising. Over half dentists who performed CMR

followed up their patients, and 75.8% did so in the first 6 months after treatment. Indeed, as there is insufficient clinical trial data on this topic, dentists may follow-up their patients out of fear of failure or to ensure patient satisfaction. Dentists reported several concerns, sometimes multiple, about CMR, including a lack of evidence on the topic, isolation and inspection concerns, marginal adaptation concerns, microleakage concerns, biological width invasion. It is known that customized follow-up of patients with tooth-borne indirect prostheses helps to reduce gingival inflammation and dental caries.<sup>24</sup> Moreover, the recommended follow-up for patients with dental prostheses is between 3 months and 6 months depending on their caries risk assessment.<sup>24</sup>

In those following up their patients, recession and bone resorption were reported by 9.1% of dentists, which might be explained by biological width invasion following placement of a restoration too close to the alveolar bone. This finding is consistent with results from a cross-sectional study in which bleeding on probing and recession were reported at sites where the biologic width was invaded.<sup>25</sup> An increase in bleeding index at follow-up was reported by only 3% of dentists, which might reflect the provision of oral hygiene instructions and patient compliance to a strict oral hygiene regimen and follow-up appointments. It might also be due to partial invasion rather than complete invasion of biological width, as seen in a previous case report,<sup>26</sup> or due to the good histological response of gingival tissues to composite restorations.<sup>27</sup> However, Ghezzi et al.<sup>28</sup> reported a 40% reduction in bleeding on probing from baseline to the end of 5–8 years of follow-up in patients treated with CMR. However, the treatment administered did not violate the biological width, while in our cohort violation of biological width of treated cases was not investigated.

Crown fracture was reported by only 3% of dentists at follow-up. Crown fracture can be attributed to the production method used like contamination or incomplete sintering, margin flaws, and finish line configuration, where feather edge or sharp margins have a higher risk of crown fracture compared with smooth and thicker margins.<sup>29</sup> Heavy or lateral occlusal loads, as well as insufficient support by marginal restoration, can also cause crown fracture.



However, the small percentage of crown fractures reported by our cohort is consistent with the recent findings of Zhang et al.,<sup>30</sup> who found that fracture resistance of maxillary premolars treated by CMR and an onlay offered higher fracture resistance than the negative control group of onlay without CMR. In addition, crown or tooth fracture was negatively impacted by root canal treatment.<sup>11</sup> In our survey, we did not address the endodontic status; however, root canal treatment might be a contributing factor to crown fracture. A relatively high percentage of dentists reported open crown margins at follow-up (10.6%). The marginal gap might be an initial error that went undetected during cementation or could have been due to a loss of restorative material or a wash off the cement material used.

This study has a few limitations. This was a self-reporting survey, which may be associated with recall bias. The available survey sample was from those contacted at different institutions and since purpose of the research was disclosed to prospective participants, this might have resulted in responder bias. Nevertheless, the final demographic reflected Saudi dental graduates and practitioners and the power of the study was confirmed through the sample size calculation. As with all cross-sectional studies, causality cannot be inferred.

Our findings are significant, since dental education in Saudi Arabia is receiving high priority and scrutiny to reach equivalence with international dental schools,<sup>31,32</sup> and promoting and providing clinical confidence in performing new procedures requires baseline knowledge of current perceptions about these procedures. Until recently, dental postgraduate studies were limited to only few specialties in a few dental schools in Saudi Arabia. Hence, most Saudi Arabian specialists are graduates of European, Asian, and American countries, and their views are therefore representative of the international dental community.

## CONCLUSION

The opinion and practice of dentists practicing in Saudi Arabia on CMR is relatively conservative and, although seemingly accepting of the concept, concerns about the procedure still remain. Nevertheless, a high percentage of respondents performed the procedure clinically. Among cases that were followed up, a small proportion of dentists reported bleeding on probing, recession and bone resorption, open margins, and fractured crowns. The opinions and practices of different specialists were predicted by educational degree, specialty, and years of clinical experience. Assessing the opinion and practice of dentists towards conservative treatment with CMR provides the basis for encouraging practitioners to use the procedure both clinically and in clinical trials. Controlled clinical trials are now required to further improve evidence, knowledge, and acceptance of CMR.

## AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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