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Original Article

Awareness of Deep Margin Elevation among Various Dental Specialists in Saudi Arabia

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ABSTRACT

Deep margin elevation (DME) with direct restorations streamlines the process of creating indirect restorations. However, there is limited information on the current awareness of DME among practicing dentists in Saudi Arabia. This study aimed to assess the knowledge of DME among dentists and its association with demographics, education, and practice environment. An online survey was conducted using Google Forms, targeting dental specialists working in clinical and academic settings across Saudi Arabia. The survey collected demographic details and assessed familiarity with the concept of deep-margin elevation. Findings revealed that 85% of respondents were aware of DME, with 50% relying on multiple sources for information, and 87% preferred the use of adhesive restorations for margin elevation. Years of professional experience, especially among recent graduates, was a consistent predictor of knowledge. Other demographic associations showed minimal predictive value (R^2 between 0.01 and 0.1). The participants in this study demonstrated a solid understanding of DME, which is likely influenced by the growing demand for conservative approaches in the Saudi dental population. Further research is suggested to confirm these findings.

Keywords: Conservative dentistry, Deep proximal carious lesions, Deep margin elevation, Crown lengthening surgery

Introduction

Deep margin elevation (DME), also referred to as cervical margin relocation, proximal margin elevation, or proximal box reduction (PBR), is a widely recognized concept in restorative dentistry [1, 2]. DME is designed to reposition the interproximal subgingival margin of an indirect restoration to a more biologically suitable location, such as supragingival or equigingival, thereby eliminating the need for surgical crown lengthening [3, 4]. For indirect metal or ceramic restorations, the margins should ideally be placed on a sound tooth structure [5]. In cases where large carious lesions extend subgingivally, introducing restorative materials or indirect restorations into the periodontium may threaten periodontal health. If restorative materials encroach upon the epithelial attachment, it can violate the biological width, potentially disrupting the overall health of the periodontal apparatus and leading to bone resorption [6].

Restorative margin placement can be accomplished through either surgical or orthodontic procedures (forced eruption) [7]. Crown lengthening, while cost-effective, is a more invasive method that requires a longer healing period, particularly in the esthetic zone. Being a surgical intervention, it carries several potential negative outcomes, such as post-operative discomfort, bleeding, sensitivity, loss of interdental papillae, and the development of black triangles. In contrast, forced eruption is a non-invasive technique that alters the osseous and gingival contours. Although considered more conservative, it tends to be both costly and time-consuming [8].

Deep carious lesions that extend past the cementoenamel junction are frequently observed, affecting 36-67% of younger individuals and 88.4% of older patients. These lesions are most commonly found in the canines, followed

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by the premolars. Consequently, there is a growing demand for minimally invasive, time-saving, and patient-friendly approaches for deep-margin elevation [9].

Indirect ceramic restorations offer reliable long-term results with excellent esthetics and mechanical strength, particularly when bonded to enamel. However, achieving a secure bond between the restoration and the tooth requires effective moisture control. Elevating deep margins with direct composite allows for bonding to an accessible supragingival margin, which improves bond strength, reduces plaque buildup, and protects the surrounding gingival tissue, in contrast to bonding to a non-raised subgingival margin that can negatively affect these factors [10].

While DME is less invasive compared to surgical crown lengthening, it remains a technically challenging procedure. Clinicians often encounter difficulty in achieving proper anatomical contours at subgingival levels, as accessing these areas with a matrix can be problematic. Some suggest that DME should be carried out in two stages: the first to establish a cervical seal and anatomical emergence profile, and the second to finalize the restoration, ensuring optimal contact areas. In vitro studies on marginal adaptation have examined the gaps between the tooth and restorations using scanning electron microscopy [11]. Additionally, microleakage has been assessed through dye penetration techniques, showing no significant differences between DME and non-DME methods [12].

Margins can be elevated using materials such as resin-modified glass ionomer (RM-GIC) and/or flowable composite. While RM-GIC releases fluoride, it has a relatively high dissolution rate, whereas composite materials offer better adhesion to teeth and ceramics, resulting in less microleakage and improved fracture resistance. Studies have shown that flowable composite placed as a liner under class II amalgam restorations increases fracture resistance in vitro [13]. When used beneath composite resin, flowable composite, despite having lower mechanical properties, acts as a shock absorber, which may enhance sealing and marginal adaptation. Research also suggests that microleakage can be minimized with delayed light curing or soft-start polymerization [14]. Various in vitro researches have indicated that the marginal adaptation of indirect inlay restorations is comparable, regardless of whether DME is performed [15].

Despite this, there is a lack of data regarding dental practitioners' knowledge of DME. To address this, our study aimed to evaluate (i) the level of awareness and perspectives on DME among periodontists, prosthodontists, restorative dentists, and general dentists working in Saudi Arabian dental hospitals and private practices, and (ii) explore correlations between knowledge levels and factors such as dental specialty, gender, practice setting (academic vs. clinical), years of clinical experience, and country of clinical training. The null hypothesis proposed was that there would be no significant difference in the knowledge of DME among dental specialists and dentists, nor their endorsement of its use in daily practice.

Materials and Methods

Sample

This study involved 432 dentists practicing in Jeddah, Saudi Arabia. The Research Ethics Committee at the Faculty of Dentistry, King Abdulaziz University (REC No. 10-12-19) granted ethical approval. The participants included undergraduate students, general dentists, advanced general dentists, periodontists, restorative dentists, and prosthodontists working in public or private hospitals and clinics across Saudi Arabia. We excluded pedodontists, orthodontists, endodontists, maxillofacial surgeons, non-practicing dentists, and dental specialists. At the beginning of the survey, participants were informed about the study's goal, a summary of the survey content, and the estimated time required for completion. After reading this information and giving consent, participants proceeded with the survey.

Questionnaire validity and reliability testing

A questionnaire was designed based on the study objectives and divided into two sections. The first section gathered demographic information, including gender, educational background, country of clinical training, work environment, years of clinical experience, and dental specialty. The second section focused on the participants' knowledge and its sources.

The questionnaire underwent content and face validity testing. To assess this, 20 specialists and general dentists with experience in DME were interviewed. They completed the survey and rated the relevance and importance of each question on a three-point scale (important, neutral, and not important). Their feedback was also sought on

whether each question should be included, using a no or yes response format. Additionally, the clarity of each question was discussed with the evaluators. After ten days, the same group of 20 specialists completed the survey again to assess its reliability. Kappa statistics were calculated, and revisions were made to the survey based on the results.

Survey distribution

The survey comprised 22 questions, including sub-questions, with an estimated completion time of 8-10 minutes. Some participants were randomly approached in person and asked to complete the survey on an electronic tablet, while others received the survey through email via the Google Forms platform. Google Forms was selected due to its user-friendly interface, cost-free nature, accessibility across various electronic devices, compatibility with email and messaging apps, and the ability to export data to Excel or SPSS.

Statistical analysis

We entered the data into IBM SPSS Statistics version 20 and analyzed it using descriptive statistics (frequencies). To compare differences between the 2 groups, chi-squared or Fisher's exact test was applied. Binary regression analysis was conducted to identify predictors of DME knowledge. Statistical significance was set at P-values < 0.05.

Results and Discussion

We performed post-hoc power analysis for the chi-square test using G*Power software. For $\alpha = .05$, an effect size of 0.3, a sample size of 432, and a maximum df of 5, the calculated power was 0.999. The counts, percentages, and results of chi-square tests are presented in **Tables 1-4**. Additionally, post-hoc power analysis for binary logistic regression was conducted using the same GPower software **(Tables 2-4)**. For $\alpha = .05$, a sample size of 432, and a two-tailed normal distribution, power was calculated for each odds ratio corresponding to the different characteristics. Binary logistic regression analyses are provided in **Tables 2-4**.

A total of 432 responses were collected, with 51.6% from male participants and 48.4% from females. Of the respondents, 49% had completed postgraduate training, and 60% were clinically trained in Asian or Arabian countries. Half of the participants (50.8%) worked both as academics and clinicians. Regarding work experience, 46% had 1-10 years of experience, while 18.5% had more than 10 years of experience. General dentists comprised 49% of the sample, followed by 22.5% restorative/advanced general dentists **(Table 1)**.

Table 1. Characteristics of the respondents.

Characteristic		Count (%)	Total sample count
Gender	Male	223 (51.6%)	432
	Female	209 (48.4%)	
Educational degree	Bachelor	220 (50.9%)	432
	Higher education	212 (49.1%)	
Training country	Arabian and Asian	196 (59.6%)	329
	European and North America	133 (40.4%)	
Work setting	Clinical or academic	162 (49.2%)	329
	Clinical and academic	167 (50.8%)	
Years of experience	0 years	155 (35.9%)	432
	1-10 years	197 (45.6%)	
	≥ 11 years	80 (18.5%)	
Specialty	General Dentist	211 (48.8%)	432
	Periodontist	61 (14.1%)	
	Restorative dentist or AGD	97 (22.5%)	
	Prosthodontist	63 (14.6%)	

AGD: Advanced general dentists

Knowledge about DME

85% of the participants were familiar with the concept of DME. In the univariable analysis, factors such as gender, years of experience, and work setting were found to be linked to awareness about DME (chi-squared test, $P < 0.05$). However, when analyzed multivariable, only the work setting (odds ratio (OR) = 2.2; 95% CI = 1.1-4.3; $P < 0.05$) and having zero years of experience (OR = 20.9; 95% CI = 4.9-88.2; $P < 0.001$) showed significant associations with knowledge about DME **(Table 2)**.

Table 2. The impact of factors such as gender, educational background, country of training, practice environment, years of experience, and professional specialty on the knowledge of DME and its influencing predictors.

		Parameter		**Chi-squared test**	**Binary regression model**			
Characteristic/ Predictor	**Criteria**	**Know DME count (%)**	**Don't know DME count (%)**	**P-value**	**OR**	**95% CI**	**P-value**	**R^2**
Gender	Male	196 (45.4%)	27 (6.3%)	0.04*	0.6	0.3, 1.0	0.05	0
	Female (reference)	169 (39.1%)	40 (9.3%)		-	-	-	
Educational degree	Bachelor	183 (42.4%)	37 (8.6%)	0.4	1.2	0.7, 2.1	0.44	0
	Higher education (reference)	182 (42.1%)	30 (6.9%)		-	-	-	
Training country	Arabian and Asian	171 (52.0%)	25 (7.6%)	0.7	0.9	0.5, 1.7	0.7	0
	European and North America (reference)	114 (34.7%)	19 (5.8%)		-	-	-	
Work setting	Clinical or academic	133 (40.4%)	29 (8.8%)	0.02*	2.2	1.1, 4.3	0.02*	0.03
	Clinical and academic (reference)	152 (46.2%)	15 (4.6%)		-	-	-	
Years of experience	0 years	101 (23.4%)	54 (12.5%)	< 0.001	20.9	4.9, 88.2	<0.001*	0.3
	1-10 years	186 (43.1%)	11 (2.6%)		2.3	0.5, 10.7	0.3	
	≥ 11 years (reference)	78 (18.1%)	2 (0.46%)		-	-	-	
Specialty	General Dentist	174 (40.3%)	37 (8.6%)	0.2	1.7	0.7 4.0	0.2	0.2
	Periodontist	48 (11.1%)	13 (3.0%)		2.2	0.8, 5.9	0.1	
	Restorative or AGD	87 (20.1%)	10 (2.3%)		0.9	0.3, 2.6	0.9	
	Prosthodontist (reference)	56 (13.0%)	7 (1.6%)		-	-	-	

Source of knowledge about DME

Half of the participants in the study relied on three key sources to gather information about DME. In the univariable analysis, all factors—such as educational level, country of training, experience, work setting, and specialty—except for gender, were linked to the selection of information sources about DME (chi-squared test, $P < 0.01$). In the multivariable analysis, the following factors were found to be associated with the number of information sources about DME: educational degree (OR = 0.4; 95% CI = 0.3-0.6; $P < 0.001$), training country (OR = 0.5; 95% CI = 0.3-0.8; $P < 0.01$), work setting (OR = 0.3; 95% CI = 0.2-0.5; $P < 0.001$), zero years of experience (OR = 3.6; 95% CI = 1.7-7.5; $P < 0.01$), 1-10 years of experience (OR = 12.5; 95% CI = 6.3-24.8; $P < 0.001$), periodontists (OR = 3.5; 95% CI = 1.5-7.3; $P < 0.01$), and restorative/advanced general dentists (OR = 5.8; 95% CI = 2.8-12.0; $P < 0.001$) **(Table 3)**. Among these variables, years of experience was the strongest predictor, although its predictive value was relatively weak with an R^2 of 0.3.

Table 3. The influence of participants' gender, educational background, country of training, practice environment, years of experience, and professional specialty on their choice of knowledge sources about DME and the factors predicting these choices.

		Parameter		Chi-squared test	Binary regression model			
Characteristic/ Predictor	**Criteria**	**One to two sources of knowledge count (%)**	**Three sources of knowledge count (%)**	**P-value**	**OR**	**95% CI**	**P-value**	**R^2**
Gender	Male	91 (24.9%)	105 (28.8%)	0.10	1.4	0.9, 2.1	0.10	0.01
	Female (reference)	93 (25.5%)	76 (20.8%)		-	-	-	
Educational degree	Bachelor	112 (30.7%)	71 (19.5%)	< 0.001*	0.4	0.3, 0.6	< 0.001*	0.1
	Higher education (reference)	72 (19.7%)	110 (30.1%)		-	-	-	
Training country	Arabian and Asian	99 (34.7%)	72 (25.3%)	< 0.01*	0.5	0.3, 0.8	< 0.01*	0.04
	European and North America (reference)	45 (15.8%)	69 (24.2%)		-	-	-	
Work setting	Clinical or academic	89 (31.2%)	44 (15.4%)	< 0.001*	0.3	0.2, 0.5	< 0.001*	0.1
	Clinical and academic (reference)	55 (19.3%)	97 (34.0%)		-	-	-	
Years of experience	0 years	61 (16.7%)	40 (11.0%)	< 0.001*	3.6	1.7, 7.5	< 0.01*	0.3
	1-10 years	57 (15.6%)	129 (35.3%)		12.5	6.3, 24.8	< 0.001*	
	≥ 11 years (reference)	66 (18.1%)	12 (3.3%)		-	-	-	
Specialty	General Dentist	107 (29.3%)	67 (18.4%)	< 0.001*	1.2	0.7, 2.3	0.5	0.1
	Periodontist	18 (4.9%)	30 (8.2%)		3.3	1.5, 7.3	< 0.01*	
	Restorative or AGD	22 (6.0%)	65 (17.8%)		5.8	2.8, 12.0	< 0.001*	
	Prosthodontist (reference)	37 (10.1%)	19 (5.2%)		-	-	-	

Knowledge about the materials used for DME

A preference for adhesive restorations to elevate margins was expressed by 87% of the participants. In univariable analysis, all the variables considered except for gender were found to be associated with the choice of material for DME (chi-squared test, $P < 0.05$). However, the multivariable analysis revealed that only educational background (OR = 0.2; 95% CI = 0.1-0.4; $P < 0.001$) and zero years of experience (OR = 0.04; 95% CI = 0.01-0.2; $P < 0.001$) were significant predictors of material knowledge for raising deep margins **(Table 4)**. The effect size for years of experience was moderate ($R^2 = 0.4$), suggesting it was a considerable factor in the cohort's likelihood of opting for adhesive restorations to elevate deep margins.

Table 4. The influence of participant gender, educational background, country of training, practice environment, years of experience, and specialty on the selection of restorative materials for DME and the factors predicting this choice.

		Parameter		Chi-squared test	Binary regression model			
Characteristic/ Predictor	**Criteria**	**Amalgam, w or w/o composite count (%)**	**Composite and/or GI count (%)**	**P-value**	**OR**	**95% CI**	**P-value**	**R^2**
Gender	Male	22 (6.0%)	174 (47.7%)	0.2	1.4	0.8, 2.7	0.2	0.01
	Female (reference)	26 (7.1%)	143 (39.2%)		-	-		
	Bachelor	40 (11.0%)	143 (39.2%)	< 0.001*	0.2	0.1, 0.4	< 0.001*	0.1

Educational degree	Higher education (reference)	8 (2.2%)	174 (47.7%)		-	-	-	
Training country	Arabian and Asian	0 (0.0%)	171 (60.0%)	< 0.001*	121922631	0	1.0	0.2
	European and North America (reference)	8 (2.8%)	106 (37.2%)		-	-	-	
Work setting	Clinical or academic	7 (2.5%)	126 (44.2%)	0.02*	0.1	0.01, 1	0.05	0.1
	Clinical and academic (reference)	1 (0.35%)	151 (53.0%)		-	-	-	
Years of experience	0 years	40 (11.0%)	61 (16.7%)	< 0.001*	0.04	0.01, 0.2	< 0.001*	0.4
	1-10 years	6 (1.6%)	180 (49.3%)		0.8	0.2, 4	0.8	
	≥ 11 years (reference)	2 (0.55%)	76 (20.8%)		-	-	-	
Specialty	General Dentist	40 (11.0%)	134 (36.7%)	< 0.001*	0	0	1.00	0.2
	Periodontist	1 (0.27%)	47 (12.9%)		0	0	1.00	
	Restorative dentist or AGD	7 (1.9%)	80 (21.9%)		0	0	1.00	
	Prosthodontist (reference)	0 (0.0%)	56 (15.5%)		-	-	-	

This study examines the awareness and understanding of DME among dentists in Jeddah, Saudi Arabia, a concept introduced to the field over 20 years ago [1, 2]. The proper placement of restoration margins is essential for indirect restorations, with DME serving to reposition subgingival interproximal margins to a more biologically favorable position, reducing the need for crown lengthening or orthodontic extrusion [3-5].

Overall, the majority of participants were familiar with DME, with 85% reporting awareness of the concept. While it is not widely discussed in the literature, the high prevalence of caries among younger populations in Saudi Arabia may explain the demand for less invasive treatments to avoid complex surgeries or the need to extract severely damaged teeth in young patients [16]. However, this figure could be inflated, as 51% of the participants were specialist dentists, who may have a greater tendency to overstate their knowledge. In the cohort, 79% of periodontists (48/61), 87% of restorative/advanced general dentists (87/97), and 89% of prosthodontists (56/63) indicated familiarity with the concept.

Years of experience consistently predicted all evaluated independent variables, including knowledge, information sourcing, and material choice, with recent graduates (zero years of experience) showing the strongest association. New graduates were 20 times more likely to be aware of the concept of DME. Furthermore, this group of dentists was more inclined to rely on 1 to 2 sources of information—such as social media, colleagues, or scientific literature—and to prefer adhesive restorations (composite or glass ionomer) for DME.

The higher likelihood of recent graduates (representing 23% of the sample) being familiar with DME may be attributed to their more recent exposure to emerging or debated topics during their undergraduate studies. In line with these findings, Gunardi *et al*. [17] noted that new dental graduates in Indonesia had better attitudes and knowledge toward HIV patients compared to their more experienced counterparts. This could be because recent graduates, having just studied HIV and its management in their academic training, were more familiar with the subject, whereas more senior dentists had less recent exposure to it due to limited contact with HIV patients in Jakarta [17].

Lifelong learning and grounding dental practice in high-quality evidence are essential to maintaining professional competence [18]. In Saudi Arabia, continuous education programs are mandatory for professional registration. In this cohort, half of the participants reported obtaining information from all 3 sources listed in the survey—colleagues, social media, and the scientific literature. Among these, 71.3% had one to ten years of experience, 69% worked in both clinical and academic settings, 61% held advanced degrees, and 47% had training in North America or Europe. Their preference for utilizing multiple sources could indicate a more thorough approach to information gathering before modifying their practices, or it may be linked to their years of experience, dual roles in academia and clinical practice, and advanced education. A weak but important correlation was observed between years of experience, dual academic-clinical roles, and higher education about the use of multiple sources

for information. Other studies have shown that dentists often rely on online resources and courses to stay updated on practice guidelines [19, 20].

Conversely, more experienced dentists in this cohort tended to rely on 1 or 2 sources for acquiring knowledge. Despite 93% of this group having higher education, 85% preferred colleagues and the scientific literature over social media as their primary information sources. This preference may reflect the views of older, more experienced dentists who are less inclined to trust social media as a reliable information tool and have not been trained to utilize it for professional development. It has been demonstrated that a lack of training in using virtual 3D planning software can impact both the efficiency and accuracy of planning [20].

Adhesive dentistry has seen significant advancements, leading to a growing trend toward more conservative approaches in dental care. With the progress in adhesive restorative systems, composite restorations are now preferred over amalgam restorations by many dentists [21-25]. However, composite materials are highly sensitive to moisture, and achieving a reliable bond to deep tooth margins remains a challenge. In such cases, amalgam may serve as a suitable alternative due to its lower sensitivity to moisture [26, 27]. Consistent with these findings, the majority of participants (87%) preferred adhesive restorations for raising deep subgingival margins. Among these, 62% had received their education in Arabian or Asian countries, 57% had one to ten years of professional experience, and 55% had advanced education and worked in both academic and clinical environments.

There are several limitations to this study. The reliance on self-reported data introduces the potential for response bias, which could limit the generalizability of the results to all dentists. Nevertheless, survey-based studies provide valuable baseline data, enabling further investigation into participants' perceptions and knowledge. The responses to questions regarding information sources likely represent a general approach to sourcing clinical knowledge rather than specific insights into DME. Most of the key predictors identified showed weak associations, which may be attributed to insufficient statistical power in subgroup analyses. As a result, the interpretation of these data should be done with caution. However, according to the power analysis, the sample size (n = 423) was adequate to yield meaningful results.

Despite limited literature on the practice of raising deep margins and its potential effects on the long-term success of indirect restorations, a considerable proportion of respondents in this group of Saudi dentists demonstrated a strong understanding of the concept. The interest in DME among Saudi dentists may stem from a growing demand for more conservative approaches in clinical care. Furthermore, this study identified a link between clinical experience and knowledge of DME. Additional research is needed to further validate these findings.

Conclusion

Dentists in the Saudi cohort exhibited a strong understanding of the concept, likely driven by the growing clinical demand for conservative management within the Saudi population. Additional research is suggested to confirm these findings.

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