Original Article

KNOWLEDGE ABOUT DEEP MARGIN ELEVATION AMONG DIFFERENT PRACTICING DENTAL SPECIALISTS IN SAUDI ARABIA

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https://doi.org/10.51847/N0yJq9s7lC

ABSTRACT

Deep margin elevation (DME) with a direct restoration simplifies the clinical fabrication of an indirect restoration. However, there are little data on current levels of knowledge about DME in dentists practicing in Saudi Arabia. Here we investigated current knowledge among dentists about DME and its association with demographics, training, and practice setting. A survey was distributed online using Google Forms to different dental specialists practicing in academic and clinical settings in Saudi Arabia. The survey obtained demographic data and levels of knowledge about the concept of DME. Results: Eighty-five percent of respondents knew about the concept of DME, 50% used multiple sources to obtain knowledge, and 87% preferred to raise margins with adhesive restorations. Years of experience were a constant predictor of all assessed independent variables, specifically recent graduate dentists. Other significant associations had only weak predictive effects (R2 between 0.01 and 0.1). Dentists in this Saudi cohort were well informed about the concept, possibly due to an increasing clinical need for conservative management in the Saudi population. Further studies to confirm these observations are recommended.

Key words: Crown lengthening surgery, Deep proximal carious lesions, Deep margin elevation, Conservative dentistry.

Introduction

The concept of deep margin elevation (DME), also known as cervical margin relocation, proximal margin elevation, and proximal box reduction (PBR), is well established [1, 2]. DME aims to relocate the interproximal subgingival margin of an indirect restoration to a more biologically favorable location (supragingival or equigingival) to avoid the need for surgical crown lengthening [3, 4]. The margins of indirect metal or ceramic restorations should be placed on healthy tooth structures [5]. As large carious lesions may extend subgingivally, periodontal health can be compromised following the introduction of restorative material or an indirect restoration into the periodontium. If the direct or indirect restorative material is placed into the epithelial attachment, violation of the biological width might affect the general health of the periodontal apparatus, leading to bone resorption [6].

Adequate space for restorative margin placement can be achieved through surgical (crown lengthening) or orthodontic treatment (forced eruption) [7]. Although relatively cost-effective, crown lengthening is a more invasive procedure that requires a prolonged healing time, especially in the esthetic zone. As it is a surgical procedure, it has several associated negative sequelae including post-operative discomfort and bleeding, sensitivity, formation of black triangles, and loss of interdental papillae. By contrast, forced eruption is a non-surgical treatment option that modifies the osseous and gingival topography. While a conservative treatment, it is both expensive and time-consuming [8].

Deep carious lesions extending beyond the cementoenamel junction are common, occurring in 36 to 67% of the young population and 88.4% of elderly patients. They most commonly occur in the canines followed by the premolars. Hence, there is a need for minimally-invasive, time-efficient, and patient-friendly techniques for DME [9].

Indirect ceramic restorations have predictable long-term outcomes and superior esthetics and mechanical properties, especially when bonded to enamel. However, moisture control is mandatory for a predictable restoration-tooth bond. Thus, elevating the deep margins with direct composite facilitates bonding to an accessible supragingival margin compared with bonding to a non-raised subgingival margin, which has a negative impact on bond strength, plaque accumulation, and the surrounding gingival tissue [10].

Although DME is considered less invasive than surgical crown lengthening, it is still technically demanding. Clinicians may find it difficult to create proper anatomical contours at subgingival levels, as finding a matrix reaching subgingival areas is challenging. It has been suggested that DME should be a two-step procedure, first to provide a cervical seal and anatomical emergence profile, and second to complete the restoration with optimal contact areas. Marginal adaptation has been studied *in vitro* by measuring

the gaps created between the tooth tissue and restorations using scanning electron microscopy [11]. Micro leakage has also been assessed *in vitro* using dye-penetrating methods, which revealed no significant difference between DME and non-DME approaches [12].

Margins can be raised using either resin-modified glass ionomer (RM-GIC) and/or flowable composite. RM-GIC releases fluoride but has a high dissolution rate, while composite may better bind to teeth and ceramic with less microleakage and increased fracture resistance. Indeed, increased fracture resistance with flowable composite as a liner below class II amalgam restorations has been demonstrated *in vitro* [13]. Flowable composite with inferior mechanical properties beneath composite resin acts as a shock absorber and may improve sealing and marginal adaptation. Microleakage has been shown to be reduced by delayed light curing or soft-start polymerization [14]. Several *in vitro* studies have demonstrated that marginal adaptation of indirect inlay restorations was similar with and without DME [15].

However, there is currently no information on levels of dental practitioner knowledge about DME. To fill this gap, here we assessed the (i) the level of knowledge and opinions of periodontists, prosthodontists, restorative dentists, and general dentists practicing in Saudi Arabia dental hospitals and private practices about DME, and (ii) associations between levels of knowledge and gender, dental specialty, years of clinical experience, practice setting (academic vs clinical), and country of clinical training. The null hypothesis was that dentists and dental specialists are equally knowledgeable about DME and advocate the use of this concept in their daily practice.

Materials and Methods

Sample

This was a study of 432 dentists working in Jeddah, Saudi Arabia. Ethical approval was obtained from the Research Ethics Committee, Faculty of Dentistry, King Abdulaziz University (REC No. 10-12-19). The dental personnel included in the study were undergraduate students, general dentists, advanced general dentists, periodontists, restorative dentists, or prosthodontists practicing in public or private hospitals/clinics in Saudi Arabia. We excluded pedodontists, orthodontists, endodontists, maxillofacial surgeons, and non-practicing dentists and dental specialists. At the start of the survey, the main purpose, a summary of the study parts, and the time required to complete the survey were provided. Once the participant had read this information and accepted it, he/she signed a consent form before completing the survey.

Questionnaire validity and reliability testing

A questionnaire was developed in accordance with the research objectives and was divided into two main parts. The first contained demographic data including gender, educational degree, country of clinical training, work setting, years of clinical experience, and specialty. The second part contained questions about knowledge and its source.

The questionnaire was tested for face and content validity. Twenty specialists and general dentists with expertise in DME were interviewed and asked to complete the survey and evaluate the level of importance and relevance of each question on a three-point scale (important, neutral, not important). Their opinion on whether a question should be included or not was also evaluated using a yes or no question format. Moreover, the clarity of each question was discussed with each evaluator. Twenty specialists were asked to complete the survey after ten days to assess reliability. Kappa statistics were calculated, and the survey was adjusted according to the results.

Survey distribution

The survey included 22 questions with sub-questions. The estimated time to complete the survey was 8-10 minutes. Some subjects were approached randomly in-person to complete the survey using an electronic tablet, while others received the survey by email using the Google Forms platform. Google Forms was chosen as it is user-friendly, free of charge, easily accessible on different electronic devices, can be sent via email and different applications, and provides the option of output to Excel spreadsheets or SPSS software.

Statistical analysis

Data were input into IBM SPSS Statistics version 20 (IBM Corp., Armonk, NY) and analyzed for descriptive statistics (frequencies). Differences between the two groups were calculated using the chi-squared test or Fisher's exact test. Binary regression was performed to assess predictors of DME knowledge. P-values <0.05 were considered significant.

Results and Discussion

Sample characteristics

Post-hoc calculation of the power of the chi-square test was performed using G*Power software. For $\alpha = .05$, an effect size of 0.3, a sample size of 432, and a maximum df = 5, power was calculated as 0.999. Counts and percentages, and Chi-square tests were shown in **Tables 1-4**. Post-hoc calculation of the power for binary logistic regression was also performed using G*Power software, **(Tables 2-4)**. For $\alpha = .05$, a sample size of 432, and a two-tailed normal distribution, the power was calculated for each odds ratio mentioned in each characteristic. Binary logistic regression tests **(Tables 2-4)**.

There were 432 responses, of which 51.6% were from males and 48.4% were from females. Forty-nine percent had postgraduate training and 60% were clinically trained in Arabian or Asian countries. Half of the participants

(50.8%) worked both as academics and clinicians. Forty-six percent of the participants had work experience of 1-10 years, while only 18.5% had work experience of over 10 years. Forty-nine percent of participants were general dentists 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

Eighty-five percent of the cohort knew about the concept of DME. In univariable analysis, gender, work setting, and years of experience were associated with knowledge about DME (chi-squared test, p<0.05). However, in multivariable analysis, only work setting (odds ratio (OR) 2.2, 95% CI 1.1-4.3; p<0.05) and 0 years of experience (OR 20.9, 95% CI 4.9-88.2; p<0.001) were associated with knowledge about DME **(Table 2)**.

Table 2. Effect of participant's gender, education, training country, practice setting, years of experience, and specialty on knowledge about DME and its 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

Fifty percent of the cohort used the three assessed sources (colleagues, social media, and the scientific literature) to obtain information about DME. In univariable analysis, all assessed parameters (educational attainment, training country, work setting, experience, and specialty) except gender were associated with sourcing information about DME (chi-squared test, $p<0.01$). Consistently, in multivariable analysis, 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; $p<0.001$), 0 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; $p<0.001$) were associated with the number of information sources about DME **(Table 3)**. Among these predictors, years of experience had the best predictive value but, with an R^2 of 0.3, can only be considered a relatively weak predictor.

Table 3. Effect of participant's gender, education, training country, practice setting, years of experience, and specialty on the source of knowledge about DME and its predictors.

		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

Eighty-seven percent of the cohort preferred to raise margins with adhesive restorations. In univariable analysis, all assessed parameters (educational attainment, training country, work setting, years of experience, and specialty) except gender were associated with knowledge about the material to use for DME (chi-squared test, $p<0.05$). However, in multivariable analysis, only educational attainment (OR 0.2, 95% CI 0.1-0.4; $p<0.001$) and 0 years of experience (OR 0.04, 95% CI 0.01-0.2; $p<0.001$) were associated with knowledge about the materials used to raise deep margins **(Table 4)**. Years of experience had a medium effect size ($R^2=0.4$) in predicting that this cohort of dentists would be inclined to choose adhesive restorations to raise deep margins.

Table 4. Effect of participant's gender, education, training country, practice setting, years of experience, and specialty on choice of DME restorative material and its predictors.

		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)		-	-		
Educational degree	**Bachelor**	40 (11.0)	143 (39.2)	<0.001*	0.2	0.1, 0.4	<0.001*	0.1
	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)		-	-	-	

Here we report awareness and knowledge about deep margin elevation (DME) in a cohort of dentists in Jeddah, Saudi Arabia, a concept introduced into the literature over two decades ago [1, 2]. The margins of indirect restorations should be placed on sound tooth structures, and DME aims to relocate the interproximal subgingival margins of indirect restorations to a more biologically favorable location in an attempt to avoid crown lengthening surgery or orthodontic extrusion [3-5].

In general, most participants knew about the concept of DME. Even though the concept is not very well documented in the literature, 85% of participants were aware of it. This might be because the prevalence of caries is high in the young population in Saudi Arabia, and there is therefore a need for conservative management to avoid complicated surgical treatment or extracting extensively damaged permanent teeth in such young patients [16]. This number may be an overestimate, however, since 51% of our population were specialist dentists, and specialists might be more inclined to falsely report knowing about the concept. In our cohort, 79% (48/61), 87% (87/97), and 89% (56/63) of periodontists, restorative/advanced general dentists, and prosthodontists said they knew about the concept, respectively.

Years of experience were a constant predictor of all assessed independent variables (knowledge, sourcing information, and the choice of material), specifically recent graduate dentists with 0 years of experience. Indeed, recent graduates were 20-times more likely to know about the concept of DME. Additionally, this group of dentists was more likely to develop their knowledge in the field by using one to two sources (colleagues, social media, or the scientific literature) and to choose adhesive restorations (composite and glass ionomer) to raise deep margins.

The higher probability that recent graduate dentists (23% of those surveyed) in this cohort were aware of the concept may reflect more recent exposure to controversial or new concepts during undergraduate training. Consistent with our data, Gunardi *et al*. [17] reported that recent Indonesian dental graduates had better knowledge and attitudes towards HIV patients than more senior dentists. This might be because, in the absence of extensive exposure to HIV patients in Jakarta, recent graduates who had just been taught about HIV and its management in their undergraduate training were more familiar with the disease [17].

Lifelong learning and basing practice on high-quality evidence is fundamental to dental practice [18]. In Saudi Arabia, participation in continuous education programs is compulsory for professional registration. Overall, 50% of

participants in this cohort reported obtaining their information from all three sources mentioned in the survey (colleagues, social media, and the scientific literature). Of these, 71.3% had 1-10 years of experience, 69% worked in a clinical and academic environment, 61% had higher education, and 47% were trained in Europe or North America. This inclination to use multiple sources to obtain knowledge might reflect that this group of dentists more thoroughly sources information before changing their attitudes and practice or be related to years of experience, working in both academia and clinics, and postgraduate training. Indeed, there was a weak but significant association between years of experience, working in a clinical and academic environment, and higher education and using multiple sources to obtain information. It has been reported that dentists in general tend to use online sources and courses to update their knowledge and information about practice guidelines [19, 20].

However, more experienced dentists in this cohort were more likely to use one or two sources to gain knowledge. Although 93% of this group had a higher education, 85% of these experienced dentists were more likely to choose two sources, preferring colleagues and the scientific literature to obtain knowledge than social media. This might reflect a generation of more experienced and older dentists who do not feel that social media is a reputable source of information and have not been trained on the use and benefits of social media as a tool in professional development. Indeed, it was shown that not received prior training in using a virtual 3D planning software affected the time and precision of planning [20].

Adhesive dentistry is significantly improving, and there is an increasing move towards conservative management in dentistry. Furthermore, due to significant advances in adhesive restorative systems, dentists prefer to use composite restorations than amalgam [21-25]. However, composite restorations are very sensitive to moisture, and achieving optimal bonding to deep tooth margins can be challenging. In such cases, amalgam can be used as an alternative, less moisture-sensitive restoration [26, 27]. Consistent with this, most participants (87%) favored using only adhesive restorations to raise deep subgingival margins, 62% of whom had an Arabian or Asian education, 57% had 1-10 years of experience, and 55% a higher education and worked in a clinical and academic environment.

This study has several limitations. The results were based on self-reported data which may increase response bias and may not be generalizable to all dentists. However, survey-based studies are still valuable, as they provide a baseline data for further investing the perceptions and knowledge of participants. The answers to the question about sourcing knowledge were likely to reflect a general approach to sourcing all clinical knowledge rather than specifical knowledge about DME. Most significant predictors were weak associations, possibly due to insufficient power in subgroup analyses, so caution is required when interpreting these data. Nevertheless, according to the power calculation, the number of participants (n=423) was sufficient to give meaningful results.

Although there is scarce literature about the concept of raising deep margins and its clinical implications for the long-term survival of indirect restorations, a significant number of respondents in this cohort of Saudi dentists were well informed about the topic. Saudi dentists might be interested in using DME due to an increasing clinical need for conservative management. Additionally, this work highlighted an association between clinical experience and knowledge about raising deep margins. Further studies are required to confirm these observations.

Conclusion

Dentists in Saudi cohort were well informed about the concept, possibly due to an increasing clinical need for conservative management in the Saudi population. Further studies to confirm these observations are recommended.

Acknowledgments: The authors would like to extend their gratitude to Professor Thamer Marghalani for providing statistical consultations and inputs.

Conflict of interest: None

Financial support: None

Ethics statement: None

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