

Knowledge and Attitude among General Dental Practitioners towards Minimally Invasive Dentistry in Riyadh and AlKharj

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ABSTRACT

Introduction: Minimally Invasive Dentistry (MID) emphasizes conservative caries management strategies resulting in less destruction of tooth structure, a deviation of the traditional GV Black's restorative principles. However, there seems to be either deficiency in knowledge or little intention by general dental practitioners to adopt these principles.

Aim: The aim of this study was to assess the knowledge and attitude among general dental practitioners towards minimally invasive dentistry in Riyadh and AlKharj cities of Saudi Arabia.

Materials and Methods: Self-administered structured questionnaires were handed to general dental practitioners (GDPs) in the cities of Riyadh and AlKharj in Saudi Arabia. Several questions, including Likert-type scale response categories (1–5), were used. The questions assessed the respondents' levels of agreement regarding diagnostic, preventive and restorative

techniques such as use of caries risk assessment, use of high fluoride tooth paste, Atraumatic Restorative Treatment and tunnel preparations.

Results: Out of 200 respondents, 161 GDPs with overall response rate of 80.5% completed the questionnaires. The GDPs showed significantly different approach with regards to the use of sharp explorer for caries detection ($p = 0.014$). Almost 60% of the participants had received no special education regarding minimally invasive procedures. Moreover, GDPs who had received MID training showed significantly better knowledge and attitude in adopting minimally invasive techniques for both diagnosis and treatment of dental caries.

Conclusion: Although GDPs possess knowledge about the benefits of MID; however, study showed deficiencies in their attitudes towards caries detection methods and application of minimally invasive dentistry procedures.

Keywords: Caries detection, Caries risk assessment, Fluoride, Remineralization

INTRODUCTION

The primary focus in the minimally invasive model of caries management is identifying and eliminating the causative factors, along with repairing the damage caused by carious lesions [1]. Dental caries is now viewed as an infection rather than as a lesion and its treatment objective is to reduce or eliminate pathogens, this can be viewed as a departure from the traditional restorative model [2]. The minimally invasive model synthesizes knowledge of the disease process into a simple conceptual model using new technologies [3]. The minimally invasive model of care addresses the early carious lesion and the causes of the disease process. Minimally Invasive Dentistry (MID) emphasizes conservative caries management strategies resulting in less destruction of tooth structure, a deviation of the traditional GV Black's restorative principles [4]. In contrast to traditional methods, this philosophy has allowed control of dental caries via prevention and conservation of tooth structure through conservative cavity preparations, adhesive materials and evidence-based decision-making [5].

MID includes the following principles; early caries diagnosis and assessment of caries activity, the classification of caries depth and progression using radiographs, the assessment of individual caries risk (high, moderate, low), the arresting of active lesions, the remineralization and monitoring of non-cavitated lesions, the placement of restorations in teeth with cavitated lesions using minimal cavity designs, and assessing disease management outcomes at pre-established intervals [6]. The MID philosophy is composed of different kinds of techniques which include hand instrumentation, chemomechanical caries removal, air abrasion, and laser cavity preparation [7]. Atraumatic Restorative Technique

(ART) involves hand instrumentation technique which is based on removing the infected layer and maintaining the demineralized dentin to arrest the caries progression (Massler's theory) while using the healing potential of glass ionomer cement (GIC) to remineralize affected dentin [8]. MID advocates use of adhesive dental materials that are associated with conservative cavity preparations because these materials do not require mechanical retention; instead, they rely on the adhesive process to bond to the tooth structure [9,10].

In Saudi Arabia, dental caries is prevalent among the population [11,12]. A lack of awareness related to oral hygiene with little attention to preventive measures and excessive consumption of processed carbohydrates are the obvious causes of impaired dental health in the population [13,14]. Dental caries is a bacterial infection and until microflora is controlled, teeth and restorations are at risk [15]. Mount GJ and Ngo H advocate that restorations by itself will not prevent or eliminate dental caries. They further advocate that the MID concepts depend on the demineralization-remineralization cycle, adhesion and biomimetic restorative materials [16]. Therefore the aim of this study was to evaluate the level of knowledge and attitude among general dental practitioners in the cities of Riyadh and Al-Kharj, Saudi Arabia towards adopting principles of minimally invasive dentistry for the management of dental caries.

MATERIALS AND METHODS

The study was a questionnaire based cross-sectional survey. As per the statistical book from the Ministry of Health, Saudi Arabia (1435H) 2014 [17], there are more than 12,000 estimated practising

dentists in the country. There are about 2,500 dentists including specialists in Riyadh and AlKharj cities of Saudi Arabia. Two hundred General Dental Practitioners (GDPs) were approached by means of convenient sampling in Riyadh and AlKharj cities of Saudi Arabia. The sample was set at 95% confidence interval. Questionnaires were handed out by one investigator to GDPs. GDPs included in the study were graduate dentists who were actively involved in dental practice. Specialist dentists were excluded from the study. The contact details of the GDPs were obtained from the Saudi Dental Society (SDS). The Ethical Committee of College of Dentistry Research Center, Prince Sattam bin Abdulaziz University (known previously as Salman bin Abdulaziz University) approved the study protocol and the survey period was from January 2015 to May 2015. All participants entered the study voluntarily following an explanation of its objectives and rationale through a participant information letter attached to each questionnaire.

The questionnaire used in this study was a shortened version of a previously used validated questionnaire from the College of Dentistry, University of Iowa [18] and was modified according to the needs of the study and its population. The developed questionnaire was first evaluated for its credibility and reliability through pilot testing on a group of 25 dental practitioners. This group was eventually excluded from the study results to avoid any bias. Cronbach's coefficient was found to be 0.75, which showed an internal reliability of the questionnaire. Content Validity Ratio (CVR) was calculated and was found to be acceptable. The questionnaire comprised of 15 items consisting of three sections. These sections contained questions about the demographic data as well as GDPs knowledge and approach related to MID. Several questions used Likert-type scale response categories (1–5) to assess the respondents' levels of agreement regarding diagnostic, preventive and restorative techniques. Questions were asked in particular about the performance of caries risk assessment for all patients, the use of Atraumatic Restorative Technique (ART), tunnel preparations and use of high fluoride toothpaste. Data was collected in the form of questionnaire responses from study participants provided with the questionnaire as per convenience of the researcher.

STATISTICAL ANALYSIS

Data entry and analyses were performed using statistical software (SPSS version 20, Chicago, IL). Data were described using frequency counts and percentages. Descriptive and inferential statistics were reported. Frequencies cross tabulations and bar charts were used in descriptive statistics. Chi-square test and Bivariate analysis were used for diagnostic and preventive techniques for respondents based on whether or not they had MID training and/or education.

RESULTS

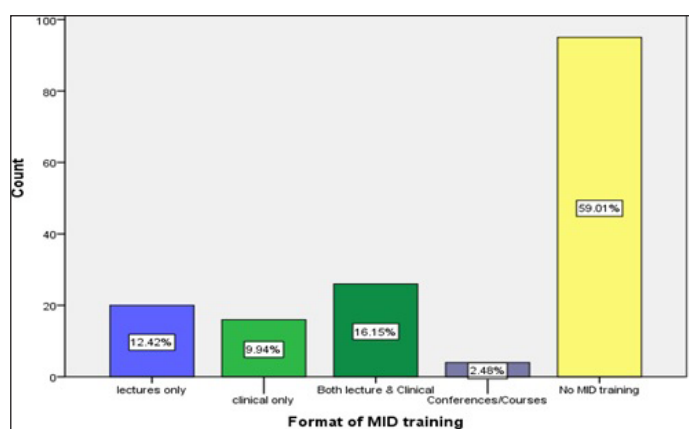
A total of 161 responses (overall response rate 80.5%) were completed and returned by participants out of the 200 hand distributed questionnaires. [Table/Fig-1] represents the demographic characteristics of the sample population in accordance with the reported knowledge about MID. The data showed that vast majority of the GDPs (78.3%) who had filled the questionnaire had been practicing dentistry for a period of more than 5 years.

Females represented 46% of the sample. Very few among the sample (9.3%) were aged 40 years or above. When asked about how much of knowledge the participants possessed about MID, there was no significant difference ($p > 0.05$) in relation to age and gender (chi-square test). However, years of experience seemed to effect the knowledge about MID. The respondents having more experience reported significantly ($p = 0.031$) more knowledge about MID.

Age	Practitioners' Knowledge about MID				Total (overall %)	p-value
	Very much	Much	Little	None		
20-30 (% within the group)	6 9.0%	22 32.8%	30 44.8%	9 13.4%	67 41.6%	0.439
31-40 (% within the group)	10 12.7%	34 43.0%	23 29.1%	12 15.2%	79 49.1%	
41-50 (% within the group)	1 9.1%	4 36.4%	6 54.5%	0 0.0%	11 6.8%	
Above 50 (% within the group)	0 0.0%	1 25.0%	3 75.0%	0 0.0%	4 2.5%	
Gender						
Male (% within the group)	13 14.9%	28 32.2%	36 41.4%	10 11.5%	87 54.0%	0.121
Female (% within the group)	4 5.4%	33 44.6%	26 35.1%	11 14.9%	74 46.0%	
Experience (Years)						
Less than 5 (% within the group)	7 20.0%	7 20.0%	12 34.3%	9 25.7%	35 21.7%	0.031*
5-10 (% within the group)	7 8.6%	35 43.2%	31 38.3%	8 9.9%	81 50.3%	
11-15 (% within the group)	1 5.6%	7 38.9%	6 33.3%	4 22.2%	18 11.2%	
More than 15 (% within the group)	2 7.4%	12 44.4%	13 48.1%	0 0.0%	27 16.8%	
Overall (Total)	17 10.6 %	61 37.9 %	62 38.5%	21 13.0%	161 100.0%	

[Table/Fig-1]: Demographic characteristics of the study population and the respective knowledge about MID.

* Significant at $p < 0.05$ (Pearson's chi-square test)



[Table/Fig-2]: Distribution of MID training within the sample.

Majority among the sample (59.01%) responded that they did not have any specific education and/or training regarding MID. Further, only 38.5% of the practitioners responded that they had received some education regarding minimal invasive technique in their undergraduate curriculum in the form of lectures and/or clinics. Only 16.1% of the respondents had received MID training in the form of both lectures as well as clinical training. A very few (2.48%) among the respondents had received such at advanced education seminars or at conferences. [Table/Fig-2] shows the distribution of the MID training format.

[Table/Fig-3] represents the knowledge of GDPs about various concepts in MID including aetiology, prevention and application of MID principles for dental caries control. More than 90% study participants agreed that there was a direct relationship between carbohydrate intake and caries formation. Majority (79.5%) of the respondents agreed that fluoride was essential for remineralization of carious lesions. Among the sample 60.3% agreed that pit and fissure sealants are helpful for prevention of fissure caries. A little more than half of the respondents agreed that caries risk

Knowledge towards MID principles	Strongly agree % (N)	Agree % (N)	Don't Know % (N)	Disagree % (N)	Total (overall %)
There is a direct relationship between carious lesions and intake of refined carbohydrates	40.4 (65)	51.6 (83)	4.3 (7)	1.9 (3)	1.9 (3)
Fluoride is an essential agent in the tooth remineralization process	35.4 (57)	44.1 (71)	5.6 (9)	7.5 (12)	7.5 (12)
Sealants are effective for pit and fissure caries prevention	16.8 (27)	43.5 (70)	5.6 (9)	26.1 (42)	8.1 (13)
Caries risk assessment should be conducted with all patients	15.5 (25)	35.4 (57)	15.5 (25)	29.8 (48)	3.7 (6)
Conservative cavity design like tunnel and box preparations are effective	21.1 (34)	34.7 (56)	11.2 (18)	21.1 (34)	11.9 (19)
Plan restorative materials and techniques based on the patient's caries risk assessment	9.3 (15)	26.7 (43)	4.9 (8)	45.9 (74)	13 (21)

[Table/Fig-3]: Knowledge about MID among the participants.

Techniques (n)	Training in MID		
	Yes (n=66) n (%)	No (n=95) n (%)	p-value
Use of a sharp explorer for caries detection? Always/Most times/Often (128) Sometimes/Never (33)	45(35.1) 21(63.6)	83(64.8) 12(36.3)	0.014*
Use of a blunt instrument for caries detection? Always/Most times/Often (131) Sometimes/Never (30)	51(38.9) 15(50)	80(61.1) 15(50)	0.048*
Use of magnification (e.g. loupes) for caries detection Always/Most times/Often (66) Sometimes/Never (95)	29(43.9) 37(38.9)	37(56.1) 58(61.5)	0.086
Use of radiographs for caries detection. Always/Most times/Often (89) Sometimes/Never (72)	44(48.9) 22(30.5)	45(51.1) 50(69.4)	0.007*
Newer methods of caries detection § ECM, QLF, IRLF, FOTI Always/Most times/Often (207) Sometimes/Never (437)	53(25.6) 88(20.2)	154(74.4) 349(79.8)	0.057

[Table/Fig-4]: shows bivariate analysis between 'Training in MID' and the attitude towards application of MID principles in diagnosing dental caries. § Responses for newer methods have been calculated together * Significant at p < 0.05 (Pearson's chi-square test)

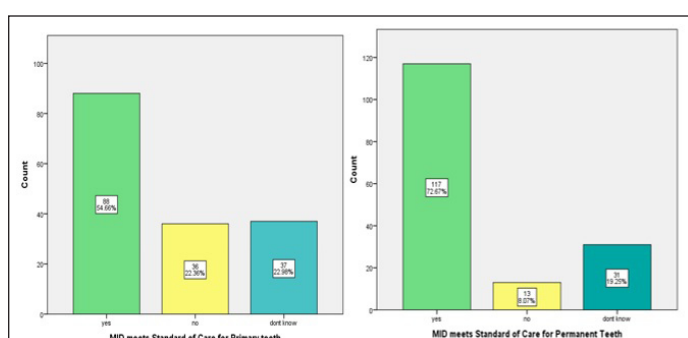
assessment should be done for all patients. In addition, more than half respondents agreed that tunnel preparations should be done instead of the conventional cavity preparation wherever possible. However, only 36% among the sample were likely to plan restorative materials and techniques based on the patient's caries risk assessment.

[Table/Fig-4] represents bivariate analysis between MID training and adoption of MID principles in diagnosing dental caries. A total of 79.5% (n= 128) of the sample still uses a sharp explorer for caries detection. However, MID training seems to significantly affect the use of a sharp explorer for caries detection (p = 0.014). Caries detection with blunt instrument and the use of radiographs for caries detection were significantly related to MID training. However, caries detection by magnification using loupes and the use of newer caries detection methods like Electric caries monitor (ECM), Quantitative light induced Florescence (QLF), Infra-Red Laser Fluorescence (IRLF), and Fibre-Optic Trans-Illumination (FOTI) were not significantly (p = 0.086 and p = 0.057 respectively) related to the MID training.

[Table/Fig-5] shows bivariate analysis for MID training and various MID techniques. Only remineralization with fluoride varnish or any other fluoride supplement was significantly related to MID training

Techniques §	Training in MID		
	Yes %	No %	p-value
ART (Atraumatic Restorative Treatment) (n) Very effective/Effective (108) Ineffective/Very Ineffective (29)	79.5 37.5	20.5 62.5	0.37
Sandwich Technique (Glass Ionomer + Composite) (n) Very effective/Effective (107) Ineffective/Very Ineffective (35)	59.8 45	40.2 55	0.28
Remineralization with fluoride varnish or any other topical fluoride products (n) Very effective/Effective (102) Ineffective/Very Ineffective (38)	81.9 20	18.1 80	0.003*
Remineralization with high concentration fluoride toothpaste at home (Duraphat 2800/5000 ppm F) (n) Very effective/Effective (98) Ineffective/Very Ineffective (44)	57.4 55.7	42.6 44.3	0.65

[Table/Fig-5]: Shows bivariate analysis between 'Training in MID' and Attitude of practitioners about various MID procedures in clinical practice. § Responses with 'Don't Know' have been excluded from the calculations. * Significant at p < 0.05 (Pearson's chi-square test)



[Table/Fig-6,7]: Shows the opinion among the sample whether principles of MID meet standard of care for primary and permanent teeth.

(p = 0.003). 81.9% among those who reported that fluoride was effective for caries control had undergone some form of MID training. Although a vast majority agreed that ART was an effective form of treatment for dental caries control, yet MID training did not significantly affect this opinion. Only 21.7% (n=35) among the sample reported that sandwich technique was an ineffective technique while as 27.3% (n=44) reported that remineralization with a high fluoride toothpaste is not an effective measure for caries control. However, the reported opinion about sandwich technique as well as high fluoride toothpaste was not significantly related to whether or not a respondent had undergone MID training.

Of the total 72.67% of the respondents agreed that MID principles met the standards of care for permanent teeth while only 54.66% agreed that the MID principles met standards of care for primary teeth. [Table/Fig-6,7] show the representation of the opinion regarding MID meeting the standards of care for primary and permanent teeth.

DISCUSSION

The principles of MID seek to convert an active lesion into an inactive or arrested lesion, thus aiding the defence and healing processes in dentin and pulp before restorative procedures are attempted [19]. In the present study, age and gender did not seem to affect the knowledge possessed about MID. However, experience within the practice seemed to increase awareness about MID knowledge of the GDPs. It was observed that more than half (51.5%) of the respondents either had no knowledge or only possessed a little knowledge about MID. In a study among dental practitioners conducted to assess the knowledge and attitude of practitioners in Karnataka, India, 97% of respondents were aware of the principles of preventive dentistry and 90.7% of the respondents possessed knowledge about the re-mineralization of initial lesions instead of

using surgical procedures on the prognosis of the caries [20]. This study was based on a similar study on public health dentists by Olivera DC [18] conducted at University of Iowa. The researcher concluded that there is a paradigm shift toward MID philosophy. Studies have also emphasized that minimally invasive techniques reduce treatment time and are cost-effective in comparison to conventional treatment strategies [2,16,19,21].

It is evident that majority among the sample (59.01%) did not get education about MID in their dental school curriculum. Most of the respondents that had knowledge about MID had either completed their education recently or had gained knowledge through advanced education seminars or conferences. It is noteworthy that the concepts of MID although are not very recent yet these need to be incorporated completely in the curriculum of dental schools across Saudi Arabia. Lynch et al., advocated that evidence-based, up-to-date teaching programs, including those in operative dentistry, are needed to best prepare students for careers in dentistry [22]. Similarly, in a study with a similar group by Shah et al., regarding treatment of special needs patients; majority of the respondents thought that a course designed to deal with the treatment needs of special care dentistry patients would be beneficial in the treatment of such a group [23].

It is evident that vast majority among the sample understand the relationship between high carbohydrate diet and development of dental caries as well as remineralization by fluoride supplements. FDI supports the recommendation that dental caries is an infectious disease, and the primary focus should therefore be on control of the infection, plaque control and reduced carbohydrate intake. It also advocates remineralisation of non-cavitated lesions of enamel and dentine by use of fluoride supplements [5]. Yet, lesser majority agreed that sealants were effective for prevention of pit and fissure caries. The American Dental Association panel concluded that sealants are effective in caries prevention and that sealants can prevent the progression of early non-cavitated carious lesions [24]. Caries risk assessment should be done for all patients. However, only about half among sample agreed for such assessment. Some researchers even suggested that online caries predictive tools will be available for GDPs in the not too distant future to help clinicians formulate accurate caries risk profiles for their patients [25]. Similarly, regarding effectiveness of tunnel and box preparations when compared to the conventional design only about half of the respondents agreed that such preparations were effective. One randomized controlled trial found no significant difference in the survival rates ($p > 0.05$) between the tunnel and the conventional restorations [26]. Moreover, the FDI statement advocates repair of restorations rather than new restorations to be able to save more tooth structure [5].

The use of sharp explorer was significantly related to the training in MID. Respondents who had not received training in MID were more likely to use sharp explorer for caries detection. The practice of continued use of a sharp explorer as a diagnostic tool for primary caries diagnosis should be discontinued as it may cause some harm and yet fails to provide a significant balancing diagnostic benefit [27,28]. Oliveira DC, also suggested that sharp explorer was still used routinely during the caries detection, suggesting that some aspects of the MID approach have not been adopted by public health dentists [18].

The respondents were likely to use radiography for caries diagnosis irrespective of the MID training. American Dental Association as well as recently developed guidelines recommends limiting the use of radiography and implementing appropriate radiation control procedures [29,30]. However, increased magnification for detection of caries as well as using newer methods of caries detection were not significantly related to training in MID. Respondents with MID training are expected to use higher magnification like loupes as well new diagnostic methods for caries detection but lack of availability

of such equipment or a lack in the adoption of the principles of MID may be a reason. Nevertheless, newer methods of caries detection have shown to be less invasive and of good diagnostic value [31,32]. These findings show a greater discrepancy in the knowledge and attitude of study population regarding caries detection methods.

Respondents view for effectiveness to ART, sandwich technique and remineralization with high fluoride toothpaste were not related to the MID training. By contrast, remineralization by fluoride varnish or other topical fluoride agents were significantly related to MID training. Lesser number of respondents agreed that preventive measures especially recommending high fluoride toothpaste (2800/5000 ppm) for caries prevention were very effective. It is noteworthy that both fluoride varnish and fluoride toothpastes have shown to be beneficial in caries reduction [33,34].

Furthermore, 54.6% of participants were of the view that MID met the standard of care for primary teeth and 72.6% of participants agreed that MID met the standard of care for adult patients. A similar study by Gaskin et al., has shown contrasting findings assessing the knowledge and attitude of dentists towards MID methods [35]. They suggested that MID was mainly for treatment strategies in children and was not suited for adult population. However, their study population included military defense personal as well, leading to possible bias of time constraints for dentists for such treatment. The higher MID acceptance rate by the participants in the present study may suggest an improved understanding of the use of MID concepts.

The limitation of this study was a small sample involving only two cities in Saudi Arabia. A more comprehensive sample size involving more regions in the country would give a better idea about the knowledge and attitude of GDPs towards MID. Furthermore, the authors recommend that in view of evidence based practice for implementation of the concepts of Minimally Invasive Dentistry; the detailed description of MID principles should be delivered during the academic and professional training period. Perhaps necessary public health strategies and changes in the academic curriculum are required to emphasize upon the application of the concepts of minimally invasive dental treatment.

CONCLUSION

The results show that GDPs in the present sample are not fully aware of the significance of minimally invasive procedures in dentistry; they show deficiencies in their attitudes towards caries detection methods and hence demonstrate a frail attitude towards the promotion of MID principles into their clinical practice.

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