An investigation of general dental practitioners' understanding and perceptions of minimally invasive dentistry

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Key points

Encourages GDPs to reflect on their current knowledge.	Encourages GDPs to reflect on their future learning needs and incorporate this topic within their personal development plan.	Encourages educators to reflect on improving the educational experience.	Provides knowledge about current ideas in restorative dentistry.

Objectives This study investigated general dental practitioners' (GDPs) understanding and perceptions of minimally invasive dentistry (MID). This questionnaire-based survey looked at GDPs currently practising in the UK. **Methods** A total of 170 questionnaires were distributed. The questionnaire enquired about demographic information, postgraduate training in MID, number of years in clinical practice, the working environment, perceptions of the methods and rationale for their choice of restorative materials in clinical practice, and tested their knowledge of MID. **Results** Of the 170 distributed questionnaires, 87.6% (N = 149) were completed. The results showed that only 28% of the respondents scored all the basic MID knowledge questions correctly, illustrating a general lack of basic contemporary understanding of MID among the GDPs. Logistic regression analysis of the data revealed a true correlation between the knowledge in MID and the perception of knowing. The analysis also showed that knowledge in MID, application of G. V. Black's concepts and change in MID approach since qualification were significant ($p < 0.05$). There were no significant relationships between the knowledge score on studied scenarios and country of education, working environment, caries risk assessment, effect of caries risk assessment on treatment planning, effect of caries risk assessment on choice of restorative material, dietary assessment and fluoride usage. **Conclusions** This study demonstrated that the knowledge of MID among UK GDPs is generally poor. There is a need for further education in the field of MID.

Introduction

The practice of restorative dentistry has changed and evolved during recent decades due to development and advancement of adhesive restorative materials, increased knowledge about the caries process and improved education.[1] Dental caries as a disease should be treated conservatively and prevented, where possible, in the first instance and by invasive procedures as a last resort.

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G. V. Black's traditional restorative approach included removal of the carious portion of the tooth and extension of the cavity for prevention into areas that were presumed likely to become carious. G. V. Black's idea of extension for prevention has been exchanged by prevention of extension.[2] Today's focus in dentistry is more on prevention and detection of caries at an early stage. This has created the concept of minimally invasive dentistry (MID).[3] The term MID is a relatively new concept for the dental profession that suggests a change in the principles of operative dentistry, as it has been proven that the invasive approach is destructive, ineffective and maximally interventionist.[4]

The concept of MID is based on caries risk assessment, prevention and control of further disease by reducing the cariogenic bacteria, early caries detection, remineralisation of early carious lesions, repair of defective restorations rather than replacement, and minimum intervention and cavity design when restoration is necessary.[5]

This study has investigated understanding and perceptions of MID among UK GDPs by reviewing the overall knowledge of MID, factors affecting the knowledge, whether there was similar understanding and perceptions of MID and the level of implication of the concept of MID among GDPs in the UK.

Materials and methods

This study was an observational, cross-sectional study. The study design was based on a bespoke paper-based questionnaire. A total of 170 questionnaires were distributed among the participants of the British Dental Association

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(BDA) conference in May 2016 and a continuing professional development (CPD) course in June 2016.

The research tool was a pre-tested, paper-based questionnaire survey consisting of 19 questions. A pilot study was conducted, in which twelve dentists took part. No changes were made to the questionnaire following the pilot study. The target population for this study was GDPs currently practising in the UK. The inclusion criteria consisted of being a dentist member of the UK General Dental Council (GDC) and currently practising in the UK. The exclusion criteria consisted of non-GDC member, retired GDC dentists and practitioners on GDC specialist lists.

The questionnaire included information about the aim of the study, and that the responses would be treated with strict confidence and would be anonymous. For the purpose of this study and questionnaire, MID was defined as 'The contemporary ultraconservative operative management of cavitated lesions, requiring surgical intervention.'[6]

The first part of the questionnaire enquired about clinicians' demographic information, such as age, gender, information about qualification (country, university and year of qualification), years being in clinical practice, number of days per week providing direct patient care, type of working environment and any postgraduate training in minimally invasive dentistry.

The second part used Likert scale-based questions to evaluate the respondent's level of agreement with regards to caries risk assessment, treatment planning and choice of material affected by caries risk assessment, dietary habits assessment, use of fluoride, application of G. V. Black's concept of extension for prevention, use of adhesive restorative material and amalgam in clinical practice. Finally, in the third section, knowledge was evaluated from three scenario-based questions.

Statistical analysis

All the questionnaires were reviewed and subsequently submitted for data entry on an Excel spreadsheet and descriptive analysis by using SPSS statistics data editor.[7]

Mean (SD), median (IQR) and proportion (%) were used as appropriate. Comparisons between groups were carried out using Chi-square Tests, Fisher's exact test for categorical data and non-parametric Kruskal-Wallis test for non-normally distributed continuous data. Spearman's correlation was used to examine the association between ordinal variables. Finally, in order to distinguish between the confounding predictor variables a multivariate logistic regression analysis was performed to evaluate the contribution of these variables in the presence of the other significant predictors. A p-value of less than 0.05 was used for statistical significance.

Sample size calculations were based on the three scenarios questions using this formula: (http://epitools.ausvet.com.au/content.php?page=SampleSize)

$n = (Z^2 \times P\ (1 - P))/e^2$

In this study assuming an infinite population, we expected that 80% of the respondents would score those three questions correctly. There was a 95% confidence interval of ±7.5% desired precision. After the calculation, the required sample size number was 110.

Table 1 Demography of samples

Sample size N = 149	Mean (SD) or median (IQR) or N (%)
Age (years)	27 (24, 41)
Male (sex)	89 (60%)
Years of qualification	2014 (2000, 2015)
Years of clinical practice	1.39 (0.9, 14.6)
Days of work	4.48 (3.9, 4.9)
UK trained	125 (83.9%)
Postgraduate Training in MID	19 (12.8%)
Duration of postgraduate study	0.12 (0, 0.6)
Type of practice	Exclusively NHS 35 (24%) Mostly NHS 76 (51%) Mixed 50/50 17 (11%) Mostly private 11 (7%) Exclusively private 10 (7%)

Results

A total number of 149 (87.6%) dentists responded to the 170-distributed questionnaires.

The statistical data for demographic characteristics of respondents are shown in Table 1. The median year of qualification was 2014 and the median year of being in clinical dental practice was 1.39. This indicated that the majority of those completing the questionnaire were young, inexperienced GDPs.

Although 58% reported having some knowledge on MID, only 11% reported knowing a great deal (Table 2). Regarding

Table 2 Knowledge and clinical practice

Sample size N = 149	N (%)	
Knowledge on MID	A great deal	16 (11%)
	Quite a lot	34 (22%)
	Some	87 (58%)
	Very little	12 (8%)
Caries risk assessment	Always	104 (70%)
	Most of the time	39 (26%)
	Sometimes	5 (3%)
	Rarely	1 (0.7%)
Caries risk assessment affecting treatment planning	Always	72 (48%)
	Most of the time	64 (43%)
	Sometimes	11 (7%)
	Rarely	2 (1.3%)
Assessment of patient's dietary habits	Always	37 (25%)
	Most of the time	69 (46%)
	Sometimes	39 (26%)
	Rarely	3 (2%)
	Never	1 (0.7%)
Fluoride usage	Always	52 (35%)
	Most of the time	55 (37 %)
	Sometimes	40 (27%)
	Rarely	2 (1.3%)
G. V. Black	Always	4 (3%)
	Most of the time	18 (12%)
	Sometimes	29 (20%)
	Rarely	43 (29%)
	Never	53 (36%)
Frequency of adhesive restorative material usage	Always	12 (8%)
	Most of the time	86 (58%)
	Sometimes	49 (33%)
	Rarely	2 (1.3%)
Frequency of amalgam usage	Always	3 (2%)
	Most of the time	58 (39%)
	Sometimes	72 (48%)
	Rarely	10 (7%)
	Never	5 (3%)
Change in MID approach since being qualified	Yes	86 (58%)
	No	60 (40%)

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caries risk assessment, 70% (n = 104) of the dentists reported always carrying out caries risk-assessment and only one dentist answered rarely. In response to the question asked about how often does caries risk assessment affect their treatment planning, only 48% participants answered always. The reports on question about the application of G. V. Black's extension for prevention concept, shows that 36% (53) never apply this concept.

Results for knowledge on studied scenarios are presented in Table 3. Scenario 1a asked the participants if they would treat and restore an interproximal lesion with a radiographic radiolucency confined to enamel in a vital, asymptomatic, lower first molar in a low caries risk patient aged 25; only 44% (n = 66) answered that they would never invasively treat this scenario. In scenario 1b, referring to the same patient with high caries risk, 69% answered they would keep the lesion under observation and would apply preventative measures.

Scenario 2 asked the participants what they would do when they are restoring a vital, asymptomatic lower first molar and a bitewing radiograph shows a radiolucent lesion well into the dentine and in close proximity to the pulp; 59% answered partial removal of soft dentine and restore the tooth, followed by re-opening after a period of time to excavate the remaining caries and re-restore the tooth. Overall, only 28% of respondents of our sample scored all three scenarios correctly.

Bivariate analysis was conducted for the purpose of exploring the association between the knowledge score and potential predictor variables (Table 4).

Statistically significant relationships (P = 0.011) were found between knowledge on MID (how much do the participants think they know about the concept of minimally invasive dentistry?) and knowledge scores on studied scenarios. The respondents who answered the three studied scenarios correctly, conveyed they know about the concept of MID.

The results of bivariate analysis in Table 5 display that there were no statistically significant relationships between knowledge scores on studied scenarios and caries risk assessment, effect of caries risk assessment on treatment planning, caries risk assessment on choice of restorative material, assessment of patient's dietary habits, frequency of fluoride usage as remineralising agent, frequency of adhesive restorative material usage and frequency of amalgam usage. However, significant statistical associations (P = 0.028) were found between the application of G. V. Black's concept and knowledge scores on studied scenarios showing that none of the respondents with full knowledge on MID reported that they always apply G. V. Black's concept.

The result presented in Table 6, shows that, 28% (n = 42) of respondents of our sample size scored all the three studied scenarios correctly, 31% (n = 46) of the respondents scored two studied scenarios correctly, 26% (n = 38) scored one studied scenario correctly and 15% (n = 23) of the respondents scored none of the studied scenarios correctly.

Significant statistical associations (P = 0.017) were found between the year of qualification and knowledge scores on studied scenarios. Median year of qualification for those who scored all the three studies scenarios correctly was 2015.

Table 3 Knowledge on studied scenarios

Sample size N = 149	N (%)	
1a. Would you treat and restore an interproximal lesion with a radiographic radiolucency confined to enamel, in a vital, asymptomatic, lower first molar in a low caries risk patient aged 25 years?	Always	3 (2%)
	Most of the time	3 (2%)
	Sometimes	18 (12%)
	Rarely	59 (37%)
	Never	66 (44%)
1b. Referring to the same patient, if the caries risk is high, what would your treatment be?	Observe the lesion	102 (69%)
	No actions required	3 (2%)
	Tunnel prep and restore	16 (11%)
	Occlusal prep and restore	27 (18%)
2. You are restoring a vital, asymptomatic lower first molar tooth. The bitewing radiograph shows a radiolucent lesion well into the dentine and in close proximity to the pulp. What would you do?	Complete caries removal and restore	56 (38%)
	Seal with no caries removal	2 (1.3%)
	Partial removal of caries and restore, re-open and re-restore later	88 (59%)

Table 4 Comparison of knowledge score by groups

	Score 0	Score 1	Score 2	Score 3	Line by line accos value	p-value
Gender						
Male	9 (10%)	22 (25%)	31 (35%)	27 (30%)	3.767	0.052
Female	14 (23%)	16 (27%)	15 (25%)	15 (25%)		
Country						
UK	17 (14%)	31 (25%)	39 (31%)	38 (30%)	3.112	0.078
Non-UK	6 (25%)	7 (29%)	7 (29%)	4 (17%)		
Working environment						
Exclusively NHS	5 (14%)	12 (34%)	9 (26%)	9 (26%)	2.161	0.142
Mostly NHS	11 (15%)	14 (18%)	22 (29%)	29 (38%)		
Mixed	3 (18%)	5 (29%)	7 (41%)	2 (12%)		
Mostly private	1 (9%)	5 (46%)	3 (27%)	2 (18%)		
Exclusively private	3 (30%)	2 (20%)	5 (50%)	0		
Knowledge on MID						
A great deal	1 (6%)	2 (13%)	6 (38%)	7 (44%)	6.5	0.011
Quite a lot	5 (15%)	6 (18%)	11 (32%)	12 (35%)		
Some	14 (16%)	26 (30%)	26 (30%)	21 (24%)		

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In order to distinguish between the confounding predictor variables a multivariate logistic regression analysis was performed showing that the remaining significant predictor variables are knowledge in MID, application of G. V. Black's concept and change in MID approach since being qualified.

Discussion

A minimally invasive dentistry concept for caries management is a new approach that is based on a medical model. This new concept prioritises caries risk assessment, prevention and control of further disease by reducing the cariogenic bacteria, early caries detection, remineralisation of early carious lesions, conservative cavity preparation, repair of defective restorations rather than replacement, and minimum surgical intervention and cavity designs when restoration is necessary to increase tooth longevity. MID is the oral physician's general team care approach, which helps to sustain oral health in the long term with preventative measures. Patients should realise that caries is a lifestyle-related disease and they should take responsibility for their oral health with the help of dental professionals. All the members of the dental team must be involved in providing the preventative care.[6]

A study by Gaskin *et al.* (2006) examined the federal service and civilian dentists' knowledge, attitude and behaviour regarding MID, showing federal dentists knew more about MID compared to their civilian counterparts. The result of this current study also indicated that younger dentists and dentists who have completed postgraduate training would apply the MID philosophy more than the older dentists.[8] This indicates that age alone did not affect the knowledge score on the studied scenarios. The findings of this study do not concur with Gaskin's study. To our knowledge, there are no studies that have examined UK GDPs' understanding of perceptions of MID. The results demonstrated that less than one third of the participants had knowledge on MID.

The poor knowledge of MID indicated by this study might be due to gaps in knowledge and understanding or gaps in training. This is despite the fact that the majority of participants in this study were younger and more recently qualified. Dentists and other members of the dental team alike will have to be provided with the necessary knowledge and training to be able to apply MID as a modern approach

Table 5 Comparison of knowledge score

	Score 0	Score 1	Score 2	Score 3	Line by line	p-value
Caries risk assessment						
Always	18 (17%)	23 (22%)	30 (29%)	33 (32%)	1.618	0.203
Most of the time	2 (5%)	13 (33%)	16 (41%)	8 (21%)		
Sometimes	3 (60%)	1 (20%)	0	1 (20%)		
Rarely	0	1 (100%)	0	0		
Effect of caries risk on treatment plan						
Always	13 (18%)	15 (21%)	18 (25%)	26 (36%)	3.032	0.082
Most of the time	7 (11%)	17 (27%)	25 (39%)	15 (23%)		
Sometimes	2 (18%)	5 (46%)	3 (27%)	1 (9%)		
Rarely	1 (50%)	1 (50%)	0	0		
Caries risk assessment on choice of restorative material						
Yes	21 (16%)	33 (25%)	41 (31%)	36 (28%)	2.477	0.116
No	1 (6%)	5 (29%)	5 (29%)	6 (35%)		
Assessment of dietary habit						
Always	11 (28%)	4 (11%)	11 (30%)	11 (30%)	0.29	0.865
Most of the time	7 (10%)	17 (25%)	22 (32%)	23 (33%)		
Sometimes	3 (8%)	16 (41%)	13 (33%)	7 (18%)		
Rarely	1 (33%)	1 (33%)	0	1 (33%)		
Never	1 (100%)	0	0	0		
Frequency of fluoride usage						
Always	10 (19%)	10 (19%)	15 (29%)	17 (33%)	0.632	0.426
Most of the time	5 (9%)	16 (29%)	18 (33%)	16 (29%)		
Sometimes	8 (20%)	11 (28%)	13 (33%)	8 (20%)		
Rarely	0	1 (50%)	0	1 (50%)		
Frequency of adhesive restorative material usage						
Always	2	2	4	4	0.046	0.663
Most of the time	12	22	31	21		
Sometimes	8	14	10	17		
Rarely	1	0	1	0		
Frequency of amalgam usage						
Always s	1	0	2	0	0.031	0.44
Most of the time	9	20	13	16		
Sometimes	12	12	26	22		
Rarely	1	3	3	3		
Never	0	3	1	1		
Application of G. V. Black concept						
Always	0	0	4 (100%)	0	4.819	0.02
Most of the time	8 (44%)	3 (17%)	3 (17%)	4 (22%)		
Sometimes	2 (7%)	9 (31%)	10 (35%)	8 (28%)		
Rarely	10 (23%)	13 (30%)	11 (26%)	9 (21%)		
Never	3 (6%)	12 (23%)	17 (32%)	21 (40%)		

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to a population with ever-changing needs and demands. Postgraduate and CPD training in particular is of utmost importance to retrain and make the older generation of dentists more confident in application of MID.

This study did not have enough power in some areas, such as to examine the associations between the knowledge score on studied scenarios and frequency of adhesive restorative material usage. It would be possible to increase the power of the study by increasing the sample size through using internet online surveys like SurveyMonkey, mailing the questionnaire by post, distributing the questionnaires in conferences and CPD courses. A re-run of this study should include questions to determine this fact as it would be interesting to see if the National Health Service remuneration system in the UK is discouraging the practitioners to implement MID.

In addition, the questionnaire did not ask the participants if they had undergraduate training in MID. It is interesting to know whether certain categories of dentists, such as the older generation or non-UK graduates have been given training in MID. Other studies to be conducted could compare the level of application of MID between dentists working in salaried positions such as community, hospital or military services to the rest of dentist population.

Table 6 Knowledge score on studied scenarios

Sample size N = 149	Score 0	Score 1	Score 2	Score 3
N (%)	23 (15%)	38 (26%)	46 (31%)	42 (28%)

Conclusions

This questionnaire-based study demonstrated that the knowledge of MID among UK GDPs is generally poor and may benefit from further training. This study showed that old methods such as G. V. Black's concept are still in use and only 40% of the participants with full knowledge on MID never apply G. V. Black's concept in their clinical practice.

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