

# Perspective and practice of root caries management: a multicountry study – Part I

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## Abstract

**Background:** Every effort needs to be made to better understand the current state of practice and trends relating to root caries management which will be of benefit to dentists universally in the practice of dentistry.

**Aim:** This article presents a multicountry questionnaire survey of the current state of practice in the management of root caries among dentists in nine different countries to get a wider range of opinions and perspectives.

**Methodology:** A questionnaire related to root surface caries was distributed among practicing dentists in nine different countries, namely the United Kingdom, Libya, Jordan, Saudi Arabia, Egypt, Brazil, India, Malaysia, and Iraq. Questionnaire responses were analyzed, and the results were compared among groups.

**Results:** The results showed statistically significant differences among dentists in most questionnaire aspects. Bleeding is the greatest obstacle facing dentists when restoring root surface lesions. Reported survival rates reflect uncertainty about the material and/or approach of choice in the management of root surface caries.

**Conclusion:** This questionnaire survey revealed the current status of management of root surface caries in clinical practice in various countries. Substantial attention is required to bridge the knowledge gap and address the current void of uncertainty as relates to root caries management by providing a common ground for communication between dentists from all around the globe. In all, this work found a degree of consensus at the international level on what appears to work well among the dental practices surveyed and identified several issues with existing approaches that need to be addressed in future studies.

**Keywords:** Dental practice; management; prevention; questionnaire; root caries

## INTRODUCTION

Root caries is a multifactorial disease that exhibits softened, brownish, and irregular tissue on the root surface in the

proximity of the cemento-enamel junction. It is a condition that commonly affects the elderly as a result of physiological gingival recession with aging that may be greatly exacerbated by poor oral hygiene. Some medications may cause hyposalivation, thus reducing the protective quality of saliva, increasing the risk of developing root caries. Root caries is relatively common and not easy to treat. Age-related, behavioral, and cultural factors play on an individual's susceptibility to this condition. If noninvasive

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treatment fails to stop the condition, operative treatment is considered. As preventive procedures have been found to be unsuccessful, operative intervention has generally centered around the excavation of the carious lesion and applying a permanent restoration. As a result, the gingival tissues become displaced apically and traumatized at the location adjacent to the excavation site and the clinician is faced with a cavity amidst bleeding from the gingival tissues. Under such circumstances, and in the absence of moisture control, amalgam and glass ionomer present a somewhat better prospect of success compared with resin composite restorations.<sup>[1,2]</sup>

Preventive and remineralization therapies should always be considered first when dealing with root surface carious lesions. Such approaches will help inhibit or eliminate the lesion before further damage to root surface tissues occurs. On the other hand, restorative treatment is recommended in deep lesions where excessive destruction of root surface tissues occurred as a result of “active” caries.<sup>[3]</sup> Root caries control can be achieved by establishing equilibrium between major risk factors such as sugar exposure, plaque control, and fluoride. However, fluoride cannot be relied upon solely to stop root caries if high amounts of acids are being produced in the dental biofilm.<sup>[4]</sup> Recently, a systematic review concluded that active root surface caries can be converted to inactive lesions by regular use of a toothbrush with conventional fluoride toothpaste combined with a professional application of silver diamine fluoride or chlorhexidine. Alternatively, this can be obtained by using high-fluoride toothpaste twice a day.<sup>[2]</sup>

Due to the relatively poor survival of restorations in teeth with root caries,<sup>[5,6]</sup> operative treatment of this condition should be kept to a minimum. Dislodgment appears to be the main cause of failure regardless of the restorative material used (glass ionomer or composite resin).<sup>[6]</sup> This might be attributed to moisture control difficulties, poor visibility, and limited access.<sup>[3]</sup> Nonoperative management of root caries is therefore always recommended unless active root carious lesions cannot be adequately cleaned by the patient.<sup>[4,7]</sup> Glass ionomer cements (conventional, resin modified) have been the materials of choice for restoring root caries lesions in recent years.<sup>[8]</sup> These materials provide good adhesive properties in such circumstances and their use may fit well within the category of minimally invasive treatment.

The variations in clinicians' perception and approach on the management of root caries are mainly due to their training and expertise which reflect the choices they make in their practice in terms of restorative material selection and operative technique to achieve the best clinical outcome for their patients. Therefore, it is perceived that efforts in improving root caries management should be directed toward improving treatment modalities and material

choice. Furthermore, gaining a deeper understanding of the risk factors and pathways that cause root caries will facilitate the prediction, prevention, and management of such lesions. Thus, every effort needs to be made to better understand the current state of practice and trends relating to root caries management which will be of benefit to dentists universally in the practice of dentistry. This can only be ascertained by surveys, personal testimonies, and observation. Therefore, this article presents a questionnaire survey of the current state of practice in the management of root caries among dentists from nine different countries to get a wider range of opinions and perspectives.

## METHODOLOGY

A multicountry cross-sectional survey of registered dentists from nine countries (UK, Libya, Jordan, Saudi Arabia, Egypt, Brazil, India, Malaysia, and Iraq) was conducted. The questionnaires sought the views and experiences of root surface caries of qualified dentists in those countries. The questionnaire consisted of two sections [Appendix]: the first section explored the prevalence of the disease, diagnostic and detection methods, intraoral distribution, management, and follow-up. The second section explored the risk factors and lifestyle habits related to the increased risk of developing root surface caries and we will publish this section in a separate article. The validity and reliability of the questionnaire were previously verified in the UK.<sup>[9]</sup>

The questionnaire was distributed by e-mail using an online survey service tool (Google Forms) with tracking disabled. E-mails were sent out to 400 registered dentists in each of the 9 countries. Potential participants were selected at random from the official dental online register database in each country. No tracking of nonresponders nor participants was possible and therefore responses were anonymous, and no follow-up was possible. Only registered dentists were included. Inclusion in the study was random with no reason to include or exclude any particular participant other than the desire to have representative data from all countries.

A relational database was created using the computer program Paradox (Paradox 3.5, Borland) for the input of data from the completed questionnaires and interrogation. Statistical analyses of the responses were undertaken using GraphPad Prism (Version 8, GraphPad Software Inc., San Diego, USA). Differences were tested using the Chi-squared test.  $P < 0.05$  was considered significant.

## RESULTS

In response to the invitation to participate in the questionnaire, a total of 1209 responses were received. The number of responses from each country was as follows: UK (134), Libya (120), Jordan (135), Saudi Arabia (118),

Egypt (133), Brazil (155), India (138), Malaysia (168), and Iraq (108). The responses were gathered between December 14, 2019, and January 14, 2020. The mean length of time respondents who had been practicing dentistry was 10.06 years (standard deviation: 4.27).

The age group reported to be most susceptible to developing root caries was the elderly group (i.e., >60 years old) according to respondents from all nine groups of countries. A Chi-square test revealed a statistically significant ( $\chi^2 = 99.4, P < 0.0001$ ) difference in the distribution of the responses. A greater proportion of Brazilian respondents reported root caries in the age group of < 60 years old [Table 1].

Where sex was considered, a Chi-square test demonstrated statistically significant differences in responses ( $\chi^2 = 79.08, P < 0.0001$ ) with the UK, Brazil, India, and Malaysia indicating proportionally more responses of no influence of sex upon root caries susceptibility. In Jordan, Saudi Arabia, Egypt, Libya, and Iraq, however, a higher proportion of males were considered more susceptible to developing root surface caries. In all countries, very few indicated that females were susceptible.

The reported proportion of patients, in the experience of respondents, prone to root caries was proportionally greatest for Iraq (85.2%) compared to the other groups of countries (18.8%–41.7%). Chi-square testing confirmed statistically significant ( $P < 0.05$ ) differences in responses ( $\chi^2 = 78.72, P < 0.0001$ ).

The lower canine was reported to be the most affected anterior tooth by root surface caries in the UK, Jordan, Saudi Arabia, and Egypt. The upper canine, however, was reported to be the most affected in Libya, Brazil, India, Malaysia, and Iraq ( $\chi^2 = 108.1, P < 0.0001$ ). As for posterior teeth, the lower first molar was reported to be the most affected posterior tooth by root surface caries in the UK, Libya, Jordan, Egypt, and India, while the upper first molar was reported to be the most affected in Saudi Arabia, Brazil, Malaysia, and Iraq ( $\chi^2 = 148.5, P < 0.0001$ ).

A range of methods were used to manage root surface carious lesions such as dietary advice, monitoring with prevention instruction, restoration, topical fluoride, and tooth coating materials. Chi-square testing revealed a statistically significant difference in responses ( $\chi^2 = 126.5, P < 0.0001$ ). Restoration was the most common method used to manage root surface caries in all countries. However, almost one-quarter of the cases were treated by fluoride application in the UK. In all other countries, fluoride was reported as the method of choice in a range of only 9.8%–16.7% of the cases.

The most commonly used restorative material for the treatment of root caries was glass ionomer in most countries

except Brazil and Iraq where composite was the most commonly used restoration. Chi-square testing revealed statistically significant differences in responses ( $\chi^2 = 267.5, P < 0.0001$ ). Malaysia was the only country with zero reports of amalgam as a restorative material option.

Bleeding was reported by a large majority of clinicians from all countries (89.4%–99.3%) as a problem in restoring root surface carious lesions. There was no statistically significant difference between all nine groups of countries ( $\chi^2 = 23.72, P = 0.0226$ ).

In the UK, it was most common to follow up root caries restorations which was not the case in any other country (UK 66.7% cf. other countries 9.3%–38.7%). Chi-square testing revealed statistically significant differences between the countries ( $\chi^2 = 215.9, P < 0.0001$ ). The most common following up interval of patients was every 6 months.

As regards the average lifespan of root surface caries restorations, the impression of dentists in Malaysia was that proportionally more root caries restorations failed during the 1<sup>st</sup> year (33.3% of the cases). Longer survival times were reported in the UK, Brazil, and Iraq (more than 5 years). A Chi-square test of this data demonstrated a statistically significant difference between the countries ( $\chi^2 = 103.7, P < 0.0001$ ).

## DISCUSSION

In discussing the results of this work, it is important to be clear why this multicountry questionnaire survey was undertaken. Its main purpose was to compare and contrast the root caries management practices in nine different locations around the world. A secondary function of the questionnaire was to see what, if anything, can be ascertained from practicing dentists that would advance the control/treatment of root caries and to help identify any overlooked factors that may contribute to less efficacious clinical outcomes.

In broad terms, no new radical treatments were found. However, a new material, fluoro-alumino-calcium silicate-based tooth coating material was repeatedly reported by respondents (particularly by Saudi dentists) as a newer treatment option for root caries. Interestingly, this new material was investigated in a very recent randomized clinical trial (RCT) and shown to be effective to suppress root caries progression.<sup>[10]</sup> Ozone therapy was also reported by some respondents (mainly Malaysian dentists) as a treatment option despite the lack of support from published RCTs to recommend the use of ozone for the treatment of dental carious lesions.<sup>[11,12]</sup>

An unexpected finding was that the UK respondents had been practicing for a significantly longer period



thought to be more susceptible. This could be because in those countries it is perceived that females are more likely to attend dental practice regularly.<sup>[14-17]</sup> It was expected that respondents from all participating countries would strongly favor the elderly age group as the most susceptible to develop root caries, as this observation is supported by many recent studies.<sup>[18-20]</sup>

Several decades of sanctions and war have completely disrupted the socioeconomic structure and health status of Iraqi society, restricting access to dental health-care services. As a result, it is not surprising that more than 85% of patients seen by Iraqi dentists suffer from root surface caries. This remains a relatively high percentage, given the percentages obtained from other countries. Therefore, we second the recommendations of Joury *et al.* and Khoshnevisan *et al.*,<sup>[21,22]</sup> among others, who are calling for urgent attention to improve and promote oral health among all citizens living in postwar communities.

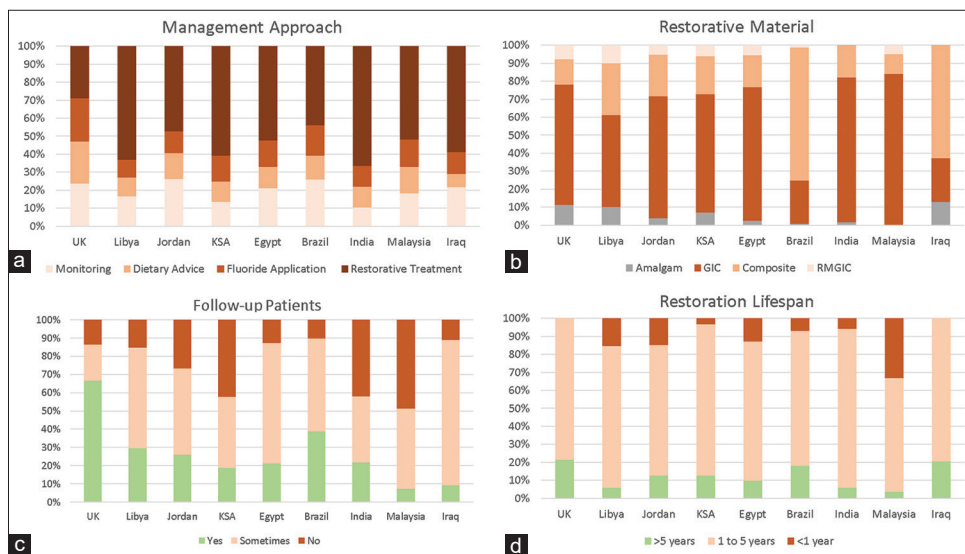
As for the intraoral distribution of root surface caries, it is well established in epidemiological studies that canines, premolars, and molars are the most commonly affected teeth by root caries.<sup>[23]</sup> However, premolars were surprisingly underrepresented among all respondent groups. It appears that dentists should pay more attention to premolars upon initial intraoral examination since a low reporting rate raises particular concern in the context of overlooked carious lesions.

UK dentists indicated that around three-quarter of root surface caries cases were treated nonrestoratively (i.e., monitoring, dietary advice, or fluoride application) [Figure 1a]. It was less common in the UK to provide a restoration for a root caries lesion than in

all other countries. This could be due to the fact that in those countries, there is relatively little patient follow-up, perhaps due to the casual nature of attendance. This assumption is also supported by the very low level of dietary advice apparently offered to patients.

As regards the type of restorations, most dentists from all countries, except Brazil and Iraq, opted for glass ionomer over composite resin [Figure 1b]. According to the World Dental Federation guidelines for minimally invasive dentistry,<sup>[24]</sup> composite resin should only be used where moisture control is optimal. Glass ionomer is said to be a practical alternative though it is acknowledged that for both materials (composite and glass ionomer) there is a lack of clinical evidence to support their use where moisture is present.<sup>[8]</sup> The results of this questionnaire indicated that bleeding from gingival tissues is a commonly encountered problem that was consistently reported by respondents from all countries which in turn warrants further investigations into the material of choice when moisture is present.

It should be remembered that a greater proportion of restorations placed in Brazil and Iraq were composite resin. Given the reported high lifespans of restorations in those countries, there is no compelling evidence to support either composite resin or glass ionomer for restoring root caries lesions. Root caries restorations might be generally associated with an increased risk of failure irrespective of which restorative material has been used (excluding amalgam),<sup>[19]</sup> thus clinical trials seem worthwhile. It is worth mentioning that amalgam restorations have demonstrated the longest clinical longevity. However, removing tooth tissue for the purposes of retention is becoming less clinically acceptable in the modern minimally invasive approach era.<sup>[19]</sup>



**Figure 1:** Cross-country differences in (a) management approach, (b) choice of restorative material, (c) follow-up of patients, and (d) restoration lifespan

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As current literature shows, there is insufficient evidence to recommend any material and/or approach for routine clinical use in the restoration of root caries.<sup>[19,25]</sup> Therefore, it seems prudent, for the time being, to recommend a follow-up period of at least 6 months. Two-third of dentists in the UK followed up their patients out of which 80% prefer the 6-month follow-up period. Unfortunately, the majority of dentists from other countries do not follow-up their patients after restoring a root surface carious lesion.

Malaysian dentists reported the highest percentage of restoration failure at <1 year among all countries. Surprisingly and importantly, the highest percentage of dentists who showed the least interest in following up their patients was also in Malaysia (48.8%) [Figure 1c and d]. In contrast, the least short-term failures and the most long-term success were reported by UK dentists, who also showed the most interest in following up their patients. This finding points to the need of follow-up procedures more adjusted to the increased risk of failure of root surface restorations. A limitation of the study, however, is its cross-sectional design, which does not allow for the exploration of trends over time. In addition, the sample of respondents does not allow a representative overview of the opinion of all dentists in a particular country.

## CONCLUSION

Attitudes and beliefs about root surface caries between the UK and non-UK respondents exhibit some commonality although differ in the emphasis on prevention. Overall, dentists carry out similar treatments when prevention fails. The decision to do so, however, would appear to be a reflection of their training and experience

Based on perspectives obtained from dentists from 9 countries, it is clear that substantial attention is needed to bridge the knowledge gap and address the current void of uncertainty by providing a common ground for communication between dentists from all around the globe. This would allow the dentist to decide on the management that brings about the greatest good, though there are several goods to consider. In all, this work found a degree of consensus at the international level on what appears to work well among the dental practices surveyed and identified a number of issues with existing approaches that need to be addressed in future studies.

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## Conflicts of interest

There are no conflicts of interest.

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## APPENDIX

### Appendix: Questionnaire items and selection options (Part II of this questionnaire will be presented as a separate article)

Part I	
1	Date of birth Selection options: Calendar date selector
2	How long have you been practicing dentistry? Selection options: Answer box
3	From your clinical experience please indicate at what age people are most susceptible to root surface caries? Selection options: Childhood, Adulthood, Elderly
4	In your experience, please indicate who are more susceptible to root caries? Selection options: Males, Females, No difference
5	Does your practice base have a large proportion of patients prone to root surface caries? Selection options: Yes, No
6	How do you usually detect root surface caries? Selection options: Visually (inspection), Tactile (probing), Dental radiographs (X-ray), Other (please specify)
7	In your experience, which surface of a tooth is most commonly affected with root caries? Selection options: Labial (Buccal) surface, Interproximal surface, Palatal (Lingual) surface
8	In your experience which anterior tooth/teeth is most commonly affected by root surface caries? Selection options: Upper Central, Upper Lateral, Upper Canine, Lower Central, Lower Lateral, Lower Canine
9	In your experience which posterior tooth/teeth is most commonly affected by root surface caries? Selection options: Upper First Premolar, Upper Second Premolar, Upper First Molar, Upper Second Molar, Upper Third Molar, Lower First Premolar, Lower Second Premolar, Lower First Molar, Lower Second Molar, Lower Third Molar
10	Which method (s) do you usually use to manage root surface caries? Selection options: Monitoring with prevention instruction, Dietary advice, Topical Fluoride, Restoration, Other (please specify).
11	Which restorative material do you most commonly use to restore a tooth with root surface caries? Selection options: Amalgam, Glass ionomer, Composite, Resin modified glass ionomer, Compomer, Other (please specify)
12	Is bleeding from the gingival tissues normally a problem in restoring root surface caries? Selection options: Never, Sometimes, Frequently
13	After you restore a tooth with root caries, what method of finishing do you use for the restoration? Selection options: Hand finishing (sharp knives or scalers) at placement visit, Rotary finishing at placement visit Hand finishing (sharp knives or scalers) at recall visit, Rotary, finishing at recall visit, Others (please specify)
14	After you treat the root caries do you follow up your patients? Selection options: Yes. if yes specify, for how long in the next question below, No, Sometimes
15	Follow up Duration if yes in the previous question. Selection options: Answer box
16	In your experience what is the average lifespan of the restoration you most commonly use for the restoration of root caries? Selection options: Less than a year, 1 to 5 years, More than 5 years
Part II	
17	In deciding which method you use to manage root surface caries tick those factors that influence your selection of the management method? Selection options: Patients oral hygiene, Diet, Patients age, Tooth type, Severity of the lesion, Other (please specify)
18	In your experience which lifestyle events are associated with root surface caries development? (tick all that apply) Selection options: Bereavement Retirement, Giving up smoking, Loss of job, Change in diet, Other (please specify)
19	From your experience, indicate which of the following factors you feel are important in the development of root caries. Please circle one number on each line, where 1=very important, 2=quite important, 3=fairly important, 4=not at all important. Selection options: Number of teeth present, Degree of crowding Presence of a partial denture, Cigarette smoking Total amount of sugars consumed Frequency of sugar intake, Oral hygiene status, Physical disability, Mental disability/senility, Active periodontal disease, Consumption of alcohol, Consumption of fizzy drinks, Overhanging restorations, Poor crown margins, Gingival recession, Reduced salivary flow, Presence of erosion, Presence of abrasion cavity, Poor general health

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