

Psychometric Properties Assessment and Trans-Cultural Adaptation of Iranian Dentists' Knowledge and Experience in Diagnosing, Recording, and Managing Root Caries

Haleh Hali¹ | Shahab Papi² | Mohammadreza Nourpour³ | Houriyeh Abedi⁴ | Afsaneh Fendereski⁵ | Melika Mollaei^{6*}

1. Department of Pediatric Dentistry, Faculty of Dentistry, Mazandaran University of Medical Sciences, Sari, Iran.

2. Department of Gerontology, Research Center for Social Factors Affecting Health, Faculty of Nursing and Midwifery, Lorestan University of Medical Sciences, Khorramabad, Iran.

3. Student Research Committee, Dental Research Center, Faculty of Dentistry, Mazandaran University of Medical Sciences, Sari, Iran.

4. Department of Restorative Dentistry, Faculty of Dentistry, Dental Research Center, Mazandaran University of Medical Sciences, Sari, Iran.

5. Department of Biostatistics and Epidemiology, Faculty of Health, Mazandaran University of Medical Sciences, Sari, Iran

6. Dental Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

Article Info

Received: 10 June, 2025

Accepted: 23 August, 2025

Published: 6 September, 2025

*Corresponding Author

Melika Mollaei, Dental Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

Email: melika.mollaei.7@gmail.com

Abstract

Background and objectives: Despite the increasing prevalence of root caries, little is known about how dentists manage this disease. The present study was carried out with the aim of cross-cultural adaptation and validity and reliability of the questionnaire of dentists' knowledge and experience in diagnosing, recording, and managing root caries and investigating the knowledge of dentists in diagnosing and recording root caries lesions in Iran.

Materials and methods: After obtaining permission from the main designer of the questionnaire, the process of translation and re-translation of the questionnaire was done. Cronbach's alpha was used to determine the internal consistency of the questionnaire. To determine the reliability of the questionnaire, the test-retest method was used, so that 30 of the questionnaires that were completed among the target group were redistributed to the same dentists after two weeks. Data analysis was done using SPSS version 22 software and a p-value less than 0.05 was considered significant.

Results: A total of 100 dentists were included. The validity of the questionnaire was confirmed. The average correlation of questionnaire questions was calculated as 0.948 (95% CI: 0.927 – 0.969) and the reliability of the questionnaire was calculated as 0.705 based on Cronbach's alpha. The most common restorative materials included composite resin and resin-modified glass ionomer cement. The highest prevalence of follow-up time was reported as 3 and 6 months.

Conclusion: This study showed the appropriate reliability and validity of the investigated questionnaire. According to the results of the study, the benefits of proper diagnosis, recording, and management of risk factors of root caries lesions should be highlighted in dental education and professional regulations should include more standardized management of root caries.

Keywords: Root caries, Psychometrics, Cross-cultural adaptation, Validity, Reliability.

Please cite this paper as:

Hali H, Papi M, Nourpour M, Abedi H, Fendereski A, Mollaei M. Psychometric Properties Assessment and Trans-Cultural Adaptation of Iranian Dentists' Knowledge and Experience in Diagnosing, Recording, and Managing Root Caries. *Journal of "Regeneration, Reconstruction & Restoration"* (Triple R). 2025; Volume 10: e8. Doi: 10.22037/rrr.v10.46593

1. Introduction

While the burden of dental caries has decreased in children and young adults in many industrialized countries over the pa-

st decades; This problem is considered an important and increasing problem in the elderly (1). Many diseases of the elderly are indirectly related to oral diseases. For example, oral health is poor in many elderly patients; Because other diseases become more important compared to dental

problems, and therefore maintaining oral health is not prioritized (1).

By definition, root caries refers to tooth decay in the root of the tooth. The process of tooth decay with the loss of calcium ions from the surface apatite crystals that make up the major part of the three calcified tissues of the tooth; under normal conditions, demineralization is balanced by the uptake of calcium through remineralization. This dynamic cycle of mineral loss and repair occurs continuously and in equilibrium within a healthy oral environment. However, in an unfavorable environment, remineralization is insufficient to counteract the rate of demineralization, leading to the development of dental caries (2). There is a consensus among doctors that for coronal caries, if the lesion causes a cavity and spreads to the dentin; Restorative treatment is recommended. There is no such consensus regarding root caries. Root caries can involve the cementum first; But in most cases, it starts from the dentin (2).

Concern about root caries is increasing, mainly related to differences in how dentists manage root caries (1, 3). Considering the increasing number of oral and dental-related diseases and risks in the elderly and the limited prognosis for treatment due to general health problems and reduced motivation for oral and dental hygiene, dental care planning for the elderly should be in newer frameworks and be done more seriously. Several factors can affect the success rate of root caries management; For example, non-invasive treatments can be used to deactivate non-cavitated caries lesions through supervision and individual oral hygiene instructions (4, 5).

For aggressive treatment of cavitated lesions, expansion of restoration is a major determinant of clinical success; Because in cases that extend to the proximal area or CL II restorations; The failure rate is twice as high as that of CL I restorations (5). more follow-ups, that is, more than twice a year, are also an effective factor in the treatment of these lesions; Because it increases the rate of intervention in inactive lesions and leads to treatments that do not require direct intervention (4). In addition, a wide range of non-invasive and invasive strategies for the prevention and treatment of root caries lesions can lead to differences in the way dentists manage this disease (6). However, there is currently almost no information on how these professionals manage root caries in private practice. To date, only two studies, one in Germany (4) and one in Queensland, Australia (7), have partially assessed these factors; But there is still inconsistency regarding the risk assessment of root caries lesions.

Overall, all studies show a need to improve registration systems; Because almost a quarter of dentists in Queensland reported that they could not easily distinguish root caries from crown caries in a patient's mouth (7).

In this regard, it is essential to explore how dentists manage root caries, including their perspectives, challenges, and views on treatment effectiveness. Well-constructed questionnaires are particularly useful for efficiently gathering such data from practitioners in private clinic settings. It seems necessary to use a questionnaire for the correct management of root caries. Recently, Niemeyer et al. (2023) designed a questionnaire to evaluate the method of diagnosis, recording,

and management of root caries lesions by dentists and measured its validity and reliability (8).

Considering the lack of sufficient data regarding this matter in Iran, the current study was conducted with the aim of psychometric properties assessment and trans-cultural adaptation of the dentists' knowledge and experience in diagnosing, recording, and managing root caries questionnaire in Iran.

2. Materials and Methods

This methodological study was conducted on 100 dentists in Sari, Iran from April 2022 to January 2023. A simple sampling method was used to collect the samples. In the process of conducting the research, after contacting the dentists, the researcher explained the goals and conditions of the research to them. The dentists were also told that their information would remain confidential. Finally, the people who volunteered to participate in the research; After obtaining their written consent, they were included in the study. In the next step, the participants were again assured that their information would remain completely confidential and that they had the right to leave the research whenever they wished. Then the questionnaires were completed by dentists.

2.1. Measurement tools

Questionnaire of knowledge and experience of dentists in diagnosis, registration, and management of root caries: This questionnaire consists of 9 questions including two clinical items (in English). The experts reviewed and identified the key topics that the questionnaire should address, focusing on the most effective wording and structure to comprehensively cover all aspects related to root caries; including its diagnosis, registration, and management methods. In addition, clinical cases were confirmed by considering the most appropriate scenarios regarding root caries lesions in elderly patients. This questionnaire includes closed questions with a combination of multiple-choice and check-box questions, as well as a Likert scale. These types of questions take less time to answer, help to increase the response rate, and quantitatively analyze the answers. The questionnaire consisted of three parts: (1) questions about the dentists' general clinical routine (eg, the type of patients treated in their office, including information about their diagnostic procedures and documentation of findings); (2) questions related to dentists' knowledge/practice, particularly on two clinical cases containing clinical images, x-rays, and other relevant patient information (eg, dentists' opinions on the diagnosis, recording, and management of root caries treatment); (3) questions about dentists' demographics (age, gender, and specialty). The average expected time to complete the questionnaire was determined to be 15 minutes (8).

2.2. Study design

After obtaining written permission from the manufacturer of the instrument via email, first, the questionnaire of dentists'

knowledge and experience in diagnosing, recording, and managing tooth root caries was independently and separately translated into Farsi by two people fluent in Farsi and English. And then the translations were discussed in a specialized group and the opinions of these people were coordinated with each other. The translated form along with a copy of the original instrument to two experts who were not present in any of the previous stages and were familiar with the English language and concepts of medical sciences; was delivered and they were asked to check the correspondence of the translated form and the original instrument, after their approval, the Persian version was approved and given to an expert in the field of Persian language and literature.

To edit this tool in terms of vocabulary and grammar. At this stage, the Farsi version of the tool was translated into English by a person fluent in Farsi and English languages, and the translated version was sent to the designer of the tool, and he was asked for his opinion regarding the compatibility of the Farsi version of this tool with the original version. After the approval of the Persian questionnaire, to calculate the quantitative face validity, the questions related to the questionnaire were examined by 10 members of the scientific faculty of the dentistry field in terms of the ambiguity and difficulty of the words, and then the Impact Score (Impact Score) of each item was examined. Items with an impact score equal to or higher than 1.5 were considered for further analysis (9).

The quantitative content validity of the tool was checked using CVI and CVR indices. The content validity index (CVI) and relative coefficient of content validity (CVR) were used for the content validity of the tool quantitatively (10). To determine CVR, dental professionals were asked to independently report the necessity of each of the items based on three ranges of the Likert scale (necessary, useful but unnecessary, unnecessary). To determine CVI, experts in the field of dentistry (10 people) were asked to independently determine the relevance, clarity, and simplicity of each item. A four-spectrum Likert scale was used to analyze these criteria separately. Therefore, the content validity index was evaluated using a four-point grading scale: a) not relevant, b) somewhat relevant, c) relevant, and d) completely relevant. A CVI value higher than 0.62 was considered suitable and acceptable for each of the items (11).

To test the reliability of the questionnaire, Cronbach's alpha coefficient was used. The data were used to calculate the internal consistency of the scales through Cronbach's alpha coefficient. Cronbach's alpha is the most common method used to check the internal correlation of instruments. Cronbach's alpha coefficient of 0.70 and above is satisfactory (12).

In test-retest, which is the most common method of stability; The test was performed twice with a time interval in one group. Therefore, to evaluate the reliability of the retest and before performing the main steps of the study, 30 participants were randomly selected and completed the questionnaires for the second time 2 weeks later. The retest reliability coefficient was calculated. The intra-class correlation coefficient was calculated with a 95% confidence interval (CI) and ICC (Intra-class Correlation Coefficient) equal to or higher than 0.70 was considered acceptable (9).

2.3. Statistical analysis

To describe the data, tables, graphs, mean, standard deviation, and frequency were used. To check the normality hypothesis, the Kolmogorov-Smirnov test was used. The reliability of the questionnaire was checked using the test-retest method. Data analysis was done using SPSS version 22 software and a P-value less than 5% was considered significant.

3. Results

Based on the data analysis results of this study, the mean $\pm$ standard deviation of the age of the participants was 34.78 ± 6.60 with a range of 25 to 49 years. 62% of the participants were female and 38% of the participants were male. In terms of education, most dentists (94%) were general dentists (Table 1). The content and form validity of the questionnaire were checked by 10 people from the panel of experts, based on which the validity of all questions was confirmed (Table 2).

The reliability of the questionnaire was checked using the test-retest method. The average correlation of questionnaire questions was calculated as 0.948 (95% CI 95%: 0.927 – 0.969). Also, the reliability of the questionnaire was calculated based on Cronbach's alpha equal to 0.705 (Table 3).

Table 1. Demographic characteristics.

Variables		Mean/ Number	Percentage
Age		34.78 $\pm$ 6.60	
Gender	Female	62	62
	Male	38	38
Degree	General Dentist	94	94
	Restorative dentistry specialist	6	6

Table 2. Checking the validity of the questionnaire.

Question	CVR	CVI	Simplicity	relevance	Clarity
1	0.87	0.90	1.00	1.00	1.00
2	0.93	1.00	1.00	1.00	1.00
3	1.00	1.00	1.00	1.00	1.00
4	1.00	1.00	1.00	1.00	1.00
5	0.87	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00
7	0.93	1.00	0.97	1.00	1.00
8	0.73	0.90	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00

Table 3. Check the reliability of the questionnaire.

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
Q5.0	47.26	59.837	0.159	0.702
Q5.1	47.41	59.583	0.277	0.698
Q5.2	47.97	59.12	0.291	0.697
Q5.3	47.68	60.347	0.113	0.704
Q5.4	46.62	57.334	0.376	0.69
Q5.5	47.21	60.956	0.046	0.707
Q5.6	47.91	58.083	0.371	0.692
Q5.7	47.38	60.061	0.153	0.702
Q5.8	47.03	60.029	0.151	0.702
Q5.9	47.65	60.478	0.122	0.703
Q5.10	47.76	59.943	0.178	0.701
Q7.5Amalgam	48.09	59.416	0.209	0.7
Q7.5Compomer	48.24	60.064	0.276	0.699
Q7.5CompositeResin	46.94	60.784	0.009	0.713
Q7.5CompositeFlow	47.76	57.882	0.241	0.697
Q7.5Crown	48.21	58.956	0.45	0.694
Q7.5GI	46.94	60.663	0.03	0.71
Q7.5RMGI	47.47	58.802	0.24	0.698
Q7.6Amalgam	47.79	56.411	0.385	0.688
Q7.6Compomer	48.15	58.129	0.342	0.693
Q7.6CompositeResin	47.35	57.447	0.248	0.697
Q7.6CompositeFlow	47.38	60.061	0.038	0.714
Q7.6Crown	46.41	58.795	0.295	0.696
Q7.6GI	45.76	56.67	0.323	0.691
Q7.6RMGI	44.94	60.845	0.029	0.709

Q8.5Amalgam	45.38	61.516	0.009	0.706
Q8.5Compomer	45.41	61.34	0.046	0.705
Q8.5CompositeResin	47.68	57.619	0.366	0.691
Q8.5CompositeFlow	47.47	60.863	0.03	0.709
Q8.5Crown	47.09	59.356	0.11	0.707
Q8.5GI	47.44	55.89	0.402	0.686
Q8.5RMGI	46.82	55.18	0.466	0.681
Amalgam	44.94	59.148	0.179	0.701
Compomer	47.85	58.857	0.247	0.697
Composite Resin	45.53	57.893	0.159	0.705
Composite Flow	47.5	58.621	0.138	0.706
Crown	47	58.909	0.105	0.709
GI	47.41	57.401	0.205	0.701
RMGI	46.56	54.012	0.395	0.683

In this study, 100 dentists in Sari City were investigated, 94 of them were general dentists and 6 were restorative dentistry specialists. Each question was answered by an expert in this field, which was highlighted in the tables. According to these results, more than half of dentists have at least one patient per week with root caries (52%).

Table 4 shows the criteria for diagnosing root caries from the point of view of dentists. According to most people, tooth color is not a good criterion for diagnosis. In terms of visual appearance, more than half of the people did not consider visual appearance as a criterion for recognition. However, according to 40% of people, the dull (opaque) appearance of teeth can be a criterion for diagnosis. Most people used being soft or leathery as a criterion for diagnosis. Almost half of the people did not know the presence of cavities and the place of decay as criteria. However, according to 52% of people, the

presence of a cavity in the tooth is the criterion for distinguishing the type of root decay.

Additionally, 88 people reported that they only use the probe, mirror, pincers, and magnifying loupe method to detect caries, however, 9 people also used the graphic method and 3 people used the Caries detector. On the other hand, 64 people reported that they do not record root caries lesions as distinct from coronal caries lesions, of which 67% reported that the reason for not recording was not important. According to the opinion of the dentists participating in the study, the most important risk factors related to root caries included poor oral and dental hygiene, the presence of plaque on the root surface, uncontrolled diabetes, the speed of saliva flow, the presence of periodontitis, and medication (Figure 1).

When diagnosing a root caries lesion, 20% of people were very confident and 65% of people were sure of their diagnosis.

Table 4. The criteria for diagnosing root caries from the point of view of dentists.

Caries criteria		Number	Test statistics	P-value
Color	White surface	7	82.8	<0.001
	Yellowish or light brown surface	13		
	Dark brown to black surface	16		
	Color is not the dominant criterion	64		
Visual appearance	Opaque	40	31.04	<0.001
	shiny	8		
	Visual appearance is not the dominant criterion	52		
Tactile sensation	Soft or leathery while exploring	67	63.62	<0.001

	Very soft when exploring	31		
	Hard consistency in exploration	2		
	The tactile sensation is not the dominant criterion	0		
Cavitation	Cavitation	52		
	Not cavitation	1	47.42	<0.001
	The Cavitation is not the dominant criterion	47		
Location	Close to the gingival margin	16		
	away from the gingival margin	1		
	Close to CEJ	4	82.9	<0.001
	The location of biofilm accumulation is more important than the distance from the margin and CEJ	28		
	Location is not the dominant criterion	51		

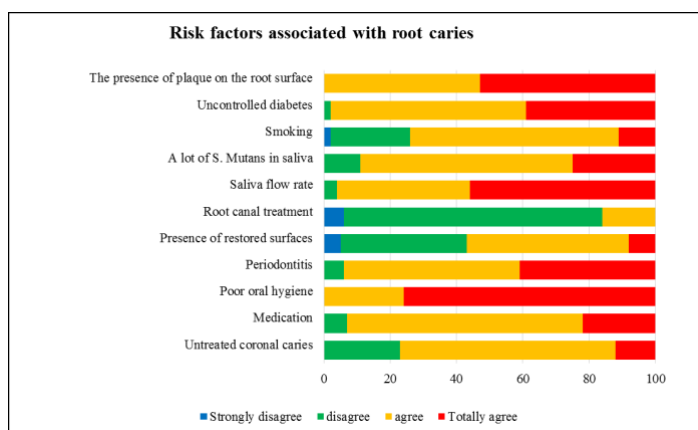


Figure 1. Risk factors associated with root caries.

However, 15% of people were unsure of their diagnosis. As for the question of clinical case A (79-year-old male patient with poor motor skills), 40 people diagnosed the patient's caries as active and 60 as inactive. Also, according to the expert's opinion, the specified lesion is inactive. Treatment methods for this patient were different from the point of view of dentists, and regardless of the type of diagnosis, the most common treatment method for this case was the use of the instructions... + fluoride 5000 ppm+ removal of biofilm + root scaling, which was suggested by 37% of doctors (Table 5). Out of 100 dentists participating in the study, 48 people reported that they treat patients with similar conditions, of which most of them chose the method of selective caries removal and access method with slot preparation (vestibuloproximal) (Table 6).

Table 5. The results of the clinical case A.

Treatment methods	Diagnosis type		Total number (percentage)
	Inactive number (percentage)	Active number (percentage)	
Root scaling	1 (1.7)	0 (0)	1 (1)
Instructions + fluoride 1450ppm	5 (8.3)	2 (5)	7 (7)
Instructions + fluoride 1450ppm + root scaling	4 (6.7)	2 (5)	6 (6)
Instructions + fluoride 1450 ppm + fluoride varnish	1 (1.7)	5 (12.5)	6 (6)
Instruction + fluoride 5000 ppm+ removal of biofilm	9 (15)	3 (7.5)	12 (12)
Instructions + fluoride 1450 ppm+ removal of biofilm in the office	4 (6.7)	0 (0)	4 (4)
Instructions + fluoride 1450 ppm+ removal of biofilm + use of silver diamine fluoride solution	4 (6.7)	7 (17.5)	11 (11)
Instructions + fluoride 5000 ppm+ removal of biofilm + root scaling	23 (38.3)	14 (35)	37 (37)

Instructions + fluoride varnish + root scaling	2 (3.3)	1 (2.5)	3 (3)
Instructions + fluoride 1450 ppm+ fluoride varnish + root scaling + removal of biofilm	4 (6.7)	6 (15)	10 (10)
Instructions + fluoride 5000 ppm+ removal of biofilm + use of silver diamine fluoride solution	1 (1.7)	0 (0)	1 (1)
Instructions + fluoride 5000 ppm+ removal of biofilm + root scaling + fluoride varnish	2 (3.3)	0 (0)	2 (2)
Fisher-Freeman-Halton Exact Test Statistics	14.73		
p-value	0.137		

Table 6. Frequency of restorative method and access to root caries lesions in question "A".

Caries treatment		Number	Percentage	Test statistics	P-value
Treatment method	Complete caries removal	3	6.3	36.75	<0.001
	Selective caries removal	45	93.8		
How to access	with slot preparation (occlusoproximal)	2	4.2	36.75	<0.001
	with slot preparation (vestibuloproximal)	34	70.8		
	with atraumatic restorative treatment	12	25		

The most common restorative materials reported by dentists included glass ionomer cement modified with resin, glass

ionomer cement, and resin composite, and they expected the most durability from these materials (Tables 7 & 8).

Table 7. The number of restorative materials used to repair "A" question root caries lesions by dentists

Restorative materials	Never	Seldom	Almost always	Always
Amalgam	35 (72.9)	8 (16.7)	5 (10.4)	0 (0)
Compomer	39 (81.3)	8 (16.7)	1 (2.1)	0 (0)
Composite resin	7 (14.6)	17 (35.4)	18 (37.5)	6 (12.5)
Flow composite	29 (60.4)	9 (18.8)	9 (18.8)	1 (2.1)
Crown (any material)	41 (85.4)	7 (14.6)	0 (0)	0 (0)
Glass Ionomer Cement	6 (12.5)	12 (25)	27 (56.3)	3 (6.3)
Resin-Modified Glass Ionomer Cement	0 (0)	5 (10.4)	25 (52.1)	18 (37.5)

Table 8. Two-year durability of restorative materials used by dentists.

Expected two-year durability of restorative materials (percentage)	0-20	21-40	41-60	61-80	81-100	I don't know
--	------	-------	-------	-------	--------	--------------

Amalgam	20 (41.7)	14 (29.2)	4 (8.3)	1 (2.1)	2 (4.2)	7 (14.6)
Compomer	25 (52.1)	3 (6.3)	4 (8.3)	0 (0)	0 (0)	16 (33.3)
Composite resin	0 (0)	2 (4.2)	4 (8.3)	28 (58.3)	8 (16.7)	6 (12.5)
Flow composite	7 (14.6)	10 (20.8)	12 (25)	3 (6.3)	0 (0)	16 (33.3)
Crown (any material)	5 (10.4)	9 (18.8)	29 (60.4)	5 (10.4)	0 (0)	0 (0)
Glass Ionomer Cement	0 (0)	1 (2.1)	15 (31.3)	23 (47.9)	7 (14.6)	2 (4.2)
Resin-Modified Glass Ionomer Cement	0 (0)	0 (0)	3 (6.3)	19 (39.6)	26 (54.2)	0 (0)

As for the question of clinical case B (68-year-old female patient with good general health and diabetes controlled with continuous use of medication), 83 people diagnosed the patient's caries as active and 17 as inactive. According to the opinion of the clinical expert, the caries were of an active type. The treatment methods for this patient were different from the point of view of dentists. In people who diagnosed the type of caries as inactive, the most common type of treatment chosen was the treatment of instruction + fluoride 1450 ppm and instruction + fluoride 1450 ppm+ removal of biofilm in the office. People diagnosed the type of caries as active, most of

the time, treatment with instructions + fluoride 5000 ppm+ removal of biofilm, instructions + fluoride 1450 ppm+ root scaling, instructions + fluoride 1450 ppm+ removal of biofilm + use of silver diamine fluoride solution and instructions ...+ fluoride 5000 ppm+ removal of biofilm + root scaling was chosen (Table 9).

Out of 100 dentists participating in the study, 83 people reported that they treat patients with similar conditions, of which most of them chose the selective drilling method of caries repair and access method with slot preparation (vestibuloproximal) (Table 10).

Table 9. The results of the clinical case B.

Treatment methods	Diagnosis type		Total number (percentage)
	Inactive number (percentage)	Inactive number (percentage)	
Root scaling	0 (0)	0 (0)	0 (0)
Instructions + fluoride 1450ppm	5 (29.4)	2 (2.4)	2 (2)
Instructions + fluoride 1450ppm + root scaling	1 (5.9)	14 (16.9)	19 (19)
Instructions + fluoride 1450 ppm + fluoride varnish	1 (5.9)	1 (1.2)	2 (2)
Instruction + fluoride 5000 ppm+ removal of biofilm	1 (5.9)	20 (24.1)	21 (21)
Instructions + fluoride 1450 ppm+ removal of biofilm in the office	4 (23.5)	2 (2.4)	3 (3)
Instructions + fluoride 1450 ppm+ removal of biofilm + use of silver diamine fluoride solution	1 (5.9)	14 (16.9)	18 (18)
Instructions + fluoride 5000 ppm+ removal of biofilm + root scaling	2 (11.8)	13 (15.7)	14 (14)
Instructions + fluoride 1450 ppm+ fluoride varnish + root scaling + removal of biofilm	0 (0)	7 (8.4)	9 (9)
Instructions + fluoride 5000 ppm+ removal of biofilm + use of silver diamine fluoride solution	0 (0)	4 (4.8)	4 (4)
Instructions + fluoride 5000 ppm+ removal of biofilm + root scaling + fluoride varnish	2 (11.8)	6 (7.2)	8 (8)

Fisher-Freeman-Halton Exact Test Statistics

9.148

P-value

0.337

Table 10. Frequency of restorative method and access to root caries lesions in question "A".

	Caries treatment	Number	Percentage	Test statistics	P-value
Treatment method	Complete caries removal	17	20.5	71.23	<0.001
	Selective caries removal	63	75.9		
	with slot preparation (occlusoproximal)	3	3.6		
How to access	with slot preparation (vestibuloproximal)	1	1.2	95.23	<0.001
	with atraumatic restorative treatment	69	83.1		

The most common restorative materials reported by dentists included composite resin and then glass ionomer cement

modified with resin, and they expected the most durability from these materials (Tables 11 & 12).

Table 11. The type of restorative materials used to repair "A" question root caries lesions by dentists.

Restorative materials	Never	Almost never	Almost always	Always
Amalgam	78 (94)	5 (6)	0 (0)	0 (0)
Compomer	76 (91.6)	7 (8.4)	0 (0)	0 (0)
Composite resin	2 (2.4)	6 (7.2)	47 (56.6)	28 (33.7)
Flow composite	17 (20.5)	45 (54.2)	21 (25.3)	0 (0)
Crown (any material)	15 (18.1)	40 (48.2)	25 (30.1)	3 (3.6)
Glass Ionomer Cement	31 (37.3)	35 (42.2)	14 (16.9)	3 (3.6)
Resin-Modified Glass Ionomer Cement	10 (12)	24 (28.9)	34 (41)	15 (18.1)

Table 12. Two-year durability of restorative materials used by dentists.

Expected two-year durability of restorative materials (percentage)	0-20	21-40	41-60	61-80	81-100	I don't know
Amalgam	36 (43.4)	35 (42.2)	8 (9.6)	0 (0)	0 (0)	0 (0)
Compomer	4 (4.8)	31 (37.3)	33 (39.8)	6 (7.2)	0 (0)	0 (0)
Composite resin	13 (15.7)	1 (1.2)	11 (13.3)	35 (42.2)	30 (36.1)	6 (7.2)
Flow composite	24 (28.9)	32 (38.6)	16 (19.3)	3 (3.6)	0 (0)	8 (9.6)
Crown (any material)	8 (9.6)	33 (39.8)	22 (26.5)	8 (9.6)	2 (2.4)	10 (12)

Glass Ionomer Cement	17 (20.5)	28 (33.7)	14 (16.9)	6 (7.2)	2 (2.4)	16 (19.3)
Resin-Modified Glass Ionomer Cement	2 (2.4)	12 (14.5)	34 (41)	18 (21.7)	5 (6)	12 (14.5)

The use of books along with congresses or symposiums, followed by the use of books and articles along with congresses or symposia was reported to be the most common way to stay up to date in the field of prevention (Figure 2).

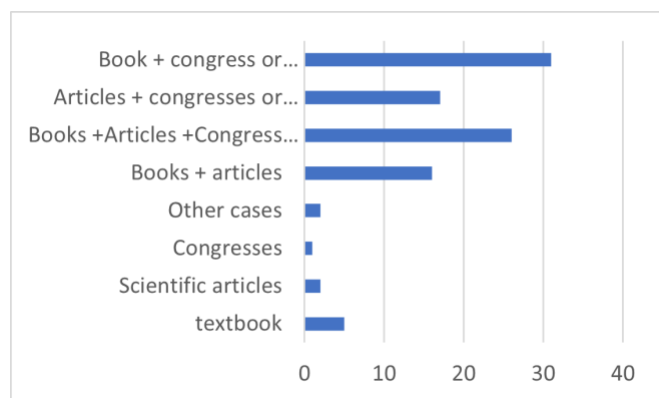


Figure 2. How to keep yourself up-to-date in the field of root caries lesions prevention in dentists.

The questionnaire was reviewed by three people from the team of experts and appropriate answers were selected based on their opinion. The table below shows the average agreement between each of the participants in the study with the opinion of the experts.

Based on these results, the level of agreement of the participants in the study with the expert, in the field of diagnosis criteria for active lesions when differentiating between active and inactive root caries lesions, was determined to be 0.44 on average, in which 63% of people significantly agreed with the expert. In the context of identifying the risk factors related to root caries, the agreement between the participants and the expert was calculated on an average of 0.35, in which only 12 subjects significantly agreed with the expert. In the questions related to clinical cases A and B, the average reliability was calculated as 0.12 with 37% significant agreement and 0.28 with 74% significant agreement, respectively (Table 13).

4. Discussion

Table 13. The average agreement between each of the participants in the study with the opinion of experts.

Section	Question number	Average kappa coefficient of agreement	Standard deviation	A significant percentage
Diagnosis	Question 2	0.44	0.29	63
Identify risk factors	Question 5	0.35	0.24	12
Clinical case "A"	Question 7	0.12	0.27	37
Clinical case "B"	Question 8	0.28	0.14	74

In this methodological study, cross-cultural adaptation and validity and reliability of dentists' knowledge and experience questionnaire in diagnosing, recording, and managing root caries lesions (RCL) in Iran were investigated. The dentists participating in the research were all residents of Mazandaran province. A total of 100 people participated in this study. The validity of this questionnaire was confirmed and its internal reliability was acceptable. In Niemeyer et al.'s study (2023), the reliability of the questionnaire was excellent in four languages: English, Italian, German, and French (8). The difference in reliability can be caused by the slight difference in the received concept of the questionnaire and the different ways of teaching and learning dentists in different countries. The difference in the reliability of different language versions of the questionnaire highlights two points:

First, there are clear differences in how dentists diagnose and manage root caries; Secondly, there is a fundamental need for training courses on the treatment of root caries. Based on this, it seems that the questionnaire is a relatively good measurement method to check the knowledge of dentists abo-

ut root caries (8).

The findings of this survey show a great difference between dentists in diagnosing, recording, and knowing the risk factors associated with root caries lesions. These findings are interesting and may indicate a learning need for dentists.

Our validation, like the study of Niemeyer et al. (2023), for collecting the data needed to support conclusions aligned with our objectives. (8). In addition, short questionnaires are a more efficient way to collect data based on the assumption that long questionnaires cannot be used in some research environments and private clinics (13). Answering long questionnaires may not be helpful because of the burden placed on patients and physicians, even if it provides more comprehensive data (14).

In the present study, more than half of dentists stated that they see at least one patient with root caries per week. The study of Wierichs et al. (2024) in Switzerland also showed that more than half of dentists encounter at least one patient with RCL per week (15), which is in line with our study. In Rabiei et al.'s study (2010), the prevalence of root caries in Iranian elderly

was 61.1% (16). In a study of Swiss residents over 70 years of age, almost half of the participants had at least one RCL. From these two studies, it can be concluded that most dentists encounter patients with RCL during their careers, which indirectly confirms the results of our study (17).

In our study, more than half of the dentists had high self-confidence in diagnosing cases of root caries. In the study of Weirich et al. (2024), most dentists showed high self-confidence when diagnosing root caries, which can indicate an underestimation of the management of root caries lesions (15).

In this study, according to most participants, tooth color is not a suitable criterion for diagnosis. In terms of visual appearance, more than half of the people did not consider visual appearance as a criterion for recognition. However, according to 40% of people, the dull appearance of teeth can be a criterion for diagnosis. Most people used being soft or leathery as a criterion for diagnosis. Almost half of the people did not know the presence of cavities and the place of decay as criteria. However, according to 52% of people, the presence of a cavity in the tooth is the criterion for distinguishing the type of root decay. In the study by Wieriche et al. (2024), graduates of three out of four universities considered the opaque or opaque surface to be the criterion of an active root caries lesion, indicating the degree of uncertainty among dentists after graduation. Also, the presence of cavities was considered as a dominant criterion for active lesions by two-thirds of dentists (15), which is more than our study; However, active root caries lesions may not necessarily have cavities (18, 19). Also, in this study, more than half of the dentists believed that soft or leathery texture during probing can indicate root decay (15), which is close to our study. This knowledge is important during treatment decisions, and any lack of clarity in the definition of active lesions always leads to under- or over-treatment (15).

In this study, 64% of dentists reported that they do not record root caries lesions as distinct from crown caries lesions, of which 67% of them reported that the reason for not recording was not important. A study of root caries in Queensland found that more than half of dentists did not differentiate root caries from crown caries (7), which is consistent with our study. In the study of Vieriche et al. (2024), most dentists distinguish between root caries and crown caries, which is contrary to our study; However, 41% still do not do this and their reasons were either because their classification system does not allow it or because they thought it was not necessary (61%), which is close to our study (15).

In our study, most of the people used common examination tools such as mirrors, probes, and forceps to detect caries, and the use of radiography and crease detectors were used as tools to help diagnose root caries. Rodrigues et al. (2011) stated that radiography may help to detect cavity root caries lesions (20). A study was not found that investigates the effect of caries detection dyes in the diagnosis of root caries, but several studies have confirmed the use of these products as an aid in the diagnosis of tooth caries in addition to other diagnostic cases (21).

In this study, the most important risk factors related to root caries included poor oral and dental hygiene, the presence of

plaque on the root surface, uncontrolled diabetes, saliva flow rate, the presence of periodontitis, and medication. A study showed that the presence of biofilm and gingival erosion are important risk indicators for root caries in the elderly (22), which is in line with our study. Also, another study showed that poor biofilm control and dry mouth are the main risk indicators related to root caries in older people (23). In addition, the study of He et al. (2024) showed that the probability of root caries is significantly higher in people with diabetes (24).

In our study, the most common restorative materials reported by dentists included glass ionomer cement modified with resin, glass ionomer cement, and composite resin, and they expected the longest durability from these materials. Resin-modified glass ionomer, glass ionomer, compomer, and composite resin are often used to repair root caries lesions (25). To choose the most appropriate restorative material for the treatment of root caries lesions, aesthetic concerns as well as physical, chemical, adhesion, and fluoride release properties should be considered (26). Recent evidence shows that fluoride-releasing materials such as glass ionomer and glass ionomer modified with resin prevent recurrent caries in restored root surfaces (26). Clinical studies provided limited data; Therefore, the most appropriate substance for the treatment of superficial root caries is still not certain (27). A study that examines and compares the durability of different materials for the treatment of root caries lesions was not found for comparison.

In our study, the most common follow-up times were 3 and 6 months. A study showed that in England, the follow-up of root caries repair is done more than in other investigated countries (Brazil, Iraq, India, Malaysia, Egypt, and Saudi Arabia). The longest follow-up interval for patients in this study was every 6 months (28).

In this study, 63% of people significantly agreed with the expert regarding the diagnostic criteria for active lesions when differentiating between active and inactive root caries lesions. In the field of identifying the risk factors related to root decay, only 12% of people significantly agreed with the expert. In the questions related to clinical cases A and B, 37 and 74% showed significant agreement with experts. A study comparing the opinions of specialists and general dentists to diagnose and identify risk factors related to root caries was not found to compare.

Despite achieving proper findings, the present study revealed some limitations. Firstly, the sample size of 100 dentists may not fully represent the diverse practices and experiences of all dental professionals. Additionally, the reliance on self-reported data could cause biases. Furthermore, the study's cross-sectional design limits the potential to establish causal relationships between dentists' knowledge and their clinical practices over time.

5. Conclusion

This study showed the appropriate reliability and validity of the investigated questionnaire. The present study highlights the enormous variability in the diagnosis, recording, and assessment of RCL risk factors. The benefits of proper

diagnosis, recording, and management of risk factors for root caries lesions should be emphasized in undergraduate and graduate dental education, and professional regulations should include more standardized management of root caries.

Acknowledgements

The authors thank all those who contributed to this study. The Research Vice-Chancellor of Sari University of Medical Sciences approved and supported this study.

Ethics

This research was approved by the Ethics Committee of the National Institute for Medical Research Development (IR.MAZUMS.REC.1402.19909).

Using artificial intelligence (AI)

It is declared by the authors of this manuscript that no generative artificial intelligence (AI) or AI-assisted technologies were used to generate content, ideas, or theories during the writing process of this work.

Author contribution

Haleh Hali: Conceptualization, Methodology

Shahab Papi: Methodology, Supervision

Mohammadreza Nourpour: Data collection

Houriye Abedi: Supervision, Visualization

Afsaneh Fendereski: Data curation and Analysis

Melika Mollaei: Conceptualization

Conflict of interest

No potential conflict of interest was reported by the authors.

Funding

None.

References

1. Paris S, Banerjee A, Bottenberg P, Breschi L, Campus G, Doméjean S, et al. How to intervene in the caries process in older adults: a joint ORCA and EFCD expert Delphi consensus statement. *Caries research*. 2020;54(5-6):459-65.
2. Banting DW. The diagnosis of root caries. *Journal of dental education*. 2001;65(10):991-6.
3. Slayton RL, Urquhart O, Araujo MW, Fontana M, Guzmán-Armstrong S, Nascimento MM, et al. Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions: A report from the American Dental Association. *The Journal of the American Dental Association*. 2018;149(10):837-49. e19.
4. Wierichs R, Kramer E, Meyer-Lückel H. Risk factors for failure in the management of cervical caries lesions. *Clinical oral investigations*. 2017;21:2123-31.
5. Wierichs R, Kramer E, Meyer-Lückel H. Risk factors for failure of class V restorations of carious cervical lesions in general dental practices. *Journal of dentistry*. 2018;77:87-92.
6. Wierichs R, Meyer-Lueckel H. Systematic review on noninvasive treatment of root caries lesions. *Journal of dental research*. 2015;94(2):261-71.
7. Garton B, Ford P. Root caries: a survey of Queensland dentists. *International Journal of Dental Hygiene*. 2013;11(3):216-25.
8. Niemeyer SH, Maniewicz S, Campus G, Tennert C, Yilmaz B, Zekeridou A, et al. Design, development, and validation of a questionnaire to assess dentists' knowledge and experience in diagnosing, recording, and managing root caries. *Clinical oral investigations*. 2023;27(6):2705-11.
9. Golafshani N. Understanding reliability and validity in qualitative research. *The qualitative report*. 2003;8(4):597-607.
10. Anthoine E, Moret L, Regnault A, Sébille V, Hardouin J-B. The sample size used to validate a scale: a review of publications on newly developed patient-reported outcomes measures. *Health and quality of life outcomes*. 2014;12:1-10.
11. Goldberg DP, Gater R, Sartorius N, Ustun TB, Piccinelli M, Gureje O, et al. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. *Psychological medicine*. 1997;27(1):191-7.
12. Lawshe C. *A Quantitative Approach to Content Validity*. Personnel psychology/Berrett-Koehler Publishers. 1975.
13. Corridor D, Campus G, Guerra F, Ripari F, Sale S, Ottolenghi L. Validation of the Italian version of the oral health impact profile-14 (IOHIP-14). *Annali di stomatologia*. 2013;4(3-4):239.
14. Saub R, Locker D, Allison P. Derivation and validation of the short version of the Malaysian Oral Health Impact Profile. *Community dentistry and oral epidemiology*. 2005;33(5):378-83.
15. Wierichs RJ, Kaspari I, Maniewicz S, Campus G, Tennert C, Carvalho TS, et al. Diagnosing and recording root caries: A survey among Swiss dentists. *Journal of Dentistry*. 2024;142:104870.
16. Rabiei M, Kasemnezhad E, Masoudi rad H, Shakiba M, Pourkay H. Prevalence of oral and dental disorders in institutionalized elderly people in Rasht, Iran. *Gerodontology*. 2010;27(3):174-7.
17. Lussi A, Maurer R, Zaugg D, Hotz P, Schaffner M. Prevalence and risk factors of root caries. A study of residents over 70 years old in the homes for the aged. *Schweizer Monatschrift fur Zahnmedizin= Revue Mensuelle Suisse D'odonto-stomatologie= Rivista Mensile Svizzera di Odontologia e Stomatologia*. 2001;111(4):422-39.
18. Fejerskov O, Nyvad B. Root surface caries-rationale behind good diagnostic practice. *Root Caries: From Prevalence to Therapy*. 26: Karger Publishers; 2017. p. 43-54.
19. Lynch E, Beighton D. A comparison of primary root caries lesions classified according to color. *Caries research*. 1994;28(4):233-9.
20. Rodrigues JA, Lussi A, Seemann R, Neuhaus KW. Prevention of crown and root caries in adults. *Periodontology*. 2000. 2011;55(1).
21. Javaheri M, Maleki-Kambakhsh S, Etemad-Moghadam S. Efficacy of two caries detector dyes in the diagnosis of dental caries. *J Dent (Tehran)*. 2010;7(2):71-6.
22. Tan HP, Lo EC. Risk indicators for root caries in institutionalized elders. *Community dentistry and oral epidemiology*. 2014;42(5):435-40.

23. Hayes M, Da Mata C, Cole M, McKenna G, Burke F, Allen PF. Risk indicators associated with root caries in independently living older adults. *Journal of dentistry*. 2016;51:8-14.
24. He L, Shi L, Zhu JH. Association Between Diabetes Status, Glycaemic Control and Untreated Root Caries Among United States Adults. *International Dental Journal*. 2025 Apr 1;75(2):537-44.
25. Burgess JO, Gallo JR. Treating root-surface caries. *Dental Clinics*. 2002;46(2):385-404.
26. Burgess JO. Dental materials for the restoration of root surface caries. *Am J Dent*. 1995;8(6):342-51.
27. Tonprasong W, Inokoshi M, Shimizubata M, Yamamoto M, Hatano K, Minakuchi S. Impact of direct restorative dental materials on surface root caries treatment. Evidence-based and current materials development: A systematic review. *Jpn Dent Sci Rev*. 2022;58:13-30.
28. Qutieshat A, Salem A, Aouididi R, Delatorre Bronzato J, Al-Waeli H, Abufadallah M, et al. Perspective and practice of root caries management: a multicountry study – Part I. *Journal of Conservative Dentistry and Endodontics*. 2021;24(2).

