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Quarterly

Review Article

**Effect of different methods of education on oral health in children with hearing impairment:
A systematic review**

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Effect of different methods of education on oral health in children with hearing impairment: A systematic review

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Review Article

Abstract

BACKGROUND AND AIM: The aim of oral health education is to prevent oral diseases. Literature review indicates that oral hygiene is poor in children with hearing impairment. Different methods have been used to teach oral health to children with hearing impairment. This systematic review was undertaken to evaluate the efficacy of different methods of oral health education to improve oral health in children with hearing impairment.

METHODS: Two independent researchers searched the Web of Science, PubMed, Scopus, and Cochrane Library databases without language restrictions, and a time limit of up to December 2016. Articles were imported to EndNote software and duplicate articles were removed. Relevant and proper articles were selected after considering the inclusion and exclusion criteria. Quality assessment was carried out, and articles with a score of more than 5 were selected for analysis in the review.

RESULTS: Of 453 articles found, 12 were assessed for eligibility based on defined inclusion criteria, and 9 studies were included in the review after quality assessment. Different methods such as video clips and dental models were used to train children. Out of the 9 studies, 8 studies showed a reduction in plaque index, and 4 studies were effective in improving gingival indexes. The results showed that educational intervention was effective in improving oral health.

CONCLUSION: Oral health education was effective in improving oral health status in children with hearing impairment without considering the method of education and learning barriers in these children.

KEYWORDS: Hearing Impairment; Oral Health; Education; Systematic Review; Children

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Oral hygiene is an essential component in human health with an effect on quality of life.¹⁻³ Despite improvements in oral health in recent decades, oral diseases are still prevalent in human societies.⁴ Furthermore, oral diseases are one of the most prevalent diseases in the world.¹

People with handicaps have a poorer oral

health than the general population. Individuals with different handicaps are faced with many social and environmental determinants of health such as lower income and educational levels compared to their normal peers.⁵ Hearing impairment is one of the common physical handicaps.¹ Nearly 360 million people live with hearing loss in the world (328 million adults and 32 million

1- PhD Candidate, Occupational Environment Research Center, Rafsanjan University of Medical Sciences, Rafsanjan AND Oral and Dental Diseases Research Center, Kerman University of Medical Sciences, Kerman, Iran

2- Dentist, Oral and Dental Diseases Research Center AND Kerman Social Determinants of Oral Health Research Center, Kerman University of Medical Sciences, Kerman, Iran

3- Professor, Endodontology Research Center, Kerman University of Medical Sciences, Kerman, Iran

4- Associate Professor, Oral and Dental Diseases Research Center AND Kerman Social Determinants of Oral Health Research Center, Kerman University of Medical Sciences, Kerman, Iran

5- Professor, Department of Epidemiology and Biostatistics AND Occupational Environment Research Center, Rafsanjan University of Medical Sciences, Rafsanjan, Iran

Correspondence to: Mohsen Rezaeian PhD

Email: moeygmr2@yahoo.co.uk

children). The majority of these individuals live in low- and middle-income countries.⁶ Children with hearing impairment “display more problems, such as depression, anxiety, and low self-concept”.⁷ In addition, they have communication barriers to receive adequate oral health awareness and inadequate ability to control their dental plaque.^{1,8} Literature review indicates that oral hygiene in children with hearing impairment is poor and inappropriate.⁹⁻¹⁴

Oral health education is the most cost-effective method for preventing dental diseases. The World Health Organization (WHO) recognizes oral health education as a behavior that improve oral health, and decrease the risk of oral diseases.² Oral hygiene instructions can be rendered with the use of educational aids.³

A study in the Rochester Institute of Technology showed that deaf students could succeed in college education if proper communication methods be used in teaching despite their limitations.¹⁵

In recent years, oral health education for individuals with hearing impairment has been the focus of attention. According to previous studies, different methods, including educational videos, illustrated books, and even manual use of toothbrushes and tooth models for education are effective in improving the oral health status in students with hearing impairment.^{8,16-18} However, to date no systematic review has been carried out in this field. Therefore, the aim of this systematic review was to determine whether oral health education in students with hearing impairment improve oral health status among them, and also to determine the most cost-effective method of oral health education in such children.

Methods

A systematic literature review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement to evaluate the impact of different educational methods to improve the

oral health status in children with hearing impairment. The bibliographic database resources, including the Web of Science, PubMed, Scopus, and Cochrane Library were searched without a time limit up to December 2016. For more precise search, the researchers used a combination of sensitive keywords according to Medical Subject Headings (MeSH) terms in the following structure: “oral health OR oral hygiene OR mouth diseases OR dental health surveys OR dental hygiene AND education OR train OR literacy program OR teaching OR educational activities OR training programs OR intervention AND deafness OR hearing impairment OR hearing loss OR hearing disorder OR disability”. Furthermore, the lists of relevant articles were reviewed to find additional references.

The search was conducted by two researchers independently, and then they reviewed the titles and abstracts of articles to select proper articles. First, the articles were found and imported to the EndNote software; then repetitive articles were deleted. After that, a list of titles and abstracts were prepared. Inclusion criteria consisted of articles on oral health education, and articles related to children with hearing impairment. The articles were considered to determine the relevance of their titles to our subject and check the full text of them. Subsequently, some articles were eliminated based on exclusion criteria. Exclusion criteria included non-compliance with the subject, inaccessibility of the full text, inadequate data, and articles in languages other than English. In all these studies, education intervention was conducted for oral health.

Then, the qualitative evaluation checklist for article¹⁹ was used to select the high-quality articles. In this checklist, the following items were evaluated to rate articles: comprehensive and structured abstract, a clear-cut target population, the outcome, the time and area of the study, random sampling, the type of blinding in the study, the clarity of goals and assumptions, the identification of initial and secondary

outcomes, and follow-up duration. If any of these items were considered, the score for the question was 1, and otherwise the score was 0. The maximum score was 10, and articles with a score of more than 5 were selected for analysis. Data were extracted from selected articles, and imported into Excel software program.

Results

Initially, 453 articles were found, and after reviewing and quality assessment, 9 articles with a score of more than 5 were included in the systematic review (Figure 1).

Five studies were conducted in India, and all the articles were published from 2011 on. In total, 1183 students aged 5-18 years with hearing impairment were trained in oral health for a mean duration of 16 weeks. Indexes such as Quigley-Hein plaque and gingival indexes were used for oral health

assessment. In all the studies, the tooth plaque index was evaluated. Different methods such as video clips and dental model were used to train children (Table 1).

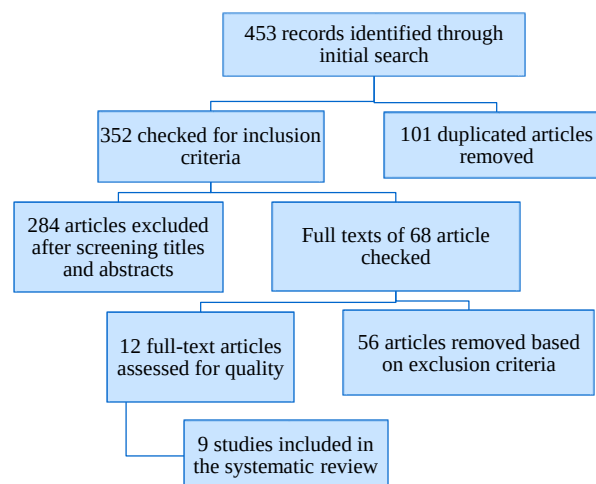


Figure 1. Selection of articles in this study

Table 1. Basic information of the included studies in review

References	Country	Age (year)	Sample size	Duration (week)	Type of education	Time for giving toothbrush and toothpaste	Outcomes assessed
Carissa et al. ²²	Indonesia	6-12	31	20	Pantomime	Not mentioned	Modified PHP index
Arunakul et al. ¹⁸	Thailand	6-10	66	12	Video clip and illustrated book	Not given	Quigley-Hein PI, Gingival bleeding index, and GI
Shetty et al. ¹	India	6-14	110	12	Video clip	Not mentioned	Quigley-Hein PI and GI
Sandeep et al. ⁸	India	6-16	372	12	Video clip	At the beginning	Silness-Löe PI and GI
Pouradeli et al. ¹⁶	Iran	7-19	73	4	Video clip and manually using brush and tooth models	At the beginning	O'Leary PI
Else et al. ¹⁷	India	5-17	56	3	Manual use of brush and tooth models	At the beginning	Quigley Hein PI and DMFS index
Pareek et al. ²⁰	India	6-15	315	6	Video and roll-on technique and dental models	At the beginning	Quigley-Hein PI and GI
Doichinova and Peneva ²¹	Bulgaria	5-12	100	12	Animated cartoons and manually using brush and tooth models and plastic dolls	Not given	Greene and Vermillion PI
Lamba et al. ²³	India	6-18	17	3	Manual use of brush and tooth models	At the beginning	Silness-Löe PI, GI, and DMFS index

PHP: Patient hygiene performance; PI: Plaque index; GI: Gingival index; DMFS: Decayed, missing, and filled surfaces

Table 2. The mean difference in plaque index (PI) before and after the education

References	Plaque index	Groups	Mean difference	P
Carissa et al. ²²	Modified PHP index	One group	1.25	0.0500
Arunakul et al. ¹⁸	Quigley-Hein PI	Group A (Only video clip)	0.79	< 0.0100
		Group B (Only illustrated book)	0.75	< 0.0100
		Group C (Both video clip and illustrated book)	0.87	< 0.0100
		Group D (Control)	0.64	< 0.0100
Shetty et al. ¹	Quigley-Hein PI	One group	0.32	< 0.0010
Sandeep et al. ⁸	Silness-Löe PI	Study	0.37	< 0.0010
		Control	0.08	0.0500
Pouradeli et al. ¹⁶	O'Leary PI	Group A (Only video clip)	15.70	0.0010
		Group B (Only models)	15.20	0.0010
Alse et al. ¹⁷	Quigley-Hein PI	Group A	0.10	0.0030
Pareek et al. ²⁰	Quigley-Hein PI	Group A	0.83	0.6400
		Group B	0.95	
		Group C	0.92	
Doichinova and Peneva ²¹	Greene and Vermillion PI	One group	0.48	< 0.0010
Lamba et al. ²³	Silness-Löe PI	One group	0.75	< 0.0001

PHP: Patient hygiene performance; PI: Plaque index

The plaque index was high in initial of the studies, and it was decreased after education in all studies, also these reductions were statically significant in eight studies (Table 2).

In 4 articles, gingival index was measured, and it improved after training significantly (Table 3).

Discussion

In this study, we reviewed the results of 9 articles that evaluated the effect of oral health education on oral health status in children with hearing impairment. The results of these studies indicated that oral health education had a positive effect on improving oral health in such children.

All the studies, except for one study, showed that oral health status significantly

improved after training. Of course, in this study, due to the considerable difference between the plaque index before and after training in each group, this difference was not statistically significant. Maybe, further statistical tests should be used to examine the difference between the mean difference in the plaque index before and after oral health education.²⁰

In a study by Doichinova and Peneva, there was simultaneous use of animated cartoons, and manual use of toothbrushes and tooth models and plastic dolls for educating oral health. The results showed that the oral health status improved.²¹ Carissa et al. used pantomime method for oral health education, which improved the oral health status.²²

Table 3. Mean difference in gingival index before and after education

References	Groups	Mean difference	P
Arunakul et al. ¹⁸	Group A (Only video clip)	0.17	< 0.0100
	Group B (Only illustrated book)	0.21	< 0.0100
	Group C (Both video clip and illustrated book)	0.17	< 0.0100
	Group D (Control)	0.17	< 0.0100
Shetty et al. ¹	One group	0.29	< 0.0010
Sandeep et al. ⁸	Study	0.31	< 0.0010
	Control	0.10	0.0500
Lamba et al. ²³	One group	0.46	< 0.0001

In Shetty et al.¹ Pouradeli et al.¹⁶ and Arunakul et al.¹⁸ studies, video clip method was used for oral health education, which proved effective in improving oral and dental health in children with hearing impairment.

Moreover, in the study by Arunakul et al.,¹⁸ in one group, video clip and illustrated book were simultaneously used for training, which significantly improved oral health status of children with hearing impairment. In another group, only an illustrated book was used for training oral health, which proved effective in improving oral health status. Finally, in this study, a comparison was made between four teaching groups, including only video, video and illustrated books simultaneously, only illustrated book, and control group with no training. The results showed that the plaque index significantly decreased in all the groups, and there was no difference between the four groups. Since all the trained and untrained children were studying in the same school, and due to their communication with each other, it was possible that the control group subjects received educational materials from other groups. Moreover, at the beginning of the study, some methods were used for standardization until the plaque score reached zero in all the groups. Therefore, the students in the control group paid more attention to their oral hygiene during the study period. Maybe, that is why the differences were not significantly different between the trained and untrained groups.¹⁸

In three studies, education was rendered using a toothbrush and a dental model with the help of sign language. The results of these studies showed that oral health status significantly improved after training.^{16,17,23}

In the study by Pouradeli et al., a comparison was made between two teaching oral hygiene methods through video and dental model. In both methods, plaque indices reduced after education, and there was no significant difference between the two methods. Perhaps, due to the relation of students in the school, the training was

communicated between them; therefore, no difference was detected between the two teaching methods.¹⁶

Besides, in Pouradeli et al.¹⁶ and Shetty et al.¹ studies, after a reinforcement period for education, the students were not given any training for a few months, and the oral health status was reassessed. The oral hygiene status was still favorable, indicating that students with hearing problems could learn as well as normal students, and education could have a stable effect on their performance if they received correct education.

In previous studies, the plaque index has been measured using different indexes such as Greene and Vermillion, and Silness and Loe, with the plaque index decreasing significantly after training in all the studies. Despite differences in the methods used for measuring and rating the plaque in each of these studies, each of these indexes can well reflect oral hygiene status.^{1,8,16-18,20-23} In addition, the gingival index was evaluated before and after training, and it improved after training in five studies.^{1,8,18,20,23} Therefore, correct and proper method of brushing can be a very effective way to improve oral hygiene status in students with hearing impairment, who are well trained, and can apply this method.

The main limitations in this study were the limited number, and average quality of articles in this field. In addition, there was high heterogeneity between studies, which could be due to differences between teaching methods, sample size, etc. In these studies, except for one study, there was not a control group to compare the effect of training with children not receiving training. Therefore, in further studies, surveying a group as a control group is recommended. Moreover, further studies are necessary to determine the best method of teaching, and to identify the needs and deficiencies of oral hygiene education in children with hearing impairment. Finally, in relation to the condition and facilities, we can choose the best method for teaching oral health in such children.

Conclusion

According to the results of this study, despite the fact that children with hearing impairment have limitations in communication and learning, they can learn oral hygiene methods like healthy children. Oral health education is effective in reducing plaque index and in improving oral health status in children with hearing impairment. Based on the availability of facilities, the best

teaching methods should be selected.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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Translation and validation of Persian version of Index of Dental Anxiety and Fear (IDAF-4C⁺)

Mohadeseh Arabsolghar DDS, MSc¹, Nazila Lashkarizadeh DDS, MSc¹,
Maryam Hashemipoor DDS, MSc², Taghi Momeni DDS³

Original Article

Abstract

BACKGROUND AND AIM: Being able to measure dental anxiety and fear is a necessary prerequisite for studying and understanding the nature and consequences of this common fear. Index of Dental Anxiety and Fear (IDAF-4C⁺) is the latest scale presented for the assessment of dental anxiety, but it has never been applied in Iran. The aim of this study was to validate the IDAF-4C⁺ for use among Persian population.

METHODS: In this cross-sectional study, 334 dental patients participated. The English original version of the IDAF-4C⁺ questionnaire was translated into Persian language by a forward-backward translation method. Reliability was determined by internal consistency using Cronbach's alpha and test-retest method measuring by intraclass correlation coefficient (ICC). Dental Anxiety Scale (DAS) was used to assess convergent validity using Pearson correlation coefficients. The relationship between demographic characteristics of age, sex, economical status, and income with dental anxiety also was assessed.

RESULTS: The Cronbach's alpha coefficient of the IDAF-4C⁺ was 0.91. The coefficient of test re-test reliability was 0.84 [95% confidence interval (CI): 0.81-0.87]. Pearson correlation coefficient between IDAF-4C⁺ and DAS was statistically significant at $P < 0.001$ ($r = 0.74$). In our study, fear and anxiety among women and patients with low income were significantly high.

CONCLUSION: The Persian version of IDAF-4C⁺ is a reliable and valid tool to measure dental anxiety and fear among Persian population.

KEYWORDS: Dental Anxiety; Validation Studies; Reliability; Validity

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Dental fear and anxiety (DFA) is defined as anxiety anticipated in a dental visit. It has been introduced as the fifth most common cause of anxiety.^{1,2} It is estimated that up to 13% of individuals suffer from severe anxiety.³⁻⁵

DFA is recognized as one of the most important factors that leads to dental avoidance.¹ As patients refuse to go to the dentist, this will result in poor oral health and influence their quality of life considerably.⁶ Therefore, a theoretical and efficient way of

measuring DFA in order to manage it properly has always been sought by the practitioners. With that in mind, different scales have been developed; however, many shortcomings have been attributed to them.^{2,7} For example, Dental Anxiety Inventory (DAI) is not popular because of large numbers of items in the scale.⁸ Dental Anxiety Scale (DAS)⁹ is another measure that is the most widely-used measure in the world and also in the population of Iran.^{3,10} However, it has some flaws such as: the theoretical basis upon

1- Assistant Professor, Department of Periodontics, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran

2- Associate Professor, Oral and Dental Diseases Research Center, Kerman University of Medical Sciences, Kerman, Iran

3- Dentist, Oral and Dental Diseases Research Center, Kerman University of Medical Sciences, Kerman, Iran

Correspondence to: Nazila Lashkarizadeh DDS, MSc

Email: nazilalashkarizadeh@yahoo.com

it the measure is developed has not been elucidated, it is limited to measure only the emotional component of fear, it is not able to distinguish between different levels of dental fear, and it has poor response scales.^{11,12}

With the aim of resolving the mentioned deficiencies of previous measures of DFA, Armfield invented the original English version of "Index of Dental Anxiety and Fear (IDAF-4C⁺)" scale in 2010, and it was evaluated in a population in Australia. It is designated based on the theoretical rules and the structure has three modules of DFA, dental phobia, and stimulus. This measure will give you information about these issues: who is a dental anxious patient, the rate of the severity and different components of DFA, the stimulating factors that incite anxiety in the patient, and who is suspected to suffer from dental phobia.¹³ Dental phobia is referred to the situation when an individual is distressed by his/her dental anxiety and this interferes with normal functioning, social activities, and occupation.^{1,14} Furthermore, because feeling of anxiety in an individual may be originated from psychological and social states beyond a simple dental stimulating factor, two items related to "panic disorder" and "social phobia" have been included in this measure as well.¹³

The aim of the present study is to make a transcultural translation of the IDAF-4C⁺ measure into Persian language, examine the reliability and validity of the Persian version of this measure, and evaluate the relationship between some demographic characteristics of an Iranian population with the DFA.

Methods

This cross-sectional study was approved by the Ethics Committee and Vice-Chancellor for Research of Kerman University of Medical Sciences, Kerman, Iran (ethical approval code number: IR.KMU.REC.1393.565). Sampling in this study was performed using convenience method, and willing adult patients (15-65 years old) getting treatment in dental clinics in Kerman were investigated and they were

assured that their information would remain confidential.

Considering the available texts,^{15,16} the sample size was calculated 330 subjects. Due to the possibility of subjects dropping out of the study, 400 individuals were included to the study.

Translation of the questionnaire: The original questionnaire was translated from English to Persian by cross-cultural adaptation process; at first, a translator competent in translating specialized English texts was asked to transfer the questionnaire independently. The questionnaire was then transcribed back to English by someone expert in Persian-English translation; this person was unaware about existence of the original questionnaire in English. Next in order to maintain the content validity, the transcribed text was compared to the original text by a specialist team in psychology and dentistry, and the final draft was obtained. In order to check the face validity, 10 graduate and undergraduate students were asked to look over the text as to test the intelligibility of its context. For the final validation, a dentist fluent in English was asked to compare both translations and point to any ambiguity in their meaning. In the end, the questionnaire was sent to its original author and after final modifications, it was used in the study.

Each study subject completed two Persian-translated questionnaires of IDAF-4C⁺ and DAS. An information form, including age, gender, marital status, economical status, and education, was also given to the subjects. IDAF-4C⁺ questionnaire includes 23 questions in 3 separate sections. The first section, the main part of the questionnaire, determines the levels of DFA and includes 8 questions. A Likert scale is used to answer these questions.¹⁵ The score range is from 8 to 40.

The "+" sign in the IDAF-4C⁺ measure stands for the second and third sections, dental phobia and stimulus modules, respectively.

The phobia module (IDAF-P) comprises of 5 questions. The first three questions are

designated to recognize the patients with dental phobia and the other two questions screen for the two psychological states of panic disorder and social phobia, respectively.¹⁷ The scoring system for this part of the measure is a "Yes" or "No" type. The score range is from 5 to 10.

The stimulus module (IDAF-S) comprises of 10 items. The patient should determine to what extend she/he feels anxious about each of these items. The scoring of this part of the measure is from "Not at all" (score = 1) to "Very much" (score = 5) for each item and it is ranged from 10 to 50.

DAS includes four items related to DFA and asks how the patient feels if he/she is going to the dentist tomorrow, if she/he is sitting in the waiting room in the dental office, if she/he is waiting for the dentist to prepare the tooth-drill device, and if she/he is waiting for teeth scaling and polishing treatment. The DAS instrument is wisely valid and reliable and the range for total mean score of this measure is 4-20. This value for IDAF-4C⁺ is 23-100.^{9,10}

In order to assess the validity of the IDAF-4C⁺, the DAS scale was utilized. The correlation between these two scales was measured using Pearson correlation coefficient. Reliability of the scale, based on the concept of internal consistency, was evaluated using Cronbach's alpha. The test-retest reliability of the IDAF-4C⁺ was measured using intraclass correlation coefficient (ICC) at two-week follow-up in 15 participants.

The correlation of the demographic

characteristic of age with the IDAF-4C⁺ mean score was evaluated using Pearson correlation coefficient; for sex and marital status independent sample t-test and for economic status and education level one-way analysis of variance (ANOVA) were used. Post-hoc test was used to make pairwise comparisons. $P < 0.05$ was considered statistically significant. All data analysis was done using SPSS software (version 16, SPSS Inc., Chicago, IL, USA).

Results

In this study, 334 subjects including 129 men (38.4%) and 205 women (61.6%) were investigated (the response rate was 83%). The average age of these participants was 30.3 ± 10.6 years.

Cronbach's α coefficient for reliability of the whole questionnaire was equal to 0.91. This coefficient was also calculated for each section of the questionnaire separately. The Corrected Item-Scale Correlation (CISC) of all included questions is mentioned in tables 1, 2, and 3.

To determine the questionnaire reliability in re-evaluating, ICC of 0.84 was obtained [95% confidence interval (CI): 0.81-0.87]. This coefficient for the first section was 0.87 (CI: 0.78-0.89), for the second section was 0.66 (CI: 0.51-0.77), and for the third section was 0.82 (CI: 0.76-0.87).

To assess the questionnaire validity, Pearson correlation coefficient was determined between IDAF-4C⁺ and DAS questionnaires as equal to 0.74.

Table 1. Results for evaluation of reliability of the scale based on Cronbach's coefficient and corrected item-scale correlation (CISC) (first module)

Internal consistency			
Item	CISC*	α^{**}	Cronbach's alpha
Feeling anxious before going to the dentist	0.65	0.88	0.89
Avoiding going to the dentist	0.63	0.88	
Getting nervous or edgy	0.71	0.87	
Thinking that something really bad would happen	0.64	0.88	
Feeling afraid or fearful	0.80	0.86	
Faster heart beating	0.73	0.87	
delaying making appointments	0.61	0.88	
Thinking about all things that might go wrong	0.59	0.89	

*Corrected item-scale correlation, **Cronbach's α if item deleted
CISC: Corrected item-scale correlation

Table 2. Results for evaluation of reliability of the scale based on Cronbach's coefficient and corrected item-scale correlation (CISC) (second module)

Internal consistency			
Item	CISC*	α^{**}	Cronbach's alpha
Avoiding to go to the dentist with intense fear	0.61	0.53	0.68
Fear being present for at least 6 months	0.39	0.65	
Affecting the different aspects of life	0.47	0.61	
To be concerned about having a panic attack	0.39	0.64	
To be afraid of being judged or watched in social situations	0.32	0.67	

*Corrected item-scale correlation, **Cronbach's α if item deleted

CISC: Corrected item-scale correlation

In addition, the correlation between the first section of the questionnaire and the second section was 0.68, the correlation with the third section was 0.65, and the correlation with DAS questionnaire was 0.68 ($P < 0.001$). Mean scores of the IDAF-4C⁺ and DAS scales is shown in table 4.

In this study, although IDAF-4C⁺ had no significant relation with age ($P = 0.210$), education ($P = 0.820$), and marital status ($P = 0.750$) variables, a significant relation was observed between this measure and gender and economical status of the individuals ($P < 0.050$). According to the post-hoc tests, people with weaker economic status showed signs of greater anxiety in comparison to others. The results are shown in table 5.

Discussion

In this study, IDAF-4C⁺ questionnaire was translated into Persian and its validity and reliability were proved. The reliability based on Cronbach's α coefficient was equal to 0.91 which is much higher than the standard value

(0.70).¹⁸ This coefficient was 0.89 for the first section. In the original document, this value was calculated 0.91 by Armfield.¹³ While for Finnish, Spanish, Swedish, and Turkish versions this value was 0.94, 0.88, 0.95, and 0.96, respectively.^{15,16,19,20} The small differences in this coefficient could be due to different study populations, social cultures, and participants' precision in answering the questions.

In the present study, based on CISC values almost all questions showed a correlation higher than the lowest acceptable value (0.40) except for two questions in the second and third modules related to "measuring levels of social phobia" and "the cost of dentist". This could be justified due to the different nature of these two questions. To verify this, Spanish version of the questionnaire as well showed that the question related to social phobia had the lowest correlation.¹⁶ In addition, question about the cost of dental treatments (in third section) in Spanish and Australian studies also had the lowest correlation with score in section IDAF-4C.^{13,16} Therefore, there was no need to change or delete any questions.

Table 3. Results for evaluation of reliability of the scale based on Cronbach's α coefficient and corrected item-scale correlation (CISC) (third module)

Internal consistency			
Item	CISC*	α^{**}	Cronbach's alpha
Painful treatment	0.56	0.84	0.85
Feeling embarrassed	0.46	0.85	
No control	0.61	0.83	
Feeling queasy or disgusted	0.68	0.83	
Numbness	0.59	0.83	
Not knowing what the dentist is going to do	0.57	0.84	
Cost	0.39	0.85	
Injection needle	0.64	0.83	
Gagging or Choking	0.62	0.83	
Unsympathetic dentist	0.47	0.85	

*Corrected item-scale correlation, **Cronbach's α if item deleted

CISC: Corrected item-scale correlation

Table 4. Scores of different sections of the Index of Dental Anxiety and Fear (IDAF-4C+) and Dental Anxiety Scale (DAS)

Variable	Minimum	Maximum	Mean $\pm$ SD
IDAF-4C ⁺	23	94	47.1 $\pm$ 15.5
First section	8	40	16.8 $\pm$ 7.8
Second section	5	10	6.0 $\pm$ 1.3
Third section	10	50	24.5 $\pm$ 8.3
DAS	4	20	10.3 $\pm$ 4.2

IDAF-4C⁺: Index of dental anxiety and fear; DAS: Dental anxiety scale; SD: Standard deviation

Table 5. Results for investigating the relationship between demographic characteristics of study subjects with Index of Dental Anxiety and Fear (IDAF-4C+) score

Variable	Score		
	n (%)	Mean $\pm$ SD	P
Gender			0.010
Men	127 (38.0)	43.24 $\pm$ 13.35	
Women	204 (62.0)	49.62 $\pm$ 16.43	
Economic status			0.002
Excellent	9 (3.0)	37.57 $\pm$ 12.42**	
Good	109 (36.0)	46.16 $\pm$ 15.43**	
Average	155 (52.0)	45.85 $\pm$ 14.07**	
Weak	26 (9.0)	57.56 $\pm$ 18.46*	
Marital status			0.750
Single	135 (41.0)	46.82 $\pm$ 15.63	
Married	193 (59.0)	47.39 $\pm$ 15.65	
Education			0.820
Lower than diploma	50 (15.4)	46.32 $\pm$ 14.85	
Diploma	133 (40.9)	47.22 $\pm$ 15.71	
Bachelor	100 (30.7)	47.64 $\pm$ 16.23	
Master	27 (8.4)	46.18 $\pm$ 14.33	
PhD	15 (4.6)	46.37 $\pm$ 13.52	

SD: Standard deviation

The mean IDAF-4C value with variant symbols was statistically different from others.

In the present study, ICC of 0.84 (95% CI: 0.81-0.87) was obtained to validate questionnaire by using the test-retest method; this value is closely similar to the value calculated in a study with the Turkish version of the questionnaire (ICC = 0.87), although the age group of this study varied from our survey, as it was done on a population of children.²⁰ The coefficient was also calculated for the first section (0.87) and it was almost similar to the results of the Australian (0.82) and Spanish (0.83) studies.^{13,16} In our study, ICC of 0.66 (95% CI: 0.51-0.77) was obtained for the second section as well; this value (ICC) in Australia was 0.57 to 0.67 and in Spain was equal to 0.22 to 1. In addition, the calculated value for the third

section was 0.82 (95% CI: 0.76-0.87) which was 0.55 to 0.73 in Australia and 0.55 to 0.78 in Spain.^{13,16} Time difference between test and re-test and also different sample sizes in these studies could be considered as justification for differences between distinguished values of ICC.

The present study used convergent validity to evaluate the questionnaire, and its correlation with DAS questionnaire was equal to 0.74, and this was 0.68 when correlating the first section with DAS questionnaire; this value was lower than what was obtained (0.84) by the original version of the questionnaire.¹³ Lack of accurate investigation in validating the Persian version of DAS and smaller sample size of our study are the reasons for this different in results. To validate, Finnish and Spanish versions used modified DAS (MDAS) questionnaire which, respectively, showed 0.74 and 0.76 for Pearson correlation coefficient.^{15,16}

Based on the results of this study, individuals with weak economic status showed higher levels of anxiety in comparison to other individuals. The same results were obtained by Armfield.¹³ Since previous studies point to the connection between unpleasant prior dental experience and DFA, we may conclude that low quality dental services for people with lower income are the cause of this problem.¹

Moreover, the present study showed that DFA in women is higher; Armfield¹³ and Carrillo-Diaz et al.¹⁶ also reached the same conclusion in their studies. On the other hand, in the Finnish version of IDAF-4C⁺ questionnaire, no significant difference

between levels of anxiety between men and women was found.¹⁵

Regarding the limitations of this research, it should be noted that the responsiveness of the questionnaire has not been examined, so it is recommended to investigate further research.

According to the results of this study, the Persian version of the IDAF-4C⁺ is appropriately reliable and valid. Hence, you can take advantage of that in diagnosis of dental anxiety in every day practice in dentistry and also in epidemiologic researches with the purpose of planning and purchasing major educational and therapeutic programs.

The modular approach of the IDAF-4C⁺ is very functional and unique. The core fear module enables you to diagnose DFA in the patient. The phobia module is useful to screen patients suffering from three separate psychological complications of "dental phobia", "panic disorder", and "social phobia". Positive results of the measure for each of these three requires additional psychiatric consultation for definitive diagnosis and treatment.^{13,15} The stimulus

module scores and its relationship with the core fear module helps identify DFA stimulating factors, therefore, improves the quality of received dental treatments by the patients as well as their oral health.

Conclusion

Application of an international measurement tool for DFA in different nations requires its complete adaptation to the cultural and social conditions of the target society; this study sought to validate the translated version of IDAF-4C⁺ questionnaire. Based on the results of this research, IDAF-4C⁺ in Persian is valid and reliable and could be used in studies concerned with evaluation of DFA among patients.

Conflict of Interests

Authors have no conflict of interest.

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A 25-year retrospective epidemiological study of intra-osseous lesions of jaw bones in Isfahan population, Iran

Sayed Mohammad Razavi DDS¹, Mohammad Ansari DDS²,
Saeedeh Khalesi DDS³

Original Article

Abstract

BACKGROUND AND AIM: Intra-osseous pathologic lesions of the jaw bones have different radiological and clinicopathological features from benign to malignant lesions. The aim of this study was to determine the prevalence of jaw lesions in Isfahan, Iran, during 1992-2017.

METHODS: In this descriptive-analytical study, all records of intra-osseous jaw lesions were investigated. All information of patients such as age, gender, location of lesion, radiographic feature, and histopathological diagnosis was collected. The lesions were divided to 7 groups including inflammatory periapical lesions, developmental odontogenic cysts, odontogenic tumors, benign non-odontogenic bone lesions, malignant bone tumors, developmental lesions, and others. The obtained data were analyzed with SPSS software, using chi-square test and Fisher's exact test.

RESULTS: A total of 1064 intra-osseous jaw lesions were evaluated. The mean age of patients with these lesions was 30.6 ± 15.1 years with the male to female ratio of 1.3:1. The most prevalent jaw lesions were inflammatory periapical lesions (49.9%), developmental odontogenic cysts (33.2%), benign non-odontogenic bone lesions (8.0%), odontogenic tumors (6.2%), developmental lesions (1.2%), malignant bone tumors (0.9%), and others (0.6%). Posterior region of mandibular bone was more affected. The frequency of jaw pathologic lesions according to site of lesions and age was statistically significant ($P < 0.05$), but no significant difference was observed based on gender ($P > 0.050$). Radicular cyst, dentigerous cyst, and central giant cell granuloma (CGCG) were the most prevalent. The most radiographic view was radiolucent.

CONCLUSION: This study showed the clinicopathological information of intra-osseous jaw bone lesions in Isfahan population. Inflammatory periapical lesions, odontogenic cysts, and tumors were the most common intra-osseous jaw bone lesions. These results showed the importance of health education to patients for prevention of inflammatory periapical lesions.

KEYWORDS: Jaw; Radiography; Prevalence; Pathology

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Intra-osseous jaw lesions have different clinical, radiological, and histopathological features.¹ Clinical and radiographic features of the lesions help determine the differential diagnosis, but the final diagnosis is only possible by histopathologic examination.² Dental radiography is necessary for complete

clinical information.³ According to radiological features, bone lesions were distributed to radiolucent, radiopaque, and a mix of both. Furthermore, these lesions might be around the root of teeth or crown of impacted teeth or might have no relation with teeth.^{4,5}

Based on histopathological features, jaw

1- Professor, Dental Implant Research Center, Dental Research Institute AND Department of Oral and Maxillofacial Pathology, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran

2- Student of Dentistry, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran

3- Assistant Professor, Dental Implant Research Center, Dental Research Institute AND Department of Oral and Maxillofacial Pathology, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran

Correspondence to: Saeedeh Khalesi DDS

Email: s_khalesi@dnt.mui.ac.ir

bone lesions can be categorized to inflammatory lesions, cysts, benign tumors, malignant lesions, and the osseous appearance of systemic disease. Although, in some studies, they were divided to odontogenic or non-odontogenic cysts, benign or malignant tumors, and developmental or reactive lesions.⁶ The prevalence of jaw lesions is different in population groups due to the impact of racial and geographic factors.^{5,6} In the most studies, odontogenic cysts were the most prevalent lesions,^{1,6,7} but in some studies, reactive lesions had more frequency than cystic lesions.⁸

Considering the great effects of geographic and racial factors on the prevalence of lesions and the importance of their early detection to improve prognosis, the aim of this study was to determine the prevalence of jaw lesions in Isfahan, Iran, during 1992-2017.

Methods

In this descriptive-analytical study, all records of jaw bone lesions from 1992-2017 registered in Department of Oral and Maxillofacial Pathology of Isfahan Dental School were investigated by a dentistry student of 12th semester. Before assessment of records of archive, the student was educated by an oral pathologist on how to extract information from registered records. All information of patients such as age, gender, location of lesion, radiographic feature

(radiolucent, radiopaque, mixed), differential diagnosis, and histopathological diagnosis was collected. The lesions were divided into 7 groups including inflammatory periapical lesions (group 1), developmental odontogenic cysts (group 2), odontogenic tumors (group 3), benign non-odontogenic bone lesions (group 4), malignant bone tumors (group 5), developmental lesions (group 6), and others (appearance of systemic disease, metastatic lesions) (group 7).^{1,6} The obtained data were entered into SPSS software (version 21, IBM Corporation, Armonk, NY, USA) and analyzed by chi-square test. A P-value < 0.05 was considered significant.

Results

In the current study, 1545 samples with intra-osseous jaw lesions were investigated in Isfahan Oral Pathology Department, of which 1064 samples were included. Due to a lack of information, 481 samples were excluded from the study. As for gender, 565 patients were male (53.1%) and 499 patients were female (46.9%). The male to female ratio was 1.3:1 and a non-significant difference based on chi-square test was observed ($P = 0.058$). Mandibular involvement was 1.5 times greater than maxilla involvement; posterior jaw was more affected. This difference was significant by chi-square test ($P = 0.050$). Table 1 shows the distribution of all samples based on clinical features of jaw lesions in seven groups of bone lesions.

Table 1. Distribution of intra-osseous lesions based on clinical features

Groups of bone lesions	Gender [n (%)]		Location [n (%)]				Age (year) (mean $\pm$ SD)	Total [n (%)]
	Male	Female	Anterior maxilla	Posterior maxilla	Anterior mandible	Posterior mandible		
Inflammatory periapical lesions	273 (51.4)	258 (48.6)	170 (32.0)	104 (19.5)	45 (8.5)	212 (40.0)	32.8 $\pm$ 13.6	531 (49.9)
Developmental odontogenic cysts	209 (59.2)	144 (40.8)	61 (17.2)	38 (10.7)	21 (6.0)	233 (66.1)	27.9 $\pm$ 16.8	353 (33.2)
Benign non-odontogenic bone lesions	36 (42.3)	49 (57.7)	6 (7.0)	11 (13.1)	10 (11.7)	58 (68.2)	28.1 $\pm$ 13.6	85 (8.0)
Odontogenic tumors	33 (50.0)	33 (50.0)	9 (13.6)	7 (10.7)	8 (12.1)	42 (63.6)	26.5 $\pm$ 13.5	66 (6.2)
Developmental lesions	6 (46.1)	7 (53.9)	7 (53.8)	5 (38.5)	1 (7.7)	0 (0)	44.7 $\pm$ 18.2	13 (1.2)
Malignant tumors	4 (40.0)	6 (60.0)	3 (30.0)	1 (10.0)	3 (30.0)	3 (30.0)	27.6 $\pm$ 11.1	10 (0.9)
Others	4 (66.6)	2 (33.4)	0 (0)	5 (83.3)	0 (0)	1 (16.7)	46.5 $\pm$ 20.5	6 (0.6)
Total	565 (53.1)	499 (46.9)	256 (24.0)	171 (16.0)	88 (8.2)	549 (51.8)	30.6 $\pm$ 15.1	1064 (100)

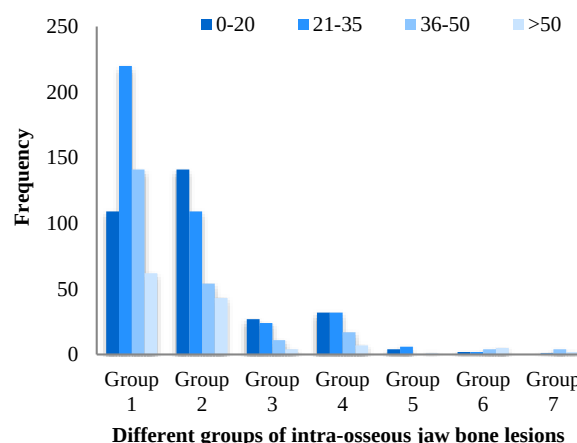
SD: Standard deviation

Table 2. Distribution of intra-osseous lesions based on radiographic features

Groups of bone lesions	Radiographic feature [n (%)]			
	Radiolucent	Radiopaque	Mixed	Total
Inflammatory periapical lesions	514 (96.8)	6 (1.2)	11 (2.0)	531 (49.9)
Developmental odontogenic cysts	345 (97.8)	2 (0.5)	6 (1.7)	353 (33.2)
Benign non-odontogenic bone lesions	65 (76.4)	8 (9.4)	12 (14.2)	85 (8.0)
Odontogenic tumors	38 (57.7)	16 (24.2)	12 (18.1)	66 (6.2)
Developmental lesions	13 (100)	0 (0)	0 (0)	13 (1.2)
Malignant tumors	8 (80.0)	0 (0)	2 (20.0)	10 (0.9)
Others	4 (66.7)	2 (33.3)	0 (0)	6 (0.6)
Total	987 (92.7)	34 (3.1)	43 (4.2)	1064 (100)

The patients' age ranged from 4 to 84 years and the average age was 30.6 ± 15.1 years. Based on chi-square test, the difference of frequency in patients' age between seven groups of bone lesions was statistically significant ($P < 0.001$). The prevalence of the group 1 lesions was more frequent in patients of 21-35 years old. In addition, most of the odontogenic cysts and tumors were seen in first and second decades. Benign non-odontogenic bone lesions were seen equally in the patients of 0-20 and 21-35 years old. The patients of 21 to 35 years old had the highest incidence of malignant bone tumors. The frequency of developmental lesions was higher in the age of 50 (Figure 1). Table 2 presents the frequency of different intra-osseous lesions based on radiographic features. The difference between radiopaque and radiolucent features was statistically significant; furthermore, there was a significant difference between seven groups of bone lesions based on chi-square test ($P < 0.001$). There was also a significant

difference between the radiolucent and mixed view ($P < 0.001$). However, the differences between radiopaque and mixed features in groups of study was not statistically significant ($P = 0.120$). Most of jaw bone lesions (92.7%) had radiolucent feature. Three most common lesions of each group are shown in table 3. Inflammatory periapical lesions were the most frequent among the jaw lesions (49.9%).

**Figure 1.** Frequency of intra-osseous jaw bone lesions based on different age groups**Table 3.** Distribution of three most common lesions in each group

Groups of bone lesions	Histopathologic diagnosis		
	First [n (%)]	Second [n (%)]	Third [n (%)]
Inflammatory periapical lesions	Radicular cyst: 376 (70.8)	Dental granuloma: 144 (27.1)	Osteomyelitis: 7 (1.3)
Developmental odontogenic cysts	Dentigerous cyst: 228 (64.5)	OKC: 101 (28.6)	COC: 7 (2.0)
Odontogenic tumors	Odontoma: 25 (37.8)	Ameloblastoma: 22 (33.3)	AOT : 6 (9.0)
Benign non-odontogenic bone lesions	CGCG: 28 (33.0)	Fibro-osseous lesions: 24 (28.2)	Osteoma: 5 (5.8)
Malignant tumors	Osteosarcoma: 4 (40.0)	Langerhans cell disease: 3 (30.0)	Chondrosarcoma: 2 (20.0)
Developmental lesions	NPDC: 13 (100)	-	-
Others	Antral pseudocyst: 6 (100)	-	-

CGCG: Central giant cell granuloma; NPDC: Nasopalatine duct cyst; AOT: Adenomatoid odontogenic tumor; COC: Calcifying odontogenic cyst; OKC: Odontogenic keratocyst

Malignant tumors [including osteosarcoma, chondrosarcoma, intra-osseous mucoepidermoid carcinoma (MEC)] and others (appearance of systemic disease, metastatic lesions) had the least prevalence among lesions. The most common lesions in the groups were radicular cyst (group 1), dentigerous cyst (group 2), central giant cell granuloma (CGCG) (group 3), odontoma (group 4), nasopalatine duct cyst (NPDC) (group 5), osteosarcoma (group 6), and antral pseudocyst (group 7).

The Cohen's kappa coefficient between clinical differential diagnosis and histopathological diagnosis was 70.0%. The concordance of diagnosis was relatively good compared to the primary and final diagnosis, but not desirable.

Discussion

In the present study, 1064 intra-osseous jaw lesions were evaluated. Based on our results, inflammatory periapical lesions (49.9%) were the most common jaw lesions. Comparing these results with other studies is difficult because the jaw bone groups are different in different studies. Most studies, such as Jamshidi et al.,⁶ Peker et al.,⁷ Mendez et al.,⁸ Ali,⁹ Al Yamani et al.,¹⁰ and other studies have shown that cystic lesions are the most commonly-reported jaw lesions. In this study, the second most common lesions were odontogenic cysts (33.2%), but in Jamshidi et al.⁶ and Ali⁹ studies, inflammatory lesions had higher prevalence than other lesions in Iran and Kuwait populations, respectively. Jaafari-Ashkavandi and Akbari reported that benign jaw bone lesions were the second greatest lesions in southern Iranian population.¹ In the present study, radicular cysts had the most frequency of intra-osseous jaw lesions followed by dentigerous cyst, dental granuloma, and odontogenic keratocyst (OKC), that was similar to other studies.^{1,2,7,9,11,12} However, Jamshidi et al. study showed the higher prevalence of OKCs than dentigerous cysts.⁶

Odontoma and ameloblastoma had the

highest incidence of odontogenic tumors in this study. This result is consistent with reports of Peker et al.⁷ and Gaitan-Cepeda et al.¹³ in Turkey and Mexico, respectively. However, some studies reported the higher prevalence of ameloblastoma than odontoma.^{1,6,14}

Consistent with the other studies, we found that CGCG and fibro-osseous lesions, respectively, were the most common benign jaw bone lesions.^{1,2,6,15} In contrast to this result, Peker et al.⁷ and Lei et al.¹² reported the higher occurrence of fibro-osseous lesions in Turkish and Taiwanese patients, respectively.

Only 0.9% of all intra-osseous jaw lesions were malignant tumors in the present study. Osteosarcoma was the most malignant jaw tumor, that was similar to other studies.^{1,6,16} In contrast to these results, Jaafari-Ashkavandi and Akbari,¹ Koivisto et al.,² and Ali⁹ indicated the higher prevalence of malignant tumors.

According to the present study, the intra-osseous jaw lesions had a slightly male predominance that was similar to other studies.^{1,6,7,15} Benign bone lesions, malignant tumor, and developmental lesions had higher prevalence in females. Some studies have shown that odontogenic tumors are more common in women than in men.^{7,13,17} In our study, these lesions were equally distributed.

In the current study, the total average age was 30.6 years, but in Jaafari-Ashkavandi and Akbari¹ study, it was reported 30.1 years, in Jamshidi et al.⁶ 29.6 years, in Peker et al.⁷ 42.0 years, and in Javadian et al.¹⁴ 36.0 years. Our study showed that the intra-osseous lesions had occurred in younger patients in Isfahan population in comparison with other populations. Furthermore, developmental lesions and malignant tumors mostly affected the older patients, that was similar to Jamshidi et al.⁶ study.

In all diagnostic groups of lesions, the posterior region of mandibular bone was the most location of involvement, that was similar to other studies.^{1,6,9,15} However, the developmental lesions such as NPDC occurred in anterior region of maxillary bone. The nature

of these lesions is the reason for this.

According to radiographic features, the lesions of current study were radiolucent, mixed, and radiopaque, respectively, that was different from Bernaerts et al.¹⁸ and Hosseini Zarch et al.¹⁹ studies in Belgium and Iran, respectively. However, this result resemble the report of Jamshidi et al.⁶

The compliance of the diagnosis as a result of the comparison of clinical and final diagnosis was 70.0% in our study, although this concordance was 80.5% in Peker et al.⁷ study. Regarding the clinical and radiographic similarities between radical cysts and periapical granulomas (PGs), these lesions have the majority of the diagnostic disagreements. The pathologic process is similar to these two lesions due to the reasons behind these results.^{7,20} However, these differences may be due to the interpretation of the clinical presentation and radiography of jaw lesions.⁷

It seems that racial and geographic factors affect the clinical, radiographic, and histopathological features of intra-osseous jaw lesions. However, different design and sample size of studies were important in

results. The limitations of present study were the lack of access to the radiographs. Defects in clinical and radiographic records show the importance of recording all information. Furthermore, if all slides of the samples were examined by histopathologic features for checking the diagnosis, the study accuracy would increase.

Conclusion

The current study showed the clinicopathological information of intra-osseous jaw bone lesions in Isfahan population. Inflammatory periapical lesions, odontogenic cysts, and tumors were the most common intra-osseous jaw bone lesions. These results showed the importance of health education to patients for prevention of inflammatory periapical lesions.

Conflict of Interests

Authors have no conflict of interest.

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Prevalence of Angle's malocclusion in sensory-deprived and normal school children of age group of 12-16 years in India: A study conducted in 2016-2018

Tarulatha R Shyagali MDS, DCE, DNHE, PhD¹, Manish Singh BDS², Rishi Joshi MDS³, Abhishek Gupta MDS⁴, Pratibha Kshirsagar BDS², Ruchi Jha BDS²

Original Article

Abstract

BACKGROUND AND AIM: Malocclusion has multifactorial etiology and the environmental factors play a major role in the occurrence of a malocclusion. Physical constraint faced by the disabled children may increase the chance of having malocclusion more than their normal counterparts. Thus, this study was done to evaluate the difference in the prevalence of Angle's malocclusion in sensory-deprived and normal children of the central India.

METHODS: A cross-sectional study was performed on 342 school-going children aged 12-16 years. The sample comprised of equal number of sensory-deprived and normal children (n = 171 for each group). Physical disabilities included being deaf, dumb, or visually-impaired. The children were examined for the type of Angle's malocclusion. Obtained data were subjected to chi-square test to note the difference in the prevalence of malocclusion between the two groups using the SPSS software. A P-value less than 0.05 was considered to be significant.

RESULTS: Angle's malocclusion was prevalent in 90.06% of the sensory-deprived children and 84.80% of the normal children. The most prevalent malocclusions in sensory-deprived children were class II division 1 and class I type I malocclusion with 24.60% and 21.63% prevalence, respectively. In normal children the most prevalent malocclusions were class I type II and class II division 1 with the prevalence of 23.39% and 21.05%, respectively. The results obtained were statistically significant.

CONCLUSION: High prevalence of malocclusion is seen in the sensory-deprived children compared to the normal children. The study warrants the need of orthodontic treatment in the current population group.

KEYWORDS: Angle's Classification; Malocclusion; Dental Occlusion; Disabled Children

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The World Health Organization (WHO) defines disability as an umbrella term describing the impairments, activity limitations, and participation restrictions.¹ Malocclusion can be caused either due to the underlying disease which might have caused the disability or the psychosocial issues associated with the disability or the physical constraint itself.² The studies in the past have

proven that malocclusion leads to poor quality of life and it is ranked third amongst the dental health problems next only to tooth decay and the periodontal diseases.³⁻⁵

The preconceived notion of the society makes the physically-disabled individuals less privileged in terms of receiving health care services and the educational opportunities.⁶ It is necessary to understand the existing dental problems in these children to improve their

1- Professor, Department of Orthodontics and Dentofacial Orthopedics, Hitkarini Dental College and Hospital, Jabalpur, Madhya Pradesh, India

2- MSc Student, Department of Orthodontics and Dentofacial Orthopedics, Hitkarini Dental College and Hospital, Jabalpur, Madhya Pradesh, India

3- Professor, Department of Orthodontics and Dentofacial Orthopedics, Hitkarini Dental College and Hospital, Jabalpur, Madhya Pradesh, India

4- Department of Orthodontics and Dentofacial Orthopedics, Hitkarini Dental College and Hospital, Jabalpur, Madhya Pradesh, India

Correspondence to: Tarulatha R Shyagali MDS, DCE, DNHE, PhD

Email: drtarulatha@gmail.com

quality of life. Around 15% of children worldwide are disabled. In India, one third of the total disabled population are children.⁷

The children who are affected with the partial or complete loss of hearing and partial or complete loss of vision and those who are deaf and dumb all have problems related to understanding and maintaining the oral hygiene instructions and practices in comparison to their normal counterparts. Poor oral hygiene maintenance may cause the premature loss of the teeth and subsequently lead to the development of malocclusion.⁸

There is paucity of the literature on the malocclusion prevalence in the sensory-deprived children. The comparison of the malocclusion prevalence in these children with normal children is also not given due consideration.⁹ To fill this research gap, the current study was aimed to evaluate and compare malocclusion status of the sensory-deprived children with that of the normal children of age group of 12-16 years using Angle's classification of malocclusion.

Methods

A cross-sectional study was carried out using the simple random method of sample collection. The sample survey was performed on 342 school-going children of 12-16 years old in Jabalpur City, India. Institutional Ethical Committee provided the permission to conduct the study (ethical clearance code: No.HDC&H/20). The sample was selected based on the selection criteria including individuals with no history of orthodontic treatment or the maxillofacial trauma, presence of sound permanent 1st molar, and no history of systemic illness.

A list of all the schools belonging to the sensory-disabled and the normal children

was obtained from the Social Welfare Department of the state. Three schools which trained and educated deaf and dumb, only deaf, and visually-impaired children were selected. The school authorities were approached and briefed about the study and their permission was sought for examining the children. All the participants signed the informed consent prior to the examination. A total of 171 sensory-deprived children met the selection criteria. The matching number of controlled group sample was selected by using the lottery system to select the school as well as the children.

The children were made to sit on chair or bench available at the time of examination. Natural illumination was utilized for the examination and if required a torch light was used. A single examiner examined all the children and the findings were entered into the preformed pro forma.

Mouth mirror was used to retract the cheek before examining the type of malocclusion to view the molar relationship in centric occlusion on either side of oral cavity.^{10,11} Relationship of the molar was classified as normal occlusion when the examined individual had bilateral Angle's class I molar relationship with an overjet and overbite of 2-3 mm and 1-2 mm, respectively¹² and the arches were in alignment with minimal crowding. The individuals with malocclusion were classified into three groups according to Angle's classification of malocclusion, i.e., class I, class II, and class III malocclusions. Further, class I malocclusion was classified into Dewey's types and the rest of the malocclusions were either bilaterally symmetrical or subdivisions (Table 1).

The data collected were transferred to Microsoft Office Excel sheet, and then analysed

Table 1. Dewey's modification of Angle's class I malocclusion

Dewey's types	Findings
Angle's class I type 1 malocclusion	Crowded incisors or labial canines
Angle's class I type 2 malocclusion	Protruded maxillary incisors
Angle's class I type 3 malocclusion	Anterior end to end occlusion or anterior crossbite
Angle's class I type 4 malocclusion	Unilateral or bilateral posterior crossbite
Angle's class I type 5 malocclusion	Mesial drift of molars

using SPSS software (version 22, IBM Corporation, Armonk, NY, USA). Pearson's chi-square test for the numerical value was applied to know the difference in the prevalence of different types of Angle's malocclusion between the normal and sensory-deprived children. The P-value less than 0.05 was considered to be statistically significant.

A single examiner examined all the subjects and to check the intra-examiner variability, 10 subjects were examined twice within the interval of a week and the data were subjected to Kappa statistics. The kappa statistics accounted for 0.88%, indicating good calibration of the examiner.

Results

Table 2 depicts the demographic data of the study population. The study was performed on 342 children of 12-16 years old, out of which 171 were sensory-deprived and 171 were normal children.

Table 2. Demographic data of the study sample

Sample	Gender	n (%)	Total [n (%)]
Sensory-deprived	Male	123 (35.96)	171 (50.00)
	Female	48 (14.04)	
Normal	Male	122 (35.67)	171 (50.00)
	Female	49 (14.33)	
Total	Male	245 (71.63)	342 (100)
	Female	97 (28.37)	

The distribution of the occlusion pattern in whole of the population including the sensory-deprived and normal children is shown in table 3. Malocclusion was prevalent in 87.1% of the population and the normal occlusion was prevalent in rest of the population (12.9%). The difference noted was

statistically significant.

Table 3. Prevalence of type of occlusion in study sample

Type of occlusion	n (%)
Normal occlusion	43 (12.90)
Malocclusion	299 (87.10)
Total	342 (100)

The difference between the sensory-deprived and the normal children for the distribution of the occlusion and Angle's malocclusion is depicted in table 4. Prevalence of malocclusion in sensory-deprived and normal children was by 90.06% and 84.80%, respectively. Class II division 1 was more prevalent in sensory-deprived (24.60%) than in the normal children (21.05%). Whereas, class I type 2 was more prevalent in normal children (23.39%) than the sensory-deprived (16.40%). Difference noted for the prevalence of all the kinds of Angle's malocclusion between two groups was statistically significant.

Comparison for the prevalence of different types of Angle's malocclusion in both sensory-disabled and normal children is depicted in table 5. Statistically significant difference was noted between sensory-deprived and normal children for the prevalence of class I and class III, and between class II and class III malocclusions ($P = 0.001$).

Discussion

The results of the study showed that there was an increased prevalence of Angle's malocclusion types in sensory-deprived children compared to the normal children.

Table 4. Comparison of prevalence of occlusion and malocclusion between the sensory-deprived and normal children groups

Occlusion Group	Normal	Class I				Class II			Class III		χ^2	P
		Type 1	Type 2	Type 3	Type 4	Division 1	Division 2	Subdivision	True	Pseudo		
Sensory-deprived [n (%)]	17 (9.94)	37 (21.63)	28 (16.40)	4 (2.23)	1 (0.58)	42 (24.60)	3 (1.80)	18 (10.52)	14 (8.20)	7 (4.10)	28.61	0.002*
Normal [n (%)]	26 (15.20)	32 (18.71)	40 (23.39)	6 (3.50)	4 (2.33)	36 (21.05)	3 (1.80)	21 (12.28)	2 (1.16)	1 (0.58)		

* $P < 0.050$

Table 5. Comparison of prevalence of Angle's malocclusion types in sensory-deprived and normal children groups

Type of malocclusion	Normal children	Sensory-deprived children	P
Class I	82	70	0.390
Class II	60	63	
Class I	82	70	0.001*
Class III	3	21	
Class II	60	63	0.001*
Class III	3	21	

The prevalence of malocclusions in different studies varies according to the methods of assessment, racial differences, and the chronological age of the sample. The need for baseline information regarding malocclusion in sensory-deprived children group is important as there is paucity of information regarding the same. This information will also help the policy makers in designing effective oral health education programs for the needy.

Normal occlusion was prevalent in 12.9% of the subjects and the remaining 87.1% of subjects had malocclusion for the overall population. When the data was segregated separately for the normal and disabled children, it was evident that the normal occlusion was more prevalent in the normal children by 15.20%, whereas only 9.94% of sensory-deprived children had normal occlusion. Similar results were also noted for the normal children (15.9%) of Benin City, Nigeria¹³ and were also comparable to the findings of a study conducted on the 10-12-year-old children of southern region of India, Kerala.¹⁴ However, higher prevalence of normal occlusion was reported in the Nigerian of Ibadan region (24.0%), Iranian (22.9%), and Brazilian (33.0%) normal children.¹⁵⁻¹⁷ Comparatively, higher percentage of normal occlusion was seen in the Nigerian disabled children compared to the current study group.¹⁸

Prevalence of class I malocclusion was greater in both the normal and the sensory-deprived children; however, the prevalence of class I malocclusion was greater in normal children (47.92%) than the sensory-deprived

children (40.81%). The difference noted between the two groups was statistically significant. However, variation in the prevalence of class I malocclusion in different groups of population can be traced in the previous literature. In India itself, in the southern regions like Kerala, Tamil Nadu, and Karnataka, the prevalence of class I malocclusion in normal children was 69.8%, 48.5%, and 62.0%, respectively.^{14,19,20} Similar regional variations were also reported in Saudi Arabian children, the prevalence ranged from 52.8% to 71.2%.^{21,23} Concurrent results for the prevalence of class I malocclusion were reported in Nigerian and Iranian children with the prevalence of 47.6%-50.0% and 52.0%, respectively.^{13,15,24} The huge variation in the reporting indicates the definite ethnic and racial influence in the propagation of malocclusion.^{15,24,25} Less prevalence of class I malocclusion was observed in Brazilian normal children with 37.3% prevalence.¹⁷

Reported prevalence of class I malocclusion in disabled children in the southern India population was 14.34%,⁹ which is less than the prevalence seen in current study group. Around 55.3% of the Nigerian handicapped children had class I malocclusion, which was comparable to results of the present study.¹⁸ In another study on the physically-disabled children in Cape Town, South Africa, it was reported that 29.0% of the disabled children had malocclusion. The findings were not in agreement with the current study as 90.96% of the physically-handicapped sample had malocclusion.²⁶ The high prevalence of malocclusion was also noticed in the special need children of south India.²⁷ In contrast, low prevalence of 69% malocclusion was reported for the Tanzanian physically-disabled children.²⁸ The type of malocclusion detected in physically-disabled children is influenced by the type of disability, general health, and the feeding habits.²⁹ Thus, generalising the results for the worldwide population seems illogical. A study on the

Saudi special needs children reported that the prevalence of class I malocclusion in children with autism was 41.0% and class III malocclusion was more prevalent in patients with Down syndrome.³⁰

Class I type 1 was more prevalent in sensory-deprived children (24.03%) and class I type 2 was more prevalent in normal children (27.60%). Least prevalent class I malocclusion in both groups was class I type 4 malocclusion. The results for the normal children were in contrast to the earlier study on Indian children.²⁰

In the current study, class II division 1 malocclusion was more prevalent in sensory-deprived children by 24.60%, next to it was class I type 1 malocclusion which was reportedly seen in 21.63% of the disabled children. In case of normal children, class I type 2 was the most prevalent malocclusion, which was seen in 23.39% of the sample, followed by the class II division 1 malocclusion with the prevalence of 21.05%. In comparison to other population groups, the prevalence of class II division 1 malocclusion was greater in the current group of normal children.^{13,15,20} Class II division 2 malocclusion was prevalent in 1.80% of the controlled and experimental group of the current study. High prevalence of class II malocclusion was also noted in children having cerebral palsy (CP).³⁰

Class III malocclusion was more prevalent in sensory-deprived children (12.30%) than the normal children (1.74%). True class III was prevalent in 8.20% of the sensory-deprived children and in normal children it was seen in 1.16% of the sample. The results indicate the need for early intervention by the orthodontist to tackle the problem of class III malocclusion specially the pseudo class III; so that, the further exaggeration of malocclusion to a full-fledged skeletal malocclusion is prevented.

Similar prevalence of class III malocclusion was reported in normal children of Tamil Nadu and Bangalore, India, with the prevalence of 1.5% and 0.6%, respectively.^{19,20} Higher prevalence of class III

was reported for the normal children and adolescents of different provinces of Iran (16.60%, 7.80%, 6.01%, and 3.70%).^{16,24,31,32} The variation in the prevalence of class III malocclusion was also reported in the Saudi children with 5.8%, 11.2%, and 15.4% prevalence in different provinces of the kingdom.²¹⁻²³ Same type of variation in prevalence of class III malocclusion was noted for the Brazilian children with 0.8% to 3.7% prevalence.^{17,25}

Class III malocclusion was prevalent in 9.5% of the disabled children in Nigeria.¹⁸ The literature, though, is explicit with the studies concerned with the prevalence of malocclusion in special needs children, has obvious lack of uniformity in terms of selection of sample. There are variabilities concerning the type of disability, age group, method of data collection, and the non-uniformity in the sample size.³³ The prevalence of subdivision malocclusion was 14.48% in normal children whereas in sensory-deprived ones, it was prevalent by 11.69%. The sensory-deprived children like the deaf and dumb and the visually-impaired children lack the normal dexterity and self-confidence exhibited by their healthy counterparts.³⁴ Their learning capabilities, which are very much different from the normal children, may lead to compromise in the status of the maintenance of their oral hygiene.³⁵ This finding can be an aggravating factor for the malocclusion to develop at such a young age. The results of the current study can be explained on the basis of the above statement.

As the study was limited to explore the malocclusion status in the sensory-disabled individuals, it will be beneficial to investigate the malocclusion status in other disability groups for comparing and planning the treatment strategies.

Conclusion

Overall prevalence of malocclusion (90.03%) was greater in sensory-deprived than the normal children (85.15%). Class II division 1

(27.28%) followed by class I type 1 (24.03%) were the most common malocclusions sited in sensory-deprived children. Class I type 2 (27.60%) and class II division 1 (24.82%) were the most common malocclusions sited in normal children. The least common malocclusion sited was class III in both sensory-deprived and normal children. Class III malocclusion was spotted by higher percentage in sensory-deprived (13.63%) than the normal children (2.05%).

The high prevalence of the malocclusion in the current study group warrants the need

for conducting the awareness programme for encouraging the children and their parents to visit the orthodontist for taking the appropriate treatment in time.

Conflict of Interests

Authors have no conflict of interest.

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Knowledge, attitude, and performance of internists regarding the relationship of periodontal disease and diabetes mellitus

Houra Shahhosseini¹, Simin Zahra Mohebbi DDS, PhD²,
Siamak Yaghobee DDS, MSc³, Mohammad Javad Kharazifard DDS, MSc, MPH⁴

Original Article

Abstract

BACKGROUND AND AIM: Studies have confirmed a strong association between periodontal disease (PD) and diabetes mellitus (DM). Treatment of DM is in the field of internists. This study aimed to assess the knowledge, attitude, and performance of Iranian internists regarding the relationship of DM and PD.

METHODS: In this cross-sectional study, a questionnaire comprising of five domains and 34 questions was utilized (12 questions regarding demographics, 2 questions regarding the need for continuing education courses on oral health for physicians, 5 questions about knowledge, 12 questions about attitude, and 3 questions about the performance of physicians regarding the association of PD and DM). This questionnaire has been previously used in a study conducted in North Carolina, United States of America. The questionnaire was translated to Persian and its validity and reliability were confirmed. Next, 134 internists participating in a national congress filled out the questionnaire. The response rate was 97%. Data were analysed using the linear regression model in SPSS software.

RESULTS: The mean and standard deviation (SD) of score of knowledge, attitude, and performance of internists was 57 ± 26 , 61 ± 12 , and 37 ± 28 , respectively, out of one hundred. Among the participants, 96% emphasized on the significance of cooperation with dentists in management of patients with DM and 81% of them confirmed the need for periodontal examination training for physicians. The total score of performance was significantly higher in internists with academic positions ($\beta = 0.177$, $P = 0.047$), older age ($\beta = 0.234$, $P = 0.011$), higher mean weekly working hours ($\beta = 0.185$, $P = 0.043$), and those who had passed a course regarding clinical, dental, and periodontal examination as part of their educational curricula ($\beta = 0.190$, $P = 0.035$).

CONCLUSION: This study showed that internists had low level of knowledge and performance regarding the relationship of PD and DM. This casts light on importance of enrichment of the educational curriculum and continuing medical educations in this regard.

KEYWORDS: Periodontal Disease; Diabetes Mellitus; Knowledge; Attitude; Professional Practice

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Diabetes mellitus (DM) is among the most challenging health dilemmas of the 21st century.¹ Its incidence is increasing worldwide due to increased mean age of the population, lifestyle changes, urban living, industrialization, and growing prevalence of obesity and sedentary

lifestyle.^{2,3} The five-year prevalence of DM in Iran was estimated to be 13.73% in 2015.⁴

Periodontal disease (PD) is among the most common infectious diseases worldwide. PD and dental caries are the two major causes of tooth loss.⁵ Review articles have confirmed a strong correlation between PD

1- Student of Dentistry, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran

2- Associate Professor, Research Center for Caries Prevention, Dentistry Research Institute AND Department of Community Oral Health, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran

3- Associate Professor, Department of Periodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran

4- Researcher, Dental Research Center, Dentistry Research Institute, Tehran University of Medical Sciences, Tehran, Iran

Correspondence to: Simin Zahra Mohebbi, DDS, PhD

Email: smohebbi@tums.ac.ir

and DM such that uncontrolled DM can lead to PD. Also, PD can affect blood sugar control.⁶⁻⁸ Moreover, PD is the sixth most common complication of DM.⁹

The American Diabetes Association (ADA) in 2003 published the standards of medical care for patients with DM and stated that oral examination should be part of physical examination of such patients.¹⁰ Physicians often examine the oral cavity by asking the patients to open their mouth and stick out their tongue and then they take a quick look at the pharynx. However, this method of examination overlooks many important clinical symptoms that may be present in the oral cavity.^{11,12} Dentists, physicians, and other healthcare providers should perform periodontal screening for patients with DM on a regular basis and recommend periodontal check-ups to their patients.¹³ Thus, some studies have recommended correct periodontal examination of patients with DM by physicians prior to their referral to dentists.^{14,15}

In the healthcare system, internists play an important role in treatment of patients with DM. Thus, assessment of their level of knowledge, attitude, and performance with regard to PD and its association with DM is imperative.

To the best of authors' knowledge, no similar previous study has been conducted at the national level in Iran. Thus, this study aimed to assess the knowledge, attitude, and performance of Iranian internists regarding the relationship of PD and DM.

Methods

This cross-sectional study used a questionnaire confirmed in a similar study conducted in North Carolina, United States of America.¹⁶ The English questionnaire was translated to Persian by a senior dental student fluent in English and was then back-translated to English by a native English speaker fluent in Persian. The questionnaire was then evaluated by a panel of experts comprising of 3 periodontists and 3 oral

medicine and community dentistry specialists in terms of content and face validity in a descriptive manner. The necessary revisions were then made. In order to assess the reliability of the questionnaire, the questionnaire was filled out by 10 internists in a pilot study. After one month, the questionnaire was filled out again by the same internists and the results were compared. The reliability for all questions was > 0.84 .

The final questionnaire comprised of 34 items and included closed and open Likert-scale questions in five domains. Of all, 12 questions were related to demographic and background information including age, gender, years providing care to patients with DM, mean weekly work hours, percentage of patients who have DM, percentage of patients with DM who experience PD, experience in having PD, last dental visit, self-perceived oral health, having any clinical experience with dentists or oral hygienists, having a dental model in office, and being interested in having a dentic for oral hygiene instruction in their office, 2 questions were related to the need for continuing education courses on clinical periodontal and dental examination by physicians, 5 questions were related to the knowledge of physicians about the association of PD and DM, 12 questions were related to the attitude of physicians towards this relationship, and 3 questions were related to their performance in this respect. Each question in knowledge, attitude, and performance was given a score from 0 to 5, and finally the scores were calculated as percentages.

Using the multiple regression power analysis option, SPSS software (version 25, IBM Corporation, Armonk, NY, USA), taking into account $\alpha = 0.05$ and $\beta = 0.20$ and 6 independent variables with $R^2 = 0.10$, the minimum sample size was estimated to be 130 samples.

The questionnaire was randomly administered among 134 internists participating in the 29th annual national congress of internists in Tehran, Iran (2018). Sampling was random using the

identification code of participants.

Data were analysed using a linear regression model via SPSS software. P-value < 0.05 was considered significant.

This study was approved by the Ethics Committee of Tehran University of Medical Sciences (ethical approval code: IR.TUMS.DENTISTRY.REC.1396.4626).

Results

The response rate was 97%. In table 1, the socio-demographic characteristics, oral health, and educational information of the respondents by number and percentage of total respondents is presented. Among the participants, 71% (n = 90) stated that less than 40% of their patients had DM.

Table 1. Sociodemographic characteristics, oral health, and educational information of respondents by number and percentage of total respondents

Variable	n (%)
Age (year)	
≤ 40	33 (25)
41-50	53 (41)
51-60	26 (20)
> 60	18 (14)
Gender	
Male	68 (52)
Female	62 (48)
Years providing care to patients with DM	
≤ 1-5	23 (18)
6-10	27 (21)
11-20	35 (27)
21-30	31 (24)
> 30	12 (9)
Mean weekly work hours	
≤ 10	24 (18)
11-20	20 (15)
21-30	6 (5)
31-40	36 (28)
41-50	22 (17)
> 50	22 (17)
Percentage of patients who have DM	
≤ 10	10 (8)
11-20	38 (30)
21-40	42 (33)
41-60	27 (21)
> 60	11 (8)
Percentage of patients with DM who experience PD	
0	1 (1)
1-10	12 (9)
11-20	17 (13)
21-40	18 (14)
> 40	23 (18)
I do not know	59 (45)
Have you ever been told that you have PD?	
Yes	13 (10)
No	107 (84)
Last time received dental care	
≤ 6 months ago	57 (45)
> 6 months to ≤ 1 year ago	27 (21)
> 1 year to ≤ 2 years ago	22 (17)
> 2 years ago	22 (17)
Never	0 (0)

Table 1. Sociodemographic characteristics, oral health, and educational information of respondents by number and percentage of total respondents (continue)

	n (%)
How do you rate your oral health status?	
Very good	18 (14)
Good	72 (56)
Moderate	28 (22)
Poor	8 (6)
Very poor	2 (2)
I do not know	0 (0)
Do you have any educational tool for oral hygiene instruction in your office?	
Yes	20 (16)
No	103 (84)
Are you interested in having educational tool for oral hygiene instruction in your office?	
Yes	94 (78)
No	27 (22)
Do you have any clinical experience with dentists or oral hygienists?	
Yes	25 (20)
No	99 (80)
How many hours of your educational curriculum were about oral health?	
≤ 3	104 (84)
> 3 to ≤ 5	17 (14)
> 5	3 (2)
Did your educational program include any clinical practice regarding dental examination?	
Yes	21 (16)
No	106 (84)

DM: Diabetes mellitus; PD: Periodontal disease

Also, 45% (n = 59) of physicians stated that they did not know what percentage of their patients with DM had periodontitis. The majority of physicians (80%, n = 99) had no clinical experience with dentists or dental hygienists, 84% (n = 104) of them reported receiving 0 to 3 hours of education about oral health and gingiva in their general medical and post-graduate education, and 84% (n = 104) reported no clinical practice with regard to gingival assessment in their educational curriculum.

The knowledge score of internists in this study ranged from 0 to 100 with a mean and standard deviation (SD) of 57 ± 26 . Table 2 presents the frequency distribution of the knowledge score of respondents. Of the participants, 64% (n = 81) reported that microbial plaque was the cause of PD. Also, 47% (n = 60) of physicians provided a correct definition for PD, i.e., bone loss around teeth. The majority of physicians (72%, n = 91) provided a correct definition for gingivitis, i.e., gingival inflammation.

Table 2. Frequency distribution of knowledge score of respondents regarding the relationship of periodontal disease (PD) and diabetes mellitus (DM)

Questions	n (%)
Which one is the cause of PD?	
Dental caries	34 (27)
Genetics	2 (2)
Microbial plaque	81 (64)
I do not know	9 (7)
What is the definition of PD?	
Gingival bleeding	11 (9)
Gingival redness	45 (35)
Bone loss around teeth	60 (47)
I do not know	11 (9)
What is the definition of gingivitis?	
Inflammation of gingiva	91 (72)
Gingival infection	23 (18)
Gingival bleeding	7 (6)
I do not know	5 (4)
What is the first symptom of gingival disease?	
Gingival recession	26 (21)
Gingival bleeding	82 (67)
Tooth mobility	7 (6)
I do not know	8 (6)
Which one is the symptom of periodontitis?	
Dental caries	17 (14)
Facial swelling	10 (8)
Tooth discoloration	8 (6)
Supporting bone loss	61 (49)
I do not know	29 (23)

PD: Periodontal disease

Table 3. Frequency distribution of attitude of respondents towards the relationship of periodontal disease (PD) and diabetes mellitus (DM)

Questions	Strongly agree	Agree	Do not know	Disagree	Strongly disagree
	n (%)	n (%)	n (%)	n (%)	n (%)
Studies confirm a strong correlation between PD and systemic health.	66 (52)	56 (44)	1 (1)	1 (1)	3 (2)
Periodontal health plays an important role in overall health.	80 (63)	45 (35)	0 (0)	0 (0)	2 (2)
Daily brushing and flossing is imperative for periodontal health.	103 (81)	22 (17)	0 (0)	0 (0)	3 (2)
I know about studies that confirm the association of PD and DM.	35 (27)	48 (37)	4 (3)	2 (2)	39 (31)
Patients with DM are at increased risk of severe PD.	62 (48)	44 (34)	4 (3)	2 (2)	16 (13)
Management of PD can improve glycemic control.	33 (26)	45 (35)	9 (7)	3 (2)	37 (30)
Risk of PD is higher in patients with poor glycemic control.	67 (52)	44 (34)	4 (3)	2 (2)	11 (9)
Internists should be taught to screen for PD in patients with DM.	52 (41)	51 (40)	17 (14)	3 (2)	4 (3)
Internists should cooperate with dentists to decrease the risk of PD in patients with DM.	81 (64)	42 (32)	2 (2)	0 (0)	2 (2)
I am interested in performing screening for PD to my patients with DM.	35 (28)	45 (36)	31 (26)	9 (7)	4 (3)
I need more information about PD and its effect on DM.	59 (47)	55 (43)	10 (8)	0 (0)	2 (2)
I am sure that I can perform oral health screening for patients with DM.	23 (19)	49 (40)	27 (21)	10 (8)	15 (12)

PD: Periodontal disease; DM: Diabetes mellitus

Only 49% (n = 61) of physicians correctly reported the symptoms of PD, i.e., supporting bone loss and more than half of physicians (67%, n = 82) correctly reported the first symptom of PD, i.e., gingival bleeding.

The attitude score of physicians ranged from 0 to 80 with a mean and SD of 61 ± 12 . Table 3 shows the frequency distribution of attitude score of participants. Of the participants, 96% (n = 122) confirmed the presence of a strong correlation between PD and systemic health in the literature but only 64% (n = 83) of them knew about the studies that confirm the association of PD and DM. Of the physicians, 81% (n = 103) agreed that the internists should be trained for periodontal examination in patients with DM; 96% (n = 123) of them agreed to cooperate with dentists to decrease the risk of PD in patients with DM. An interesting finding was that 64% (n = 80) of physicians were interested in screening of patients with DM for PD and oral hygiene instruction; whereas, only 59% (n = 72) of

them were sure that they could correctly perform the screening. Also, 90% (n = 114) of physicians stated that they required further information about periodontitis and its effect on DM.

The minimum and maximum performance score in this study was 6 and 100, respectively, with a mean and SD score of 37 ± 28 . Table 4 shows the frequency distribution of performance score of respondents. In response to the question "how many patients with DM you referred to a dentist for PD in the past year?" 40% (n = 51) reported zero and 31% (n = 40) reported 1 to 5 patients. Regarding the frequency of oral examination of patients with DM by physicians, 55% (n = 72) reported oral examination only when the patient complained of oral or gingival problems and 22% (n = 28) reported regular oral examination in each visit. Of all, 52% (n = 64) stated that they did not provide their patients with DM with any information about the risk of PD and its symptoms.

Table 4. Frequency distribution of the performance score of respondents regarding the relationship of periodontal disease (PD) and diabetes mellitus (DM)

Questions	n (%)
How many patients with DM did you refer to a dentist for PD in the past year?	
0	51 (40)
1-5	40 (31)
6-10	15 (12)
11-20	12 (9)
21-30	4 (3)
> 30	7 (5)
When do you perform oral examination for your patients with DM?	
In each visit	28 (22)
Self-reporting the problem by patient	72 (55)
Only in the first visit	9 (7)
Rarely or never	21 (16)
Do you instruct your patients with DM about PD and its symptoms?	
Yes	59 (48)
No	64 (52)

PD: Periodontal disease; DM: Diabetes mellitus

Our findings showed a positive correlation between the performance and attitude of physicians ($P = 0.001$). There was no statistically significant relationship between knowledge and performance.

Table 5 shows factors associating with performance in respondents as shown by linear regression (backward method). The mean performance score was significantly higher in physicians with academic practice ($\beta = 0.177$, $P = 0.047$), older physicians ($\beta = 0.234$, $P = 0.011$), those with longer mean weekly work hours ($\beta = 0.185$, $P = 0.043$), and those who had received training on oral and dental examination as part of their educational curricula ($\beta = 0.190$, $P = 0.035$). None of the background characteristics were associated with a higher knowledge and attitude.

Discussion

This study was aimed to assess the knowledge, attitude, and performance of internists regarding the relationship of PD

and DM. In the present study, the majority of internists were not aware of the signs and symptoms of PD and only 49% of them correctly mentioned the symptoms of PD. However, in studies conducted in other countries such as those by Tasdemir and Alkan (Turkey),¹⁷ Obulareddy et al. (India),¹⁸ and Asa'ad et al. (Saudi Arabia),¹⁹ 87.0%, 94.6%, and 80.0% of physicians correctly reported the signs and symptoms of PD, respectively. This difference may be attributed to the study populations as well as the field of specialty of physicians.

In the present study, the majority of physicians were aware of the strong correlation between PD and systemic health, which was in agreement with the results of previous studies such as those by Owens et al.,¹⁶ Tasdemir and Alkan,¹⁷ Obulareddy et al.,¹⁸ and Quijano et al.²¹ However, in a study by Al-Khabbaz et al., the majority of general physicians were not aware of this correlation.²⁰

Table 5. Factors associating with performance in respondents as shown by linear regression (backward method)

Performance	β	Non-Standard coefficient	P
Physicians with academic practice	0.177	11.463	0.047
Older physicians	0.234	0.626	0.011
Those with longer mean weekly work hours	0.185	3.958	0.043
Those who had received training on oral and dental examination as part of their educational curricula	0.190	14.923	0.035

In this study, the majority of physicians agreed that internists should receive training regarding gingival examination of patients with DM, and they need to cooperate with dentists to decrease the rate of PD in their patients with DM. This finding was in line with the results of Owens et al.¹⁶

An interesting finding of our study was that the majority of physicians stated that they were interested in performing gingival examination and oral health screening when examining their patients with DM; whereas, only 59% of them were sure that they could correctly perform such examinations. This finding highlights the need for training of physicians regarding periodontal examination.

On the other hand, our study showed that the majority (81%) of physicians agreed that internists should receive training regarding gingival examination of patients with DM. Moreover, Bassir Shabestari et al., in their study in Zanjan, Iran, indicated that 80.3% of medical interns agreed with the inclusion of oral medicine course in their educational curriculum.²² Considering the need for such training as well as the positive attitude of physicians towards it in Iran, it would be ideal to revise the medical educational curricula with respect to inclusion of training courses about PD. The majority of physicians expressed that they needed further information about PD and its effect on DM, which highlights the need for continuing education courses in this respect.

In our study, 60% of physicians stated that they referred their patients with DM to a dentist due to PD; whereas, Tasdemir and Alkan¹⁷ reported that they referred 56.5% of their patients to dentists due to general dental problems. The rate of referral of patients with DM to a dentist was 50.0% in the study by Al-Habashneh et al.²³ and 48% in the study by Owens et al.¹⁶

Physicians in our study reported that they never or rarely performed an oral examination for patients or did it only for those who complained of an oral problem. This finding was in agreement with that of

Owens et al.¹⁶ and Quijano et al.²¹

In our study, 52% of physicians stated that they did not inform their patients with DM about the risk of PD and its signs and symptoms and did not recommend periodontal examination as part of their medical care. This finding supported that of Owens et al. (47%).¹⁶ On the other hand, evidence shows that patients with DM have a low level of knowledge and attitude about the oral presentations and complications of DM.^{13,24} Therefore, providing patients with the information in this respect by the internists can enhance their level of knowledge.

Our findings showed a positive correlation between the performance and attitude of physicians. Similarly, Al-Habashneh et al. reported that physicians with high score of attitude referred higher number of patients to dentists.²³

The performance score of physicians with longer clinical experience was found to be higher in our study, which highlighted the need for inclusion of theoretical and practical courses in this respect in their medical educational curricula.

There was a probability that internists would not cooperate in completing the questionnaires. To solve this problem, oral health educational packages were prepared and delivered to the participants as an incentive. Future studies are required to assess strategies to increase the cooperation of physicians and dentists, enhance their knowledge, and revise their continuing education courses to maximize their efficacy.

Conclusion

This study revealed that internists had a low level of knowledge and performance with respect to the relationship of PD and DM; however, they had a rather positive attitude towards it. The majority of physicians emphasized on the significance of cooperation with dentists for treatment of patients with DM and agreed with periodontal examination training for

physicians. Thus, it is recommended to revise the educational curricula of physicians to pay more attention to the relationship of oral health and DM. Furthermore, continuing education courses in this respect seems imperative to enhance the level of knowledge of physicians and increase their level of cooperation with dentists in order to promote the health of patients with DM.

Conflict of Interests

Authors have no conflict of interest.

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Retained primary tooth in unusual ages in southern Iran: A population-based study

Hossein Famarzi MD¹, Zahra Damankesh DMD²,
Razieh Sadat Mousavi-Roknabadi MD³, Soheila Keshavarz MD⁴

Original Article

Abstract

BACKGROUND AND AIM: The retained primary tooth (RPT) is a tooth that remains beyond its exfoliation time, which can cause some problems. This study aimed to evaluate the prevalence of RPT in unusual ages in Larestan, a city in Fars Province, southern Iran.

METHODS: In this cross-sectional population-based study (April-October 2015), clinical and radiological evaluations were done for all patients referred to Larestan dentistry clinics. The characteristics of RPT were evaluated. All data were analyzed statistically using SPSS and MedCalc software ($\alpha = 0.05$).

RESULTS: Among 2106 patients, 145 (6.88%) had at least one RPT. The most frequent RPT were primary canine in the maxilla (42.45%) and second primary molar in the mandible (33.01%). The main cause of RPT was absence of permanent successor tooth congenitally (67.45%) and impaction of it (33.54%). The most tooth mobility was class III (17.92%) and the second molar in mandible had the most mobility (6.60%). Root resorption was seen in about 45% of patients, which level 3 was the most (24.76%), mostly in second molar in mandible. Infra-occlusion was seen only in 5.18% of patients. There were significant correlations between root resorption and age ($r = 0.175$, $P = 0.0360$) and gender ($r = 0.171$, $P = 0.0400$), mobility and decay ($r = 0.470$, $P < 0.0010$), as well as infra-occlusion ($r = 0.262$, $P = 0.0010$).

CONCLUSION: The prevalence of RPT in unusual ages was not high in this study, but exact examination can detect the RPT earlier, to prevent the related problems by suitable treatments. Studies in larger population are recommended.

KEYWORDS: Primary Tooth; Panoramic Radiography; Epidemiology; Iran; Health Policy

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The retained primary tooth (RPT) is the tooth that still remains beyond the time of shedding.¹ Few studies on the RPT at the unusual age have been conducted.^{2,3} In some researches, RPT had been studied besides the malocclusion evaluation or dental anomalies,³⁻⁷ and others studied the causes,² methods of treatment,¹ and the mineralized tissue in the pulp of RPT.⁸ The frequency of the RPT is about 3.20% to 16.60% according to previous studies.³⁻⁷

Primary tooth may be maintained for

different reasons; however, the most common reason is congenitally missing permanent successor tooth,^{9,10} but it has not been fully explained. It could be due to a combination of genetic and environmental factors such as infection, trauma, drugs, radiation, and endocrine system or may be related to the syndromes such as Down syndrome.¹⁰ RPT may lead to periodontitis disease, decay, dental ankylosis, as well as cosmetic problems.^{1,11} Dentists often are the first ones that recognize the dental anomalies. Clinical and radiographic assessment for all patients

1- Assistant Professor, Department of Community Medicine, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran

2- Dentist, Larestan University of Medical Sciences, Larestan, Iran

3- Department of Emergency Medicine, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran

4- Communicable Diseases Unit, Shohada-e-Enghelab Health Center, Shiraz University of Medical Sciences, Shiraz, Iran

Correspondence to: Razieh Sadat Mousavi-Roknabadi MD

Email: mousavi_razieh@sums.ac.ir

with RPT is essential. In clinical examination, tooth shape, color, and structure, gums, teeth relationship with opposite and adjacent teeth, and teeth relationship with occlusal plane should be checked. In radiographic examination, the apical position of the tooth, root resorption, periodontal support tissues, bone height, and inter-radicular space should be examined.¹ Our literature review showed that few studies assessed the prevalence of RPT in Iran. Sheikhi et al. reported that the prevalence of congenital missing tooth in evaluation of 2422 patients between 7 and 35 years old in 8 provinces of Iran was 10.90%.¹² Also, in the study of Vahid-Dastjerdi et al., this rate was reported as 9.10% from 1999 to 2009 in Tehran, Iran, which was conducted on 1751 patients (9-27 years old).¹³

Hence, the RPT in unusual ages leads to wide dental problems and it is important to know the prevalence in health policy and prevention programs; this study aimed to assess the prevalence of RPT in unusual ages in southern Iran.

Methods

The current prospective cross-sectional population-based study (April-October 2015) was conducted on all patients referred to dental clinic of Larestan University of Medical Sciences and Rahgozar Charity Dentistry Clinic in Larestan, a city in Fars Province, southern Iran, with about 213920 populations in 2016.¹⁴

The inclusion criteria were all patients aged upper than 10 years, with good physical condition, Persian language, no previous pulled primary tooth, no contraindication for radiological imaging, and without any systemic disease or syndrome associated with RPT, such as Down syndrome, cleidocranial dysplasia, hypothyroidism, or hypopituitarism.¹⁰ All of these patients were examined for RPT clinically by 5 dentists. Data collecting form was filled for all of them, which included demographic information such as age, gender,

occupational status, telephone number and address, their awareness about RPT and its way. Panoramic radiography (Planmeca Promax, Finland, 64 kV/10 mA) was done for patients who were diagnosed clinically as having RPT, by a specific radiology center. Image processing and fixing were done automatically (care stream).

For the second time, clinical evaluation for types of RPT, number, place, being one-sided or two-sided, being decayed or not, mobility, tooth infra-occlusion, and conducted treatment were done by one specific dentist. Also radiological evaluations involving impaction, being decayed or not, existence of permanent successor tooth, and root absorption were done for them.

In this study, tooth mobility was classified according to Miller's classification:¹⁵

- 1) Class 0: Normal (physiologic) movement
- 2) Class I: Horizontal movement less than 1 mm
- 3) Class II: Horizontal movement 1 mm and more
- 4) Class III: Horizontal and vertical movement 1 mm and more

The amount of root resorption of second primary molar tooth in mandible in radiological images was classified in 6 levels:¹⁶

- 1) Level 1: No root resorption
- 2) Level 2: 1/4 root resorption
- 3) Level 3: 2/4 root resorption
- 4) Level 4: 3/4 root resorption
- 5) Level 5: 4/4 root resorption with remained tooth
- 6) Level 6: 4/4 root resorption without any tooth

Based on Nordquist et al.³ study, the other teeth root resorption was evaluated. Tooth infra-occlusion was measured via the space between primary tooth occlusal level and the adjacent permanent tooth. If this interval was 1 mm or more, infra-occlusion was occurred.¹⁷

All findings were recorded on data collecting form. The SPSS software (version 20, IBM Corporation, Armonk, NY, USA) and MedCalc statistical software (version 13.3.3, MedCalc Software bvba, Ostend, Belgium;

<http://www.medcalc.org>; 2014) were used for the statistical analysis, through descriptive and analytical tests such as chi-square test, Fisher's exact test, one-way analysis of variance (ANOVA), and Spearman's rho correlation test. Results were summarized in number and percentage for categorical variables. Two-sided P-value less than 0.050 and confidence interval (CI) of 95% were considered to be statistically significant.

The study was reviewed and approved by Larestan University of Medical Sciences (#1393/117 on 1393.7.14). To consider ethical issue, the collected data were not revealed to anybody, except to the researchers; therefore, the patients' names were confidential. Also, all participants signed the written informed consent.

Results

Among 2106 patients referred to these centers, 145 (6.88%) patients had at least one RPT, and totally 212 RPT were diagnosed, which 51 (35.20%) were men and 94 (64.80%) were women ($P < 0.0001$) using chi-square test. RPT was more frequent in women ($P < 0.0001$) and the ages between 20 and 29. Using one-way ANOVA test, the number

of RPT was significantly associated with age ($P < 0.0001$). Total of 64 (44.10%) patients knew about their RPT existence and 39.30% of this knowledge was dependent on dentists' examination. Women were more aware about having RPT ($P = 0.0250$) using chi-square test. Only 5 (3.40%) patients had positive family history for RPT, although we cannot rely to their responses because of information bias. Total of 100 patients (68.96%) had only 1 RPT (Table 1).

The most frequent RPT was primary canine in maxilla (42.45%) and the second primary molar in mandible (33.01%). The least frequent was primary central incisor in maxilla (0.94%). The first primary molar in maxilla was not seen. The main cause of RPT was absence of permanent successor teeth, congenitally (34.81%). Although 4.71% of patients had tooth extraction, a total of 56.60% of RPT were seen in one side of the jaw (left or right), and the most common teeth were second molar in mandible (21.70%) and canine in maxilla (21.70%). The most rate of dental pathology was periodontal disease (28.77%) and dental decay (17.05%), respectively.

Table 1. Patients' characteristics

Variable		Frequency of patients [n (%)]	RPT [n (%)]	Knowledge about RPT existence [n (%)]
Gender	Female	94 (64.80)	130 (61.32)	44 (30.30)
	Male	51 (35.20)	82 (38.67)	20 (13.80)
	Total	145 (100)	212 (100)	64 (44.10)
		$P < 0.0001^*$	$P < 0.0001^*$	$P = 0.0250^*$
Age (year)	10-19	51 (35.20)	79 (37.26)	6 (4.10)
	20-29	52 (35.90)	69 (33.54)	32 (22.10)
	30-39	27 (18.60)	39 (18.39)	15 (10.30)
	40-49	12 (8.96)	22 (10.37)	9 (6.20)
	50-59	3 (2.75)	3 (1.88)	2 (1.40)
	Total	145 (100)	212 (100)	64 (44.10)
		$P < 0.0001^*$		$P < 0.0001^*$
Number of RPT	1	100 (69.00)	-	-
	2	35 (24.10)		
	3	4 (2.80)		
	4	4 (2.80)		
	5	0 (0)		
	6	1 (0.70)		
	7	0 (0)		
	8	1 (0.70)		
	Total	145 (100)		

*Statistically significant using chi-square test

RPT: Retained primary tooth

Table 2. The characteristics and the cause of retained primary tooth (RPT)

Maxilla	Central incisor [n (%)]	Lateral incisor [n (%)]	Canine [n (%)]	First molar [n (%)]	Second molar [n (%)]	Total [n (%)]
Number of RPT	2 (0.94)	4 (1.89)	90 (42.45)	0 (0)	22 (10.38)	118 (55.66)
On one side of the jaw	2 (0.94)	4 (1.89)	46 (21.70)	0 (0)	8 (3.77)	60 (28.30)
Hidden RPT	1 (0.47)	0 (0)	53 (25.00)	0 (0)	3 (1.41)	57 (26.89)
Absence of permanent successor tooth	1 (0.47)	4 (1.89)	29 (13.68)	0 (0)	8 (3.77)	42 (19.81)
Decay	0 (0)	0 (0)	7 (3.30)	0 (0)	10 (4.72)	17 (8.09)
Restoration	0 (0)	0 (0)	1 (0.47)	0 (0)	0 (0)	1 (0.47)
Root treatment	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mandible						
Number of RPT	9 (4.26)	3 (1.41)	7 (3.30)	3 (1.41)	72 (33.01)	94 (44.34)
On one side of the jaw	2 (0.94)	3 (1.41)	7 (3.30)	2 (0.94)	46 (21.70)	60 (28.30)
Hidden RPT	0 (0)	2 (0.94)	4 (1.89)	1 (0.47)	0 (0)	7 (3.30)
Absence of permanent successor tooth	9 (4.26)	1 (0.47)	2 (0.94)	1 (0.47)	40 (18.87)	53 (25.00)
Decay	0 (0)	0 (0)	1 (0.47)	1 (0.47)	17 (8.01)	19 (8.96)
Restoration	0 (0)	0 (0)	0 (0)	0 (0)	13 (7.10)	13 (7.10)
Root treatment	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.94)	2 (0.94)

RPT: Retained primary tooth

The most percentage of decay was seen in second molar in mandible (8.01%) and maxilla (4.72%). Restoration was done in 7.57% of the RPT, and only 2 roots (0.94%) were treated (Table 2).

Totally, 25 (17.20%) of patients had teeth mobility in 61 teeth. The motile RPT in maxilla and mandible were 30 and 31, respectively, which had no significant difference ($P = 0.960$). Most grade of teeth mobility was class III (17.92%), and the second molar in mandible had the most mobility (6.60%) (Table 3).

Of 212 RPT, 3 roots (1.41%) were not visible completely, due to root coverage by hidden latent permanent successor teeth, and total of 209 teeth were evaluated in root resorption. In about 45% of patients, root resorption was seen, which level 3 and 4 were

the most (24.76% vs. 13.89%). The root resorption was more in mandible compared to maxilla (36.36% vs. 18.66%, $P = 0.0520$). Second molar in mandible had the most root resorption in this study (30.62%) (Table 4). Also, only 11 (5.18%) second molars in mandible had infra-occlusion and no infra-occlusion was seen in maxilla.

Using Spearman's rho correlation test, there was association between root resorption and age ($r = 0.175$, $P = 0.0360$) in addition to gender ($r = 0.171$, $P = 0.0400$); but there were no associations between root resorption and decay ($r = -0.102$, $P = 0.2220$), mobility ($r = -0.137$, $P = 0.1010$), and infra-occlusion ($r = -0.080$, $P = 0.3430$). Moreover, there were associations between decay and mobility ($r = 0.470$, $P < 0.0001$), as well as infra-occlusion ($r = 0.262$, $P = 0.0010$) (Table 5).

Table 3. Distribution of retained primary tooth (RPT)'s mobility degree according to Miller's classification¹⁵

Maxilla	Central incisor [n (%)]	Lateral incisor [n (%)]	Canine [n (%)]	First molar [n (%)]	Second molar [n (%)]	Total [n (%)]
Class I	0 (0)	0 (0)	1 (0.47)	0 (0)	2 (0.94)	3 (1.41)
Class II	0 (0)	0 (0)	5 (2.36)	0 (0)	3 (1.41)	8 (3.77)
Class III	1 (0.47)	1 (0.47)	9 (4.25)	0 (0)	8 (3.77)	19 (8.96)
Total	1 (0.47)	1 (0.47)	15 (7.08)	0 (0)	13 (6.13)	30 (14.15)
Mandible						
Class I	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.94)	2 (0.94)
Class II	1 (0.47)	0 (0)	2 (0.94)	0 (0)	7 (3.30)	10 (4.72)
Class III	1 (0.47)	0 (0)	2 (0.94)	2 (0.94)	14 (6.60)	19 (8.96)
Total	2 (0.94)	0 (0)	4 (1.89)	2 (0.94)	23 (10.85)	31 (14.62)

Table 4. Distribution of retained primary tooth (RPT) root resorption's degree according to Bjerklin and Bennett16/Nordquist et al.3 classification

Maxilla	Central incisor [n (%)]	Lateral incisor [n (%)]	Canine [n (%)]	First molar [n (%)]	Second molar [n (%)]	Total [n (%)]
Level 1	1 (0.48)	3 (1.44)	67 (32.06)	0 (0)	8 (3.83)	79 (37.80)
Level 2	0 (0)	0 (0)	2 (0.96)	0 (0)	2 (0.96)	4 (1.91)
Level 3	0 (0)	1 (0.48)	12 (5.74)	0 (0)	5 (2.39)	18 (8.49)
Level 4	0 (0)	0 (0)	4 (1.91)	0 (0)	6 (2.87)	10 (4.79)
Level 5	1 (0.48)	0 (0)	5 (2.39)	0 (0)	1 (0.48)	7 (3.35)
Level 6	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	2 (0.96)	4 (1.91)	90 (43.06)	0 (0)	22 (10.53)	118 (56.46)
Mandible						
Level 1	2 (0.96)	2 (0.96)	2 (0.94)	1 (0.48)	8 (3.83)	15 (7.18)
Level 2	0 (0)	0 (0)	0 (0)	0 (0)	12 (5.74)	12 (5.74)
Level 3	2 (0.96)	1 (0.48)	3 (1.44)	0 (0)	28 (13.40)	34 (16.27)
Level 4	2 (0.96)	0 (0)	2 (0.96)	1 (0.48)	14 (6.70)	19 (9.10)
Level 5	0 (0)	0 (0)	0 (0)	1 (0.48)	10 (4.79)	11 (5.26)
Level 6	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	6 (2.87)	3 (1.44)	7 (3.35)	3 (1.44)	72 (34.45)	91 (43.54)

Discussion

This study aimed to assess the prevalence of RPT in unusual ages, in Fars Province. Unlike the previous studies that used intraoral radiography, the panoramic radiography was used in the current study, which is consistent with the study of Aktan et al.¹¹ The prevalence of RPT was 6.88%, and the most frequent RPT was primary canine in the maxilla and second primary molar in the mandible. RPT was more frequent in women. The main cause of RPT was absence of permanent successor tooth congenitally, and then impaction of it. RPT was more frequent in women and the ages between 20 and 29 years. About 43.00% of the patients had RPT on both sides of the jaw. Most grades of teeth mobility were related to class III (17.92%), and the second molar in mandible had the

most mobility. Second molar in mandible had the most root resorption in this study, and only 5.18% of second molars in mandible had infra-occlusion.

In the present study, of 2106 subjects, 145 people (6.88%) had RPT; but a study which was conducted by Sheikhi et al.¹² in Iran on 2422 patients showed that the prevalence of congenital missing permanent tooth was 10.9%. Vahid-Dastjerdi et al. reported this rate as 9.10%, and they concluded that this rate in Iran was higher than many other countries.¹³ This prevalence was reported 7.66% in another study in Shiraz, Iran, in 2013,¹⁸ 5.90% in Germany,¹⁹ 7.50% in Turkey,²⁰ and 11.20% in Korea.²¹

Our results presented that RPT was more frequent in women significantly; but Amini et al.²² reported that although it was seen in

Table 5. Results of Spearman's rho correlation test

Variables	Gender	Decay	Root resorption	Mobility	Infra-occlusion
Age	0.077	-0.106	0.175*	-0.0620	-0.089
	0.357	0.205	0.036	0.4590	0.287
Gender		-0.200	0.171*	-0.0800	-0.147
		0.814	0.040	0.3380	0.078
Decay			-0.102	0.4700*	0.262*
			0.222	0.0001	0.001
Root resorption				-0.1370	0.080
				0.1010	0.343
Mobility					0.083
					0.323

*Correlation is significant at the 0.05 level (2-tailed). The first row of each variable is 'r' and the second row is 'P-value'.

women more, this difference was not significant, even the number of missing was more in men. A study in Shiraz showed that no statistical difference was seen in both genders, too.¹⁸ Gender ratio in this study did not match the similar researches, e.g., Nordquist et al.³ study carried out on the population of Varmland, Sweden, (50.76% men) and Jose and Joseph⁵ study conducted in a rural area in India (52.00% men). But this rate was more similar to the study of Aktan et al.,¹¹ which was done on the Turkish population (34.74% men) and Gupta et al.⁴ study in India (44.55%). Also, in the current study, unlike previous ones, the way of awareness of participants about RPT was assessed. Only 40.00% of patients were aware of their RPT, and this awareness was also made through dentist, which represents the important role of dentist in the early detection of RPT.

This study showed that the most frequent RPT was primary canine in maxilla (42.45%) and the second primary molar in mandible (33.01%), respectively, which was different from the results of studies by Nordquist et al.³ (59.55% second primary molar in mandible and 19.10% primary canine in maxilla) and Aktan et al.¹¹ (58.35% second primary molar in mandible, 23.24% primary canine in maxilla). A study in Shiraz with smaller sample size showed that the most frequent absent teeth were upper lateral incisor and lower second premolar.¹⁸ Nordquist et al. in 2005 pointed out that the primary canine had the highest frequency in some previous studies conducted in 1930, 1961, and 1972.³ This difference could be due to early diagnosis and treatment of displaced permanent canine teeth in those regions where the previous studies were conducted.

In this study, the most rates of dental pathologies were related to periodontal disease (28.77%) and dental decay (17.05%). In Aktan et al.¹¹ study, the rates of dental decay and periodontal disease were reported as 37.96% and 24.96%, respectively. This difference can be due to more awareness of

the RPT and better compliance of oral health in the city of Larestan. Also, in the current study, the mobility of teeth was assessed. The highest percentage of tooth mobility belonged to class III, and the highest percentage of mobility was seen in the second primary molar in the mandible (6.60%). To our knowledge, the mobility of teeth has not been reported in the previous studies. The mobility of RPT can influence the prognosis and treatment, because periodontal disease is known as one of the major causes of RPT.⁸

Aktan et al. reported that the most important causes for RPT were lack of permanent successor tooth (81.39%) and hidden permanent successor tooth (16.40%). Other factors were cysts, added tooth, and crowding.¹¹ Also, in the current study, these two factors were known as the causes of RPT. In a study by Nordquist et al.,³ absence of permanent successor teeth was as the most important cause, especially in the second molar in the mandible, which was mentioned by other previous studies.^{16,17} In the current study, the most important cause of remaining canine in maxilla was the hidden permanent successor teeth (25.00%), similar to study by Aktan et al.¹¹

The percentage of the restoration was 7.57% in the current study, which is higher than Aktan et al.¹¹ study (6.06%), but tooth treatment was performed in only 2 (0.94%). In Nordquist et al.³ study, the total restoration and decay was reported as 52.8%. In the previous studies, the type of treatment has not been evaluated. Moreover, in the current study, the number of RPT was assessed in each patient (67.70% had 1, 27.70% had 2, and 4.60% had 3 RPT), which was similar to Nordquist et al.³ study. The considerable point was that in about 5.00% of patients more than 3 RPT were observed, in the present study. Another study reported that if the second molar in mandible remained up to age 20, it would remain in upper age.¹⁶ Nordquist et al. have reported that if this tooth remains up to age of 20, it will remain until the age of 30-40. In the

current study, most of patients were in the age group of 20-29 years, but the age group of 10-19 years had more RPT than any other age group (35.90%).³ In this study, unlike the previous ones, the one-sided or two-sided RPT were evaluated, because viewing the RPT on one side of the jaw can guide in the diagnosis of RPT on the other side. The results showed that 43.40% of patients had RPT on both sides of the jaw (right and left).

The results of this study showed that the most frequent root resorption levels were level 3 (24.76%) and level 4 (13.89%), while the result of Aktan et al.¹¹ study showed that level 4 of root resorption was the most frequent (20.09%). But the ratio of level 2 to level 5 was similar in both studies. It is noticeable that panoramic radiography was used in both studies. In the study by Nordquist et al.,³ intraoral radiography (periapical) was used and 74.00% of second molar in mandible had root absorption level ≤ 3 . This difference could be due to difference in the type of used radiography. Intraoral radiography had more accuracy compared to extra-oral for examination of the root resorption, because extra-oral panoramic radiography had some disadvantages such as difference in the positioning the patient's head, possible movement of the patient's head during the radiography, and the angle of radiation, which can reduce the radiography resolution.

Many studies evaluated the relationship between root resorption and other factors such as age, gender, caries, and infra-occlusion. In the current study, significant relationships between root resorption and age as well as gender were seen. Also, decay had positive linear relationship with mobility. Bjerklin and Bennett noted that there was not any statistical correlation between root resorption and gender,¹⁶ which is inconsistent with the results of our study. Hvaring et al. reported that there was a statistically significant relationship between infra-occlusion, root resorption, and age, but no relationship was observed with gender.¹⁷

In Nordquist et al.³ study, no significant relationships between root resorption and gender, restoration, caries, and infra-occlusion were seen, but root resorption had a relationship with age. They reported that root resorption was more in older patients. Hvaring et al.¹⁷ showed that infra-occlusion was more important in tooth prognosis compared with root resorption. The remarkable thing in the current study is a statistically significant relationship between infra-occlusion and caries. It can be concluded that the tooth with infra-occlusion has more potential for decay, because the occlusal surfaces of teeth are lower than the adjacent teeth, and this factor could be involved in lack of access to dental hygiene. Previous studies indicated that the root resorption was not the primary cause for the loss of RPT, but also decay or gum diseases were underlying causes.⁸

This study was conducted only on patients who were referred to the clinics that were mentioned above. Although these two clinics cover a very high percentage of the Larestan population, some patients might refer to dental clinics in other cities and the center of province. Therefore, the calculated prevalence might be less than actual prevalence. Also, this study was done in one city, and the results cannot be generalized to whole Fars Province, as well as to Iran. Therefore, larger population-based studies are suggested.

Conclusion

RPT in unusual ages is an important and considerable public health issue. The prevalence of RPT in unusual ages was not high in this study, but as limited similar studies was conducted in Iran, we could not compare this rate. Careful and exact examinations by dentist and using the panoramic radiography are necessary to detect the RPT earlier and try to prevent the related problems and complications by suitable treatments. Also, conducting more detailed studies about the prevalence of RPT

and its related factors in other populations in Iran is suggested.

Conflict of Interests

Authors have no conflict of interest.

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Evaluation of the antibacterial effects of three natural formulated mouthwashes against *Streptococcus mutans*: An in vitro study

Reihaneh Nikseresht¹, Saeed Shams PhD², Aida Mehdipour DDS, MSc³,
Somayeh Kermani MSc⁴, Ali Hashemi PhD⁵, Amir Hamta PhD⁶

Original Article

Abstract

BACKGROUND AND AIM: *Streptococcus mutans* (S. mutans) is a well-known bacterial cause of dental caries. The aim of this study was to develop an herbal mouthwash with anti-biofilm activity and compare it with a commercial preparation containing 2% chlorhexidine.

METHODS: The main components of the mouthwashes included *Punica granatum*, pomegranate rind, *Eugenia caryophyllata*, *Rhus coriaria* L., etc. (No. 1); *Pistacia lentiscus* L., *Punica granatum*, *Areca catechu* L., etc. (No. 2); *Cyperus articulatus*, *Terminalia chebula* Retzius, *Cinnamomum zeylanicum*, *Elettaria cardamomum*, *Zingiber zerumbet*, *Punica granatum*, etc. (No. 3). Plants were weighed and soaked into sterile distilled water. Filtration and sterilization were performed using Whatman and Millipore filters, respectively. The antibacterial susceptibility assay was performed by an agar well diffusion method according to Clinical and Laboratory Standards Institute (CLSI). Anti-biofilm activity of mouthwashes and chlorhexidine was evaluated on polystyrene microtiter plates by a broth dilution method. Finally, a comparative analysis of the results was done by Tukey and analysis of variance (ANOVA) tests.

RESULTS: No positive effect of mouthwash No. 1 was observed in the agar well diffusion method. This mouthwash showed an effect on biofilm formation only at 50% concentration. In agreement with well diffusion, the effect of mouthwash No. 2 was moderate and similar to 2% chlorhexidine. The mouthwash No.3 showed an excellent effect (even at 3.125%) against S. mutans.

CONCLUSION: Overall, mouthwash No.3 appears to be suitable as an herbal anti-biofilm solution. Further studies are necessary to identify the active ingredients of the plants.

KEYWORDS: *Streptococcus Mutans*; Biofilms; Mouthwashes; Chlorhexidine; Plants

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Dental caries, an ancient disease, is formed by the colonization and the accumulation of oral bacteria and is considered as one of the most common chronic diseases worldwide. Biofilm is an example of dental plaque, which results in tooth dysfunction and loss.¹ Mutans group *Streptococci* have been recognized as main Gram-positive oral bacteria and etiological

agents of human dental caries. Amongst them, *Streptococcus mutans* (S. mutans) has high capabilities of biofilm formation, acid production, high tolerance to low pH, and high affinity for various carbohydrate sources.^{2,3} Three stages of dental plaque formation have been recognized: I) salivary molecules attach to the enamel; II) some oral bacteria, e.g., *Streptococcus sanguis* and

1- Student of Dentistry, Student Research Committee, School of Dentistry, Qom University of Medical Sciences, Qom, Iran

2- Assistant Professor, Cellular and Molecular Research Center, Qom University of Medical Sciences, Qom, Iran

3- Assistant Professor, Department of Pediatric Dentistry, School of Dentistry, Qom University of Medical Sciences, Qom, Iran

4- Cellular and Molecular Research Center, Qom University of Medical Sciences, Qom, Iran

5- Assistant Professor, Department of Medical Microbiology, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

6- Assistant Professor, Clinical Research Development Center AND Department of Social Medicine, School of Medicine, Qom University of Medical Sciences, Qom, Iran

Correspondence to: Saeed Shams PhD

Email: sshams@muq.ac.ir

Actinomyces viscosus, interact with the acquired layer producing an initial biofilm on the tooth surface; III) *S. mutans* binds to the primary colonizers, followed by growth leading to the formation of biofilm and a water-insoluble glucan layer synthesized by its sucrose-dependent glucosyltransferase (GTFs) activity on the tooth. The presence of *S. mutans* in the tooth cavities is followed by the decay after 6 to 24 months.⁴

For preventing and controlling biofilm formation, various types of chemicals such as chlorhexidine and antimicrobial agents such as penicillin, erythromycin, and vancomycin have been used.¹ However, a change in the oral flora after usage of these agents can be observed.² Furthermore, undesirable side effects on long term use of chlorhexidine have been reported, e.g., mucosal ulceration, tooth and tongue staining, taste perturbation, unilateral/bilateral parotid swelling, and enhanced supragingival calculus formation.⁵

Several studies on the antibacterial effects of cultured plants on *S. mutans* and its biofilm have been published in different countries.^{2,6,7} Study of Kunte et al. showed that chlorhexidine and pomegranate peel extract had significant antimicrobial activities on *S. mutans* and were equally effective.⁸ Another report conducted by Batubara et al. determined that the essential oil of Zingiberaceae leaves and *Elettaria cardamomum* was successfully effective against *S. mutans*.⁹ Due to its geographical location and traditional herbal treatments, Iran has a high potential for culturing medicinal plants showing broad activities against different bacterial diseases.¹⁰

In this study, we tried to investigate the anti-biofilm effects of three natural mouthwashes, prepared in-house from various plant extracts including *Punica granatum*, pomegranate rind, *Eugenia caryophyllata*, *Rhus coriaria* L., *Andricus kollari*, *Pistacia lentiscus* L., *Areca catechu* L., *Quercus infectoria*, *Aquilaria malaccensis*, *Cyperus articulatus*, *Terminalia chebula* Retzius, *Cinnamomum zeylanicum*,

Anacyclus pyrethrum, *Piper longum*, saffron, *Rhus coriaria* L., *Elettaria cardamomum*, and *Zingiber zerumbet*, using the formulations presented in the historical books, Encyclopedia of herbal medicine in Iran, and *Al-Qanoon Fil Tibb* by Ibn Sina.^{11,12} The references describe about a collection of plant extracts recommended for traditional prevention and treatment of some infectious diseases. Therefore, in order to evaluate the anti-biofilm activity produced by *S. mutans*, we compared these home-made mouthwashes with a commercial 2% chlorhexidine mouthwash. So, the aim of this study was to evaluate antibacterial and anti-biofilm effects of three traditional mouthwashes (called No. 1, 2, and 3) against *S. mutans*.

Methods

Preparation of bacterial cells and mouthwashes: In this in vitro study, *S. mutans* ATCC35668 was used as reference strain and cultured on Tryptic Soy Agar (TSA) (Ibresco, Iran) at 37 °C overnight under 5% CO₂ atmosphere. According to historical orders listed in table 1, the fresh natural agents were purchased from a grocery store in Qom City, Iran; they came from different geographical areas of Iran and were collected during 2018 spring and summer seasons. Plants were dried for 10 days in a dark box at room temperature. After powdering using a mechanical grinder, the components of each mouthwash were weighed and soaked into 100 ml sterile distilled water on a rotator at dark for 24 hours. The extracts were filtered separately by Whatman filters and then sterilized through a 0.22 µm pore size membrane. The extracts were mixed together and prepared mouthwashes were stored at 4 °C as stock solutions until analyses.¹³ The ingredients of the mouthwashes and their weight are listed in table 1.

Biofilm formation ability: *S. mutans* colonies [10⁸ colony-forming units per milliliter (CFU/ml)] were grown at 37 °C for 24 hours on TSA and were collected and inoculated into 1% D-glucose-supplemented

Table 1. Herbal mouthwashes formulated in this study

Mouthwash name	Components (used amounts)	Reference
No. 1	Punica granatum (25g), pomegranate rind (25g), clove (<i>Eugenia caryophyllata</i>) (10g), sumac (<i>Rhus coriaria</i> L.) (100g), <i>Andricus kollari</i> (25g)	11
No. 2	<i>Pistacia lentiscus</i> L. (50g), Punica granatum (50g), <i>Areca catechu</i> L. (25g), <i>Quercus infectoria</i> (50g), <i>Andricus kollari</i> (50g), <i>Aquilaria malaccensis</i> (50g)	12
No. 3	<i>Cyperus articulatus</i> (Cyperaceae) (30g), <i>Terminalia chebula</i> Retzius (50g), <i>Cinnamomum zeylanicum</i> (30g), <i>Anacyclus pyrethrum</i> (70g), <i>Piper longum</i> (10g), saffron (<i>Crocus sativus</i>) (10g), sumac (<i>Rhus coriaria</i> L.) (20g), <i>Cardamom</i> (<i>Elettaria cardamomum</i>) (40g), <i>Zingiber zerumbet</i> (160g), Punica granatum (40g)	

Tryptic Soy Broth (TSB) (Merck, Darmstadt, Germany) in sterile 96-well flat-bottom polystyrene microtiter plates without agitation. Following incubation at 37 °C for 48 hours, the content of the wells was removed and gently washed three times with sterile physiological saline [phosphate-buffered saline (PBS), pH = 7.4]. The attached bacteria were fixed with 1 ml of 96% ethanol for 15 minutes. After emptying and drying, the wells were stained with 200 µl of 1% crystal violet solution for 15 minutes and then the dye was washed gently with distilled water and allowed to dry. To obtain quantitative data, the crystal violet bound to the adherent cells was re-solubilized with 96% ethanol and the optical density (OD) of the resulting solution was measured using an enzyme-linked immunosorbent assay (ELISA) reader apparatus at 492 nm.

Antimicrobial susceptibility test (AST):

The antimicrobial susceptibility assay was done by an agar well diffusion method according to the guidelines of Clinical and Laboratory Standards Institute (CLSI).¹⁴ Firstly, holes with a diameter of approximately 5 mm were prepared on Mueller-Hinton Agar (MHA) (Merck, Darmstadt, Germany). A bacterial suspension, with turbidity of 0.5 McFarland standard, was cultured on the plate and 100 µl of each mouthwash stock and 2% chlorhexidine were added to the wells. Bacteria were incubated as described above.

Inhibition of biofilm formation: The biofilm formation was carried out by broth dilution method with 100 µl of 1% glucose - supplemented TSB in sterile 96-well

flat-bottom polystyrene microtiter plates. 100 µl of each prepared stock mouthwash and 2% chlorhexidine were added to the first well of the microplate. To obtain the same conditions, serial dilutions were done to prepare 50%, 25%, 12.50%, 6.25%, and 3.125% concentrations. Finally, 10 µl of a suspension of *S. mutans* (10⁸ cells/ml) was inoculated into the wells. The medium alone and a cultured well without mouthwash were used as negative and positive controls, respectively. The wells with the medium and the different herbal concentrations, without bacteria, were used as another control to eliminate turbidity due to plant extractions. The plate was then incubated as described above. The tests were repeated three times.¹³

Results were presented as mean and standard deviation (SD) of the ODs. For statistical analysis, one-way analysis of variance (ANOVA) and Tukey tests, as a post-hoc, were used and *P* < 0.05 was determined as the significant level. Statistical analysis was performed by SPSS software (version 22, IBM Corporation, Armonk, NY, USA).

Results

S. mutans was employed as a bacterial model for the formation of biofilm. Bacteria were able to create biofilm into the microplate wells (data not shown). Agar well diffusion test showed that mouthwash No. 1 was not successful to reduce *S. mutans* biofilm formation (0 mm). On the other hand, results of mouthwash No. 2 and 2% chlorhexidine were the same (5 mm). The best inhibitory effect was observed for mouthwash No. 3 (10 mm). According to OD results,

mouthwash No. 1 showed an effect on the biofilm formation only at 50% concentration compared to the other mouthwashes and no differences in absorbance values at lower concentrations were observed. The effect of mouthwash No. 2 on *S. mutans* biofilm formation inhibition was moderate at 50%, 25%, and 12.5% concentrations, similarly to chlorhexidine. Lower concentrations of mouthwash No. 2 did not show any anti-biofilm activity on *S. mutans*. Mouthwash No. 3 showed potent inhibitory activity at all concentrations and even at 3.125% was excellently able to inhibit biofilm formation of the bacteria. According to the absorbance readings of OD, although chlorhexidine exhibited good effects on *S. mutans* at all concentrations, the mouthwash No. 3 had a stronger biofilm inhibition activity. Obtained curves from anti-biofilm effects of the mouthwashes and chlorhexidine against absorbance are shown in figure 1.

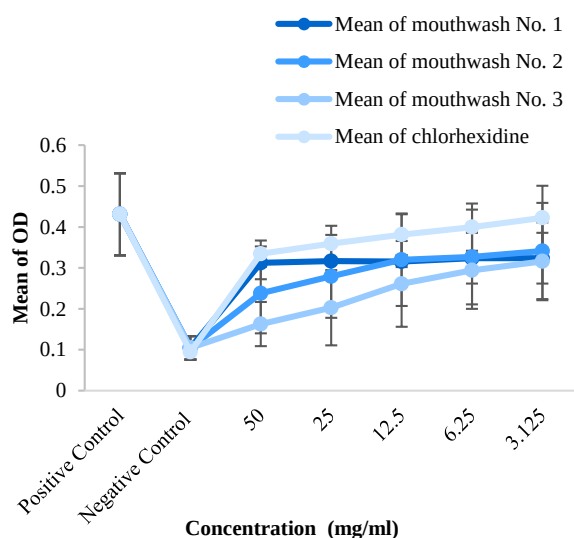


Figure 1. Obtained curve from anti-biofilm effects of the mouthwashes and chlorhexidine against absorbance of optical densities (ODs)

Statistical analysis showed that according to concentration, the effect of each mouthwash on the biofilm was significant ($P < 0.010$), while interaction effects between mouthwashes and their concentrations were not statistically significant ($P = 0.986$).

Additionally, Tukey test indicated that the antibacterial effects of mouthwash No. 1 and 3, mouthwash No. 2 and chlorhexidine, as well as mouthwash No.3 and chlorhexidine were significantly different. Also the mean of OD for all concentrations of mouthwash No. 3 was lower than the other mouthwashes and chlorhexidine. Mouthwash type/chlorhexidine vs. mean of ODs and the concentration of the different mouthwashes/chlorhexidine vs. mean of ODs are presented in figures 2 (A and B), respectively.

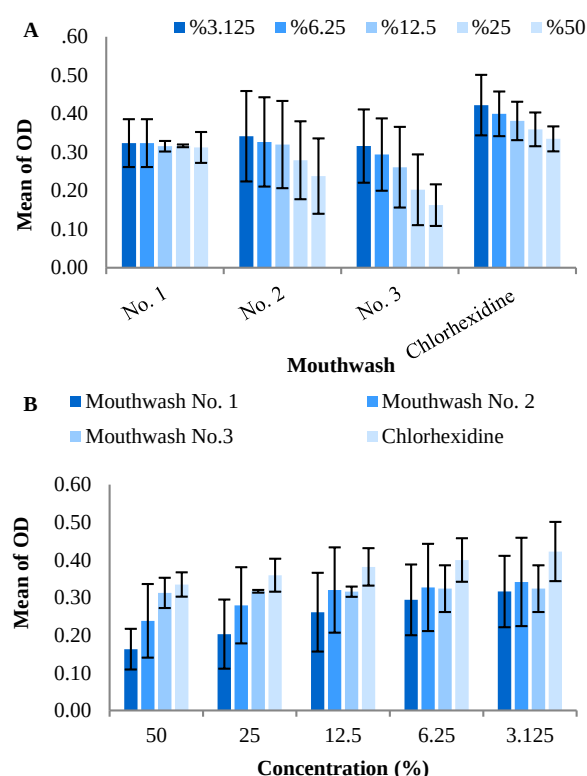


Figure 2. Mouthwash type and chlorhexidine against mean of optical densities (ODs) (A) Different concentration of the mouthwashes and chlorhexidine against mean of ODs (B)

Discussion

The result of this study showed that there was no positive effect of mouthwash No. 1 in the agar well diffusion method. This mouthwash also showed a partial effect on the biofilm formation at 50% concentration. In agreement with the well diffusion, the effect of mouthwash No. 2 displayed a moderate activity that was similar to 2%

chlorhexidine. Although we could not evaluate each plant separately on the bacterium and isolate different fractions of the used plants, as some limitations, the mouthwash No.3 showed an excellent effect against *S. mutans*.

Due to antibiotic resistance and reduced availability of some antibiotics in treatment, natural plant compounds have been widely evaluated as new agents against bacteria, viruses, fungi, and parasites. For example, *Lippia citriodora*, Algerian *Juniperus*, *Eucalyptus globulus*, etc. are a part of extractions that were tested on the microorganisms.¹⁵⁻¹⁷

Other works have also indicated excellent antimicrobial effects of plants on multidrug-resistant bacteria. Valle et al. have shown that *Psidium guajava*, *Phyllanthus niruri*, *Ehretia microphylla*, and *Piper betle* have antibacterial activity on methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococcus* (VRE).¹⁸

Therefore, several studies have determined that plant extractions have the potential to replace chemical therapy. However, a few other studies showed no effects on microorganisms. Bhalodia and Shukla detected that *Cassia fistula* lacked antibacterial activity against fungal isolates, Gram-positive, and Gram-negative bacteria.¹⁹ Another study showed that the lavender essential oil was inactive against *Pseudomonas aeruginosa*.²⁰

Dental caries is a common problem in human health. Most of the new strategies to prevent the disease include the control of the dental plaques caused by cariogenic bacteria.²¹ Biofilm is known as a specific mechanism for the initial attachment, community structure, ecosystem, and detachment from surfaces.²² Among bacteria, *Streptococci* species, especially *S. mutans*, are able to form a biofilm which can cause dental caries development. To prevent tooth decay by *S. mutans*, chlorhexidine is commonly used among people. However, due to the emergent resistance of *S. mutans* to

chlorhexidine, its use should be limited to a short period of time.²³

Thus, the aim of this study was to evaluate several natural extractions within three formulations according to Encyclopedia of herbal medicine in Iran and Al-Qanoon Fil-Tibb of Ibn Sina, whose antibacterial properties were already recognized. Although there are a number of already published studies on anti-biofilm effects,^{24,25} this study is the first evaluation of new formulations from a mixture of Iranian medicinal plants against *S. mutans* biofilm formation. Among the evaluated mouthwashes, the mouthwash No.3 (*Cyperus articulatus*, *Terminalia chebula* Retzius, *Cinnamomum zeylanicum*, *Anacyclus pyrethrum*, *Piper longum*, saffron, sumac, Cardamom, *Zingiber zerumbet*, and *Punica granatum*) showed a stronger inhibition of *S. mutans* growth (10 mm) compared to the other mouthwashes and chlorhexidine, which is in accordance with the results of the biofilm assay. This value is lower than that obtained with the extract of *Dodonaea viscosa* var. *angustifolia* tested by Naidoo et al. who indicated that 25% of crude extract killed 100% of *S. mutans*.⁶

Among antibacterial agents, *Punica granatum*, *Rhus coriaria*, and *Andricus kollari* were common between mouthwashes. Although the antibacterial activity of some extracts (e.g., *Rhus coriaria*²⁶ and *Punica granatum*²⁷) has been demonstrated, it seems that other plants included in No.3 mouthwash had better effects on *S. mutans* than the rest of mouthwashes. Indeed, *Cyperus articulatus*,²⁸ *Terminalia chebula* Retzius,²⁹ *Cinnamomum zeylanicum*,³⁰ *Anacyclus pyrethrum*,³¹ saffron (*crocus sativus*),³² *Elettaria cardamomum*,³³ and *Zingiber zerumbet* Linn³⁴ have been demonstrated to possess antimicrobial activity on a number of Gram-positive and Gram-negative bacteria.

Similar to chlorhexidine, mouthwash No. 2 activity was better than mouthwash No.1, showing a moderate effect on biofilm

formation. It seems that some extracts included into this mouthwash had different effects against bacteria. Cyriac et al. reported that oral bacteria were resistant to *Areca catechu* L. plant,⁷ while Wan Nor Amilah et al. showed that *Quercus infectoria* inhibited more Gram-positive than Gram-negative bacteria.³⁵ Both well diffusion and broth dilution results demonstrated that mouthwash No.1 had the lowest activity against biofilm.

Conclusion

Results of this study suggest that the formulation of mouthwash No.3 can be a good candidate as an effective antibacterial agent in the prevention of biofilm formation. Furthermore, it is necessary to detect the

active fractions of the used plants in the mouthwash No.3 and evaluate them by in vivo methods. If the future results be similar to the current study, it can be used to prepare commercial antibacterial compounds (similar to chlorhexidine but cheaper and without side effects) and also to apply it in toothpastes. So this study has an innovative idea at its level.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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Dental considerations in acrodermatitis enteropathica: A report of two cases

Mahboobeh Shokrizadeh DDS¹, Fatemeh Sadat Sajadi DDS, MSc²

Case Report

Abstract

BACKGROUND AND AIM: Acrodermatitis enteropathica (AE) is a rare and severe genetic disorder with autosomal recessive inheritance, which is usually diagnosed with deficiency of zinc intestinal absorption. This disease is classified into hereditary and acquired forms that the hereditary form is much rare. AE can be characterized by triad of periorificial and acral dermatitis, alopecia, and diarrhea. The present study aimed to report the dentistry treatment of two boys with hereditary AE and special considerations about this disease.

CASE REPORT: Patients included two brothers aged 6 and 8 years with AE, and they were examined at a health center. Three days after the birth, the erythematous, erosive, and crusted lesions were seen on their mouths, perianal areas, feet, and hands. The serum zinc levels were normal. The preventive treatment like fissure sealant on four first permanent molars was performed on the 8-year-old patient, and for the other patient, two mandibular deciduous anterior teeth were extracted.

CONCLUSION: AE is a rare genetic disease which can be along with dental anomaly and oral infections. Despite the fact that there are cases with normal serum, the clinical and radiographical examinations will be helpful for the final diagnosis. This study presented two male siblings with normal zinc serum who demonstrated hair and skin lesions without dental disorders.

KEYWORDS: Acrodermatitis Enteropathica; Oral Manifestations; Child; Case Reports

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Acrodermatitis enteropathica (AE) is a rare congenital metabolic disease with autosomal recessive inheritance which can lead to the severe zinc deficiency in the blood serum. Its inherited form can be seen in 1500000 people.^{1,2} Males and females are equally affected by this disease.³ Serum zinc deficiency is due to intestinal zinc malabsorption and may be related to the mutation in solute carrier family 39 member 4 (SLC39A4) that codes zinc transporter (ZIP4) protein.⁴ The missing protein is responsible for decreasing the zinc uptake and abnormal zinc metabolism.⁵

AE can be characterized by the triad of periorificial and acral symmetrical dermatitis, alopecia (hair loss), and diarrhea. Paronychia,

angular cheilitis (AC), and glossitis can be also seen.⁶ More progressive clinical manifestations in non-treated cases include the delayed growth, delayed puberty, anemia, anorexia, and difficult wound healing.⁵

The skin around orifice such as mouth, anus, and the skin on elbows, knees, hands, and feet can be inflamed. Skin lesions are usually vesiculobullous, and then dry and become psoriasis-like. Around of nails can be also involved, and this abnormality may be due to the zinc deficiency. Hair loss of head, eyelid, and eyebrows may be also occurred (alopecia). The membrane inflammation on eyelid (conjunctivitis) is also common.⁷

Zinc is an imperative component of growth and the immune system, and its normal serum level is 85-160 µg/dl. The

1- Resident, Oral and Dental Research Center AND Department of Pediatric Dentistry, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran

2- Associate Professor, Oral and Dental Research Center AND Department of Pediatric Dentistry, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran

Correspondence to: Fatemeh Sadat Sajadi DDS, MSc
Email: fsajadi1234@gmail.com

serum level less than 83 $\mu\text{g}/\text{dl}$ refers to the zinc deficiency. The gold standard laboratory test can diagnose the plasma zinc deficiency; however, it may show normal serum concentrations even in the case of tissue depletion. For this respect, the dosage of alkaline phosphatase (ALP) can be helpful because ALP is a zinc-dependent enzyme that responds to its replacement by increasing the initial low serum levels.⁵

Moreover, some diseases should be considered for the differential diagnosis of AE, like kwashiorkor, acquired immunodeficiency syndrome (AIDS), glutaric aciduria type 1 (GA1), prematurity, malabsorption syndromes secondary to cystic fibrosis or intestinal diseases, atypical epidermolysis bullosa (EB), and leucinosi. The proper diagnosis will be distinguished by plasma zinc level.⁷

Zinc is also a crucial element in the mineralization of enamel after the eruption of teeth, whereas decreases the susceptibility of caries. Animal studies suggested that zinc deficiency was a potential risk factor for oral and periodontal disease.⁸ In another study, it was reported that aphthous ulcers were more prominent in a zinc deficiency group. Furthermore, the zinc deficiency contributed to the high susceptibility to bacterial and fungal infections like candidiasis.⁹ Kelly et al. observed AE with peripheral edema, glossitis, and cheilitis.⁶ Sutton and Newin noted that these lesions were annular, crusted, and in advanced disease erosive. Secondary infections by *Candida albicans* or *Staphylococcus aureus* may worsen these conditions.² The present study aimed to report two dental patients with AE in whom skin lesions were manifested in a similar way to other patients with this skin disorder, but showed no oral lesion or infection.

Case Report

Patients were two brothers, 6 and 8 years of age, referring to the health center of Feiz Abad City, Iran. The six-year-old patient had a chief complaint of improper eruption of

permanent mandibular incisors because of over-retained deciduous anterior teeth. According to parents' history, the clinical manifestation of AE was seen three days after birth as erythematous and crusted lesions on periorificial areas, hands, feet, and neck. The laboratory tests including zinc and ALP serum levels and also skin biopsy were then performed. Their normal zinc serum levels were 86 $\mu\text{g}/\text{dl}$ and 89 $\mu\text{g}/\text{dl}$, respectively. Also, ALP was $< 350 \text{ U/L}$. Oral zinc therapy was prescribed, but no healing was observed. In the clinical examination, skin lesions included the erosive and crusted ones and were more seen around their mouths, hands, and feet. In the oral examination, the soft tissue had no ulcer and candidiasis, and the hard tissue was also normal without any dental anomaly or enamel disorder.

For the 6-year-old child, two over-retained teeth were extracted after local anesthesia in buccal vestibule and lingual papilla (lidocaine 2%, epinephrine 1:80000). Sterile bandage was slightly pressed on sockets for 5 minutes. After this period, no excess bleeding occurred and the clot formed. (Figure 1, A-G). The older patient had no delay in the eruption of six anterior teeth in both jaws (Figure 2, A and B).

In the radiographic assessment, there was no observed missing or dental anomaly like enamel/dentin hypoplasia or any problem in the eruption (Figure 2, C and D).

For the 8-year-old patient, dental prophylaxis with rubber cap and pumice powder was performed to professionally remove the dental plaque. The pit and fissures of first permanent molars were then sealed in 4 quadrants without any injection (Figure 2, E).

Oral opening was our limitation for these patients at dentistry procedures because of the crusted lesions of periorificial and the difficulty in the intercommunication. To overcome this limitation, the dentist should utilize the body language, tell, show, do, and spend more chair time to decrease the patients' worries and phobia. Preventive treatment should be prescribed with regular follow-up.



Figure 1. Crusted lesion around the mouth of 6-year-old patient (A), normal feature of tongue in the 6-year-old patient (B), erythematous scaly plaques on hands of the 6-year-old patient (psoriasis-like form) (C), panoramic radiography of the 6-year-old patient (D), over-retained primary incisors (71 and 81) (E), after extraction (5 minutes later) (F), extracted teeth (G)

Discussion

AE is a congenital recessive autosomal disease characterized by skin lesions around body orifices like mouth and anus, and also with alopecia and diarrhea.¹⁰

For differential diagnosis of congenital AE, it is necessary to rule out zinc deficiency of other etiologies like inadequate zinc stocks due to the premature birth, poor absorption in cystic fibrosis or small intestine resection,

and EB.⁵

The skin lesions in AE are erythematous and vesiculobullous and can evolve into dry, scaly, and crusted lesions like psoriasis.¹¹ Lesions around orifices are dominant and may be secondarily infected with staphylococcus aureus or *Candida albicans*.³ They are often around the mouth, red and inflamed patches and can become crusted, pussy, and erosive lesions. There is often a sharp demarcation line between the normal and affected area.²

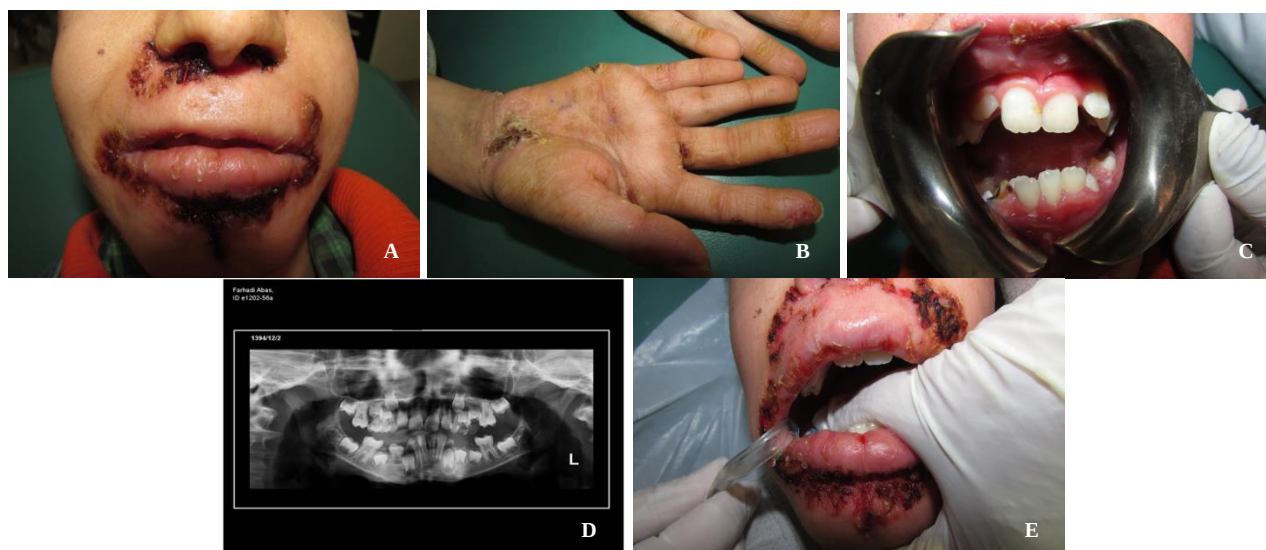


Figure 2. Erythematous lesion around the mouth of the 8-year-old patient (A), crusted lesion on palms (B), normal permanent anterior teeth in mixed dentition in older patient (C), panoramic radiography of the 8-year-old patient (D), etching stage in fissure-sealant therapy (E)

The oral mucosa can be shown glossitis and also angular cheilitis. Anemia, anorexia, paronychia, conjunctivitis, sensitivity to light, depression, delayed growth, and recurrent infections were usually observed in the older children.¹²

The histological findings are not specialized for AE. Furthermore, the lesions are varied in different ages. Initial lesions show parakeratosis as the result of reduced granular layer, but psoriasis-like epidermal hyperplasia is reported in late lesions.³

Zinc deficiency could occur when zinc is released from blood to vicinity microenvironment, where the actual site of zinc biologic actions are impaired; even when the serum zinc level is normal, if the albumin-bound form of zinc is low, actual zinc deficiency can occur. Diagnosis of AE is primarily made by clinical manifestation and lower zinc level. Although, if the plasma zinc level was normal, with characteristic clinical features and good response to zinc supplementation, the diagnosis could be established.¹³

Zinc deficiency can be related to conditions relating to the immune system like aphthous ulcers. Khademi and Shaikhian reported that serum zinc level was significantly lower than normal level in patients with recurrent aphthous stomatitis (RAS).¹⁴

In an animal study, Seyedmajidi et al. found that there was a statistical significant difference in gingival index between zinc deficiency group and zinc normal group. The authors also reported that hyperkeratosis could be more prominent among the papillae on dorsal surface of tongue;⁸ whereas Orbak et al. reported this hyperkeratinization on the dorsal surface of tongue.⁹

Nistor et al. noted that in children with watery diarrhea, secondary bacterial infections (Gram-positive, sometimes Gram-negative) or candidiasis (especially *Candida albicans*) were common and they can modify the clinical picture of disease.¹⁰

Normal level of serum zinc is 85-160 µg/dl. It is worth noting that normal levels of serum

zinc were observed in 30% of cases that could not rule out AE.⁵ One to three mg/kg/day of zinc was recommended for treatment of AE.¹¹ The zinc level should be checked every 3-6 months after prescription of oral zinc for adjusting the required dose.¹⁵ High doses for a long time may lead to the copper deficiency, dizziness, and gastrointestinal (GI) symptoms. The antibiotic therapy is necessary if the recurrent bacterial and/or fungal infection occurs.²

In the patients of the present study, the serum zinc levels ranged from 85 µg/dl to 96 µg/dl, but the zinc absorption from intestine was insufficient. Zinc deficiency may occur in fulminant candida infection (in people with weak immune system) or dental deformity.¹⁶ Tooth is an organ with epidermal origin, like mucosa or skin. In both brothers, there were skin lesions and recurrent cold sores indicating the skin involvement and weak immune systems, but fortunately, no dental deformity or oral fungal/bacterial infection like candidiasis was observed. In patients with AE, we should notice more to preventive strategies like applying fluoride varnish, seal pits and fissures, enhancement of oral health through indicating chemical plaque control by mouth rinses like chlorohexidine due to the opening mouth limitation for toothbrushing, and arranging recall appointment to stop any initial caries as soon as possible.

Conclusion

The cases emphasized on an open mind for different treatment plans for patients with AE. Clinicians should think about special consideration of these patients in application of preventive and treatment procedures. A pedodontist should also reduce the patient anxiety by behavior management techniques. In the first dentistry visit, managing the discomfort of mouth opening could result in the better treatment of patients.

Conflict of Interests

Authors have no conflict of interest.

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