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Quarterly

Review Article

Can dental treatments improve oral health-related quality of life? A systematic review
Maryam Rad DDS, MSc, PhD, Shiva Pouradeli MSc, Nader Navabi DDS, MSc (109-116)

Original Articles

The knowledge of the dentists in dental clinics in Kerman City, Iran, about ocular complications after local anesthesia
Sina Kakooei DVM, Shahla Kakoei DDS, MSc, Masoud Parirokh DDS, MSc, Amir Hossein Nekouei MSc, Mahshid Mostafavi DVM, PhD (117-123)

The knowledge and attitude of Turkish pre-clinic and clinic dental students towards the dental treatment of patients with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS)
Duygu Recen, Gulter Devrim Kaki, Baris Kaki (124-130)

The relationship between learning style preferences from VARK model and academic performances among the students of Dentistry in 2016-2017
Azadeh Horri DDS, MSc, Saeed Hajmohammadi DDS, MSc, Homa Kamyabi DDS, Mohammadjavad Asadipour DDS, Maryam Rad DDS, MSc, PhD, Elaheh Asadipour MSc (131-137)

Comparison of the effect of chewing mastic and spearmint sugar-free chewing gum on salivary flow rate and pH
Goli Chamani DDS, MSc, Mohamad Reza Zarei DDS, MSc, Neda Yazdani-Anaraki DDS, Sahar Mafi DDS ... (138-144)

Dental health by age, gender, and residence place in 6- to 12-year-old children living in Shahroud, Iran
Mohammad Hassan Emamian MD, PhD, Arash Sang MD, Mohammad Shamsaei DDS, Hassan Hashemi MD, Akbar Fotouhi MD, PhD (145-152)

What explains socioeconomic inequality in dental caries among school children in west of Iran? A Blinder-Oaxaca decomposition
Ali Kazemi Karyani PhD, Mohammad Habibullah Pulok PhD, Sina Ahmadi PhD, Shahin Soltani PhD, Zhila Kazemi MSc, Enayatollah Homaie Rad PhD, Mohammad Ebrahimi PhD, Satar Rezaei PhD ... (153-160)

Case Report

Partial removable prosthesis in a patient with unilateral maxillectomy: A case report
Somayeh Niakan DDS, MSc, Mehrnaz Karimi-Afshar DDS (161-166)

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Table of Contents

Review Article

Can dental treatments improve oral health-related quality of life? A systematic review

Maryam Rad DDS, MSc, PhD, Shiva Pouradeli MSc, Nader Navabi DDS, MSc(109-116)

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The knowledge and attitude of Turkish pre-clinic and clinic dental students towards the dental treatment of patients with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS)

Duygu Recen, Gultur Devrim Kaki, Baris Kaki(124-130)

The relationship between learning style preferences from VARK model and academic performances among the students of Dentistry in 2016-2017

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Can dental treatments improve oral health-related quality of life? A systematic review

Maryam Rad DDS, MSc, PhD¹, Shiva Pouradeli MSc², Nader Navabi DDS, MSc³

Review Article

Abstract

BACKGROUND AND AIM: Oral health-related quality of life (OHRQoL) is a practically new but rapidly growing approach. The concept of OHRQoL can become a tool to explain and shape the state of clinical practice. This study was aimed to do a systematic review about the impacts of different dental treatments on OHRQoL.

METHODS: We searched the databases of PubMed, Google Scholar, Science Direct, Scopus, Cochrane, and Thomson Reuters Web of Science up to January 2018 with the Medical Subject Headings (MeSH) keywords: “Intervention”, “Management”, “Improvement”, “Impact”, “Change” in combination with “Dentistry” AND “Oral health-related quality of life”. The reviewers screened the identified publications in three steps according to title, abstract, and full text; thereafter, they extracted all the related data in screened articles and finally classified it according to the field of dental treatment. Extracted data were saved in Excel software.

RESULTS: Finally, 22 articles were enrolled in the review and based on the type of dental treatment were categorized into three groups: implant and prosthesis, oral surgery, and periodontics and aesthetic; overall, in 72.7% of the studies, improvement of OHRQoL was considered.

CONCLUSION: The majority of used dental treatments have shown improvement of OHRQoL in studied patients.

KEYWORDS: Oral Health; Quality of Life; Dental Care; Systematic Review; Clinical Trial

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Oral health-related quality of life (OHRQoL) is a relatively new phenomenon and has rapidly grown over the last two decades.¹ Most studies on OHRQoL have based their theoretical foundations on the concept of oral health proposed by Locker.² According to Locker, the common clinical and epidemiological methods for the study of oral diseases cannot be indicative of individuals' experiences of illness and suffering. His framework examines the personal experiences of health and disease consistent with the World Health Organization (WHO) classification of impairment, disability, and

handicap.^{3,4} Therefore, researchers began to develop alternative methods that assess the physical, mental, and social effects of oral conditions for the individual. These alternative criteria are in the form of standardized questionnaires.^{5,6} OHRQoL is “a multidimensional standard questionnaire that reflects the comfort of people at eating, sleeping, and engaging in social interaction, self-esteem, and their satisfaction with their oral health”.^{6,7}

In recent years, studies have evaluated the effectiveness of treatment aimed at improving care. In interventional studies, OHRQoL is used to measure changes in

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grades from the beginning to the post-treatment period. In these studies, researchers are looking at whether interventions have improved OHRQoL or not. Therefore, subjective evaluations, such as OHRQoL, are important to determine the effect of interventions and if it does, whether it changes over time or not.⁸⁻¹⁰ In terms of evidence-based care, it is very important to better understand the effectiveness of treatment from the perspective of patients. Therefore, OHRQoL is used in studies to assess the effect of treatment on QoL and using this questionnaire as a measure to evaluate the outcome is in line with patient-centered care.⁸⁻¹⁰

A preliminary search shows that the volume of published documents related to the relationship between OHRQoL and dental treatments is significant and requires summarizing and synthesizing new data. The aim of the present study was to investigate the effects of dental therapeutic interventions on patients' OHRQoL.

Methods

This systematic review study was approved by the Ethics Committee of Kerman University of Medical Sciences, Kerman, Iran (ethical code: IR.KMU. REC. 1395.464).

In the present investigation, we systematically reviewed all the published studies in English up to January 2018. The review question was defined by the PICO components: population (patients attending dental clinics), intervention (different dental treatments mentioned), comparison (other ordinary dental treatment modalities), and outcome (improvements in OHRQoL). The international electronic databases including PubMed, Google Scholar, Science Direct, Scopus, Cochrane, and ISI Web of Science were searched. Our search included Medical Subject Headings (MeSH), the keywords of "Intervention", "Dentistry", "Management", "Improvement", "Impact", "Change" (using OR term) in combination (using AND term) with "Oral health-related quality of life". Keywords also included different fields of

dental treatment as follows: "oral medicine", "oral surgery", "pediatric dentistry", "operative dentistry", "esthetic dentistry", "endodontics", "periodontics", "prosthodontics", and "implant dentistry". In the next step, to identify other related articles, we considered summaries of all the presentations at international congresses in the field of oral health. In addition, we used the references cited in the related papers in order to avoid missing any pertinent data or studies. All the obtained articles were imported into EndNote software. The software eliminated duplicate studies.¹¹

The title and abstract of each article resulting from the literature search were independently reviewed by two investigators, and when the article was considered relevant, the full paper was ordered. Disagreement about eligibility was settled by a discussion between the two reviewers. The investigators screened the relevant publications in three steps based on the titles, abstracts, and body texts. Inclusion and exclusion criteria for the eligible studies were as follows: 1. pre- and post-operative assessment of OHRQoL, 2. randomized clinical trial (RCT) design, 3. using Oral Health Impact Profile-14 (OHIP-14) as a measurement questionnaire for OHRQoL, and 4. definition of exact follow-up period. Therefore, non-randomized prospective studies, cross-sectional, and retrospective studies or studies without any comparison with a control group were excluded.^{8,11} In this study, adults (aged 18-60 years) were considered. Therefore, studies on the upper and lower extremities of this range were not included.

In the next step, in order to strengthen the reporting of RCTs, we used Consolidated Standards of Reporting Trials (CONSORT) checklist (2015) for critical appraisal.¹² Irrelevant articles based on title, abstract, and body text were excluded. At the end of these steps, for the remnant studies, data regarding the author(s), publication year, type of intervention, sample size, follow-up period, and the main result (significant or non-significant difference in OHRQoL

between before and after treatment or between two interventions) were extracted and saved separately for each article in a file in the Excel software.¹¹

Results

In the present study, 210 papers were collected after removing duplicate records. Figure 1 shows the process of selecting articles. Finally, 22 articles were included in the systematic review. The full texts of these 22 articles were evaluated, and the key data of each study were recorded. In tables 1 to 3, a description of all the extracted data is presented, which distinguishes these tables based on the treatment of three categories: implant and prosthesis (9 papers), oral surgery (6 papers), and periodontics and aesthetic (7 papers). The chief results of the studies showed that treatment in 16 articles (72.7%) improved OHRQoL. In other studies, either this

improvement was not observed or there was no significant difference in the effectiveness of OHRQoL between the two therapeutic interventions (Tables 1, 2, and 3).¹³⁻¹⁸

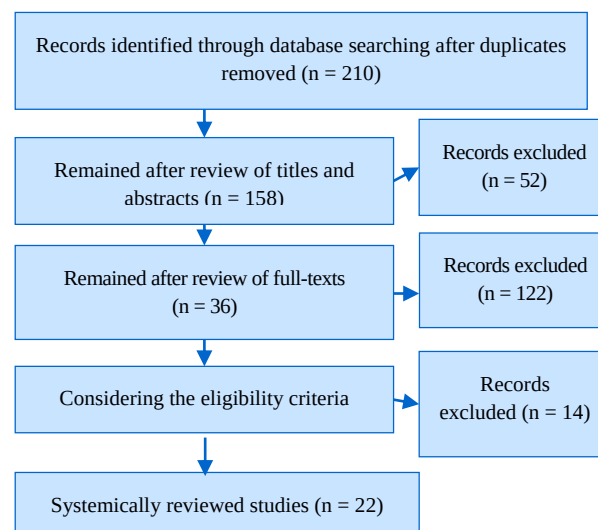


Figure 1. Flow diagram of studies considered for inclusion

Table 1. The characteristic of studies in the field of implant and prosthesis treatments

References	Type of dental intervention	Sample size	Follow-up period	Main finding	P
Nicolaisen et al. ¹³	Metal ceramic vs. all ceramic posterior three unit fixed dental prosthesis	34 patients, 20 controls	2 weeks, 3 months, 1, 2, 3 years	Significant difference in OHIP-14 before and after intervention No important difference in OHIP-14 between two interventions	< 0.0500 > 0.0500
Awad et al. ¹⁹	Mandibular implant overdentures vs. conventional dentures	60 patients	2 months	Mandibular implant overdentures provided better OHRQoL than conventional dentures	0.0010
Karbach et al. ²⁰	Mandibular overdentures retained with two or four locators	30 patients	6 months	Implant-retained overdenture had better OHRQoL than conventional dentures, four implants having a significant advantage over two implants	< 0.0500
McKenna et al. ²¹	Functionally-oriented treatment according to SDA and conventional treatment using RPD	89 patients	1, 6, and 12 months	SDA concept achieved better result than RPDs based	< 0.0500
Bilhan et al. ²²	Self-aligning and ball attachment system for two implant-retained mandibular overdentures	25 patients	3 months	Self-aligning attachment system for 2 implant-retained mandibular overdentures was equal or superior to traditional ones	< 0.0500
Heydecke et al. ²³	Conventional and implant-supported prosthesis (overdentures)	100 patients	2 months	Mandibular overdentures provided greater improvement than new conventional mandibular dentures	< 0.0500
Awad et al. ²⁴	Mandibular implant-supported overdentures vs. conventional dentures	102 patients	2 months	Implant treatment provided significant short-term improvement over conventional treatment	0.0002
Allen et al. ²⁵	Implant-retained mandibular overdentures vs. conventional complete dentures	118 patients	3 months	Significantly greater for patients receiving implants than for those who refused them	< 0.0010
Fueki et al. ²⁶	NMCDs vs. conventional (MCDs)	24 patients	3 months	NMCDs allowed for better OHRQoL compared with MCDs	< 0.0500

OHIP-14: Oral health impact profile-14; SDA: Shortened dental arch; RPD: Removable partial denture; NMCD: Non-metal clasp denture; MCD: Metal clasp-retained denture; OHRQoL: Oral health-related quality of life

Table 2. The characteristic of studies in the field of oral surgery treatments

References	Type of dental intervention	Sample size	Follow-up period	Main finding	P
Brandao et al. ²⁷	Microvascular free fibula flap with intraoral and extraoral acrylic resin-based surgical guides for dental prosthetic rehabilitation	40 patients	One year	Surgical guide revealed a significant improvement in OHRQoL	0.020
Batinjan et al. ²⁸	LLLT after surgical removal of impacted lower third molars	40 patients	3 and 7 days	OHRQoL was better through the 7-day post-operative period in comparison to the placebo group	0.010
Ibikunle et al. ²⁹	Third molar surgery with either oral administration or submucosal injection of prednisolone	186 patients	Post-operative days 1, 3, 7	Administration of prednisolone was significantly associated with less deterioration in OHRQoL when compared with subjects who did not receive prednisolone	0.001
Ibikunle and Adeyemo ³⁰	Effect of ice pack therapy on OHRQoL following third molar surgery	128 patients	Everyone and half hours on post-operative 24 hours	OHRQoL after third molar surgery was significantly better in subjects who had cryotherapy	< 0.050
Andabak et al. ¹⁷	LLLT after third molar removal	60 patients	2 and 7 days after surgery	No significant effect detected	> 0.050
Cassetta et al. ¹⁶	PS vs. conventional RT for corticotomy-assisted orthodontic treatment	12 patients	3 and 7 days after surgery	Expected decrease in OHRQoL by using both PS or RT	0.350
No significant difference in OHRQoL between PS and RT					

LLLT: Low-level laser therapy; PS: Piezoelectric surgery; RT: Rotatory osteotomy technique; OHRQoL: Oral health-related quality of life

The sample sizes of studies varied from 12 to 344. The duration of follow-up of patients varied from 24 hours to 3 years.

Discussion

The current systematic review was based on 22 articles¹³⁻³⁴ and showed that most of the therapeutic interventions were performed to measure the effects of prosthesis implants and oral surgery on OHRQoL. Studies that have shown significant statistical results in relation to the impact of dental treatments on OHRQoL in patients have mostly been related to the two fields. In these studies, significant statistical differences are obtained either between OHRQoL in the intervention group with the control group or between OHRQoL in a number of patients before and after specific treatment. Sischo and Broder argue that these significant differences cannot always be in line with clinical significance and that OHRQoL

should be considered as patient-based, while clinical significance is mixed with disease-based criteria.⁸ Therefore, the use of the results of such studies might be more likely to be found in population-based health policy.

One of the main causes of significant discrepancy in the investigated studies was sample size. The Cassetta et al.'s study, which had the smallest sample size among the reviewed studies and was conducted in the field of oral surgery, did not provide statistically significant outcomes.¹⁶ The largest sample size among the articles in this review was for Broccoletti et al. study, which examined the interventions in laser therapy and cold knife excision for the treatment of non-dysplastic oral lesions.³² It seems that although the treatment process is complicated and selection of eligible patients is more difficult, the feasibility of the study is limited in the form of a clinical trial.

Table 3. The characteristic of studies in the field of periodontics and aesthetic treatments

References	Type of dental intervention	Sample size	Follow-up period	Main finding	P
Bardellini et al. ¹⁵	Fluoride toothpaste (Bioxtra) vs. fluoride toothpaste without menthol on OHRQoL of children with oral mucositis receiving chemotherapy for ALL	64 patients	Days 1 and 8	Bioxtra toothpaste did not affect OHRQoL of children undergoing chemotherapy	0.3300
Stone et al. ³¹	Structural plaque control for patients with gingival manifestations of OLP	82 patients	20 weeks	Structural plaque control intervention was effective in improving OHRQoL	< 0.0500
Broccoletti et al. ³²	Er:YAG laser vs. cold knife excision in treatment of non-dysplastic oral lesions	344 patients	First week after surgery	Er:YAG was significantly better in the immediate post-operative surgical period	< 0.0500
Hegarty et al. ³³	Topical FP spray and BSP mouthrinse upon the signs and symptoms of OLP	48 patients	6 weeks	FP was more acceptable to patients than BSP, but there was not any significant difference between two drugs in OHIP and OHRQoL	> 0.0500
				Both drugs significantly were effective in improving OHIP	< 0.0500
Ozcelik et al. ³⁴	Immediate post-operative effects of different periodontal treatment modalities [surgical vs. non-surgical (SG vs. NS)] plus EMD	60 patients	1 week	On the immediate post-operative period, EMD and NS were significantly better when compared to SG group	0.0010
Andabak et al. ¹⁷	NAVS naphthalan with topical betamethasone in the treatment of OLP and RAS	18 patients	28 days	NAVS statistically was effective in improving OHIP-14	0.0002
				No significant difference in OHIP-14 between two drugs	0.3200
Bruhn et al. ¹⁴	Vital tooth whitening in older adults	53 patients plus control group (without intervention)	3 weeks, 3 months	Vital tooth whitening did not improve overall OHRQoL in older adults	> 0.0500

OLP: Oral lichen planus; ALL: Acute lymphoblastic leukaemia; FP: Fluticasone propionate; BSP: Betamethasone sodium phosphate; EMD: Enamel matrix derivative; NAVS: Non-aromatic very rich in steranes; RAS: Recurrent aphthous stomatitis; OHRQoL: Oral health-related quality of life; OHIP-14: Oral health impact profile-14

Similar to the sample size, the length of the follow-up period for patients was considered as the key indicator of the studies. Ibikunle and Adeyemo examined ice pack therapy in the first 24 hours after the molar surgical treatment,³⁰ while the follow-up period of the patients in the Nicolaisen et al. study, which related to fixed metal and ceramic prosthetic prostheses, was 3 years.¹³ It seems that the nature of the treatments will

have a more important effect on the follow-up of the patients (as compared to the sample size). However, If the influential factors related to third molar surgery (such as edema and trismus) occur acutely on OHRQoL, but factors associated with the effects of therapies such as prosthesis (for example beauty) need a lot of time.

The final selected papers were RCTs that used OHIP-14 for measuring OHRQoL. In

these studies, OHRQoL was measured before and after dental treatments in adult patients. RCTs in terms of their approach have the highest credibility among studies,³⁵ and the most commonly-used instrument for measuring OHRQoL in world-level studies is OHIP-14.¹⁻⁹ A study by Oliveira et al. on the effect of low-level laser imaging on post-surgical inflammatory process after third molar surgery was presented as a double-blind clinical trial.¹⁸ However, the definition of a double-blind clinical trial is a significant method; in this context, carrying out a double-blind clinical trial to measure health interventions such as dental treatment is often difficult and sometimes impossible.

The results of the researches that considered OHRQoL as an outcome measure were as follows:

1. Helping clinicians better understand the risks and benefits associated with their therapeutic options.⁸ The results of the review revealed that, according to Bruhn et al., vital tooth whitening has been effective in improving OHRQoL in adults.¹⁴ Today, this treatment is being carried out by dentists for patients who are looking for esthetic appearance and it seems that incentives for material gain are also involved.

2. Providing evidence to show how much the cost of treatment protocols is worth.⁸ Nicolaisen et al. showed no significant difference between the effect of fixed metal ceramic and all-ceramic prostheses on OHRQoL,¹³ while the cost difference between these two treatments is significant.

3. Analyses provide data that help patients

and their families in treatment decision-making.⁸ Karbach et al. reported that the implant-retained overdenture as well as the number of implants (4 vs. 2) improved OHRQoL significantly compared to conventional denture.²⁰ However, the diversity of therapeutic options is sometimes confusing for the patient and his family, and this decision will be handed over to the clinician, and might be troublesome in the future.

4. No studies are available on some specialized dental treatments such as root canal treatment; therefore, it is recommended that the relevant researchers take action in the future. Similar studies can also be carried out to assess the effect of dental treatment on OHRQoL in children and the elderly. Studies should consider other tools such as OHIP-49 and OHIP-EDENT (Edentulous) to measure OHRQoL changes.

Conclusion

The results of this study showed that the majority of RCTs undertaken to improve the level of OHRQoL have shown improvements in the effectiveness of treatments (prosthesis, implants, oral surgery, periodontal, and oral diseases) in adults. This shows the positive effects of these dental treatments on patients.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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The knowledge of the dentists in dental clinics in Kerman City, Iran, about ocular complications after local anesthesia

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Original Article

Abstract

BACKGROUND AND AIM: Ocular disorder like, diplopia, mydriasis, blurred vision, ptosis, exophthalmos, and blindness (permanent or temporary) are infrequent complications of an injection of local anesthetics in mouth. The main purpose of this study was to survey the dentist's knowledge and attitude about ocular disorders due to intra-oral anesthetics injection.

METHODS: A three-part questionnaire including demographic data and questions on knowledge and attitude about ocular complication was distributed among 197 dentists in Kerman, Iran. Data analysis were performed using the SPSS.

RESULTS: Of the study participants, 7.6% did not have any knowledge regarding the ocular complications after local anesthetics injection and 10.7% indicated that eye problems have not been occurred following the dental anesthesia. Among the participants who were aware of this issue expressed self-experience in the clinical practice as the major source of their information, while just 2.0% indicated that their awareness on the ocular complications was from the studies published. In addition, this lack of knowledge in general dentists was more than the specialists.

CONCLUSION: The knowledge of the dentists regarding the ocular complications due to anesthesia in the present survey investigation is not satisfactory and needs enhancement. There is a necessity for precise protocol for dentists in recognizing and managing ocular complications by intra-oral anesthetics injections.

KEYWORDS: Ocular; Complications; Intra-oral; Anesthesia

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Using appropriate local anesthetics technique is one of the most important challenges for dentists. In previous studies, some complications such as cardiovascular diseases (CVDs), systemic complications, allergic reactions, drug interactions, methemoglobinemia, and peripheral nervous disorders after injection of anesthetics were noted.¹

One of the most important side effect of the intra-oral anesthetics injection is ocular disorders and most of the dentists were not aware of these side effects based on the

previous studies.² These complications can include temporary³ or permanent blindness,^{4,5} blurred vision,^{6,7} motor complications such as palpebral ptosis, mydriasis, diplopia and exophthalmos, and eye ptosis.⁸

The survey about dentists' information regarding this issue has been carried out only in one country.² In Iran, no study was found published in this regard. Therefore, the present study was conducted with the aim to assess the dentists' awareness of possible emergencies during and after injection of anesthetics in mouth in Kerman province, the largest

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province in Iran. In necessity situation, this study can help dentists to take the best action.

Methods

From the 200 dentists in Kerman among whom the questionnaires were distributed, 197 of them accepted to participate in this cross-sectional study which was performed in 2019. The individuals were selected by random sampling method from the government sector, private sector, and also universities.

The survey was approved by the research ethics Committee of Kerman University of Medical Sciences (code: IR.KMU.REC.1398.099).

The first and second phases of the study included questionnaire designing and collecting and the data analysis, respectively. In the first phase, the questionnaire was designed in three parts; the first part addressed the demographic and individual characteristics such as age, sex, work experience, and education level and the second and third parts of the questionnaire contained questions around dentist's knowledge and attitude about ocular disorder due to intra-oral anesthetics injection, respectively. The knowledge and attitude parts included respectively 8 and 6 questions. The responses were based on three options: Yes, No, and I do not know.

The validity and reliability of the questionnaire were measured by the content validity index (CVI) and intraclass correlation coefficient (ICC) as 0.78 and 0.80, respectively. The content validity of the questionnaire was approved by 10 experts of the dental school, and the questions' intelligibility and level were discussed as well. Given the experts' opinions, a total of 15 questions were considered appropriate and very appropriate. The ICC was calculated with the test-retest method using SPSS software (version 21, IBM Corporation, Armonk, NY, USA). The validity and reliability indices were at acceptable levels.

All subjects signed the inform consent and they were ensured that the data would remain confidential and would be investigated for purely statistical reasons.

The results were expressed by a 95% confidence interval (CI) and percentages. The results were analyzed using SPSS software (version 21, IBM Corporation, Armonk, NY, USA).

Results

A total of 197 dentists participated in this survey, with the demographic characteristics presented in table 1.

Table 1. Demographic characteristics of study population

Demographic characteristics	General dentists [n (%)]	Specialists [n (%)]
Gender		
Male	72 (55.8)	26 (38.2)
Female	57 (44.2)	42 (61.8)
Age (year)		
≤ 35	90 (69.7)	33 (48.5)
36-45	22 (17.1)	16 (23.6)
> 45	17 (13.2)	19 (27.9)
Work experience (year)		
< 5	54 (42.0)	28 (41.0)
5-10	44 (34.0)	19 (28.0)
> 10	31(24.0)	21 (40.0)

Knowledge on ocular complications:

Among the dentists who were aware of the ocular complications after dental anesthesia, 26.0% declared that just self-experience in the clinical practice was a major source of their information, while only 2.0% indicated that their information about this issue was from the published studies.

Most of the participants (44.7%) encountered ocular complications following the local dental anesthesia in the clinical practice and the most signs were blurring of vision and double vision together (13.2%) and transient dizziness (13.2%).

Most of the symptoms lasted for few seconds or few minutes and 5.6% of the specialists indicated that the ocular complications remained for few days.

Just 11.6% of all participants consulted an ophthalmologist about ocular signs due to local anesthesia. Surprisingly, only 30.8% general dentists knew about the permanent blindness as an ocular complication due to dental anesthesia.

About 42.6%, 10.2%, and 17.0% of the

participants declared that ocular complications were seen following infra orbital injection, superior alveolar nerve, and inferior alveolar nerve blocks, respectively. Furthermore, the specialists and general dentists indicated that most of the ocular

complications were associated with the infra orbital nerve block, as 51.8% and 39.7%, respectively. However, 21.3% and 3.6% of the participants responded that all and none of the injections could be associated with the ocular complications, respectively (Table 2).

Table 2. Percentage of knowledge according to qualification degree in dentists about ocular problems after anesthesia

Knowledge questions	Qualification (%)	
	Specialists	General dentists
Do you know that ocular complications occur due to intra oral local anesthesia?		
Yes	90.4	76.6
No	5.8	13.5
I don't know	3.8	9.9
If yes, then what is the source of your information?		
Personal experience	19.2	34.3
Colleagues	1.9	13.7
Text books	11.5	5.9
Internet	5.8	7.8
Journals	5.8	1.0
Magazines and news papers	0	1.0
Retraining	3.8	3.9
Congress	7.7	5.9
All of the above	44.2	26.5
Did you encounter any ocular complications during or after administration of intra oral local anesthetic?		
Yes	46.4	46.8
No	44.6	42.3
I don't know	8.9	10.8
If yes, what were the symptoms you noticed in a patient?		
Blurred vision	3.0	13.6
Double vision	6.1	10.2
Squinting	0	0
Transient dizziness	18.2	6.8
Loss of vision	3.0	3.4
Difficulty in reading	0	1.7
Drooping of the upper eyelid	6.1	11.9
Decreased sensation on the lateral side of the upper and lower eyelids	3.0	1.7
All of the above	15.2	3.4
Blurred vision and double vision	3.0	15.3
Blurred vision and transient dizziness	6.1	8.5
Blurred vision and decreased sensation on the lateral side of the upper and lower eyelids	6.1	0
Blurred vision and drooping of the upper eyelid	9.1	3.4
Double vision and transient dizziness	6.1	5.1
Blurred vision, double vision, and transient dizziness	3.0	8.5
Blurred vision, double vision, and drooping of the upper eyelid	9.1	6.8
How long did the symptoms last?		
Few seconds	47.2	63.6
Few minutes	27.8	25.8
Few hours	19.4	10.6
Few days	5.6	0
Did you consult an ophthalmologist for ocular complications?		
Yes	22.0	15.6
No	78.0	84.4
Do you know that sometimes an ocular complication due to intra oral local anesthesia causes permanent blindness?		
Yes	51.9	30.8
No	16.7	40.2
Don't know	31.5	29.0
Which intra oral nerve block can cause maximum ocular complications?		
PSA	8.9	11.2
Infra orbital	51.8	39.7
Inferior alveolar	14.3	19.0
Infiltration	1.8	0.9
All of the above	19.6	23.3
None of the above	3.6	4.3
Infra orbital and PSA	0	1.7

PSA: Posterior superior alveolar

Attitude questions: Interestingly, the immediate reaction in most of the general dentists (48.7%) and specialists (69.1%) when encountered with an ocular complication was to assure the patient and discontinue the dental procedure. In addition, 14.5% of the specialists and 8.5% of the general practitioners choose to call medical emergencies, and some of the general dentists (14.5%) and specialists (5.5%) preferred to call an ophthalmologist. Besides, about 7.5% of the participants preferred to transfer the patient to a hospital and 3.6% of the specialists and 20.5% of the general dentists ignored the ocular signs and continued the intended dental procedure. Regarding the prevention of the ocular complications, 20% of the participants indicated that these problems could be prevented by knowing the exact anatomy of the nerve block location, in addition, 1.8% of the specialists and 3.4% of the general dentists answered the aspiration and avoiding injection into blood vessels. And some of the specialists (1.8%) and general dentists (7.7%) preferred to follow optimal injection techniques. Furthermore, about 3.5% of the participants indicated that knowing the accurate anatomy of the nerve block area and following the accepted techniques of injection together could prevent the ocular complications. The majority of the participants responded all the questions, however many specialists (3.3%) and general dentists (16.2%) answered none of the questions.

The majority of the participants consulted an ophthalmologist if an ocular complication persisted for 24 hours, however a few of the participants indicated it after completion of the intended dental procedure. The specialists immediately consulted more than the general dentists with an ophthalmologist (41.1% vs. 21.6%). The specialists (16.1%) and general dentists (19.8%) answered whether the symptoms of the ocular complications lasted for more than 4 hours, and only 8.6% of the general dentists expressed they would never consult an ophthalmologist.

Regarding the importance of the ocular

complications due to dental anesthesia, 31.3% of the general dentists and 9.1% of the specialists indicated “no”, and 87.3% of the specialists and 51.3% of the general dentists reported it might cause irreversible damage, moreover 3.6% of the specialists and 17.4% of the general dentists responded “I do not know”.

Most of the participants (98.0%) had the same opinion, requiring more investigations on ocular complications following the dental anesthesia. Furthermore, they declared that the information about this subject should be trained and published (Table 3).

Most of the participants believed that oral and maxillofacial surgery department was more responsible for teaching primarily in the field of pharmacology and proper techniques of local anesthesia in dentistry (Figure 1).

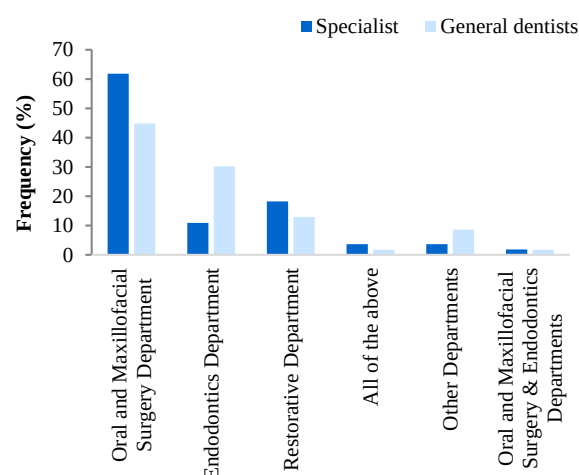


Figure 1. Departments responsible for primary training in the field of pharmacology and techniques of local anesthesia in dentistry

Discussion

Among the participants in this survey, 7.6% did not have any knowledge on the ocular complications due to dental anesthesia and 10.7% indicated that these complications did not occur following the dental anesthesia. In addition, this lack of knowledge among the general dentists was more than specialists. 96.4% the specialists and 98.3% of the general dentists know that more studies should be conducted on ocular complications after local anesthesia in dentistry.

Table 3. Percentage of attitude in participants according to qualification degree

Attitude questions	Qualification (%)	
	Specialists	General dentists
If you encounter ocular complications during or after administration of the intra oral local anesthetics, what would be your immediate reaction?		
Reassuring the patient and stopping the intended dental procedure	69.1	48.7
calling medical emergency	14.5	8.5
Calling ophthalmologist	5.5	14.5
Transferring the patient to a hospital	7.3	7.7
Ignoring and proceeding with the intended dental procedure	3.6	20.5
Prevention of ocular complications due to intra oral local anesthesia is by		
Knowing accurate anatomy of the nerve block area	20.0	20.5
Aspiration before the injection and avoiding injecting into blood vessels	1.8	4.3
Following accepted injection techniques and procedures	1.8	7.7
Knowing accurate anatomy of the nerve block area and following accepted injection techniques and procedures	3.6	3.4
All of the above	69.1	47.9
None of the above	3.6	16.2
If you encountered with ocular complications during or after the administration of the intra oral local anesthetics, when do you consult an ophthalmologist?		
Immediately	41.1	21.6
After completing the intended dental procedure	5.4	7.8
If signs and symptoms of ocular complications persist for more than 4 hours	16.1	19.8
After 24 hours	37.5	42.2
I will never consult an ophthalmologist.	0	8.6
Do you think a dentist should take seriously the ocular complications due to the intra oral local anesthesia?		
Yes because if neglected sometimes it may cause irreversible damage.	87.3	51.3
No, because most of the ocular complications are transient.	9.1	31.3
Don't know.	3.6	17.4
Do you feel more research and review should be carried out on ocular complications due to intra oral local anesthesia?		
Yes	96.4	98.3
No	3.6	1.7
Do you want more information should be published in the journals/books/other literature about ocular complications due to dental anesthesia?		
Yes	96.4	100
No	3.6	0

Only one study was found in this field carried out by Patil et al.² reporting that about 14.0% of specialist and 39.0% of general dentists knew about this kind of ocular problems. The outstanding source of knowledge among both specialists and general dentists were journals. Based on the results of this study, 17.6% of the specialists and 8.3% of the general dentists experienced ocular complications. Most of them responded that ocular complications were under-reported in the studies. Besides, 84.3% of the specialists and 90.5% of the general dentists know that more studies should be performed on ocular complications. About

97.3% of the generals and 98.3% specialists preferred to prevent ocular complications after anesthesia.

Ocular complications after intra-oral anesthetics injections are an exceptional issue because they can cause permanent blindness,⁴ although it can occur in 0.1% of the cases as estimated twenty years ago by Meyer in Germany. The very low rate of the ocular accident due to the administration of the intra-oral anesthetics injection as 1 case per 500 million or 1 billion cases indicates that this complication is very uncommon, however it does not mean its lack of occurrence, needing more studies.⁹

Complications during the inferior alveolar nerve block anesthesia could be categorized into local and systemic ones. The local side effects are hyperesthesia or permanent post injection paresthesia, burning feeling at the time of injection, and separation of needle and hematoma which may lead to infection, trismus or shedding of tissues, and trauma. The systemic complications are caused by coincidental intravascular injection, fast absorption of anesthetic into the circulation system, slow clearance, toxicity affiliated with vasoconstriction, overdose, drugs interactions, and allergic reaction. Ocular complications, such as ophthalmoplegia, diplopia, and vision loss are very uncommon. These symptoms can be due to visual problems, such as motor problems, like palpebral ptosis, mydriasis, blurred vision, or diplopia and blindness.^{5,8,10,11}

The best way to avoid the appearance of complications such as ocular problems is to check the patient and use a correct and careful technique, especially avoiding intravascular injection. In the case of lack of any complication, the most important phase is to calm the patient. In addition, in cases of diplopia, it is recommended to cover the patient's affected eye in order to inhibit the annoying sensation of double vision.¹²

Additionally, Blanton and Jeske suggested injection in the proper location to be as the best way for minimizing the risk of complications considering blood vessels, nerves, and glands.¹³ In the case of happening these complications, the patient should be referred to an ophthalmologist for evaluation of the ocular complications lasting longer than 6 hours and before that the patient should be escorted home by a responsible adult.^{14,15}

Conclusion

Dental staff should be able to appropriately recognize and manage ocular complications caused by the intra-oral anesthetics injections. Regrettably, the data from this study indicated that few dentists have enough knowledge on ocular complications due to intra-oral anesthetics injections. This important epidemiologic finding should serve as a warning.

Conflict of Interests

Authors have no conflict of interest.

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The knowledge and attitude of Turkish pre-clinic and clinic dental students towards the dental treatment of patients with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS)

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Original Article

Abstract

BACKGROUND AND AIM: Acquired immunodeficiency syndrome (AIDS) is one of the most stigmatised diseases which leads the individuals to feel alone with the social and economic anxiety. The aim of the present study was to evaluate the knowledge and attitude of dental undergraduate students about human immunodeficiency virus (HIV)/AIDS.

METHODS: This study comprised pre-clinic and clinic students of School of Dentistry, Usak University, Usak, Turkey. A web-based questionnaire (WBQ) was administered to total of 280 students. The data were collected and interpreted.

RESULTS: According to AIDS Knowledge Questionnaire and AIDS Attitude scale (AAS), there was a statistically significant difference only in the protection dimension ($P \leq 0.05$). No statistically significant difference was found between pre-clinic and clinic groups with respect to the AAS ($P > 0.05$).

CONCLUSION: Despite the fact that they all had lack of information about HIV/AIDS, clinic group had better knowledge about how they could protect themselves. Also, they all had stigmatized attitudes towards this group of patients.

KEYWORDS: Human Immunodeficiency Virus; Acquired Immunodeficiency Syndrome; Students; Dental; Awareness; Knowledge; Social Stigma

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Acquired immunodeficiency syndrome (AIDS) is a notable health disease that can be endemic. It was described in the United States in 1981.¹ The human immunodeficiency viruses (HIVs) such as HIV-1 and HIV-2 belong to the family of retrovirus.² Besides the fact that it is contagious and so far the treatments only have limited the illness itself, AIDS is the most stigmatised disease which leads the individuals to feel alone with the social and economic anxiety. Moreover, they often have problems in benefiting from health services.³

United Nations Program on HIV/AIDS (UNAIDS) estimated that 36.9 million people all over the world were living with HIV, of

whom 1.8 million had been newly infected in 2018.⁴ Although it has not been endemic in Turkey, 3356 new HIV-infected (HIV+) and AIDS cases were seen and they have a considerable extent in young adults in ages of 25-29 years.⁵ Based on these data, it is important to educate people about transmission ways and protection against HIV especially the young adult ones.³

It is a fact that HIV is most commonly transmitted through sexual intercourse. The second most common transmission route of HIV is through the narcotic addicts who use intravenous drugs with the same needles. Moreover, the virus is transmitted from the HIV+ mother to the infant, in the uterus and

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during delivery. Also, there is a risk of transmission through breastfeeding. If the disease is not under control, this vertical transmission rate of HIV can range from 15% to 45%.⁶ During dental treatment, the transmission of HIV/AIDS virus is quite rare.² Despite major progress in treatment response, still HIV epidemic is a public health threat. Dentists should be educated enough to diagnose HIV/AIDS-related early oral lesions. HIV+ patients have more dental care needs than the healthy ones.⁷ In this case, the dentist responsibility is to treat the HIV+ individual ethically without any patient discrimination.⁸

Dentists, nurses, and co-workers must have a detailed knowledge of self-protection and methods of cross-infection prevention about HIV. Furthermore, the transmission paths which are frequently related to direct contact with blood in a dental office must be known and a certain procedure must be followed. Fear of HIV contagion which can be resulted in declining to treat the patient is very common among dentists. Studies reveal that dental students are not educated enough to know HIV/AIDS transmission routes.⁹

The null hypothesis of this study is that with increase in education about HIV/AIDS, dental students approach will not be discriminative to treating HIV+ patients. The aim of this study was to demonstrate the data from a chosen target population and compare knowledge and attitude of the pre-clinic and clinic dental students about HIV/AIDS.

Methods

After ethical committee approval (date: 22/03/2019, number: 2019/06-01), this descriptive cross-sectional study was conducted on the dental students of Usak University, Usak, Turkey. 280 students participated in the study. The HIV/AIDS awareness of dental students was assessed by a web-based questionnaire (WBQ). Students were suitable for the survey if they were 18 years of age or older, willing to take the WBQ, and able to answer the questions in

Turkish. WBQ was administered to first, second, and third year dental students as the pre-clinic group and to fourth and fifth year dental students as the clinic group. These groups were selected as they had a clinic internship experience or not.

The WBQ used in this survey was based on the study of a novel questionnaire which was tested on Turkish population and resulted in acceptable psychometric values.³ A 21-item AIDS Knowledge Scale and a 17-item AIDS Attitude Scale (AAS) were used in this study.

In the first part, there was a 21-item AIDS Knowledge Scale. It had closed-ended questions and the answer for questions was "agree", "unsure", or "disagree". A score of 1 was given for agree answer and a zero for the unsure and disagree answers. Hence, a student's total score ranged from 0 to 21.

In the second part, there was a 17-item AAS. It had closed-ended questions and participants were asked to choose the answer "strongly agree", "agree", "neutral", "disagree", or "strongly disagree" to each question in the form of a five-point Likert scale. Thus the total score for attitude ranged from 22 to 73.

In the evaluation, the reliability of WBQ was determined with Cronbach's alpha and the correlations of the scale expressions were examined. Then the scale sub-dimensions were obtained by exploratory factor analysis (EFA). Cronbach's alpha coefficients were calculated for the obtained dimensions. Factor analysis was based on Kaiser-Meyer-Olkin (KMO) and Bartlett's tests. However, in factor analysis, dimensions were determined by direct oblimin rotation on the basis of principal component analysis (PCA). Expressions contained in more than one factor and less than 0.10 difference in terms were excluded from the evaluation. For the obtained dimensions, the normal distribution assumption was controlled with the Kolmogorov-Smirnov test. The comparison of pre-clinical and intern students in terms of obtained dimensions was performed with

Mann-Whitney U test. Statistical analyses were performed using SPSS software (version 22, IBM Corporation, Armonk, NY, USA).

Results

Total number of 280 students were included in this study, 53.2% (n = 149) were women and 46.7% (n = 131) were men. There was no statistically significant difference between the genders in terms of the dimensions discussed in the clinical group ($P > 0.05$). However, there was a significant difference in AIDS Knowledge Scale between the genders for protection and sexuality dimensions in the pre-clinical group ($P < 0.05$). In terms of protection knowledge, the average of women was higher than men ($P < 0.01$), while the average level of sexuality knowledge was higher in men than women ($P < 0.01$). Across these samples, the mean age of the students was 21.4 years. 63% (n = 180) of them were in pre-clinic group and 36% (n = 102) of them were in clinic group.

Distribution of AIDS knowledge is given in table 1. AIDS Knowledge Scale was examined in three dimensions: transmission, protection, and sexuality (Table 2). The overall Cronbach's alpha value of the AIDS Knowledge Scale is acceptable as 0.767. Cronbach's alpha values of the three sub-dimensions were between 0.572 and 0.848. A low correlation of 29.7% was found

between transmission and protection sub-dimensions and it was found to be statistically significant ($P < 0.01$). Also, a statistically significant but lower correlation (15.2%) was found between transmission and sexuality ($P < 0.05$). The 6.3% correlation between protection and sexuality was not statistically significant. The expressions in each dimension are given in table 2. Regarding pre-clinic and clinic groups, a statistically significant difference was found only in the protection dimension ($P \leq 0.05$). Clinic group was more informed than the pre-clinic one.

AAS was examined in 4 dimensions which were physical contact, social relationship, special relationship, and stigma, reliability was assessed as well (Table 3). The overall Cronbach's alpha value of the AAS is questionable as 0.614. Cronbach's alpha values of the four sub-dimensions were between 0.437 and 0.739. The acceptable Cronbach's alpha value was 0.739 in the physical contact sub-dimension, while the alpha values of the other sub-dimensions were poor. Correlations between physical contact and social relationship, special relationship, and stigma were -5.6%, 40.3%, and 30.4%, respectively. The last two of these correlations were statistically significant ($P < 0.05$). The correlations between social relationship and special relationship and stigma were -10.4% and -10.0%, respectively.

Table 1. Distribution of acquired immune deficiency syndrome (AIDS) Knowledge Scale and AIDS Attitude Scale (AAS)

Variable		Descriptive statistics						Mann-Whitney U	
Dimension	Term	N	Mean $\pm$ SD	Median	IQR	Minimum	Maximum	Z	P
Transmission	Pre-clinic	188	3.50 $\pm$ 2.24	4	3.5	0	7	-0.600	0.548
	Clinic	91	3.67 $\pm$ 2.38	4	5	0	7		
	Total	279	3.56 $\pm$ 2.28	4	5	0	7		
Protection	Pre-clinic	188	1.60 $\pm$ 1.20	2	3	0	3	-2.475	0.013
	Clinic	91	1.98 $\pm$ 1.10	2	2	0	3		
	Total	279	1.72 $\pm$ 1.18	2	2	0	3		
Sexuality	Pre-clinic	188	3.23 $\pm$ 1.09	4	1	0	4	-0.709	0.478
	Clinic	91	3.21 $\pm$ 0.97	4	1	1	4		
	Total	279	3.23 $\pm$ 1.05	4	1	0	4		
General	Pre-clinic	189	12.00 $\pm$ 4.30	12	6	0	21	-2.802	0.005
	Clinic	91	13.68 $\pm$ 3.85	14	5	4	21		
	Total	280	12.55 $\pm$ 4.23	13	5	0	21		

IQR: Interquartile range; SD: Standard deviation

Table 2. Dimensions of acquired immune deficiency syndrome (AIDS) Knowledge Scale

Dimension	Expressions	Component		
		1	2	3
Transmission, Cronbach's alpha = 0.848	Kissing a patient with AIDS can spread the disease.	0.837		
	Kiss from a patient with AIDS can spread the disease.	0.798		
	Eating from the same plate with the patient with AIDS can spread the disease.	0.768		
	Cough of a patient with AIDS can spread the disease.	0.756		
	Sharing the same items (teacup, towels, clothes, etc.) with the patient with AIDS can spread the disease.	0.749		
	Swimming in the same pool with the patient with AIDS can spread the disease.	0.636		
Protection, Cronbach's alpha = 0.742	Using the same toilet as the patient with AIDS can spread the disease.	0.501		
	Regular exercise can be a way to protect from AIDS.		0.840	
	Healthy nutrition helps protect against AIDS.		0.811	
	Too much stressful life can lead to AIDS.		0.797	
	Avoiding a one-night relationship helps protect against AIDS.			0.735
	Monogamy helps protect against AIDS.			0.724
Sexuality, Cronbach's alpha = 0.572	Getting to know your partner is helpful in protecting against AIDS.			0.719
	Using condoms helps protect against AIDS.			0.458
	Extraction method: Principal component analysis (PCA); Rotation method: Oblimin with Kaiser normalization			

AIDS: Acquired immune deficiency syndrome

These correlations were not statistically significant ($P > 0.05$). There was a 11.9% correlation between the special relationship and stigma, which was statistically significant ($P < 0.05$). In general, all correlations were low. No statistically significant difference was found between the pre-clinic and clinic groups in 4 dimensions ($P > 0.05$).

Distribution of AAS is given in table 4.

Discussion

In this study, which was performed to assess the dental students' knowledge and attitude about HIV/AIDS, it was seen that the general education of the participants was noticeably low.

Table 3. Dimensions of acquired immune deficiency syndrome (AIDS) Attitude Scale (AAS)

Dimension	Expressions	Component			
		1	2	3	4
Physical contact, Cronbach's alpha = 0.739	I would not want to work in the same job with someone who has AIDS.	0.853			
	Working with someone who has AIDS makes me feel uncomfortable.	0.832			
	If a friend had AIDS, I would stay away from him.	0.712			
	I think it is dangerous for patients with AIDS to get in touch with others.	0.532			
Social relationship, Cronbach's alpha = 0.437	I feel comfortable with someone who has AIDS.		0.742		
	I live in the same house as someone with AIDS.		0.670		
	If I was an employer, I would hire someone with AIDS.		0.608		
Special relationship, Cronbach's alpha = 0.584	If my lover said he had AIDS, I would leave him.			0.729	
	I turned against my child marrying someone with AIDS.			0.728	
	I prefer to be away from someone with AIDS.			0.653	
Stigma, Cronbach's alpha = 0.463	It is a shame to have AIDS.				0.771
	It would be embarrassing for me to have one of my parents suffering from AIDS.				0.673
	I would be ashamed to go to the doctor to get an AIDS test.				0.606
	Extraction method: Principal component analysis (PCA); Rotation method: Oblimin with Kaiser normalization				

AIDS: Acquired immune deficiency syndrome

Table 4. Distribution of acquired immune deficiency syndrome (AIDS) Attitude Scale (AAS)

Variable			Descriptive statistics					Mann-Whitney U	
Dimension	Term	N	Mean $\pm$ SD	Median	IQR	Minimum	Maximum	Z	P
Physical contact	Pre-clinic	188	12.15 $\pm$ 4.01	12	6	4	20	-0.317	0.751
	Clinic	91	12.33 $\pm$ 3.73	12	4	3	20		
	Total	279	12.21 $\pm$ 3.92	12	6	3	20		
Social relationship	Pre-clinic	188	7.54 $\pm$ 2.63	7	3	3	15	-1.866	0.062
	Clinic	91	8.11 $\pm$ 2.82	8	4	3	15		
	Total	279	7.73 $\pm$ 2.70	7	4	3	15		
Special relationship	Pre-clinic	188	8.74 $\pm$ 3.38	9	4.5	3	15	-0.984	0.325
	Clinic	91	8.29 $\pm$ 2.76	8	3	3	15		
	Total	279	8.59 $\pm$ 3.19	9	4	3	15		
Stigma	Pre-clinic	188	10.14 $\pm$ 2.57	10	4	3	15	-0.987	0.323
	Clinic	91	9.92 $\pm$ 2.22	10	4	5	15		
	Total	279	10.07 $\pm$ 2.46	10	4	3	15		
General	Pre-clinic	188	49.82 $\pm$ 8.48	50	11	22	73	-0.219	0.827
	Clinic	91	50.07 $\pm$ 7.78	50	10	33	72		
	Total	279	49.90 $\pm$ 8.24	50	10	22	73		

IQR: Interquartile range; SD: Standard deviation

An increasing number of HIV+ patients requires appropriate dental care and as a consequence dentistry students, who are the dentists of the future, should be well trained. By this way, HIV/AIDS-related risk behaviors can be reduced in dental practice. Having knowledge and experience in practice are the keys in an attempt for improvement of a healthy behaviour.^{10,11} Professional attitude can be provided with the help of an integrated education that includes the ethical aspects and a better perception of the disease.¹² In the present study, there was no significant difference between the groups in terms of transmission and sexuality. Also, it was determined that clinic group was more informed in the dimension of protection. Unlike this study, Singh et al. found that dental students had adequate information about transmission patterns although they had lack of knowledge about infection control.¹³

A study done in the School of Dentistry of Yeditepe University, Istanbul, Turkey, indicated that 72.8% of the students were concerned about the transmission of HIV/AIDS infection from patients, 81.6% of them thought that they had insufficient knowledge, and 87.2% of them thought they needed further education.¹⁴ In another study involving dentistry students, 81.0% of the

students reported that they were worried about the risk of transmission during dental treatment.¹⁵ Moreover, in the present study, HIV/AIDS knowledge level was found inadequate. Even though the protection dimension was found statistically and significantly better in clinic group than the pre-clinic group, it was not satisfactory either. With more education, the concerns about treating an HIV/AIDS-infected patient can be reduced.

Regarding gender, a study at Jazan University, Jazan, Saudi Arabia, revealed that male and 4th year dental students had better HIV-related knowledge and attitudes when compared to female and lower level students.¹⁶ In the present study, there was no statistically significant difference in terms of gender in clinic group ($P > 0.05$). Also, contraversally to this study, men in pre-clinic group were less informed than women according to AIDS Knowledge Scale. These differences in two study can be explained by the difference of culture.

There were no statistically significant differences between the two groups in AAS for all these 4 dimensions. So, this study showed an undesired data about attitude of dental students toward patients with HIV/AIDS and current findings showed that in both groups, dental students had

substantially prejudiced thoughts. These high rates of HIV+ patients discrimination are congruent with previous study done in an other dentistry school in India in which the students had adequate knowledge about patients with HIV/AIDS.¹⁷ The findings of this study are different from those of previous researches who found students having positive attitude about HIV/AIDS-infected patients.¹⁸ On the other hand, a research revealed that students who had adequate knowledge about patients with HIV/AIDS, had a positive attitude.¹⁸ One of the most salient findings of this study was that both in clinic and pre-clinic groups, the knowledge and attitude toward HIV/AIDS fell short of the expectations. These stigmatized thoughts can be changed with an adequate qualified education.^{19,20}

The results indicated that students' knowledge and attitude about HIV/AIDS did not change as the year of study progressed. This is not compatible with the findings of previous studies observed.¹⁹ This may be attributed to insufficient content of knowledge acquired as one progresses through the curriculum. In line with the present study, different studies in different countries revealed educational deficit in medical and dental students with regards to HIV/AIDS.²¹ Nasir et al. revealed that students were not prepared for facing an HIV/AIDS-infected patient and they

suggested that dental curriculum should be improved with respect to treating patients with HIV/AIDS.⁸ Therefore, the low knowledge level about the HIV/AIDS found in our study should be a source of concern because of the risk of cross-infection.

The limitation of the present study is the inclusion of only one dental school. This limited sample size may limit the generalization of the findings. Far-reaching further researches should be done in the future.

Conclusion

The present study revealed that most of the respondents did not have enough education with respect to HIV/AIDS. Even though non of them were well-informed about HIV/AIDS, clinic group had better knowledge about how they could protect themselves; nevertheless, they all had stigmatized attitudes towards this group of patients. Further education should be given to improve the future dentists thoughts. This will be important in decreasing both HIV/AIDS discrimination stigma and cross-infection among the dentists and the patients.

Conflict of Interests

Authors have no conflict of interest.

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The relationship between learning style preferences from VARK model and academic performances among the students of Dentistry in 2016-2017

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Original Article

Abstract

BACKGROUND AND AIM: Individual's learning style determines the mechanism of processing, internalization, and retention of new information. The higher education centers and professors need information and conformity to various learning styles to help students learn effectively. In addition, researchers believe that learning styles are one of the factors responsible for differences in students' academic performance.

METHODS: The sample of present study consisted of all the first-year to sixth-year dental students and the postgraduate students of School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran, in the second semester of 2016–2017. The subjects were included in the study using the census method (343 undergraduate and 59 postgraduate students). Data were collected using VARK questionnaire. The students' overall mean grades were used to evaluate their academic performance. The data were analyzed with SPSS software; also descriptive statistics (frequencies, central indices, and distribution) and analytical statistics were used. The correlation between learning style and the average of the students was evaluated with analysis of variance (ANOVA) test and chi-square test was used to evaluate the relationship of learning styles with age, gender, and grades of education.

RESULTS: 88.3% of the learners were unimodal and 11.7% used multi-modal learning style. No statistical correlation between the students' learning style and their academic performance was found ($P = 0.066$).

CONCLUSION: The professors should be aware of the different preferences of students in learning styles and take the necessary steps to develop effective educational techniques that fit the students' learning styles.

KEYWORDS: Learning; Academic Performance; Education; Students; Dental

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The personal learning style determines how an individual processes, internalizes, and retains new information.¹ The majority of teachers and instructors believe that high-quality teaching helps effective learning. Effective learning depends on the learner's

active participation in the learning process. The higher education institutes and professors require knowledge and conformity to different learning styles in order to help students learn effectively.² One of the responsibilities of the medical group professors is to impart knowledge, attitudes,

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and skills and evaluate them. The motivation and performance of students are promoted when there is conformity between the teaching style and the students' learning style.³

Academic performance is a criteria of the success of academic activities in all the educational systems and its prediction is one of the most favorable fields for the majority of researchers.⁴ Academic performance is defined as the outcome of an individual student's efforts in relation to official educational activities and in fact, all the endeavors of the educational system are directed toward it. Academic performance is a dependent variable and it is affected by various factors.⁵ Learning styles are variables that have attracted researchers' attention to predicting academic performance.⁶ Students prefer a variety of learning styles, while the professors use only one technique for teaching. Professors should have sufficient knowledge about using diverse learning methods among students.⁷

Different techniques are available to determine learning styles, one of the newest and the most intelligible of which is the VARK learning style questionnaire.² Researchers believe that learning styles are one of the factors responsible for differences in the students' academic performance. So, for professors, it is valuable to have knowledge about the educational preferences of learners and implement the most suitable learning strategies to increase the quality of learning and adjust it to the learners' interests.⁸ Dental students need a certain type of practical training because of the major nature and professional importance of their job. The choice of these teaching methods and media depends on a variety of factors, including student's learning style. So, awareness of the student's characteristics and needs in the teaching-learning process helps the instructor in the logical design of education. There is no study in Iran that addresses the issue of VARK learning styles and academic performance in dental students. It is likely to promote the information about factors that affect learning style and its relation with educational performance by

implementing the VARK questionnaire.

There have been various researches in this area around the world including the studies of Salimi et al.,¹ Baykan and Nacar,³ Asiry,⁷ and Urval et al.⁹ Salimi et al. in a research at Isfahan University of Medical Sciences, Isfahan, Iran, showed that 48.4% of students preferred single-modal and 51.6% of them preferred multi-modal learning styles. The results showed that learning styles and educational grades had statistical significant relevancy ($P < 0.05$).¹

In a study among medical students, Baykan and Nacar showed that 4.1% of students had single-modal learning style (1.5% kinematic, 1.2% auditory, 4.9% visual, and 1.5% reading/writing) and 2.9% had multi-modal learning style.³

Asiry conducted a research among dental student of King Saud University, Riyadh, Saudi Arabia. His findings show that 58.4% and 41.6% of the students prefer multi-modal and single-modal learning styles, respectively, and there is no relationship with educational levels.⁷

Urval et al.'s findings in medical students showed that the majority of them were multimodal and their dominant unimodal style was aural (45.5%) and kinesthetic (33.1%). It should be mentioned that sex or academic performance had no effect on learning styles.⁹

The major goal of the current research was to determine the dominant learning style of dental students of Kerman University of Medical Sciences, Kerman, Iran, using VARK questionnaire and also to investigate the relationship between learning style and academic performance. We hope that this study will provide valuable findings as a guide for teachers and curriculum designers to select the most suitable educational content and method.

Methods

This cross-sectional research was performed at School of Dentistry, Kerman University of Medical Sciences in 2016–2017. 343

undergraduate and 59 postgraduate dental students were included in the study by using the census technique. Students transferred from other universities, guest students, and those not interested to participate in the study were excluded. Finally, statistical analyses were carried out on 236 undergraduate and 34 postgraduate dental students. All the students were given adequate information orally and were reassured that the data acquired from the study would be kept confidential and would only be used for statistical analyses. Students who were reluctant to complete the questionnaires were omitted. The Ethics Committee of Kerman University of Medical Sciences approved this study under the code of IR.KMU.REC.1396.1519.

In order to identify students' learning style, the VARK questionnaire was used. We implemented the standard VARK questionnaire of Salimi et al. in this research. Its validity and reliability have been measured previously. The experts confirmed the validity of the questionnaire by Cronbach's alpha coefficient ($\alpha = 0.86$); its reliability was also approved.¹

The questionnaire has been designed in two sections. The first section deals with demographic data and the second section consists of questions on learning styles. Each question has 4 choices and each choice surveys one of the aspects of learning style. The students can choose more than one choice for each question. Each choice in every aspect or field has one point. A higher grade in each learning style indicates a greater inclination for that style. If an individual achieves an equal score in two or more field, the learning style is considered multi-modal.¹

In order to evaluate the educational performance of the students, their overall mean grades were evaluated from the beginning of their studies at the university until the time of this study. To eliminate the self-reporting limitation, the students' mean grades were also provided by the Education Office of the School and categorized as follows:

A mean grade of > 17 (out of 20): good educational performance

A mean grade of 14-17: moderate educational performance

A mean grade of < 14 : poor educational performance

The data were analyzed by SPSS software (version 22, IBM Corporation, Armonk, NY, USA); also descriptive statistics (frequencies, central indices, and distribution) and analytical statistics were used. Analysis of variance (ANOVA) test was used to assess the relationship between students' learning style and grade point average (GPA) and chi-square test was performed to assess the relationship of learning style preferences with age, sex, and educational levels.

Results

The mean age of the students was 23.59 years and the students' mean grade point was 15.96. Of the students evaluated, 171 (63.3%) were women and 99 (36.7%) were men. In relation to the educational level, 236 students (87.4%) were undergraduate and 34 (12.6%) were postgraduate students.

Figure 1 shows distribution of learning styles among students. 88.3% of 270 students that were studied, had single-modal learning style, 11.3% had bimodal learning style, and 0.4% had tri-modal learning style.

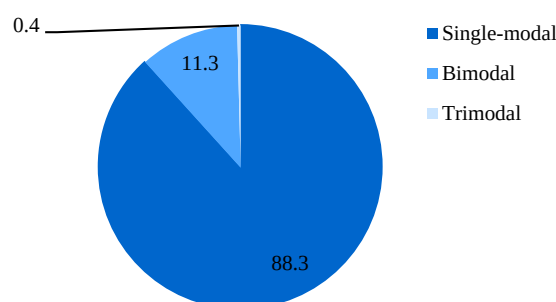


Figure 1. Distribution of learning styles among students

Among 204 students with single-modal learning style, the highest frequency of learning styles was related to aural style, followed by read/write, kinesthetic, and

visual styles in descending order. There were 27 students using multimodal styles; the highest frequency was related to aural and read/write styles (48.14%). The frequency distributions of other combinations of styles are presented in table 1.

Table 1. Distribution of learning styles

Learning style		n (%)
Single-modal	Aural	50.00
	Read/write	25.40
	Kinesthetic	14.21
	Visual	10.29
Multimodal	Aural and read/write	48.14
	Aural and kinesthetic	11.11
	Aural and visual	14.81
	Read/write and visual	11.11
	Kinesthetic and visual	3.70
	Read/write and kinesthetic	7.40
	Aural, read/write, and kinesthetic	3.70

Table 2 demonstrates the learning styles and characteristics of the dental students.

There was no significant relationship between the students' learning style and sex ($P = 0.308$) and no correlation were found between learning style and age ($P = 0.388$); also no statistically significant difference was found between learning style and academic performance ($P = 0.668$).

The undergraduate and postgraduate students did not have any significant difference in the learning style ($P = 0.066$).

Figure 2 shows distribution of learning styles in students and residents. 45.2% of undergraduate students and 33.3% of postgraduate students selected aural learning style as their dominant learning style.

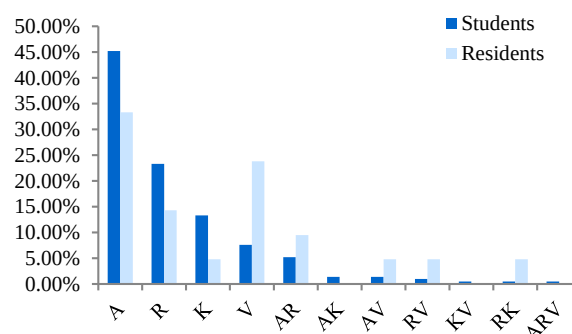


Figure 2. Distribution of learning styles in students and residents

Figure 3 shows distribution of learning styles among students based on the mean grades. Of the students studied, 11.4% had low mean grades, 66.7% had moderate mean grades, and 21.9% had high mean grades. The aural learning style was the dominant learning style in all the three categories of students.

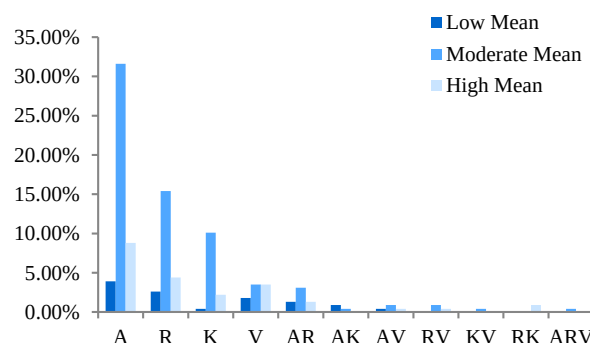


Figure 3. Distribution of learning styles among students based on the mean grades

Discussion

Knowledge of learning style is a valuable skill that can help teachers solve educational problems and improve students' learning.³

Table 2. Learning style and characteristics of dental students

Characteristics		Learning styles					P
		Auditory	Read/write	Kinesthetic	Visual	Multimodal	
Age (year) (mean $\pm$ SD)		23.11 $\pm$ 3.94	24.04 $\pm$ 4.41	22.66 $\pm$ 2.54	24.31 $\pm$ 3.01	23.30 $\pm$ 3.24	0.388
Sex (%)	Male	32.4	44.2	51.7	38.1	33.3	0.308
	Female	67.6	55.8	48.3	61.9	66.7	
GPA (mean $\pm$ SD)		15.81 $\pm$ 1.42	15.83 $\pm$ 1.43	15.73 $\pm$ 1.28	16.34 $\pm$ 2.19	15.83 $\pm$ 1.77	0.668
Educational level (%)	Undergraduate	93.1	94.2	96.6	76.2	81.5	0.066
	Postgraduate	6.9	5.8	3.4	23.8	18.5	

GPA: Grade point average; SD: Standard deviation

In the present study, undergraduate dental students (first to sixth year) and postgraduates completed VARK questionnaire in order to determine their learning style; then, the relationship between learning style and academic performance was assessed.

Single-modal learning style was used by most of the students in this study (88.3%) and aural was the dominant learning style (50.0%); also the least preferred one was visual (10.3%). These results are in line with the findings of Prabha¹⁰ and Siddiqi et al.¹¹

57.96% of dental students in Prabha's study had single-modal learning style, so that aural was the most dominant one and 42.04% of them had multi-modal style.¹⁰ Siddiqi et al.'s study revealed that 52.0% of the dental students who were studying in first and second year were single-modal, while multi-modal style was preferred by 48.0% of them. Based on the results, the students used kinesthetic and aural styles.¹¹ 68.7% of the students used multiple learning styles in Urval et al.'s research and the dominant single-modal style was aural.⁹ Javadinia et al. found that 48.6% of medical students preferred aural learning style,⁸ that is in line with the present study. Baykan and Nacar reported that the unimodality preference of first-year medical students was 36.1% and multi-modality was 63.9% and kinesthetic (23.3%) was dominant in unimodals.³ The majority of dental students at King Saud University preferred multimodal learning style (58.4%), while others preferred a unimodal learning style (41.6%) and in the unimodal learners, kinesthetic and aural styles (35.1%) were dominant.⁷

Learners with multimodal learning style have greater flexibility in acquiring knowledge compared to those with single-modal learning style.¹²

Multimodal students do not just use passive approaches to learning but also obtain the required information in different ways. Further, by using active learning methods, students' learning becomes better. Active learning methods enhance thought by

finding reasons, problem solving, and decision making skills. Educators can implement active learning strategies like discussion, models, role play, games, simulation, etc. in large classes too. These methods increase teamwork and generate more enthusiasm and motivation in students. Since dental students do clinical works, these learning strategies are very valuable for them.³ In this research, just 11.7% of learners used multimodal learning style, while inactive methods such as aural was used by most of the students. Some factors can help boost the aural learning style and note-taking habits among students. These factors include the education methods, the dominance of professor-oriented system, and the professor being the sole speaker in classes from school to college.¹³ In our university, it is assumed that all students are auditory and it is due to the effect of education methods in school years, which was mainly in a lecture format. It is difficult to change student's dominant learning style at university. However, students' clinical activities indicate that improving their learning abilities also requires the development of learning styles. Such a change in education strategies should occur during school, so that it can be manifested at the university, too. Learning styles are not unchangeable and they can be modified by altering the teaching techniques in various fields; therefore, adequate attention should be paid to the clinical and practical training in addition to learning styles.⁸

Sex and unimodal learning style did not have any significant relationship in the current study. Furthermore, grades of education did not have a correlation with learning modals. The results of a study by Salimi et al.¹ are different from those of the present study.

Salimi et al. did a study like the current one, and reported a correlation between sex and unimodal learning style; also the results showed that aural style was used by 21.3% of women and 12.9% of men. Grades of education and learning modals had

significant relationships ($P > 0.050$).¹ Baykan and Nacar,³ Javadinia et al.,⁸ Urval et al.,⁹ Ahmadi and Allami,¹⁴ and Amini et al.¹⁵ found different results in their studies. The learning style and educational grades did not show any statistical significant relationship. This research did not report any relationship between mean grade point and learning modals. These are in consistency with Behnam Moghadam et al.,² Baykan and Nacar,³ Asiry,⁷ Urval et al.,⁹ Ahmadi and Allami,¹⁴ and Hamouzadeh et al.¹⁶ findings. There is no general comment about academic performance and learning style relationship. If learning styles become more active, they can have positive effects on students' educational performance. Using different educational methods is valuable for teachers, so that they can cover a variety of learning modes. Hence, the instructors should combine different educational and teaching strategies in each educational program to cover divergent learning styles.¹⁷

According to what mentioned above, changing the learning style of dental students of Kerman University of Medical Sciences to more active styles is necessary. The role of professors is vital to make students' learning styles more active. They can use motivational and incentive strategies to change students' learning styles. It is suggested that higher education authorities become sensitive to the use of teaching techniques and assessment of professors. In addition, they should arrange educational workshops to make the professors aware of teaching style.²

The research limitations were: first, students did not return some questionnaires; second, number of residents was low and their cooperation to fill out the questionnaires was not satisfactory; and third, some data were missed because of incomplete questionnaire filling.

Conclusion

The results of the present study revealed that the dominant learning style of dental students of Kerman University of Medical Sciences was auditory. Most of the students preferred single-modal learning styles over multi-modal learning styles. This study showed no significant relationship between students' dominant learning style and their academic performance.

Based on this research, the attention to the empowerment of professors in learning styles is necessary. The professors should be aware of the students' preferences and the rate of using different senses in learning in order to implement multi-modal techniques and media for teaching.

Conflict of Interests

Authors have no conflict of interest.

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Comparison of the effect of chewing mastic and spearmint sugar-free chewing gum on salivary flow rate and pH

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Original Article

Abstract

BACKGROUND AND AIM: Hyposalivation can cause many difficulties for patients like opportunistic infections such as candidiasis, mouth sores, and dysphagia as well as reduced quality of life (QOL). Methods such as using sugar-free chewing gum are recommended to treat this complication. Mastic is a natural substance and since it has various properties in addition to increasing salivary flow rate, it can reduce oral complications of patients suffering from xerostomia. In the present study, a comparison was made on the effect of chewing mastic and spearmint sugar-free chewing gum on saliva flow rate and pH.

METHODS: This was a single blind interventional clinical study carried out on 26 healthy individuals (10 men and 16 women). Simple non-probability sampling method was used to select the subjects. Initially, unstimulating saliva was collected and then all subjects were asked to chew Parafilm, mastic, and spearmint sugar-free chewing gum with a randomized order and in a 15-minute interval. Salivary flow rate was estimated by dividing the amount of the collected saliva (weight or volume) by the sample collection period (5 minutes). Saliva pH was measured by a manual pH meter. Data were analyzed using SPSS software by t-test.

RESULTS: A total of 26 volunteers (10 men and 16 women) participated in this study, with a mean age of 23.5 years. The saliva flow rate and pH after chewing mastic (the main substance in this study) were not significantly different from those after consuming the chewing gum ($P > 0.050$). Mastic and chewing gum increased the salivary flow rate significantly compared to Parafilm ($P < 0.001$).

CONCLUSION: The results showed that mastic and sugar-free chewing gum could increase salivary flow rate and pH. Due to the flavor and high price of sugar-free chewing gum, mastic can be recommended instead of sugar-free chewing gums.

KEYWORDS: Mastic Gum; Saliva; Xerostomia; Xylitol

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Saliva is a compound of different molecules and an essential ingredient in the formation of acquired pellicle on the tooth surfaces and preservation of the integrity of oral and upper digestive tract mucous surfaces.¹ In addition, saliva has an important role in antimicrobial and physicochemical defense and wound healing. Most of the salivary components, including proteins,

carbohydrates, lipids, and ions have a delicate role in performing these tasks. Some local and systemic disorders can derange this complex performance and cause dental and mucosal injuries.¹

Prevalence of dry mouth (xerostomia) is estimated to be about 20% in the general population.¹ The main reasons of feeling mouth dryness (xerostomia) include salivary gland disorders, systemic disorders, drugs,

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radiotherapy, and aging.¹⁻⁵ Salivary resting flow rate in healthy individuals is about 1 ml/minute.² Usually, xerostomia appears when resting flow rate and stimulated flow rate decrease to less than 0.1-0.2 ml/minute and 0.4-0.7 ml/minute, respectively.³ Hyposalivation can cause many difficulties for patients like opportunistic infection such as candidiasis, sore mouth, and dysphagia.⁶ Other concern is the reduced quality of life (QOL) in these patients.⁷

There are numerous treatment modalities for managing xerostomia,⁸⁻¹⁰ most of which being supportive such as drinking small amounts of water or placing a piece of ice in the mouth. These methods can relieve the discomfort of xerostomia to some extent. Methods such as using artificial saliva, taking sympathomimetic drugs such as pilocarpine hydrochloride or bethanechol tablet, using 1% sodium fluoride mouth rinse, limiting caffeine consumption and avoiding alcoholic drinks or alcohol-containing mouth rinses, and using sugar-free chewing gum are also recommended.¹¹⁻¹⁴ However in most patients, using sympathomimetic drugs such as pilocarpine hydrochloride or bethanechol tablet are contraindicated because of systemic condition and drug interaction.¹⁵

Orbit[®] sugar-free chewing gum, which has been approved by Iran Food and Drug Administration (IFDA), is available in Iran and also in many other countries.¹³ This chewing gum is produced by Wrigley Company, USA. This chewing gum contains xylitol as a sweetener. Xylitol is a natural 5-carbonated sugar and is obtained from birch tree. This sugar naturally exists in some fruits such as strawberry, vegetables (cauliflower), and mushrooms.¹¹ Despite the safety and effectiveness of xylitol, there are some concerns about dose dependent and long term side effects of consumption of this matter such as tumors, diarrhea, and intestinal gas.¹⁶ On the other hand, a large number of patients cannot afford these products because of their high cost.

Mastic is a natural substance also known

as Arabic gum and is extracted from pistacia (*Atlantica kurdica*) tree which is native to a part of Eurasia as west of Iran. This resin is used in a wide range of industrial applications such as production of medications, food, chemical substances, and chewing gum.^{17,18}

Most of the mastic components have strong antimicrobial activities against a wide range of bacteria and probably these components act synergistically. Since mastic is quite compatible with the gastrointestinal tract and has antibacterial nature, it can act against *Helicobacter pylori* (*H. pylori*). Studies have shown that mastic gum significantly reduces oral bacterial counts and gingival inflammation.^{17,18} In addition, mastic is traditionally used by the elderly people in Iran and is cheaper than other products. These factors make it a preferable choice for stimulating saliva.

This study was designed to investigate the effect of mastic gum as a natural substance on pH and saliva flow rate. Since mastic has various properties besides increasing salivary flow rate, it can reduce oral complications among patients with dry mouth and hyposalivation. In this study, Jajik mastic grown in Kermanshah, Iran, was used. This mastic is one of the best mastics available, and its color, texture, and other physical properties are identical to commercially available chewing gums. The acceptance of mastic flavor over other chewing gum flavors is dependent on each individual taste.

Methods

This was a single blind interventional clinical study carried out on 26 healthy individuals (10 men and 16 women) referred to oral medicine department of Kerman Dental School, Kerman, Iran, for dental checkup. Simple non-probability sampling method was used to select the subjects. This study was approved by the ethics committee board (code: 13488) and volunteers were asked to fill out an informed consent form. They did not show any symptoms or signs of

conditions such as xerostomia or sialorrhea and were not taking any sialogenic or salivary flow suppressing drugs including pilocarpine, cevimeline, anti-depressants, anti-psychotics, and antihypertension medicines. Patient with systemic diseases such as diabetes mellitus (DM), hypertension, cardiovascular diseases (CVDs), Sjogren's syndrome, and connective tissue disorders were excluded from the study. Patients in the age range of 18-50 years old were included in the study. Baseline salivary samples were collected from 7:30 to 11:30 in the morning by a calibrated oral medicine resident while the participants were sitting and bending their heads forward. The volunteers had been asked not to eat or drink anything one hour before sampling. Meanwhile, they were not in a dehydrated condition. At the beginning, unstimulated saliva was collected and its volume was measured to determine the baseline salivary flow rate. Saliva collection was carried out by spitting method and pre-weighed test tube was used for collecting saliva.^{1,9,19-22}

In order to collect unstimulated saliva, after a swallow, the volunteers remained still for 5 minutes and spit their saliva passively in a pre-weighed test tube.²³

In order to measure the salivary flow rate during chewing Parafilm, mastic, and spearmint sugar-free chewing gum, the volunteers were asked to wash their mouth. After a 15-minute break, they were asked to chew a 5 × 5-cm piece of Parafilm, 70 times per minute and spit the saliva every minute.²²

This process was repeated with 1.5 g of mastic and a piece of sugar-free spearmint chewing gum, 70 times per minute and spitting the saliva every minute. The order of chewing these three substances was different and randomly selected. Since a 15-minute interval was considered between the saliva flow rate measurements, unstimulated saliva before chewing was not collected. Since the chewing order of these three substances was chosen randomly, the probable insufficiency of the 15-minute interval was equal in each group.

Therefore, this did not affect the results.

Preparing identical mastic pieces indistinguishable from sugar-free chewing gum was not possible, but the individual who measured the pH and saliva flow rate was not aware of the substance that was chewed.

Saliva flow rate was calculated by dividing the amount of the saliva collected (weight or volume) by the sample collection period (5 minutes). Saliva pH was measured by a manual pH meter.

Various factors such as physical position, hydration status, diet, and chronological variations can affect salivary flow rate.^{22,23} Since the saliva flow rate was assessed in the same person during the same time and was compared with the subject's own unstimulated saliva, these factors had no effect on the results.

Data were analyzed by SPSS software using the paired t-test.

Results

A total of 26 volunteers (10 men and 16 women) participated in this study, with a mean age of 23.5 years. As mentioned above, the baseline salivary flow rate was measured initially. Then the salivary flow rate was measured after chewing mastic, chewing gum, and Parafilm. Comparison of the salivary flow rate after chewing mastic, Parafilm, and chewing gum with baseline salivary flow rate revealed that these three substances were able to increase salivary flow rate and pH significantly ($P = 0.001$) (Tables 1 and 2) (Figures 1 and 2).

Table 1. Comparison of mean salivary flow rates after use of chewing gum, mastic, and parafilm with the mean baseline salivary flow rate

Group	Salivary flow rate (mean ± SD)	P
Baseline saliva	0.29 ± 0.13	0.001
Mastic	1.79 ± 0.64	
Baseline saliva	0.29 ± 0.13	0.001
Parafilm	1.24 ± 0.43	
Baseline saliva	0.29 ± 0.13	0.001
Sugar-free chewing gum	1.89 ± 0.61	

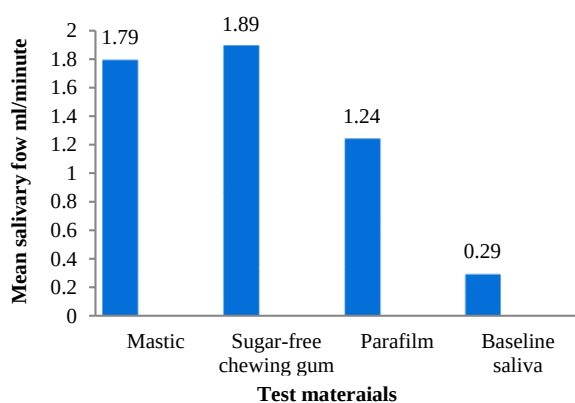
SD: Standard deviation

Table 2. Comparison of mean pH of saliva after using chewing gum, mastic, and Parafilm with mean pH of baseline saliva

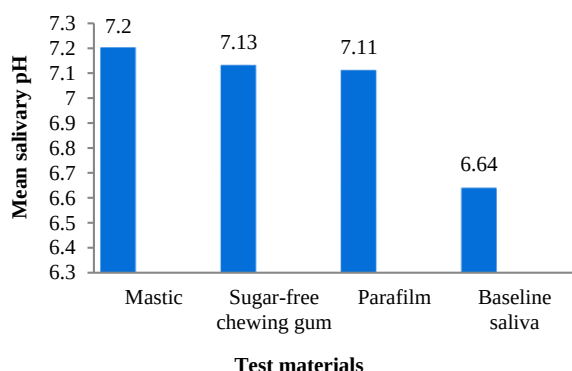
Group	pH (mean $\pm$ SD)	P
Baseline saliva	6.64 $\pm$ 0.22	0.001
Mastic	7.02 $\pm$ 0.16	
Baseline saliva	6.64 $\pm$ 0.22	0.001
Parafilm	7.11 $\pm$ 0.23	
Baseline saliva	6.64 $\pm$ 0.22	0.001
Sugar-free chewing gum	7.13 $\pm$ 0.26	

SD: Standard deviation

pH and Saliva flow rate after chewing mastic (the main substance in this study) were not significantly different from those after the use of the chewing gum ($P > 0.050$) (Tables 3 and 4) (Figures 3 and 4).

**Figure 1.** Mean salivary flow rates in different groups

Mastic and chewing gum increased salivary flow rate significantly compared to Parafilm ($P = 0.001$) (Table 3).

**Figure 2.** Mean salivary pH in the test groups

Mastic increased pH more significantly than Parafilm ($P = 0.031$), however chewing

gum did not exhibit such an effect ($P > 0.050$) (Table 4).

Table 3. Comparison of salivary flow rates in different groups of the study

Group	Salivary flow rate (mean $\pm$ SD)	P
Mastic	1.79 $\pm$ 0.64	> 0.050
Sugar-free chewing gum	1.89 $\pm$ 0.61	
Mastic	1.79 $\pm$ 0.64	0.001
Parafilm	1.24 $\pm$ 0.43	
Parafilm	1.24 $\pm$ 0.43	0.001
Sugar-free chewing gum	1.89 $\pm$ 0.61	

SD: Standard deviation

Discussion

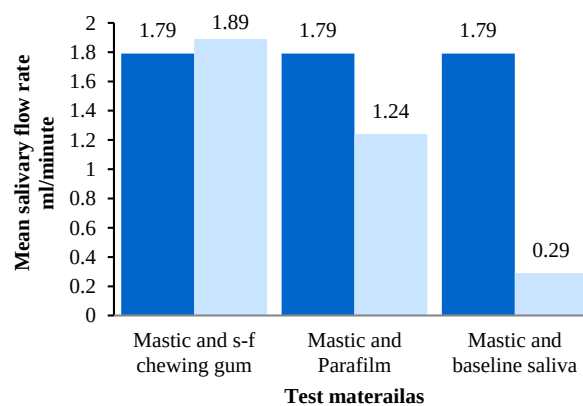
Saliva secretion is critical for maintaining oral health. A decrease in salivary flow rate is accompanied by numerous harmful clinical effects and reduces QOL.⁷

Table 4. Comparison of mean salivary pH in different groups of the study

Group	pH (mean $\pm$ SD)	P
Mastic	7.20 $\pm$ 0.16	> 0.050
Sugar-free chewing gum	7.13 $\pm$ 0.26	
Mastic	7.20 $\pm$ 0.16	0.031
Parafilm	7.11 $\pm$ 0.23	
Parafilm	7.11 $\pm$ 0.23	> 0.050
Sugar-free chewing gum	7.13 $\pm$ 0.26	

SD: Standard deviation

The relatively high prevalence of xerostomia and its significantly long-term effects on oral health and QOL encourage clinicians to seek for the new materials and methods to manage dry mouth effectively.

**Figure 3.** Comparison of salivary flow rates after chewing mastic with salivary flow rate after chewing other test materials

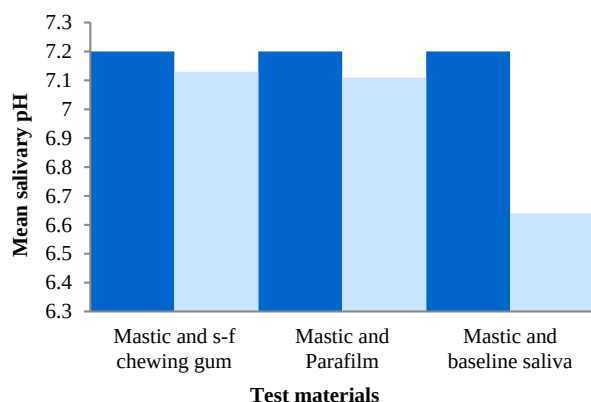


Figure 4. Comparison of mean salivary pH after chewing mastic with mean salivary pH after chewing other test materials

In spite of the treatment options available, because of some limitations of each of the current treatment methods, many patients are still suffering from xerostomia and its side effects.^{3,4,24-27} This study showed that mastic and chewing gum increased salivary flow rate significantly compared to Parafilm. Moreover, the saliva flow rate and saliva pH between the subjects who chewed mastic and those who chewed chewing gum showed insignificant differences. These findings suggest that mastic may be considered as a suitable substitute for chewing gum in patients suffering from hyposalivation.

Several studies have assessed the effect of non-organic chewing gums on salivary secretion. Some of the studies, similar to the current study, have shown an increase in pH and saliva flow rate following chewing sugar-free chewing gums.^{1,10-12,28-30} Some researchers have studied the antimicrobial, antiplaque, and anticavity properties of mastic and its efficacy in treating the gastrointestinal tract diseases.^{17,31}

Mastic gum reduces oral bacterial counts significantly and cures gingival inflammation. Studies have shown the ability of mastic to suppress the growth of cariogenic bacteria and reduce *Streptococcus mutans* counts.^{17,18}

Bakhtiari et al. studied the effect of Orbit[®] sugar-free chewing gum and mastic on salivary flow rate and pH. They concluded that both mastic and sugar-free chewing gum

could increase salivary flow rate and pH, but sugar-free chewing gum increased these items more significantly compared to mastic.¹³ However, this difference was not significant in the present study. This discrepancy might be attributed to different sampling conditions in these two studies. Furthermore, Bakhtiari et al.¹³ measured the salivary flow rate and pH in three consecutive days. As it is clear, alterations in psychological or physical conditions of participants during these consecutive days may change the salivary flow rates and pH. In contrast, the current study was performed using the repeated measures method and all the samples of each volunteer were collected at the same day. This method may increase the liability of the study.

In contrast to the present study, Biria et al. revealed that xylitol mastic gums increased the pH of the saliva insignificantly, however it decreased the pH of the saliva significantly in probiotic mastic gum.²⁸ In the current study, the results showed an insignificant difference between salivary PH after chewing mastic and xylitol gum.

Karami-Nogourani et al. studied the effect of different flavors of chewing gum on salivary pH. The results indicated that only cinnamon and spearmint gum significantly increased the salivary pH.¹² In the present study, vanilla chewing gum was chosen to minimize simulations by flavor.

Ship et al. studied the efficiency and safety of topical products available for managing xerostomia containing olive oil, betaine, and xylitol in reducing dry mouth and hyposalivation for medication induced xerostomia.⁸ The outcome showed that the use of topical treatments increased unstimulated salivary flow rates significantly. These findings are in agreement with those of the present study.

Additionally, in order to eliminate the effect of chewing the preceding substance on the salivary flow rate and pH, a 15-minute rest was set before chewing the next material. In order to increase the reliability of the

results, the resting time was longer than the previous similar studies.¹⁷

Another interesting result was obtained from the comparison of mastic and sugar-free chewing gum with Parafilm. Contrary to mastic, sugar-free chewing gum did not increase salivary pH significantly compared to Parafilm. Mastic may contain components that effectively increase salivary pH, preventing tooth decay. To the best of the researchers' knowledge, there is no other study comparing the effect of Parafilm and sugar-free chewing gum on salivary pH.

Parafilm was used in this study, which is a neutral, odorless, thermoplastic, colorless, and tasteless substance, in order to stimulate oral baroreceptors, as flavor of the substances used can stimulate salivary secretion. The results showed that both mastic and sugar-free chewing gum can increase salivary flow rate and pH significantly in comparison to Parafilm.

Since the results of this study showed that mastic and sugar-free chewing gum can increase salivary flow rate and pH, due to the flavor and high price of sugar-free chewing gum, mastic can be recommended instead of sugar-free chewing gums.

Although comparison of mastic and sugar-free chewing gum was not the aim of this study, all the volunteers were satisfied with the mastic flavor and even some of them preferred mastic.

One of the problems that attracted the

attention of researchers was the adhesion of mastic to teeth. This problem was solved by keeping mastic in a refrigerator before chewing. However, there are some variants of mastics that can be used without keeping them in a refrigerator.

The interval duration between chewing the substances may be considered as a limitation in this study because long intervals seem to decrease patient's compliance.

Conclusion

In conclusion, according to the results of this study and the fact that mastic is accompanied by numerous useful properties, chewing mastic is preferred to sugar-free chewing gums in patients suffering from xerostomia.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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Dental health by age, gender, and residence place in 6- to 12-year-old children living in Shahroud, Iran

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Original Article

Abstract

BACKGROUND AND AIM: This study aims to determine dental health indices and their associated factors in 6-12-year-old Iranian school children.

METHODS: In this cross-sectional study, a total of 5620 students, living in Shahroud, northeast of Iran, participated as the participants of Shahroud School Children Eye Cohort Study (SSCECS). Children were selected through cluster sampling in urban areas and by census in rural areas. The children were examined by two trained dentists, using disposable dental mirrors and dental explorers on a dental unit. The indices of decayed, missing, and filled teeth (DMFT), decayed filled teeth (dft), and Significant Caries Index (SiC Index) as well as decay percentage were estimated by age, gender, and place of residence, with 95% confidence intervals (CIs). The differences in mean value were investigated by independent t-test or analysis of variance (ANOVA).

RESULTS: Dental examinations were performed for 5577 students, 3005 (53.9%) of whom were boys and 4434 (79.5%) were urban residents. The mean age of the participants was 9.7 ± 1.7 years. The overall DMFT, dft, and SiC indices were 0.97, 2.84, and 2.48, respectively. At the age of 12, DMFT and SiC indices were 1.80 and 4.07, respectively. Moreover, the mean DMFT was higher in girls and in rural areas, increasing with age. Overall, 36.2% and 38.9% of the male and female students had at least one decayed permanent tooth, respectively.

CONCLUSION: Dental health status in 6-12-year-old Iranian children was not favorable in Shahroud, especially in girls and in rural areas. Therefore, preventive and therapeutic programs and access to health care services need to be expanded.

KEYWORDS: Dental Caries; DMF Index; Dental Health Surveys; Oral Health; Iran

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Dental caries affect 60%-90% of the school children worldwide.¹ However, this high burden of disease can be prevented by controlling risk factors and using fluoride.² Worldwide, 621 million children are affected by untreated caries in deciduous teeth, which was 10th most prevalent condition in 2010.³

World Health Organization (WHO) believes that "oral health means more than good teeth" and implies any diseases and

disorders that affect craniofacial complex.¹ A person with good oral health, can speak, smile, kiss, touch, smell, taste, chew, swallow, and cry without pain.¹

The decayed, missing, and filled teeth (DMFT) index, which refers to the number of decayed (D), filled (F), and missing (M) teeth, is used to assess severity of dental caries. Accordingly, WHO and World Dental Federation (FDI) specified six goals in 1981 to be achieved by 2000.¹ In school children the

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goal was to achieve an average DMFT of no more than 3 at 12 years of age.¹ A number of countries achieved the specified goals while others were not very successful in doing so. Therefore, WHO added a new strategy for managing prevention and control of oral diseases to the common risk factor approach in prevention and control of non-communicable diseases (NCDs) strategy.¹ The International Association for Dental Research (IADR), WHO, and FDI specified new goals to be obtained by 2020. These goals are not numerical because public health status is different in each country. Based on these goals, all countries, under any economic, social, political, and cultural conditions, should make the maximum effort to improve oral health status in various aspects.⁴ The results of a systematic analysis carried out in 195 countries between 1990 and 2015 showed that oral health had not improved over the past 25 years, remaining as a serious challenge by 2015. In fact, population growth and aging have led to a dramatic increase in the burden of untreated oral conditions throughout the world.⁵

Various national⁶ and regional^{7,8} studies on oral health status have been conducted in Iran. Most of these studies have either lacked sufficiently large sample sizes or standard dental examinations. Given the importance of oral and dental health as a determinant of quality of life, increased DMFT index values in Iran and throughout the world, and specified goals to be achieved by 2020, the dental health status of 6-12-year-old children should be monitored consistently and the effectiveness of the existing interventions should be assessed. The present population-based study aims to assess dental health by age, gender, and residence place in 6 to 12-year-old children living in Shahroud, Iran.

Methods

This cross-sectional study was a part of Shahroud School Children Eye Cohort Study (SSCECS) which was conducted on 6-12-year-old children in Shahroud. The first phase of

the study was carried out in 2015 on primary school children (first to sixth grade), studying in Shahroud School District (urban and rural areas).⁹ All primary school students living in 15 villages, located in south of Shahroud District (1214 students) were invited to participate in the study. In urban schools, 200 out of 483 classrooms were selected using cluster sampling. Finally, among 6624 invited children, 5620 (84.8%) students participated. All children underwent comprehensive optometric examinations and corrected and uncorrected visual acuity tests. Other examinations such as blood pressure measurement, anthropometry, and complete dental examination were also carried out. The students' age, gender, economic status, place of residence, and body mass index (BMI) were assessed. All participants of cohort study were included in this study and the only exclusion criterion was unwillingness for dental examination.

Oral and dental examinations were carried out by two trained dentists. Before beginning the study, the procedures for examination and recording results were explained to the dentists and the significance of an identical performance was stressed. All examinations were conducted using disposable dental mirrors, dental explorers, on a dental chair with standard halogen dental light for illumination. The data were collected directly by the dentists into the special software for examinations.

Dental examinations were carried out separately by measuring the decayed filled teeth (dft) index for deciduous teeth (proposed by Gruebbel) and the DMFT index for permanent teeth (proposed by Klein, Palmer, Knutson). Visible evidence of a cavity in tooth, including untreated and recurrent caries, was considered decayed (D-component). M-component represented a tooth that had been extracted due to caries. F-component included filled teeth. The Significant Caries Index (SiC Index) was also measured by classifying the students according to the DMFT value. The mean DMFT of the upper third (students with

higher DMFT) was then reported. A 95% confidence interval (CI) was calculated for all mean values.

The dft, SiC, and DMFT indices were calculated for different age and gender groups. Independent t-test or analysis of variance (ANOVA) was used to assess the difference in mean values. Bonferroni test was used for pairwise comparison after ANOVA. The adjusted associations of independent variables with outcomes were investigated by multiple linear regression. A significance level of 0.05 was assumed for all tests. The design effect of cluster sampling was taken into account to arrive at a better estimate of the CIs. Considering different sampling weights in urban and rural areas, poststratification was also carried out.

This study was carried out based on the declaration of Helsinki. All examinations were approved by Ethics Committee of Shahrood University of Medical Sciences (ethics code: 100/108054). Written informed consents were obtained from the children's parents and students participated in the study willingly.

Results

Out of 5620 students participating in the cohort study, 5577 students underwent dental examinations; therefore, total number of missing data for this study was 43 (0.8%). Among the participants in this study, 3005

students (53.9%) were male and 4434 (79.5%) lived in urban areas. The mean age of the participants was 9.7 ± 1.7 years.

The overall DMFT, dft, and SiC indices were 0.97, 2.84, and 2.48, respectively. Table 1 describes most of these indices by gender, place of residence, and age groups. At the age of 12 years, the DMFT index was 1.80 and the mean DMFT for permanent teeth in boys (1.70), girls (1.92), urban areas (1.80), and rural areas (1.76) was not significantly different. At the age of 12, the SiC Index was 4.07 (95% CI: 3.86-4.27) and was not significantly different in terms of age and place of residence.

The DMFT index in girls and rural areas was higher and increased with age. The dft index in boys was higher and decreased with age. The SiC Index was not different in terms of gender and place of residence; however, it increased with age, reaching 4.07 at the age of 12 (Table 1). Multiple comparisons of outcomes in different age groups showed that except for age groups of 6 and 7 years old, all mean differences in age categories were significant for DMFT, dft, and SiC indices ($P < 0.001$).

The results of multiple linear regression showed that DMFT and SiC indices increased with increasing in age, SiC Index increased by 0.29 in rural area and DMFT increased by 0.19 in girls (Table 2).

Table 1. Description of dental indices according to the age, gender, and residence place, Shahrood, Iran, 2015

Independent variables		n	DMFT		dft		SiC	
			Mean (95% CI)	P	Mean (95% CI)	P	Mean (95% CI)	P
Gender	Male	3005	0.90 (0.81-0.99)	< 0.001*	2.91 (2.60-3.21)	0.018*	2.41 (2.19-2.63)	0.362*
	Female	2572	1.05 (0.93-1.18)		2.75 (2.42-3.09)		2.55 (2.34-2.75)	
Residence place	Urban	4434	0.96 (0.88-1.04)	0.048*	2.82 (2.75-2.90)	0.172*	2.47 (2.30-2.64)	0.683*
	Rural	1143	1.06 (0.87-1.25)		2.94 (2.79-3.10)		2.54 (2.24-2.82)	
Age (year)	6	220	0.18 (0.11-0.26)	< 0.001**	5.03 (4.69-5.38)	< 0.001**	0.61 (0.36-0.86)	< 0.001**
	7	839	0.28 (0.21-0.34)		4.97 (4.74-5.19)		0.84 (0.68-0.99)	
	8	1004	0.64 (0.57-0.71)		4.36 (4.20-4.52)		1.94 (1.83-2.04)	
	9	1058	0.91 (0.82-1.00)		3.31 (3.13-3.49)		2.42 (2.29-2.55)	
	10	887	1.11 (1.00-1.23)		1.94 (1.78-2.10)		2.90 (2.77-3.04)	
	11	932	1.46 (1.34-1.59)		0.91 (0.79-1.03)		3.40 (3.21-3.60)	
	12	637	1.80 (1.64-1.95)		0.33 (0.26-0.40)		4.07 (3.86-4.27)	
Total	6-12	5577	0.97 (0.89-1.05)	-	2.84 (2.61-3.07)	-	2.48 (2.32-2.63)	-

*Independent sample t-test; **Analysis of variance (ANOVA)

DMFT: Decayed, missing, and filled teeth; dft: Decayed filled teeth; SiC: Significant caries; CI: Confidence interval

Table 2. The association of dental indices with age, gender, and residence place in multiple linear regression, Shahroud, Iran, 2015

Independent variables	DMFT		dft		SiC	
	Coefficient (95% CI)	P	Coefficient (95% CI)	P	Coefficient (95% CI)	P
Gender (Female/male)	0.190 (0.100, 0.270)	< 0.001	-0.260 (-0.410, -0.120)	< 0.0010	0.060 (-0.060, 0.180)	0.3150
Residence place (Rural/urban)	0.160 (-0.003, 0.320)	< 0.055	-0.100 (-0.330, 0.130)	0.3800	0.290 (0.110, 0.460)	0.0010
Age (year)	0.300 (0.270, 0.320)	< 0.001	-0.990 (-1.030, -0.950)	< 0.0010	0.600 (0.570, 0.640)	< 0.001

DMFT: Decayed, missing, and filled teeth; dft: Decayed filled teeth; SiC: Significant caries; CI: Confidence interval

In this study, 36.2% of the boys (95% CI: 33.2-39.2) and 38.9% of the girls (95% CI: 35.2-42.7) had at least one decayed permanent tooth. This difference was statistically significant ($P = 0.017$). Tooth decay in permanent teeth was not different in urban and rural areas. Overall, 9.0% (95% CI: 5.2-12.7) of the 6-year-old students and 56.8% (95% CI: 52.5-61.1) of the 12-year-old students had at least one decayed permanent tooth. At the age of 12, 55.5% of the boys, 58.4% of the girls, 55.8% of urban students,

and 66.7% of rural students had at least one decayed permanent tooth.

Table 3 summarizes the status of the filled, decayed, and extracted teeth by tooth type (deciduous or permanent). As seen, the mean number of decayed deciduous teeth was 2.55 in the studied population and it was higher in boys and in rural areas than in girls ($P = 0.007$) and urban areas ($P < 0.001$) (Table 3).

The mean number of filled deciduous teeth was 0.28, which increased between the ages of 6 and 8 and then decreased until the age of 12.

Table 3. Comparison of mean decayed filled teeth (dft) in primary and decayed, missing, and filled teeth (DMFT) in permanent dentition, Shahroud, Iran, 2015

Independent variables		Primary dentition		Permanent dentition		
		Mean decayed (95% CI)	Mean filled (95% CI)	Mean decayed (95% CI)	Mean missed (95% CI)	Mean filled (95% CI)
Gender	Male	2.63 (2.35-2.92)	0.27 (0.21-0.34)	0.77 (0.68-0.85)	0.04 (0.03-0.05)	0.10 (0.08-0.13)
	Female	2.46 (2.16-2.76)	0.29 (0.22-0.36)	0.84 (0.73-0.93)*	0.04 (0.03-0.05)	0.18 (0.13-0.22)*
Residence place	Urban	2.51 (2.29-2.74)	0.31 (0.26-0.36)*	0.790 (0.73-0.86)	0.03 (0.02-0.03)	0.140 (0.11-0.17)*
	Rural	2.93 (2.47-3.39)	0.02 (0.004-0.03)	0.84 (0.69-1.00)	0.14 (0.09-0.20)*	0.07 (0.04-0.10)
Age (year)	6	4.72 (4.35-5.11)	0.31 (0.15-0.46)	0.12 (0.07-0.18)	0.04 (0.02-0.07)	0.03 (0.01-0.06)
	7	4.44 (4.17-4.71)	0.52 (0.38-0.67)	0.22 (0.17-0.27)	0.02 (0.01-0.03)	0.04 (0.02-0.07)
	8	3.84 (3.65-4.03)	0.52 (0.40-0.63)	0.54 (0.48-0.61)	0.02 (0.01-0.04)	0.07 (0.05-0.09)
	9	2.98 (2.81-3.16)	0.33 (0.23-0.42)	0.78 (0.69-0.86)	0.04 (0.02-0.06)	0.09 (0.06-0.13)
	10	1.81 (1.64-1.98)	0.13 (0.09-0.17)	0.92 (0.81-1.02)	0.05 (0.03-0.07)	0.15 (0.11-0.19)
	11	0.83 (0.72-0.95)	0.08 (0.05-0.10)	1.19 (1.09-1.29)	0.05 (0.03-0.07)	0.23 (0.16-0.29)
	12	0.30 (0.23-0.36)	0.04 (0.01-0.06)	1.46 (1.33-1.59)	0.06 (0.03-0.09)	0.28 (0.18-0.38)
	Total	2.55 (2.35-2.76)	0.28 (0.24-0.33)	0.80 (0.74-0.86)	0.04 (0.03-0.05)	0.13 (0.11-0.16)
	6-12					

*P-value < 0.05

CI: Confidence interval

Table 4. The comparison and summary results of different studies on oral health

Authors	Study place	Study year	n	Age (year)	dft	DMFT	Caries prevalence (%)
Current study	Iran, Shahroud	2015	5577	6-12	3.12	0.97	56.8*
Babaei Hatkehlouei et al. ⁸	Iran, Mazandaran	2016	3000	6-7	4.08		
Dehghani et al. ⁷	Iran, Shiraz	2010	760	7-11		0.93	
Seyedein ⁶	Iran	1993-1994	43772	12		1.67	
Momeni et al. ¹⁰	Iran, Tehran/Isfahan	1999	1102	12		0.77	58.7
Meyer-Lueckel et al. ¹¹	Iran, Tehran	2003	103	6	3.30		
Hamissi and Hamissi ¹²	Iran, Qazvin		792	6-9	6: 3.83 7: 3.57 8: 3.04 9: 2.80	0.31	
Hamissi ¹³	Iran, Qazvin	2012-2013	4701	6	3.17	0.06	68.1
Ajami and Ebrahimi ¹⁴	Iran, Mashhad	2001	1938	6-7	4.72		
Ramezani et al. ¹⁵	Iran, Dayer		506	13		1.80	
Rezaei et al. ¹⁶	Iran, Sanandaj	2014	400	6-11	3.63		
Sajadi et al. ¹⁷	Iran, Sirjan	2009	700 (boys)	12		3.56	
Faezi et al. ¹⁸	Iran, Tehran	2009	820	6-12	2.90		
Sadeghi and Bagherian ¹⁹	Iran, Rafsanjan	2008	353	12		2.46	75.7
Hiremath et al. ²⁰	India		13200	6-11	2.97	0.17	78.9
Al-Haddad et al. ²¹	Yemen, Sana'a	2002-2003	1489	6-14	4.16	2.25	
Srisilapanan et al. ²²	Thailand	2012	2312	12		0.70	52.3
Srisilapanan et al. ²²	Thailand	2012	2456	5-6	4.40		78.5
Kim et al. ²³	Korea	2012	4379	12		1.84	

*In 12-year-old students

DMFT: Decayed, missing, and filled teeth; dft: Decayed filled teeth

The mean number of filled deciduous teeth in urban students (0.31) was higher than that in rural students (0.02) ($P < 0.001$); however, it was not different in terms of gender ($P = 0.489$) (Table 3). The mean number of decayed, extracted, and filled permanent teeth was 0.80, 0.04, and 0.13, respectively. The number of decayed permanent teeth was higher in girls than in boys ($P = 0.024$); however, it was not different in urban and rural areas. The number of filled permanent teeth was higher in girls and urban areas than in boys and rural areas ($P < 0.001$); whereas the number of extracted permanent teeth was higher in rural areas than in urban areas ($P < 0.001$) (Table 3).

Discussion

This population-based study with a large sample size on 6-12-year-old Iranian students showed that the mean number of decayed, missing, and filled permanent teeth was 0.97 and the mean number of decayed and filled deciduous teeth was 2.8. The DMFT of

permanent teeth at the age of 12 was 1.8, and 56.7% of the students at this age had at least one decayed tooth. Table 4 compares the above results with those of studies conducted in Iran and other countries.^{6-8,10-24}

The DMFT index in the present study is similar to that of other studies conducted in Iran. The small differences can be attributed to the studied age groups and the study time. For example, although the DMFT value was higher in the study by Babaei Hatkehlouei et al.,⁸ it was conducted within an almost identical period among 6-7-year-olds, while the participants in the present study aged 6-12 years. It is not surprising that DMFT value decreases with increase in age and loss of deciduous teeth. Due to this limitation, it is better to report dft, instead of DMFT for deciduous teeth. In the present study, the mean DMFT values at ages of 6 and 7 years were 5.2 and 5.4, respectively, which were higher than the values obtained in other studies, even those conducted in Yemen²¹ and Thailand.²² Only one study conducted by

Ajami and Ebrahimi¹⁴ in Mashhad, Iran, had almost similar results, reporting DMFT of 4.72 at age of 6-7 years. Personal hygiene, nutritional conditions, and water fluoride level might be the main reasons for this difference, which should be taken into consideration.

The DMFT index in the present study was largely similar to other studies conducted in Iran. For example, the results of the present study are similar to those of Dehghani et al.,⁷ with a relatively similar age group. For the age of 12, the results of the present study are almost similar to those of Seyedein⁶ and Ramezani et al.¹⁵ The mean DMFT in the present study was lower than that in the studies by Sajadi et al.¹⁷ and Sadeghi and Bagherian¹⁹ in Iran and Al-Haddad et al.²¹ in Yemen, and higher than that in the studies by Momeni et al.¹⁰ in Iran, Hiremath et al.²⁰ in India, and Srisilapanan et al.²² in Thailand. Such discrepancies may be attributed to the study year and students' personal hygiene and nutritional levels. The study by Momeni et al.¹⁰ in which DMFT at the age of 12 was reported to be 0.77 appears to be an exception that is not representative of the status of the Iranian population at this age.

According to the studies by Sajadi et al.¹⁷ and Sadeghi and Bagherian,¹⁹ it seems that the DMFT index in southern provinces of Iran is lower, which calls for further investigation. Fluoride concentration in drinking water was between 0.45 and 0.75 mg/l in Shahroud.²⁵ This situation, which is below the WHO recommended limit, is similar to most of the provinces in Iran.²⁶ However, in some cities of southern Iran, more concentration of fluoride has been reported,²⁶ which could be a reason for the low level of DMFT in the southern provinces. In Iran, water and milk resources are not usually enriched with fluoride. We did not find any report about usage of fluorinated toothpaste and mouthwash in different provinces of Iran, but it seems that toothpaste use in Iranian students is not enough.

In the present study, 56.8% of the students' teeth at the age of 12 were decayed,

which was almost similar to the study by Momeni et al.,¹⁰ lower than the study by Sadeghi and Bagherian,¹⁹ and slightly higher than the study by Srisilapanan et al.²² in Thailand. In fact, studies have reported the percentage of decayed teeth using various methods and among different age groups, which should be taken into consideration when comparing the results. Such major discrepancies in examination methods and oral health reports have even rendered numerous national studies across Europe incomparable.²⁴

In the present study, the DMFT index and decay percentage in permanent teeth were higher in girls than in boys. On the other hand, the dft index was higher in boys and SiC Index was not different among the two genders. Other studies in Iran also reported a higher DMFT index in females.^{6,15} Similar to these results, a study conducted in India also reported a higher DMFT index in boys than in girls.²⁰

In the present study, the mean DMFT and extracted permanent teeth were higher in rural students than in urban students, whereas the mean filled permanent teeth was higher in urban students. However, in multiple regression model, the residence place was not significantly associated with DMFT, although SiC Index was significantly higher in rural areas. In addition to poor personal hygiene in rural areas, this is also attributed to diminished access to preventive dental care services. The study by Kim et al.²³ in Korea also showed similar results.

The results of the present study showed that the SiC Index values in the 6-12-year-old and 12-year-old age groups were 2.48 and 4.07, respectively. Very few studies have calculated this index. For example, according to a study in Korea²³ and a study by Sajadi et al.¹⁷ in Iran, SiC Index at the age of 12 was 4.51 and 6.04, respectively. Since the results of the present study are higher than the recommended value by WHO, preventive measures and health education among students need to be promoted.

The results of the present and similar

studies in Iran shows that the oral health status in Iran has not improved significantly over the past two decades, whereas the number of dentists has increased dramatically within the same period, and general education and access to dental care services in rural areas have improved. More extensive studies need to be conducted on a national scale to arrive at the specified conclusion. Lack of significant improvement in oral health status in Iran might be due to increased prevalence of obesity and changes in nutritional status, which have exacerbated in recent years. In another report on the participants of current study, the prevalence of obesity and overweight was 24.7% (unpublished paper). Unlike this conclusion, which makes it difficult to achieve the 2020 goals of the WHO, studies conducted in Korea^{23,27} between 2000 and 2012 are indicative of reduced tooth decay at the age of 12. The study by Srisilapanan et al.²² also showed that oral health indices improved in Thailand between 1997 and 2012. Moreover, in the United Arab Emirates, DMFT at the age of 12 ranged from 1.60 to 3.24, with oral health representing a serious issue both in this country and in similar Arab countries.²⁸ Studies have shown that although DMFT at the age of 12 has decreased by 90% in developed countries between the last decade of the 20th century and the first decade of the 21st century, it has not decreased in low- and middle-income countries. This status could be due to decreased use of fluoride toothpastes

and increased risk factors such as cigarette, alcohol, salt, and sugar consumption.²⁹

Large sample size, examinations by trained dentists, and proper sampling method from both urban and rural areas were the main strengths of this report. These factors led to generalization of the results to Iranian 6-12-year-old children. However, there are no data on the periodontal situation, fluoride concentration in water, the frequency of using fluorinated toothpastes and mouthwashes among students, and agreement between dentists' examinations, which can be considered as limitations of this study.

Conclusion

The DMFT index and oral health status in 6-12-year-old Iranian students, living in Shahroud were not favorable. Therefore, caries prevention programs and provision of health care services should improve, especially in rural areas.

Conflict of Interests

Authors have no conflict of interest.

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What explains socioeconomic inequality in dental caries among school children in west of Iran? A Blinder-Oaxaca decomposition

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Original Article

Abstract

BACKGROUND AND AIM: Dental caries among children is considered as a main public health concern in most of the countries over world and its prevalence is widespread in low-income countries like Iran. The aim of this study was to measure socioeconomic-related inequality in poor decayed, missing, filled (DMF) index and identify the determinants among school children in west of Iran.

METHODS: A survey was carried out among school children aged 12 to 15 years in Kermanshah City, Iran, in 2018, to collect data on dental caries, demographic characteristics, and socioeconomic status (SES). A total of 1457 students were included in the analysis of this cross-sectional study. Logistic regression analysis examined the association of poor DMF index with the socioeconomic and behavioral determinants. We used the relative index of inequality (RII) and the slope index of inequality (SII) to measure wealth-related inequality in poor DMF index. The Blinder-Oaxaca (BO) decomposition technique was also employed to identify the factors of the difference in poor DMF prevalence between the poorest and the richest groups.

RESULTS: The overall and age-adjusted prevalence of poor DMF index was 36.92% [95% confidence interval (CI): 34.48-39.43] and 37.32% (95% CI: 34.64-40.08), respectively. The SII and RII indicated that the poor DMF index was mainly prevalent among poorer children. The absolute gap (%) in the incidence of poor DMF index between children from the richest and the poorest groups was 22.50. The BO results showed that the most important factors affecting the difference in poor DMF index were mother's education (18.23%), being girl (6.12%), and visit to dentist (2.93%).

CONCLUSION: There was a significant pro-rich distribution of poor DMF index among school children in the capital of Kermanshah Province. Interventions aimed at increasing mother's education and good oral health behavior among poorer children could contribute to decline of the difference in poor DMF index between the highest and the lowest SES groups.

KEYWORDS: Inequality; Dental Caries; Adult Children; Socioeconomic Factors; Iran

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Oral health is a fundamental component of overall health, wellbeing, and quality of life.¹ One of the most important oral health indicators is decayed, missing, filled teeth (DMFT) index, which is used as the oral

health assessment criteria in most epidemiological studies.^{2,3} DMFT is the mean number of DMF teeth in a group of individuals and its total score ranges from 0 to 28 or 32.^{4,5} Dental caries among children is a major public health problem.¹ According to

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the World Health Organization (WHO), about 60%-90% of school children worldwide have dental caries⁴ and this disease is more prevalent in low- and middle-income countries.⁶ The number of children who suffer from pain and discomfort and miss school lessons is increasing in developing countries. It is estimated that more than 51 million school hours are lost each year worldwide due to dental-related illness.⁷ Dental health indices could be hallmarks of socioeconomic conditions² and oral health inequalities exist within and between different population groups through the life course and are associated with socioeconomic status (SES).⁸

Previous studies have shown that a significant inequality in oral health outcomes exists across social groups. Oral health inequalities are caused by a broad range of interacting biological, socio-behavioral, psychosocial, societal, and political factors that create 'the conditions in which people are born, grow, live, work, and age' - the so-called social determinants of health.³ SES is highly associated with oral health condition.^{9,10} Although the effect of SES on oral health has been extensively examined, there is little information on socioeconomic-related inequalities in oral health and its main determinants among school children in Iran. Then, the aim of this study was to quantify the extent of socioeconomic inequality in poor DMFT index and identify the main factors that explain this inequality among 12-15-year-old students in Kermanshah City, western Iran.

Methods

A cross-sectional survey was conducted out from October to November 2018 in Kermanshah City, the capital of Kermanshah Province. The study population was school children aged 12 to 15 years. The multistage sampling technique was employed to choose the sample population. We first divided the Kermanshah City into five areas of central, western, eastern, southern, and northern to

select our sample. Secondly, at least one girl's school and one boy's school were randomly selected from each area. Finally, all school children in each school were included using census method. If the number of sample in a school was not sufficient, more than one school was included in the study. Finally, 14 schools (8 girl's schools and 6 boy's schools) were selected for data collection in the survey. Data were collected by public health students (bachelor of science) who were trained by the authors. A total of 1577 school children were selected to complete the questionnaire. Due to missing data, 120 observations were excluded which resulted in a final sample of 1457 school children for statistical analysis.

The questionnaire had two parts: sociodemographic part and status of dental caries and dental care utilization. The first part consisted of questions about age, gender of child, sex of household head, father's education, mother's education, and household durable assets (house, car, computer/laptop, access to internet, freezer, dishwasher, TV, and etc.). The second part included questions on regular brushing, visiting dentist in every six months, and number of DMFT of the school children.

The prevalence of poor DMFT index (as a binary variable) was used as an outcome variable of this study; we followed Moradi et al.⁸ to construct this variable. We first gave more weight to missed teeth (multiplied by 2), less weight to filled teeth (multiplied by 0.5), and counted decayed teeth multiplied by 1. Then a cut-off point was used to define poor and good oral health condition and the cut-off point was set at the mean of DMF score. The subjects with score above cut-off point were considered as poor DMF index and the rest of subjects with score less than mean of DMF score were defined as good DMF index. The principal component analysis (PCA) was used to develop the wealth index.¹¹ The items included in the wealth index are having car, color TV, computer/laptop, cell phone, freezer,

dishwasher, microwave, vacuum cleaner, motorcycle, and bicycle, number of rooms per capita, type of house ownership, and house size per square meter. We divided households into five categories (quintiles) from the poorest to the richest based on wealth score. We used age of children, gender of children, gender of household head, mother's education, father's education, regular brushing, regular dentist visit per 6 months, and wealth index as the determinants of prevalence of poor DMF index in the study.

The slope index of inequality (SII) and relative index of inequality (RII) were used to measure socioeconomic-related inequality in poor DMF score.¹² We also employed multivariate logistic regression model to examine the association between poor DMF score and independent variables. Finally, the Blinder-Oaxaca (BO) decomposition approach was used to quantify the contribution of each dependent variable.¹³⁻¹⁶ We used the following formulas to estimate the gap between the poorest and the richest in poor DMF: (in these equations P is the poorest and R is the richest)

$$y_i = \begin{cases} \beta^P x_i + \varepsilon_i^P & \text{if } P \\ \beta^R x_i + \varepsilon_i^R & \text{if } R \end{cases}$$

The gap between the mean outcomes, y^P and y^R , is equal to:

$$y^R - y^P = \Delta x \beta^P + \Delta \beta x^R$$

Where

$$\begin{cases} \Delta x = x^R - x^P \text{ and } \Delta \beta = \beta^R - \beta^P \\ y^R - y^P = \Delta x \beta^R + \Delta \beta x^P \end{cases}$$

It can be written as follow:

$$y^R - y^P = \Delta x \beta^P + \Delta \beta x^P + \Delta x \Delta \beta = E + C + CE$$

Where x^R and x^P are the average independent variables for the richest (Rich group in above formula) and the poorest (Poor group in above formula). The mean difference in the outcome variable (in this study, poor DMF score) was separated into

three components. E (explained part) is the gap in the average value of the explanatory variables, C shows the difference in the mean β (coefficient/unexplained part), and CE is the multiplication between the difference in mean of independent variables and their coefficients. If there are only two explanatory variables, the following formula can be used:

$$y^R - y^P = (\beta_0^R - \beta_0^P) + (\beta_1^R x_1^R - \beta_1^P x_1^P) + (\beta_2^R x_2^R - \beta_2^P x_2^P) = W_0 + W_1 + W_2$$

Where y is the poor DMF, W_0 shows the differences in the constant, W_1 is the difference between x_1 and β_1 , and W_2 is the difference between x_2 and β_2 . We used the non-linear BO decomposition method to decompose the factors explaining the gap in poor DMF score between the poorest and the wealthiest children.¹⁵ All statistical analyses were performed in Stata software (version 14.1, Stata Corporation, College Station, TX, USA) and P-value less than 0.05 was used as the level of significance.

The Ethics Committee of the Deputy of Research of Kermanshah University of Medical Sciences reviewed and approved the study protocol (KUMS.REC.1397.436).

Results

Table 1 presents the descriptive statistics of the sample. The number of girls was 945 and the remaining 512 were boys. The mean age of the children was 13.15 years with a standard deviation (SD) of 0.99. The overall and age-adjusted prevalence of poor DMF index was estimated to be 36.92% [95% confidence interval (CI): 34.48-39.43] and 37.32% (95% CI: 34.64-40.08) for the entire sample, respectively. The crude prevalence of poor DMF score between boys and girls was different; it was 42.75% (95% CI: 39.62-45.93) for girls and 26.17% (95% CI: 22.53-30.16) for boys.

Table 2 reports the results of multivariate logistic regression analysis on the determinants of poor DMF index. The results showed an inverse association between prevalence of poor DMF score and wealth status.

Table 1. Descriptive characteristics and prevalence of poor decayed, missing, filled (DMF) index in Kermanshah City, Iran, 2018

Variable	mean $\pm$ SD n (%)	Prevalence of poor DMF (%)	
		Crude (95% CI)	Age-adjusted (95% CI)
Age (year)	13.15 $\pm$ 0.99 n (%)	36.92 (34.48-39.43)	37.32 (34.64-40.08)
Sex			
Male	512 (35.14)	26.17 (22.53-30.16)	23.71 (20.03-27.83)
Female	945 (64.86)	42.75 (39.62-45.93)	44.60 (41.15-48.09)
Mother education			
Uneducated or elementary	643 (44.13)	47.58 (43.74-51.46)	48.73 (44.55-52.92)
Academic degree	814 (55.87)	28.50 (25.49-31.70)	27.97 (24.71-31.49)
Father education			
Uneducated or elementary	501 (34.39)	48.30 (43.93-52.69)	49.13 (44.32-53.95)
Academic degree	956 (65.61)	30.96 (28.10-33.97)	31.02 (27.89-34.33)
Gender of household head			
Male	1390 (95.40)	36.76 (34.26-39.33)	37.14 (34.41-39.95)
Female	67 (4.60)	40.29 (29.02-52.69)	41.94 (27.54-57.85)
Wealth index of households			
Poorest	292 (20.04)	49.65 (43.91-55.39)	51.50 (44.64-58.29)
Poor	291 (19.97)	42.95 (37.35-48.74)	44.50 (38.01-51.18)
Middle	293 (20.11)	37.88 (32.47-43.60)	40.66 (34.29-47.35)
Rich	290 (19.90)	26.89 (22.08-32.32)	27.39 (22.26-33.20)
Richest	291 (19.97)	27.14 (22.09-32.20)	26.49 (21.62-32.00)
Regular brushing			
Yes	1229 (84.35)	35.39 (32.76-38.11)	35.92 (33.07-38.88)
No	228 (15.65)	45.17 (38.78-51.72)	45.82 (38.08-53.76)
Visiting dentist per six months			
Yes	384 (26.36)	35.41 (32.60-38.33)	36.50 (33.32-39.80)
No	1073 (73.64)	41.14 (36.30-46.16)	39.79 (34.80-45.01)

DMF: Decayed, missing, filled; CI: Confidence interval; SD: Standard deviation

For example, the likelihood of poor DMF score was 63% [odds ratio (OR): 0.37, 95% CI: 0.26-0.53] among the children belonging to the richest wealth quintile compared to the children from the lowest quintile. The prevalence of poor DMF score was more than two times (OR: 2.10, 95% CI: 0.29-0.43) higher among girls. There was also statistically significant association between low education of mother, irregular brushing, and no visit to dentists per six months with poor DMF score. There was no significant association between poor DMF score and age and gender of household head ($P > 0.05$).

Age-adjusted SII was 0.29 (95% CI: 0.19-0.40), while it was 0.23 (95% CI: 0.11-0.34) after adjusting for age and sex. The RII was 2.33 (95% CI: 1.72-3.16) when we adjusted for age and 1.93 (95% CI: 1.40-2.68) when we adjusted for age and sex. This suggests that the poor DFM score was more prevalent among poorer children.

Table 3 presents the results of the BO

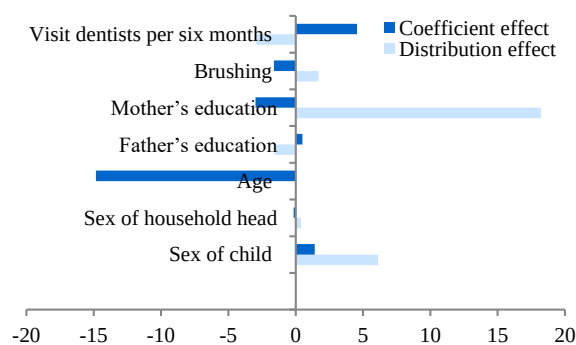
decomposition. The prevalence of poor DMF score for the poorest and the richest wealth groups was 49.65% (95% CI: 43.92-55.39) and 27.14% (95% CI: 22.09-32.20), respectively. The gap between the lowest and the highest wealth groups was 22.50% (95% CI: 22.09-32.20). About 97.3% of this gap between them was because of the differences in the distribution of independent variables (i.e., sex of child, mother's education, brushing, and visit to dentist) of the analysis. The difference in sex of child, mother's education, and brushing were found as the main determinants of gap in the prevalence of poor DMF score between the better-off and the worse-off groups. 39.7% of this difference between two groups was related to the differences in the coefficient of variables (response) or other factors that were not considered in our study. Additionally, -37.05% of the gap between two groups was attributed to the interactions (Table 3).

Table 2. Association between independent variables and poor decayed, missing, filled (DMF) index (logistic regression model)

Explanatory variables	OR			
	Crude (95% CI)	P	Adjusted (95% CI)	P
Age	1.10 (0.99-1.22)	0.071	1.07 (0.95-1.20)	0.214
Sex				
Male	1.00 (Reference)		1.00 (Reference)	
Female	2.10 (0.29-0.43)	0.001	1.66 (1.28-2.16)	0.001
Mother education				
Academic degree	1.00 (Reference)		1.00 (Reference)	
Uneducated or elementary	2.27 (1.83-2.83)	0.001	1.55 (1.17-2.04)	0.002
Father education				
Academic degree	1.00 (Reference)		1.00 (Reference)	
Uneducated or elementary	2.08 (1.66-2.60)	0.001	1.26 (0.95-1.67)	0.108
Gender of household head				
Male	1.00 (Reference)		1.00 (Reference)	
Female	1.16 (0.74-1.91)	0.558	1.10 (0.65-1.87)	0.700
Wealth index of households				
Poorest	1.00 (Reference)		1.00 (Reference)	
Poor	0.76 (0.55-1.05)	0.105	0.83 (0.59-1.18)	0.314
Middle	0.62 (0.44-0.85)	0.004	0.78 (0.55-1.12)	0.188
Rich	0.37 (0.26-0.52)	0.001	0.52 (0.35-0.76)	0.001
Richest	0.37 (0.26-0.53)	0.001	0.21 (0.41-0.96)	0.033
Regular brushing				
Yes	1.00 (Reference)		1.00 (Reference)	
No	1.50 (1.13-2.00)	0.005	1.54 (0.46-0.77)	0.006
Visiting dentist per six months				
Yes	1.00 (Reference)		1.00 (Reference)	
No	1.27 (0.48-0.62)	0.001	1.66 (1.28-2.16)	0.001

OR: Odds ratio; CI: Confidence interval

Figure 1 summarizes the share of each factor to the difference in prevalence of poor DMF score between the lowest and the highest SES groups due to distribution (explained part) and coefficient effects (unexplained part). The most important factors affecting the difference in poor DMF score were mother's education (18.23%), sex of children (6.12%), and visit to dentist (2.93%).

**Figure 1.** Contribution factors to differences in poor decayed, missing, filled (DMF) index in Kermanshah, Iran, 2018

Discussion

Although the occurrence of dental caries decreased in developed countries over the past 30 years, its prevalence remains high in children living in developing countries.³ This study examined SES inequality in oral health among school children in Kermanshah. In our study, the overall prevalence of poor DMF index was 36.92% among school children in Kermanshah which was higher than the results found in other studies.^{17,18} The logistic regression results indicated that being girl, low education of mother, irregular brushing, and no visit to dentist per six months were associated with poor DMF index. Our results suggested that poor DMF index was more prevalent among poorer children and the incidence of this indicator across SES groups was different. It was also different between boys and girls and the prevalence of poor DMF between girls (42.75%) was more than boys (26.17%).

Table 3. Blinder-Oaxaca (BO) decomposition of poor decayed, missing, filled (DMF) index in Kermanshah, Iran, 2018

Explanatory variables	Prediction (%)	95% CI	% of total gap*
Prevalence of poor DMF in the poorest group	49.65	43.92, 55.39	
Prevalence of poor DMF in the richest group	27.14	22.09, 32.20	
Total gap (difference)	22.51	14.86, 30.15	
1) due to distribution (explained)			
Sex of child (being girl)	6.12	0.36, 11.87	27.17
Sex of household head (being female)	0.39	-0.59, 1.37	1.75
Age	-0.02	-0.71, 0.67	-0.11
Father's education level (low)	-1.57	-16.70, 13.56	-6.97
Mother's education level (low)	18.23	6.33, 30.12	80.98
Brushing (irregular)	1.70	-0.17, -3.56	7.53
Visiting dentist per six months (no)	-2.93	-6.56, 0.69	-13.03
Subtotal gap (explained part)	21.91	5.69, 38.11	97.32
2) due to coefficient (unexplained)			
Sex of child (being girl)	1.41	-3.91, 6.73	6.27
Sex of household head (being female)	-0.16	-1.20, 0.88	-0.70
Age	-14.84	-109.35, 79.68	-65.92
Father's education level (low)	0.50	-1.05, 2.05	2.22
Mother's education level (low)	-2.99	-5.64, -0.34	-13.29
Brushing (irregular)	-1.62	-3.94, 0.69	-7.20
Visiting dentist per six months (no)	4.55	-4.63, 13.72	20.20
Constant	22.09	-72.23, 116.57	98.15
Subtotal gap (unexplained part)	8.94	-4.74, 22.63	39.73
3) due to interaction			
Sex of child (being girl)	2.01	-5.52, 9.55	8.94
Sex of household head (being female)	-0.14	-1.07, 0.80	-0.62
Age	0.14	-0.75, 1.02	0.60
Father's education level (low)	4.83	-9.16, 18.83	21.48
Mother's education level (low)	-16.41	-32.36, -0.45	-72.89
Brushing (irregular)	-1.17	-3.00, 0.66	-5.21
Visiting dentist per six months (no)	2.40	-2.45, 7.24	10.64
Subtotal gap	-8.34	-28.25, 11.57	-37.05

*Computed by dividing prediction for each determinant by the total gap (22.51)

DMF: Decayed, missing, filled; CI: Confidence interval

The inequality indices indicated that there was a pro-rich inequality in poor DMF index among the study samples. The RII showed that the prevalence of poor DMF index among the poorest children was 2.33 times higher than the richest children. The SII revealed that the prevalence of poor DMF index among the poorest children was 0.29 higher than the wealthiest ones. In other words, the prevalence of poor DMF index for the poorest was more than the richest and the gap difference between the poorest and the richest wealth status groups was 22.50%. It could be explained by this fact that oral health care are very expensive and patients face high out-of-pocket payments to use these services. Negative statistical association

between wealth status and DMF index are well established in studies conducted in developing and developed countries. For example, SES was the important factor affecting teeth caries and had an inverse relation with the DMF index in Iran.¹⁹ Furthermore, Hosseinpour et al.,⁹ Pothidee et al. in Thailand,²⁰ Martins et al. in Brazil,²¹ and Moradi et al. in Kurdistan Province, west of Iran,⁸ found that there was a positive association between poor oral health and lower SES.

We found that poor DMF index was about two times more prevalent among girls than boys. This is contrasting to the finding of a previous study from Kurdistan, which reported poor DMF index more prevalent

among boys.⁸ Nonetheless, similar studies found that boys had a healthier oral health.²² Our results suggest a significant association between prevalence of poor DMF index and irregular brushing. Subjects who brushed their teeth regularly had better oral health status, while those who did not brush their teeth had poorer DMF index. The possible explanation is that children with a high caries rate could have lack of fluoride. These findings are similar to studies conducted by Shirzaei and Mohageri.²³ The current study indicated that poor DMF index was associated with lower education level and the poor DMF index among school children who had a parent with academic degree was almost 2.27 times less than children who had a parent without academic degree. Hernandez-Palacios et al. found that association between poor oral health condition and lower education status was positive.²⁴ One reason for this is associated with the environment and community conditions where child was born and grown up.

Our analysis recommends that poor DMF index among school children who visited dentists in every six months was less than those who did not have regular visits to dentists. The reason behind this finding could be that children from poorer families could not visit dentist regularly and among this children, visits were mostly problem- or symptom-driven. On the other hand, children from richer families, visited dentist for preventive purposes. These findings follow the results reported by Mouradian et al.²⁵

Our study had few limitations and any interpretation of the results should be based on

these limitations. Firstly, this was a cross-sectional study which did not allow to establish any causal relationship between prevalence of poor DMF index and its determinants. Secondly, the current study was undertaken in one city which could preclude the generalization of our results to Kermanshah Province and Iran. Further studies from different regions of Iran are required to make the results more robust and generalizable.

Conclusion

Monitoring socioeconomic inequality in DMF index is a major step for designing and implementing of effective interventions to reduce inequalities in oral health. The findings of this study suggested a high prevalence of poor DMF among school children from poorer households. Despite of having higher dental disease burden, these populations often have limited or no access to dental care. Inadequate access to essential health services may be one of the main drivers affecting social inequalities in oral health among school-going children. A holistic approach is needed to decrease these inequalities and oral health education for children should involve the poorest children and their parents.

Conflict of Interests

Authors have no conflict of interest.

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Partial removable prosthesis in a patient with unilateral maxillectomy: A case report

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Case Report

Abstract

BACKGROUND AND AIM: Maxillofacial defects due to malignant or benign tumors or congenital defects often result in complications such as the impairment of facial aesthetic, mastication, speech, and swallowing. Remedy of these defects, especially in a dentate patient is an important challenge in prosthodontics. Maxillectomy can lead to severe anatomical changes following tumor resection and reconstruction such as decreasing skeletal soft tissue support. The present study describes an implant-supported obturator in a dentate patient.

CASE REPORT: The present study indicates an obturator prosthesis in a 58-year-old patient with hemimaxillectomy (Aramany's Class 1 defect) undergoing the treatment of mucoepidermoid carcinoma of the right palate. The research describes clinical and laboratory procedures in rehabilitation of a dentate patient with tooth, tissues, and implant-supported obturator.

CONCLUSION: In dentate patients, the maxillectomy requires careful planning for removable partial denture (RPD) framework design to achieve the best retention and soft tissue supporting. The patient was satisfied with her prosthesis in the mean aesthetic, phonetic, and swallowing aspects.

KEYWORDS: Palatal Obturators; Reconstruction; Maxillectomy; Maxillofacial Prosthesis

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Congenital defects in maxilla lead to relationships of maxillary sinus and oral cavity, oropharynx and nasopharynx, resulting in the loss of facial aesthetic, problems in swallowing and speech, and also a significant decrease in the quality of life.¹⁻⁴ Recent studies indicate that most of the maxillofacial surgeons prefer the treatment of cancer patients with jaw resection than the radiotherapy or chemotherapy.^{5,6} Maxillectomy can lead to severe anatomical changes after the tumor resection and reconstruction such as decreasing skeletal soft tissue support.² There are many options for maxillary reconstruction including prosthesis obturators, non-vascularized grafts, local flaps, regional flaps, and microvascular free tissue transfer.⁷

The most frequent option for maxillary reconstruction is an obturator prosthesis that makes a barrier between nose and oral cavity⁸ to prevent the liquid leakage into nasal cavity and hyper nasal speech.⁹ Maxillary defect obturators should restore the mastication, facial contour, face appearance, and swallowing.¹⁰ Unilateral maxillectomy obturators either total or subtotal are challenging for prosthodontics. A successful obturator depends on defect size and remained soft and hard tissues that are involved in the prosthesis stability and supporting.¹¹⁻¹³ The obturator weight can act as a dislocating force, and thus the prosthesis should be as light as possible.¹²

For the reconstruction of maxillary defects, obturators should restore the mastication, speech, deglutition, facial contours, and

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dental appearance. Clinicians need to provide a comprehensive treatment planning and sound physiological design principles for a removable partial denture (RPD) in order to achieve it for partially-edentulous patients. We should evaluate the periodontium status, conditions of remaining teeth, and abutment occlusion and remaining dentition. Size and quality of defect, accessibility to defect, maximum mandibular opening, and oral and soft tissue changes due to the radiation therapy should be considered in the design planning. Factors such as patients' age and aesthetic demands, medical conditions, tumor prognosis, motivation, and manual ability may affect the overall treatment plan. Clinical conditions are important factors in designing a practical and affordable RPD that fulfills patients' functional needs and demands.¹⁰ The present clinical report indicated a unilateral maxillectomy obturator in a dentate patient with implant and teeth for maximum retention and support.

Case Report

A 58-year-old woman with a hemimaxillectomy defect was referred to the Department of Prosthodontics at Tehran University of Medical Sciences, Tehran, Iran, for the prosthetic reconstruction of palatal defect. The patient's major complaints included the impaired speech, aesthetic, and mastication, leakage of food and liquid from the oral cavity into the nasopharynx, and also the lack of retention and stability of the surgical obturator. The patient had a history of mucoepidermoid carcinoma of the maxillary sinus that was treated by a unilateral maxillectomy followed by the post-surgical radiation therapy a year earlier.

According to Aramany, the defect was classified as a Class I curved arch form.¹⁴ Extra-oral examination revealed that the right side of her face slightly depressed inwards and also had an asymmetric smile line that built an unaesthetic appearance. An intraoral examination indicated a large unilateral defect extending from left incisor region to

the soft palate (Figure 1).



Figure 1. Preoperative maxillary occlusal view (palatal defect)

The patient had 8 viable maxillary teeth (from left central incisor to left third molar) and a mild periodontal disease. The lower arch was completely dentulous. She had a surgical obturator. The teeth examination indicated the left maxillary second and third molars and first mandibular molar with periapical abscesses, and they were hopeless. Mandibular right bridge did not have any proper level (Figure 2).



Figure 2. Preoperative mandibular occlusal view

Since the improper occlusion can affect the maxillary obturator stability, changes were considered in the mandibular bridge and right mandibular occlusal plan correction. Extraction of hopeless teeth and implant insertion in the maxillary left second molar was considered in the treatment plan.

An interim obturator was fabricated according to surgeon's recommendation three months after the radiotherapy completion.

An interim obturator was first built (Figure 3). All treatments were done such as the hopeless teeth extraction, changing the mandibular right bridge, and insertion of implant in maxillary left second molar.



Figure 3. Interim obturator

The fixture level impression was built six months after the implant insertion. The obturator pass of insertion with implant and framework was checked by attaching impression coping to analog in the cast.

The partial denture was designed based on general principles of a partial denture design. The research considered the mesial occlusal rest and circumferential clasp on the left first premolar and the embrasure rest and embrasure clasp on the left first molar and second premolar. A positioner was inserted with 4.8 mm diameter and 3 mm gingival height, and the final torque was applied in patient's mouth. Border molding was done by Green Compound Stick (Kerr, KAVO, USA) in borders and the defect was molded with ISO Functional Compound Material (GC, USA) (Figure 4). During the border molding, the patient was asked to perform the following movements: exaggerated head movements by turning right to left, opening and closing mouth, and swallowing.¹⁵ Impression was made with additional silicone (Monopren, Kettenbach, Germany) by a special tray after preparing rest seats.

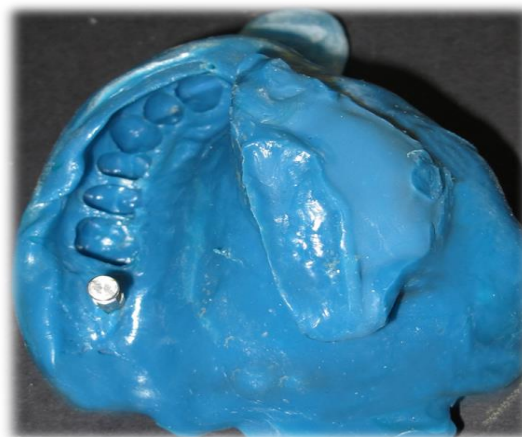


Figure 4. Implant level closed tray impression

Laboratory procedures consisting of beading, boxing, and casting were done, and master and duplicate casts were relieved and blocked out. Framework design was waxed on a duplicate cast. Framework laboratory procedure consisting of the sprue insertion, investing, casting, finishing, and polishing were done. Complete framework path of oral insertion was checked in patient by the chloroform rouge. Occlusal record was done by an acrylic base attached to the framework. Wax rim was adjusted based on the lip support, smile line, V, F, and S sounds. Maxillary record was transferred to the articulator with face bow. Teeth were selected according to color and shape of the remaining teeth. Group function occlusion was also considered. The occlusal adjustment was done in articulator and oral cavity after the whole laboratory procedures (Figures 4-12).



Figure 5. Abutment level closed tray final impression



Figure 6. Relief and block out

The patient was instructed in hygiene procedures, and follow-up appointments were recommended to evaluate the denture fit and oral mucosa.



Figure 7. Refractory cast

The obturator treatment provided the patient's aesthetics, proper retention and speech, and no penetration of water and foods into nose, and generally fulfilled the patient satisfaction.

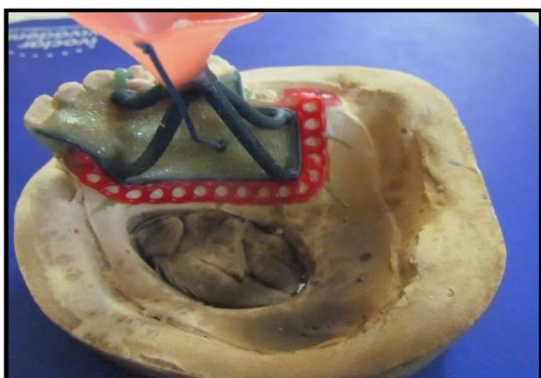


Figure 8. Sprue placement



Figure 9. Partial denture implant-assisted framework

Discussion

Reconstruction of maxillectomy cases is challenging for clinicians and patients. Factors such as size of the defect and its extension, number and quality of the remaining teeth, and quality of available bone play important roles in choosing the best treatment plan.^{16,17}



Figure 10. Occlusal recording

Radiotherapy has side effects and complications such as hyposalivation, decreased or loss of taste, xerostomia, decreased prosthetic restoration tolerance, compromised bone remodeling, and trismus.¹⁸



Figure 11. Final set-up and waxing

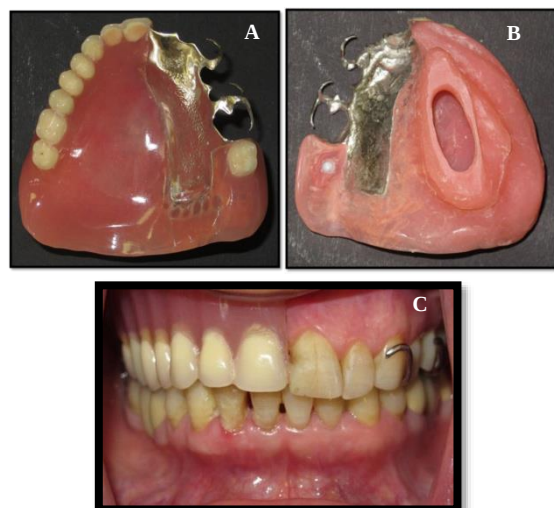


Figure 12. Final prosthesis from external view (A), internal view (B) and in mouth (frontal view) (C)

There was limitation in mouth opening in patients' with maxillectomy due to the secondary intention healing and formation of scar tissue after the radiotherapy.¹⁹

This case was Class II arch form, that edentulous area was unilateral from upper right central to posterior area. In the present case, support achieved from the left canine and first molar and edentulous area. In traditional design for partial removable prostheses, circumferential clasp, cast I bar, and wrought wire were used to achieve retention from the nearest abutment tooth

from the missing area.²⁰

The advantages of maxillofacial prostheses included the improved mastication, swallowing, and speech, improved social life after surgery, easy removal of obturator in order to examine the prosthesis' underneath tissues, and ease of use by patients.²¹

Conclusion

In dentate patients, the maxillectomy requires careful planning for RPD framework design to achieve the best retention and soft tissue supporting. In the present clinical report, we made an obturator with a RPD which was implant, tooth, and tissue-supported. We followed all the principles of RPD design to maximize the retention and support, which is very crucial in such patients. We also used tissue conditioner in order to have maximum use of tissue undercuts without too much force on remaining teeth. The patient was satisfied with her prosthesis in the mean aesthetic, phonetic, and swallowing aspects.

Conflict of Interests

Authors have no conflict of interest.

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