

Risk Factors Associated with Denture Stomatitis in Healthy Subjects Attending a Dental School in Southeast Iran

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عوامل الاختطار المرتبطة باعتلال الفم الناتج عن البدلة السنية في الأشخاص الأصحاء المراجعين لمستشفى طب الأسنان بجنوب شرق إيران

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المخلص: الهدف: هناك نقص في المعلومات المتعلقة بالعوامل المتعددة المسببة لمرض اعتلال الفم الناتج عن البدلة السنية في العالم، بالرغم من كثرة التواتر، هذا بالإضافة إلى عدم الفهم الكامل للعوامل المصاحبة. هدفت هذه الدراسة إلى بحث عوامل الخطر التي يمكن أن تكون مصاحبة لهذه الآفة. الطريقة: تم تقسيم مجموع 70 مريضا عديم الأسنان ممن لديهم بدلات سنية متحركة إلى مجموعتين. مجموعة الفحص مكونة من 43 مريضا مصابا باعتلال الفم الناتج عن البدلة السنية ومجموعة التحكم مكونة من 27 شخصا مثبتين طبيا بصحة الغشاء المخاطي الحنكي. تم القيام بأخذ التاريخ المرضي الشامل بالإضافة إلى الفحص السريري للمرضى، تم أيضا الإجابة على الاستبيان من قبل المشاركين. تم قياس مستوى مصل فيتامين أ لكل مشارك من عينة الدم المأخوذة بعد عملية الفحص. النتائج: أظهرت هذه الدراسة وجود علاقة معتددة بين حدوث اعتلال الفم الناتج عن البدلة السنية والعوامل الرئيسية الثلاثة: عمر البدلة السنية (بالسنوات)، والممارس المصنع للبدلة السنية (طبيب أسنان عام مقابل معالج صحة سنية)، ليس البدلة السنية ليلا. كذلك كان معدل مستوى مصل فيتامين أ منخفض في 94.29% من المشاركين (مجموعة الفحص والتحكم). الخلاصة: بالرغم من وجود عدة عوامل عارضة لهذه الحالة، كان أكثرها شيوعا هو الاستخدام المتواصل للبدلة السنية.

مفتاح الكلمات: فيتامين أ؛ اعتلال الفم؛ بدلة سنية؛ السببيات؛ العادات؛ عوامل الاختطار؛ إيران.

ABSTRACT: Objectives: There is scant information regarding the multifactorial aetiology of denture stomatitis (DS) in the world and, despite its frequency, associated factors are not completely understood. The aim of this study was to investigate the risk factors that may be associated with this lesion. **Methods:** A total of 70 edentulous patients, all wearing removable dentures, were divided into two groups. The test group comprised 43 patients with DS and the control group comprised 27 subjects with clinically healthy palatal mucosa. A thorough history-taking and physical examination were carried out; the subjects also answered a questionnaire. The serum level of vitamin A for each subject was assayed from a blood sample taken after the examination. **Results:** This study showed a significant relationship between the incidence of DS and three major factors: denture age (in terms of years), the practitioner manufacturing the dentures (general dental practitioner *versus* dental hygienist), and the night-long wearing of dentures. Also, the vitamin A serum level was low in 94.29% of all subjects (cases and controls). **Conclusion:** Although many predisposing conditions were related to this situation, the most important risk factor was the continuous use of the dentures.

Keywords: Vitamin A; Stomatitis; Denture; Etiology; Habits; Risk Factors; Iran.

ADVANCES IN KNOWLEDGE

- According to the literature review, the aetiology of denture stomatitis (DS) is not fully understood, despite its high prevalence rate, and is somewhat controversial.

APPLICATION TO PATIENT CARE

- The results of this study will help in increasing awareness of DS for dentists.
- Dentists can help prevent this condition by instructing patients to take their dentures out for 6–8 hrs each day.
- Mechanical plaque control and appropriate denture-wearing habits are the most important measures in preventing and treating the disease.

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DENTURE STOMATITIS (DS) IS A COMMON inflammatory response which usually manifests as a shiny erythematous area with varying intensities in the palatal mucous membrane under the acrylic base of removable prosthetic appliances.¹⁻⁴ Epidemiological studies have indicated a prevalence rate of 15–70% of denture-wearers.^{1,2} This wide range of prevalence rates has been attributed to the diversity of populations studied; however, a high prevalence rate has been reported for DS in women and individuals older than 60 years of age.^{2,5} The affected area is not tender to touch and in almost all of the patients, the entity remains unknown due to the asymptomatic nature of the lesion.⁵ According to a classification proposed by Newton in 1962, DS is divided into three types based on the clinical features.^{6,7}

Despite its high prevalence rate, the aetiology of DS is not fully understood⁸ and is also somewhat controversial; however, researchers believe that the entity has a complex and multifactorial pathogenesis.⁹ Infection by *Candida albicans* has been surmised to be the main aetiological agent and it has been correlated with the incidence of DS in various studies.¹⁰⁻¹² Other factors have also been reported in the aetiology of DS. In 1981, Abelson reported that DS is related to the triad of loose-fitting dentures, trauma from denture-wear and poor denture hygiene.¹³ Some studies have reported the continuous and round-the-clock wearing of dentures as an aetiological local factor involved in the pathogenesis of DS.^{14,15} Poorly-fabricated dentures have a lot of porosities in their acrylic base, which encourages the adhesion of *C. albicans*, making it difficult to maintain denture hygiene.¹⁷ The frequency of dental visits by denture-wearing patients each year and the number of years since denture manufacture (denture age) have also been reported as local factors contributing to DS.¹ Various studies on the aetiology of DS have indicated that diabetes mellitus and smoking might have a role in inducing the lesion.^{5,7,16}

A review of 15 studies, published in the years 1989–2011 in various parts of the world, on the factors involved in the pathogenesis of DS, showed that the most significant factors are continuous and overnight denture-wearing;^{3-5,8-11} poor denture hygiene;^{2,4,12,17-19} smoking;^{14-16,20,21} denture age and poor denture manufacturing techniques;^{22,23} low serum levels of vitamin A; young age, and the

number of visits to the dental surgery.⁷

Nimri showed that nocturnal denture-wearing habits, deficient oral and denture hygiene, and cigarette smoking were all important predisposing factors to DS; however, none of these factors was the sole cause of mucosal inflammation.³ Also, Shulman *et al.*, showed that DS prevalence was associated with the amount of tissue covered by the dentures, low vitamin A levels, cigarette smoking, and constant denture-wear.⁷ In their study on an Asian edentulous population, Jeganathan *et al.* observed a relationship between denture hygiene habits, denture-wearing behaviours, denture cleanliness and the presence of DS.¹⁴

The treatment of patients with DS does not yield high success rates because of its complex aetiology; there is also no uniform treatment protocol for all patients.^{1,12} On the other hand, with an increase in the proportion of elderly persons in various communities, the identification of the specific aetiological factors of the condition is of utmost importance.²¹ There are great discrepancies in the results of studies on the role of various aetiological agents in the pathogenesis of DS.²¹⁻²³ The research work carried out by Shulman in 2005 is the only study that deals with the role of vitamin A in the pathogenesis of DS.⁷ Based on the evidence available, vitamin A deficiency makes individuals susceptible to infections. The previous studies showed that a higher percentage of neutrophils from vitamin A-deficient rats are hypersegmented and contain lower levels of cathepsin G than the neutrophils from control rats.²⁴

The aim of the present work was to study the risk factors associated with DS in healthy subjects attending a dental school clinic in Southeast Iran.

Methods

In this case-control study, the subjects with and without DS were divided into case and control groups, respectively. The subjects were selected from the patients referred to the Dental Clinic of the Kerman Faculty of Dentistry using a convenience sampling method. Patients unwilling to participate in the study, those who were using solid oils, taking oral contraceptives, who had a history of diabetes mellitus, or who might have had nutritional problems interfering with vitamin A level measurement, were excluded from the study.^{7,24} The inclusion criteria

Table 1: Frequency of risk factors for denture stomatitis

Characteristics of the denture-wearers		n	%
Gender	Male	34	48.57
	Female	36	51.43
Level of education	Illiterate	18	25.71
	Pre-diploma	36	51.43
	Diploma	11	15.71
	Academic	5	7.14
Denture manufacturer	General dentist	54	77.14
	Dental hygienist	16	22.86
Denture hygiene	Cleaning	65	92.86
	No cleaning	5	7.14
Frequency of cleaning per day	Once	14	20
	Twice	18	25.7
	Three times	28	40
	More	10	14.3
Overnight denture-wear	Yes	40	57.14
	No	30	42.86
Overnight denture solutions	Water	18	25.7
	Saline	12	17.2
	None	40	57.1
Dental check-ups per year	Yes	6	8.57
	No	64	91.43
Smoking	Yes	18	25.71
	No	52	74.29

were the continuous wearing of complete or partial dentures in one arch or both arches for at least the previous 6 months.¹⁹ All of the 76 subjects included in the study signed a written consent form (6 of the patients examined did not present themselves at the laboratory; therefore n = 70). In the case of any pathological lesions present in the oral cavity, the patients were accordingly referred to the Department of Oral Medicine at Kerman Faculty of Dentistry for treatment. The study was approved by the Ethics Committee of Kerman University of Medical Sciences under the protocol No. K.88.218.

A questionnaire was used to collect information from the subjects. The questions related to dentures were read by the researcher to the patient and the questionnaire was completed for each patient. Clinical examinations were carried out by a dental practitioner. In the first part of the examination,

the diagnosis of DS was based on criteria proposed by Newton.⁷ In the second part, the denture was evaluated using the following criteria: denture extension, stability, occlusion, polishing and tissue side surface characteristics.^{17,19} After the clinical examination, all the subjects were sent to the laboratory for a vitamin A test. The subjects' blood samples were used for the test in the laboratory (haemoglobin A1C [HbA1C] test). A columnar chromatography technique was used to measure vitamin A (retinol) serum levels using centrifugation to separate the blood sera. High performance liquid chromatography (HPLC) (Sigma-Aldrich Co., Yongin, Korea) was used to measure vitamin A levels. Vitamin A serum levels of less than 30 µgr/mL were considered to indicate vitamin A deficiency.⁷

Median statistical parameters were used to express the position of each quantitative risk factor. Odds ratios, 95% confidence intervals and chances of encounter with each risk factor were calculated in both groups. The effects of various independent variables (age, gender and education) on the presence or absence of DS (as a dependent variable) were evaluated using a logistic regression model by considering the role of confounding factors and the reciprocal effects of predictors. All statistical analyses were carried out using Stata Software, Version 10 (StataCorp LP, College Station, Texas, USA) at a significance level of 0.05 and a strength of 80%, as a default for the test carried out.

Results

In this study, the 70 subjects who participated were examined for DS. They were 33–89 years of age with a mean age of 58.24 ± 12.3 years. A total of 36 subjects (51.43%) were female; in relation to the educational status, the majority of the subjects (51.43%) had had high school education but had not graduated from high school. The mean denture-wearing period was 5 years, and the longest period was 37 years (mean ± standard deviation [SD] = 15.26 ± 7.11). The dentures had been manufactured by a general dental practitioner for 77.4% of the subjects and the rest had been manufactured by a dental hygienist. A total of 92.86% of the subjects cleaned their dentures on a daily basis, with the highest frequency being three times daily (43.08%). A total of 57.14% of the subjects wore their dentures

Table 2: The relationship between multiple risk factors and denture stomatitis

Factors		Control group (n = 27)	Study group (n = 43)	P
Age ± SD		59.8 ± 12.3	57.2 ± 12.4	0.08
Gender n (%)	Male	13 (48.15)	21 (48.84)	0.124
	Female	14 (51.85)	22 (51.16)	
Level of education n (%)	Illiterate	3 (11.11)	15 (34.88)	0.08
	Pre-diploma	17 (62.96)	19 (44.19)	
	Diploma	4 (14.81)	7 (16.28)	
	Academic	2 (11.11)	3 (4.65)	
Years of denture-use ± SD		13.30 ± 2.98	18.42 ± 6.69	0.03
Denture manufacturer n (%)	General dentist	26 (96.3)	28 (65.12)	0.02
	Dental hygienist	1 (3.7)	15 (34.88)	
Denture hygiene n (%)	No cleaning	27 (100)	38 (88.37)	0.6
	Cleaning	0 (0)	5 (11.63)	
Frequency of cleaning n (%)	Once	5 (18.52)	9 (23.68)	0.07
	Twice	6 (22.22)	12 (31.58)	
	Three times	12 (44.44)	16 (42.11)	
	More	4 (14.81)	1 (2.63)	
Overnight denture-wear n (%)	Yes	9 (33.33)	31 (72.09)	0.001
	No	18 (66.67)	12 (27.91)	
Denture solution at night n (%)	Water	10 (55.56)	8 (66.67)	0.08
	Saline	8 (44.44)	4 (33.33)	
Dental check-ups per year n (%)	Yes	2 (7.41)	4 (9.30)	0.1
Smoking n (%)	No	25 (92.59)	39 (90.7)	0.14
	Yes	22 (81.48)	30 (69.77)	
Denture quality n (%)	Non-ideal	20 (74.07)	38 (88.37)	0.09
	Ideal	7 (25.93)	5 (11.63)	
SL of vitamin A ± SD		0.66 ± 0.14	0.59 ± 0.13	0.09

SD = standard deviation; SL = serum level.

during the night. Of the subjects who removed their dentures at night, 18 patients kept them in water and 12 patients kept them in a saline solution [Table 1].

Only 8.57% of the subjects paid an annual visit to a dental practitioner. A total of 25.71% of the subjects smoked, with an average of 1.8 cigarettes per day.

According to the classification proposed by Newton in 1962, DS is divided into three types based on clinical features. Type I is characterised by pin-point hyperaemic lesions (a localised simple inflammation), type II shows as diffuse erythema confined to the mucosa in contact with the denture (a generalised simple inflammation) and type III has a granular surface (an inflammatory papillary hyperplasia).²⁵ A total of 61.5% of the subjects examined had DS, with 62.79% of these having type I DS (the most severe) and 4.65% having type III DS (the least severe). A total of 88.37% of patients with DS wore complete dentures and the rest wore partial dentures. Dentures were ill-fitting in 37.88% of DS cases.

The study showed a significant relationship between three factors: denture age (in terms of years), the practitioner manufacturing the denture (general dental practitioner *versus* dental hygienist), and the overnight denture-wear and the incidence of DS ($P = 0.03$, $P = 0.02$ and $P = 0.001$, respectively). In other words, patients with a significantly high incidence rate of DS had had their dentures manufactured by a dental hygienist a long time previously and wore their dentures during the night [Table 2].

An important and interesting finding of the present study was the fact that only 4 out of the 70 subjects (5.71%) had a normal vitamin A blood level. However, a low vitamin A blood level did not exhibit a significant relationship with the DS incidence rate ($P = 0.09$), compared to factors such as age, gender, education, denture hygiene, the number of annual visits to a dental surgery, smoking and denture quality, which exhibited a significant relationship with DS. The logistic regression model of odds ratio (95% confidence interval [CI]) showed an increase in the chance of DS affliction related to three factors: the denture-manufacturer, overnight denture-wear and denture age; this was after eliminating the effect of other factors involved. The highest odds ratio (OR) (6.92, 0.75–51.1) was related to the effect of the denture-manufacturer, followed by overnight denture-wear (OR = 3.98, 1.3–12.1).

Discussion

In the present study, the highest frequency of DS was related to grade I of the lesion, which is consistent with the results of studies carried out by Diaz *et al.* and Kossioni *et al.*^{18,21} This supports the previous findings that this grade of lesion is more likely to be encountered in clinical situations compared to the two other grades.

The results of the present study showed a significant relationship between DS and denture age, the denture-manufacturer, and overnight denture-wear as local factors for this condition. Denture age has been correlated to DS in three recent studies carried out by Figuerial *et al.*,¹⁵ Bilhan *et al.*⁴ and Kossioni *et al.*²¹ which are consistent with the results of the present study. An important finding of the present study is the relationship between the higher incidence of DS in patients whose dentures had been manufactured by a dental hygienist, a factor which has not been evaluated in any similar studies. This finding might be attributed to the fact that general dental practitioners observe scientific principles in protecting the tissues covered by the denture base. Continuous and overnight denture-wear is the factor most associated with DS in previous studies, which is consistent with the results obtained in the present study. Furthermore, the logistics model showed an increase in the odds of DS incidence in patients with low serum levels of vitamin A. It is noteworthy that the logistic model (by maintaining the effect of other confounding variables) has only been used in two other studies, those carried out by Shulman *et al.* and Kossioni *et al.*^{7,21} An increase in the odds of DS incidence (OR) due to overnight denture-wear was higher in a study carried out by Shulman *et al.* compared to the present study. However, the results of the present study showed a higher OR with vitamin A deficiency in relation to DS compared to Shulman's study.⁷

The highest OR in the logistic model in the present study was related to the denture-manufacturer, whereas Kossioni reported overnight denture-wear as the most important risk factor for DS.²¹ Another important finding of the present study was the fact that low serum levels of vitamin A were observed in 92.29% of the subjects (including healthy and patients with DS). It was, therefore, concluded that most subjects in the present study suffered from malnutrition.

The results of the National Health Survey conducted in 2002 have shown that 2.5% of the population over two years old in Iran have night blindness. The criteria proposed by the World Health Organization state that in a society where 1% of children more than two years old have experiences of night blindness, there is vitamin A deficiency.²⁵ In Kerman, the last survey of clinical vitamin A deficiency was performed in 2001. This survey showed that the serum levels of vitamin A in the population of Kerman were low (vitamin A serum levels between 13–24 $\mu\text{g}/\text{mL}$).²⁶

The majority of studies carried out in this regard have been designed to examine a large number of cases in a cross-sectional manner to determine DS prevalence definitively; however, the design of the present study (information collected on: denture-manufacture date; denture-manufacturer; the way in which the patient washed his/her hands; the overnight wearing of dentures by the patient; the number of annual dental check-ups and tobacco use) was similar to that of studies carried out by Jeganathan *et al.*¹⁴ and Kulak *et al.*²⁷ Both of these studies highlighted poor denture hygiene as a significant risk factor for DS, which is not consistent with the results of the present study. However, overnight denture-wear was found to be a major risk factor in Jeganathan's study,¹⁴ and this is consistent with the present findings. It is possible that the similarity in the identified DS risk factors is somehow related to the study design.

It appears therefore that longitudinal studies are necessary to clarify the effect of various risk factors involved in DS, so that recovery from DS might be evaluated over time by controlling for various factors (such as improvements in denture hygiene). Figueiral *et al.* showed significant associations between DS and yeasts, gender, age and alcohol consumption.¹⁵ A study carried out by Pires *et al.* was very important in this regard because differences in the incidence of DS in various populations under study were evaluated at two intervals (6 months apart), before and after the delivery of new higher quality dentures. This resulted in a decrease in the incidence of DS from 50.6% to 18.2% in the same population.¹²

Of the factors in the present study not exhibiting a significant relationship with DS, poor denture hygiene and smoking can be mentioned. The evaluation of denture hygiene in various studies

has been carried out by asking questions about the daily washing of dentures (similar to the present study) and a direct assessment of plaque formation on the denture surface. Regarding smoking, based on the results of the present study, it appears the selection of subjects in the present study did not favour smokers, with a mean of 1.8 cigarettes per day. However, in a study carried out by Al-Dwairi, 70% of subjects (210 cases, aged 50–78 years-old) with grade 3 DS were heavy smokers (more than 15 cigarettes/day).²⁸

The number and diversity of discussions in relation to the aetiology of DS necessitate devising a standard protocol to finalise clinical decision-making processes. At present, there is a need to determine to what extent the control of each aetiological factor for DS can control the lesion.²⁹ Research is now focusing on new treatment modalities for DS;³⁰ therefore, there is a need for clinical trials to evaluate their effectiveness. Also, this study showed that the connection between vitamin A and DS is weak; this is very likely due to the multifactorial causes of DS.

Conclusion

The prevalence of DS was high in denture-wearers. Although many predisposing conditions were recorded, the most important risk factor was the continuous use of dentures. Also, DS may be associated with low vitamin A levels but more studies are required to confirm this impression.

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