

## Oral Symptoms of Diabetes Mellitus in Complete Denture Wearers Patients: A Case Control Study

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### Abstract

**Aim:** To study of oral manifestations of diabetes mellitus in complete denture wearers

**Methods:** This prospective case-control study conducted in the Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India. The sample consisted of 60 adult subjects using complete maxillary or maxillary and mandibular dentures. Thirty subjects diagnosed with type-2 diabetes were matched with 30 controls on the basis of gender, race, and age.

**Results:** Comparison of the 2 groups revealed no significant difference in mean (SD) salivary flow between the control group (1.14 (0.87) mL/min) and the diabetic group (0.95 (0.61) mL/min) ( $t=0.98$ ;  $df=51$ ;  $P=.331$ ). A significant difference in mean (SD) buffering capacity was observed between the control (5.80 (0.85)) and diabetic groups (5.26 (0.83)) ( $t=2.478$ ;  $df=57$ ;  $P=.017$ ). Regarding blood glucose levels, the Mann-Whitney test for distribution values indicated a significant difference between the 2 groups (control: 111 mg/dL versus diabetic: 182 mg/dL;  $P=.001$ ). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) showed the same behavior in the 2 groups, with a mean SBP close to 140 mm/Hg and a mean DBP of 90 mm/Hg. Denture retention was observed in 66.7% (20/30) of the control group and in 50% (15/30) of the diabetic group. Comparison of proportions demonstrated no significant differences ( $\chi^2=1.714$ ;  $df=1$ ;  $P=.190$ ). Comparison of proportions was statistically significant ( $\chi^2 = 18.261$ ;  $df = 1$ ;  $P=.001$ ). Low salivary buffering capacity and reduced salivary flow require special care and greater attention on the part of the dentist ( $\chi^2 = 18.261$ ;  $df=1$ ;  $P=.001$ ). Reported alcohol consumption did not differ significantly between the control (3/30, 10%) and diabetic groups (1/30, 3.33%) ( $\chi^2=1.071$ ;  $df=1$ ;  $P=.301$ ).

**Conclusion:** Within the limitations of this study, no significant differences were observed in salivary flow, self-reported denture retention, or oral mucosal lesions when comparing diabetic and nondiabetic subjects.

**Keywords:** Mucosal Lesions, Complete Denture, Buffering Capacity.

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### Introduction

Diabetes mellitus (diabetes) is a complex metabolic disease characterized by altered

carbohydrate, lipid, and protein metabolism, which results in marked or

absolute insulin deficiency - type 1 diabetes - or peripheral tissue insulin resistance - type 2 diabetes.[1] A Brazilian multicentre study on the prevalence of diabetes, coordinated by the Ministry of Health,[2] has mapped the disease in this country: the prevalence is 7.6 % in the urban adult population of nine capitals. The study revealed that 46.5% of diabetics ignored their condition, and 22.3 % had but did not treat the disease. Faced with an increasing diabetic and hypertensive population, the Ministry of Health, in a partnership with State and Municipal Secretariats, scientific societies (diabetes, cardiology, and nephrology), and associations of diabetic and hypertensive patients, has reorganized healthcare through the plan for reorganizing Healthcare for Arterial Hypertension and diabetes, to reduce the morbidity and mortality of these conditions. The plan improves healthcare for patients with these diseases by health-promoting actions involving preventive, curative and control measures.[3]

Several systemic diseases manifest in the mouth, including diabetes. Absence of metabolic control appears to alter the susceptibility of patients with diabetes to periodontal disease, fungal infections, and changes in taste. The relationship between diabetes and oral lichen planus and dental caries is less obvious; several studies have shown widely diverging results.[4,7]

Diabetes mellitus is one of the most prevalent diseases worldwide and is commonly found in dental patients. Patients with a diagnosis of diabetes mellitus present a higher susceptibility to infections due to a deficiency in polymorphonuclear leukocytes, as a result of vascular alterations and neuropathies.[8] An increased risk of infections has been observed with reduced salivary flow, low salivary buffering capacity[9] and inadequate hygiene of the complete dentures[10] Special care and greater attention on the part of the dentist in terms of anamnesis and clinical examination is necessary, since subjects commonly report

specific symptoms such as a sensation of dry mouth and burning, mastication and speech difficulties, dry lips, altered taste, and a lack of adaptation to the complete denture.

Diabetes mellitus increases the susceptibility to erosion and ulceration of the mucosa where it comes in contact with the base of the complete denture.[11] Most complete denture wearers report a combination of dry mouth sensation and oral and functional symptoms.[12] The maintenance of oral health and prevention of oral diseases are associated with systemic health.[13] Salvi et al[14] compared a group of insulin-dependent diabetes mellitus subjects to systemically healthy individuals and observed a higher degree of the inflammatory response in the former. In addition, other oral manifestations have been reported, such as ketonic breath (sweet breath), a high frequency of periodontal disease, gingival displacement, residual bone resorption, periodontal abscess, gingival overgrowth, vascular alterations, candidiasis, blood coagulation and tissue regeneration times above normal, and xerostomia[15,7] The oral mucosa also loses resilience, which is necessary for good adaptation of a complete denture[17] Sennerby et al[18] also demonstrated that patients with diabetes present a lower level of retention of complete dentures than patients without the disease, since diabetes increases the osteoclastic activity of bone tissue in the mandible and maxilla.

Belazi et al[19] found no significant difference in the salivary flow rate between subjects with diabetes mellitus and controls. Bergdahl[20] showed that psychological factors play an important role in xerostomia. Hypo salivation is significantly associated with depression and anxiety. Wettability, surface tension, viscosity, and muscle control are factors that enhance denture retention[21] Sreebny and Schwartz[22] reported that the use of medications may alter the salivary gland secretion, with the most influential drugs

being anti depressive, antihypertensive, and diuretic agents.

The aim of the present study was to compare diabetic and nondiabetic subjects wearing complete dentures regarding salivary flow, salivary buffering capacity, denture retention, and oral mucosal lesions. The research hypotheses were: (1) reduced salivary flow causes subjective feelings of denture instability in patients with diabetes; (2) salivary buffering capacity is decreased in complete denture-wearing subjects with diabetes compared to healthy controls; and (3) oral mucosal lesions are more frequent in complete denture-wearing subjects with diabetes.

### Material and methods

This prospective case control study conducted in the Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India for 1 year. The sample consisted of 60 adult subjects using complete maxillary or maxillary and mandibular dentures. Thirty subjects diagnosed with type 2 diabetes were matched with 30 controls on the basis of gender, race, and age. Of the 30 control subjects, 21 (70%) were women, with a mean (SD) age of 63 (12) years (range: 45 to 88 years). Of the 30 subjects with diabetes, 19 (63.3%) were women; the mean (SD) age was close to 60 (9) years (range: 46 to 78 years). Subjects with only complete mandibular dentures and subjects with maxillary and/or mandibular teeth were excluded. An intraoral and extraoral clinical examination was performed, and glycemia and blood pressure were measured. These procedures were performed during the postprandial period in most subjects. Subjects self-reported any medications they were taking.

Blood glucose was measured with a lancing device (Roche Accu Chek Advantage; Roche Diagnostics GmbH, Mannheim, Germany). Fasting plasma glucose levels up to 110 mg/dL were considered as normal fasting glucose, levels ranging from 110 to 125 mg/dL were considered to indicate

impaired fasting glucose, and levels higher than 126 mg/dL measured in at least 2 tests were considered as hyperglycemia[23]s. When the measurements were performed during the postprandial period, glucose levels up to 140 mg/dL were considered to be normal and those ranging from 141 to 199 mg/dL indicated a suspicion of diabetes[22]

Stimulated salivary flow was considered to be normal at a flow rate of 1 to 2 mL/min, hyposalivation was defined as a flow rate of less than 0.7 mL/min, and a flow rate of less than

0.1 mL/min was classified as xerostomia.[24] For the salivary buffering capacity test, 1 mL saliva was pipetted into a test tube containing 3 mL 0.005 N hydrochloric acid (Ecibra, Sao Paulo, Brazil), and the pH was measured with indicator sticks in different scales (pH-FIX, pH 0-14; Macherey-Nagel, Duren, Germany). The buffering capacity of the subject was classified as follows: low when the pH was below 4.5, medium from pH 4.5 to 5.5, and high when the pH was above 5.5[24]

Each subject was evaluated regarding denture retention and was asked for a self-report of comfort, efficacy, and occlusion of the complete denture. Retention was considered to be present when the subject did not complain about movement or displacement of the complete denture during mastication, talking, breathing, smiling, or even at rest. Subjects were asked to self-report about current behaviors such as controlled or uncontrolled diet, alcohol consumption, and smoking.

The dependent variables were salivary flow, salivary buffering capacity, blood glucose level, blood pressure, denture retention, presence of mucosal lesions, use of medications, and behavioral factors (controlled or uncontrolled diet, alcohol consumption, and smoking). Disease's state (present/absent) was considered to be the independent variable. The data obtained were analyzed by statistical measures of

central tendency (mean and median) and variation (range, standard deviation, and interquartile range). The results are presented graphically as dot plots and box plots. The student *t* test was used for the variables salivary flow and buffering capacity that met the Kolmogorov-Smirnov test for normality. For the variable blood glucose level that was not normally distributed, differences were evaluated by the Mann-Whitney test. The qualitative variables, including denture retention, prevalence of mucosal lesions, use of

medications, and behavioral variables, and significant differences between the 2 groups were tested by the chi-square test for homogeneity.

### Results

Comparison of the 2 groups revealed no significant difference in mean (SD) salivary flow between the control group (1.14 (0.87) mL/min) and the diabetic group (0.95 (0.61) mL/min) ( $t=0.98$ ;  $df=51$ ;  $P=.331$ ) table 1.

**Table 1: Comparison of salivary flow**

Comparison of Salivary Flow	Control Group	Diabetic Group	T	Df	P value
	1.14 (0.87) mL/min	0.95 (0.61) mL/min	0.98	51	$P=.331$

A significant difference in mean (SD) buffering capacity was observed between the control (5.80 (0.85)) and diabetic groups (5.26 (0.83)) ( $t=2.478$ ;  $df=57$ ;  $P=.017$ ) table 2.

**Table 2: Comparison of buffering capacity**

Comparison of Buffering Capacity	Control Group	Diabetic Group	T	Df	P value
	5.80 (0.85)	5.26 (0.83)	2.478	57	$P=.17$

Regarding blood glucose levels, the Mann-Whitney test for distribution values indicated a significant difference between the 2 groups (control: 111 mg/dL versus diabetic: 182 mg/dL;  $P=.001$ ) table 3.

**Table 3: Comparison of blood glucose levels**

Comparison of Blood Glucose Levels	Control Group	Diabetic Group	P Value
	111 mg/dL	182 mg/dL	$P=.001$

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) showed the same behavior in the 2 groups, with a mean SBP close to 140 mm/Hg and a mean DBP of 90 mm/Hg. Denture retention was observed in 66.7% (20/30) of the control group and in 50% (15/30) of the diabetic group. Comparison of proportions demonstrated no significant differences ( $\chi^2=1.714$ ;  $df=1$ ;  $P=.190$ ).

Mucosal lesions were diagnosed in 90% (27/30) of the control group and in 83.3% (25/30) of the diabetic group, with no significant differences between the 2 groups ( $\chi^2=0.577$ ;  $df=1$ ;  $P=.448$ ).

Petechiae were observed in 33.3% (10/30) of the subjects of each group. Inflammatory fibrous hyperplasia was observed in 36.7% (11/30) of the control group and in 26.7% (8/30) of the diabetic subjects. Recurrent aphthous stomatitis was diagnosed in 16.7% (5/30) of the control group and in 10% (3/30) of the diabetic group; gingivitis in 23.3% (7/30) of the control group and in 10% (3/30) of the diabetic group; varicosities were observed in 13.3% (4/30) of the control group and 10% (3/30) of the diabetic group; fissured tongue in 6.7% (2/30) of the control subjects and in 10% (3/30) of the diabetic subjects; periodontitis was diagnosed in 10% (3/30) of the control

subjects and in 3.3% (1/30) of the diabetic subjects; leukoplakia was diagnosed in 6.7% (2/30) of the control group and in 3.3% (1/30) of the diabetic group. In the diabetic group, 10% (3/30) of the subjects had erythematous candidiasis; 10% (3/30), geographic tongue; 3.3% (1/30), mucus extravasation phenomenon, and 3.3% (1/30), actinic cheilitis. In the control group, lichen planus was diagnosed in 6.7% (2/30), major aphthous ulceration in 3.3% (1/30), and leukoedema in 3.3% (1/30). Medications were used by 70% (21/30) of the control subjects and by 83.3% (25/30) of diabetic subjects, with no significant differences between the 2 groups ( $\chi^2=1.491$ ;  $df=1$ ;  $P=.222$ ). A controlled diet was reported by none of the control subjects and by 53.3% (16/30) of the diabetic subjects. Comparison of proportions was statistically significant ( $\chi^2 = 18.261$ ;  $df = 1$ ;  $P=.001$ ). Low salivary buffering capacity and reduced salivary flow require special care and greater attention on the part of the dentist ( $\chi^2 = 18.261$ ;  $df=1$ ;  $P=.001$ ). Reported alcohol consumption did not differ significantly between the control (3/30, 10%) and diabetic groups (1/30, 3.33%) ( $\chi^2=1.071$ ;  $df=1$ ;  $P=.301$ ). The prevalence of smoking was 16.7% (5/30) in the control group and 13.3% (4/30) in the diabetic group. Comparison of proportions demonstrated no significant differences ( $\chi^2=0.131$ ;  $df=1$ ;  $P=.718$ ).

## Discussion

The salivary flow rate did not differ between the groups, and no subjective feelings of denture instability were reported. The results support the research hypothesis that salivary buffering capacity is decreased in complete denture-wearing subjects with diabetes compared to controls. The data do not support the research hypothesis that oral mucosal lesions are more frequent in complete denture-wearing subjects with diabetes.

Sykes et al[8] observed that subjects with diabetes mellitus are more susceptible to

infections as a result of vascular alterations and neuropathies. Astor et al[9] reported an increased risk of infections in the presence of reduced salivary flow, low buffering capacity, and inadequate hygiene of complete dentures. Within the scope of this investigation, statistical analysis failed to reveal a difference in salivary flow rate between the groups. The results of the present study are in agreement with Belazi et al[19] The salivary flow rate was 0.95 (0.61) and 1.14 (0.87) mL/min in the diabetic and control groups, respectively( table 1).

The buffering capacity of saliva is responsible for the maintenance of oral pH in order to guarantee tooth integrity and to inhibit acid production by bacterial plaque.<sup>24</sup> Considering that the normal salivary flow rate ranges from 1 to 2 mL/min, with lower values indicating low salivary flow (<0.7 mL/min) or xerostomia (<0.1 mL/min)[24] 6 subjects, including 1 control and 5 diabetic subjects, presented low salivary flow and low buffering capacity. The other subjects with normal or low salivary flow showed normal salivary buffering capacity, regardless of whether they belonged to the control or diabetic group. The evaluation of salivary buffering capacity revealed a statistically significant difference between groups ( $P=.017$ )( table 2.)

The greatest difficulty encountered in the analysis of the data was related to the measurement of fasting glucose level. Among the 60 subjects studied, fasting glucose level was measured in only 3 (1 from the control and 2 from the diabetic group), whereas the remaining subjects had measurements made during the postprandial period. Median blood glucose levels were 111 mg/dL in the control group and 182 mg/dL in the diabetic group ( $P=.001$ ). This difference in median values of data was expected. A difference in variability was observed, with the range (maximum-minimum) being narrower in the control group compared to the diabetic group. The same was observed for

interquartile range, which corresponds to 50% of the more stable values of the distribution (table 3.) Control subjects who presented borderline glucose levels indicating the possible presence of diabetes were advised to seek a physician for a more precise assessment. Blood pressure was similar in the 2 groups, with SBP close to 140 mm/ Hg and DBP of 90 mm/Hg (Fig. 4). Subjects were advised to correctly follow the medication prescribed by the physician.

Abbas et al[17] reported that subjects with diabetes present certain alterations in the oral mucosa, such as a sensation of dry mouth, diffuse erythema, stomatitis, higher residual bone resorption, and loss of resilience. Resilience is necessary for good adaptation of a complete denture. Clinical studies suggest that the level of pressure tolerated by the mucosa depends on the systemic condition of the patient. Many physical and physiological factors have been reported to cause or enhance retention, such as atmospheric pressure, vacuum, adhesion, cohesion, wettability, surface roughness, gravity, surface tension, viscosity, base adaptation, border seal, and muscular control[21] Subjects self-reported comfort, efficacy, and occlusion of the complete denture. Retention was considered to be present when the subjects did not complain about movement or displacement of the complete denture during mastication, talking, breathing, smiling, or even at rest. Evaluation of self-reported denture retention revealed no statistically significant difference between the groups. This is a limitation of the present study that should be considered for data interpretation because self-report is a subjective assessment tool.

Subjects with diabetes mellitus had their disease controlled, which explains the lack of observation of more marked alterations. Mucosal lesions were observed in 83.3% of the diabetic group and in 90% of the control group. Ujpal et al[10] found some type of lesion in 57.5% of the diabetic subjects studied, and the frequency of lesions was

significantly lower in the control group. Soysa et al[15] reviewed and discussed clinical data reported in the literature regarding the relationship between diabetes and infection. According to the authors, it remains controversial whether poor glycemic control predisposes to oral candidal infection in diabetic subjects. Interestingly, in the present investigation only 3 (10%) diabetic subjects were diagnosed with erythematous candidiasis.

In the present study, 10 subjects (33.3%) in each group had petechiae. Petechiae arise from repeated or prolonged increased intrathoracic pressure associated with activities such as repeated coughing, vomiting, seizures, or giving birth[7] Another alteration diagnosed in the 2 groups was inflammatory fibrous hyperplasia, which was observed in 11 control subjects (9 women) and 8 diabetic subjects (6 women). Macedo Firoozmand et al[13] in a study on complete denture wearers, demonstrated a higher frequency of inflammatory fibrous hyperplasia among subjects over 40 years of age and among women, a fact also observed in the present study. According to the authors, the predominance of inflammatory fibrous hyperplasia among women is related to the following observations: women live longer than men, more frequently use a complete denture compared to men, more frequently seek dental treatment (thus facilitating the diagnosis), are more concerned with esthetics, and undergo postmenopausal hormonal changes. All subjects with a diagnosis of hyperplasia were referred to the Department of Dental Materials and Prosthodontics for excision of the lesion and fabrication of a new complete denture.

The prevalence of drug use was 70% in the control group and 83.3% in the diabetic group. In the control group, 18 of the 30 subjects used antihypertensive ( $\square$  and  $\square$  receptor blockers) medication and/or minor tranquilizers (benzodiazepines), and 13 subjects presented with salivary flow below normal. In the diabetic group, 20 of the 30 subjects used anti-hypertensive ( $\square$  and  $\square$

receptor blockers) medication and/or minor tranquilizers (benzodiazepines), and 11 subjects presented with salivary flow below normal. The reduced salivary flow observed may be related to the medications used by the subjects, as reported by Sreebny and Schwartz.<sup>22</sup> Many drugs and drug classes have been related to xerostomia and the xerogenic effect increases when many drugs are taken concurrently.<sup>22</sup> Dry mouth is an uncomfortable and potentially harmful oral symptom which is usually caused by a decrease in the salivary secretion rate (salivary gland hypo function). This condition is more prevalent in the elderly population, primarily because of the increased use of drugs and susceptibility to disease in this age group.<sup>[22]</sup> Future studies should consider classes of antihypertensive drugs, the duration of medication intake, and medications taken concurrently. Concerning diet, none of the control subjects reported having a controlled diet, whereas 53.3% of the diabetic subjects had a controlled diet.

### Conclusion

Within the limitations of this study, no significant differences were observed in salivary flow, self-reported denture retention, or oral mucosal lesions when comparing diabetic and nondiabetic subjects.

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