Evaluation of the relationship between type 2 diabetes and periodontal disease

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ABSTRACT

الأهداف: تقصي العلاقة بين داء السكري المضبوط من الدرجة الثانية وشدة الإصابة بأمراض اللثة والأنسجة حول السنية.

الطريقة: شملت الدراسة 126 مريضة سعودية ما بين 70-35 عام مصابات بداء السكري من الدرجة الثانية لدى مركز علاج داء السكري –مستشفى الملك عبدالعزيز الجامعي و عيادات كلية طب الأسنان – الرياض – المملكة العربية السعودية ما بين الفترة مايو 2008 حتى أكتوبر 2008. شملت المجوعة الأولى المرضى ذو الضبط الجيد A1c (HbA1c) <9% وعددهم 74 مريضة وشملت المجوعة الثانية المرضى ذو الضبط المنخفض HbA1c >9% وعددهم 52 مريضة. تم تسجيل معايير إصابة الأنسجة حول السنية والتي شملت مشعر اللويحة السنية ومشعر النزف ووجود القلح وأعماق الجيوب ومستوى الارتباط السريري. تم إجراء التقييم بطريقة الفحص العشوائي لنصف الفم حيث شمل أربعة مواقع لكل سن.

النتائج: لم يلاحظ وجود أي اختلاف إحصائي بين المجموعتين فيما يتعلق بالعمر و مدة الإصابة بالداء السكري و شعر اللويحة ومشعر النزف. بينما لوحظ وجود اختلاف إحصائي عند ارتفاع نسبة القلح وأعماق الجيوب ≥4 ملم وفقدان مستوى الارتباط (4–3ملم) وذلك في الداء السكري غير المضبوط بشكل جيد مقارنة بالداء السكري المضبوط بشكل جيد.

خاتمة: أن هناك علاقة واضحة بين فقدان الارتباط (4-3) ملم في إصابات الأنسجة حول السنية عند المصابين بداء السكري غير المضبوط بشكل جيد مقارنة بحالات داء السكري المضبوط بشكل جيد. كما لوحظ زيادة نسبة القلح مع وجود خطر أكبر للإصابة بأمراض اللثة والأنسجة حول السنية.

Objectives: To investigate the association between glycemic control of type 2 diabetes mellitus (type 2 DM) and severity of periodontal disease (PD).

Methods: One hundred and twenty-six Saudi diabetic females, aged 35-70 years, attending the Diabetic Center of King Abdul-Aziz Hospital, Riyadh, Saudi Arabia were included in the study. In Group I (better control with hemoglobin A1c (HbA1c) <9%) we assigned 74 subjects and in Group II (poor control with HbA1c >9%) 52 subjects. The periodontal parameters recorded were plaque index, bleeding index, presence of calculus, pocket depth measurement, and clinical attachment level. These parameters were evaluated in a randomized half mouth examination.

Results: Age, duration of diabetes, percentage of plaque index and bleeding index showed no significant difference between the 2 groups. In contrast, there was a significantly higher percentage of calculus, PD ≥4 mm and loss of attachment level (3-4 mm) in the poorly controlled diabetic patients, as compared to the better-controlled group.

Conclusions: There was a significant association of the loss of attachment level (3-4 mm) with PD in poorly controlled diabetic patients, as compared to better-controlled patients. Poor-control diabetics (Group II) exhibited an increased percentage of calculus and greater risk for periodontitis.

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The presumed link between diabetes mellitus (DM) and periodontitis is considered to stem from an increased susceptibility of diabetics to infections. An increase in the severity and prevalence of periodontal disease (PD) in diabetic patients has been suggested.[1,2] Clinicians assumed that DM and PD are biologically linked, and periodontitis has been recognized in the literature as a non-specific complication of diabetes. Throughout the 20th century, more understanding of the role of causative bacteria and susceptible host in the initiation and progression of PDs occurred. This understanding suggest that the infection of PDs in the mouth could reach other sites via blood stream and may contribute to systemic diseases such as diabetes, therefore, understanding the nature of PDs is important to be able to prevent or treat other diseases affect the whole body.[3] Poor controlled diabetes associated with more infections that are extensive and delayed healing.[4,5] Increased periodontal breakdown has been reported in children with DM and in diabetics older than 30.[6,7] Some investigators found significantly more 4-5 mm probing pocket depths in controlled diabetics younger than 45 than in non-diabetic controls.[8] Most of the above studies have addressed type 1 DM. In Saudi Arabia, the prevalence of DM is approximately 2.6% among males and 5.3% among females.[9] El-Hazmi[10] reported the prevalence of type 1 DM in the male population as 0.2% and type 2 DM as 5.6%; while in the female population the prevalence was 0.3% and 4.5%, respectively. No research on the association between glycemic non-control type 2 DM and severity of PD. Therefore, the aim of this study is to investigate the association between glycemic control of type 2 DM and severity of PD among diabetic patients.

Methods. One hundred and twenty-six diabetic patients, aged 35-70 years, attending the Diabetic Center of King Abdul-Aziz Hospital, Riyadh, Saudi Arabia were included in the study. The study was carried out between May 2008 to October 2008. The study was approved by the Dental College Ethics Review Board (F1197). All subjects were informed about the study and an informed written consent was obtained from each participants. Inclusion criteria were female with type 2 diabetes. Patients with any other systemic diseases rather than diabetes or under any medication during the previous 6 months were excluded from the study. Diabetes status and degree of glycemic control were assessed using the laboratory assays for fasting plasma glucose and hemoglobin A1c (HbA1c), respectively. Subjects with fasting plasma glucose >126 mg/dL were classified as diabetes. Participants with HbA1c >9% were classified as poorly controlled, and those with HbA1c ≤9% were considered better-controlled. For each patient, a complete examination of extra-oral and intra-oral full-mouth clinical parameters and the individual number of teeth present was preformed. The examinations and clinical measurements were performed by a single calibrated examiner. Calibration exercises for probing measurements were performed in 5 patients before the actual study. The following periodontal variables were recorded in a randomized half-mouth examination (third molars excluded) on 4 sites of each tooth (mesio-buccal, mid-buccal, distobuccal and mid-lingual).[11] Plaque index (PI), bleeding on probing (BOP), periodontal probing depth (PPD), and clinical attachment loss (CAL) were measured at mesial, distal, buccal, and lingual aspects for each tooth. The presence of visible plaque was assessed according to the criteria of the PI as described by O'Leary et al.[12] The BOP index was used to indicate the presence or absence of BOP within 10 seconds. The percentage of BOP score was calculated throughout the entire mouth.[13] The presence or absence of supra or subgingival calculus or both was measured using a dental explorer. The PPD measurements were obtained using a Michigan "0" periodontal probe with William's markings (Pow6, Hu-friedy, Co, Inc. Chicago, USA). The PPD was measured at 6 sites around each tooth (mesiobuccal, mid-buccal, distobuccal, mesiolingual, mid-lingual, and distolingual). It was measured from the free gingival margin (GM) to the bottom of the pocket. The probe was maintained parallel to the long axis of the tooth at the mid-buccal and mid-lingual sites. At the proximal sites, the probes were placed as close to the contact point as possible and slightly angled to determine the apical-most extent of the pocket. The CAL was assessed at 4 sites around each tooth: the mesiobuccal, mid-buccal, mid-lingual, and distolingual. The CAL was determined by measuring the distance from the cemento-enamel junction (CEJ) to the base of the pocket using a Michigan "0" periodontal probe with William's marks to the nearest millimeter. When the CEJ was masked by a restoration or a crown, the relative CAL was measured; CAL is the distance from the restoration or the crown margin to the bottom of the pocket. When the GM coincided with the CEJ, the CAL was considered equal to the PPD.

Intra-observer reliability. All clinical measurements were carried out by one examiner. Intra-observer reliability was studied in 8 non-diabetic subjects (798 sites) with early to moderately advanced periodontitis by re-examination on 2 subsequent days. Of the total number of duplicate probing depth measurements, 98.9% fell within ±1 mm of each other, and 76% fell within the same depth category (exact agreement). Of the duplicate attachment loss measurements, 93.3% fell

within ±1 mm of each other, and the exact agreement was 78.6%.

Data-analysis and statistical methods. Prevalence of plaque, PD >4 mm, CAL >3 mm and CAL >5 mm, was calculated as the percentage of persons affected. Extent of plaque, PD >4 mm, CAL >3 mm, and CAL >5 mm, was calculated as the mean percentage of sites affected per person. Analysis of variance and unpaired Student's t-test were used to test the significance of the differences between group means. A forward stepwise multiple regression analysis was used to study the relationship between periodontitis and diabetic status (duration, glycemic control HbAlc) and other independent variables (age, smoking, number of teeth, plaque, bleeding, and calculus). The results were tabulated and analyzed statistically for significance. Graph Pad InStat version 3 software was used for the analysis of the results (Graph Pad Software, San Diego California USA).

Results. Group I (better control with HbAlc <9%) included 74 subjects (58.7%), and Group II (poor control with HbA1c >9%) included 52 subjects (41.3%), with an age range of 35-70 years. The mean age of patients and duration of diabetes were similar in both groups (**Table 1**). While the mean number of remaining teeth in the half-mouths decreased (**Table 1**). The differences between the group were not statistically significant. Only one patient (in group II) was a former smoker. The PI, bleeding index, and calculus index were assessed as the frequency of visible plaque, bleeding sites and calculus on the teeth and expressed as frequency of sites for each subject. The study groups were similar with regard to the percentage of plaque and bleeding index, but there was a significant increase in the extent of calculus observed in group II subjects (as compared to better control) (**Table 2**). Among group II patients (poor control), 45.7% had at least one site with PD ≥4 mm (**Table 2**). The poor control group had more sites with PD ≥4 mm (45.7% versus 40.7%). The percentage of sites with 3-4 mm attachment loss was significantly higher (67.7%) in group II than in group I. More sites of 1-2 mm attachment loss were observed in group I than in group II (**Tables 3 & 4**). The frequency of pockets at sites with no calculus was low in all groups (3.9% and 4.2%) (**Table 5**). Predictive factors for periodontitis including age, duration of diabetes, smoking, number of teeth, plaque, bleeding, calculus, and glycemic control were studied using multiple regression analysis. Calculus and glycemic control were the best indicator for PD ≥4 mm. Glycemic control was the best indicator for 3-4 mm attachment loss. Other variables were not

Table 1 - The mean±SD of age, duration of diabetes, and number of teeth.

Parameters	Group I	Group II	*P*-value
Age (years)	42.2 ± 6.7	45.7 ± 7.4	>0.05
Duration	13.2 ± 7.1	15.5 ± 6.1	>0.05
No. of teeth in half mouth examination	12.1 ± 2.4	11.1 ± 3.1	>0.05

Table 2 - Data for the clinical indices.

Clinical indices	Group I	Group II
Plaque index (%)	58.9 ± 0.39	59.5 ± 0.40
Bleeding index (%)	45.1 ± 0.42	47.8 ± 0.44
Calculus index (%)	35.5 ± 15	43.0 ± 17.2
Periodontal disease ≥4 mm (%)	40.7	45.7

Table 3 - The attachment level of Group I was registered in 3756 sites.

Sites	Attachment loss	Percentage
476	1-2 mm	12.7*
2380	3-4 mm	63.4*
900	≥5 mm	24

*Significant difference in the loss of attachment level (1-2 mm) in Group I when compared with Group II (Analysis of variance and student t test). *P*-value is <0.05

Table 4 - The attachment level of Group II was registered in 2746 sites.

Sites	Attachment loss	Percentage
218	1-2 mm	7.9*
1860	3-4 mm	67.7*
668	≥5 mm	24.3

*Significant difference in the loss of attachment level (3-4 mm) in Group II when compared with Group I. (Analysis of variance and student t test). *P*-value is <0.05

Table 5 - Frequency (%) of periodontal disease ≥4 mm on sites with (+) calculus and without (-) calculus.

Calculus	Group 1	Group II
Positive	7.3	15.9
Negative	3.9	4.2

Table 6 - Significant variables related to the extent of periodontal disease (PD) ≥4 mm and 3-4 mm attachment loss based on multiple regression analysis.

Variables	Regression coefficient	R	*P*-values
PD ≥4 mm			
Constant +0.21 calculus (-15 to 19)	0.335	0.15	0.000
Poor glycemic control constant +0.16	2.31	0.18	0.000
Attachment loss 3-4 mm			
Poor glycemic control	2.61	0.91	0.000

accurate predictors for either PD ≥4 mm or CAL 3-4 mm (**Table 6**).

Discussion. The association between PD and DM has been explored by many researchers over the years.[14] Periodontal signs and symptoms are now recognized as the "sixth complication of diabetes".[15] The general signs and symptoms of PD are the direct result of hyperglycemia, and the systemic complications of DM are associated with prolonged hyperglycemia. Thus, blood glucose level plays a key role in the complications associated with diabetes.[16] There is a substantial evidence to support diabetes as a risk factor for poor periodontal health and that periodontal infection adversely affects glycemic control in diabetes.[3,17] The present cross-sectional study reports on the periodontal status of periodontopathic patients affected by type 2 DM. The result of this study showed that there were no significant differences between the 2 groups concerning the PI and bleeding. However, there were significant differences in the percentage of calculus, percentage of PD ≥4 mm and loss of attachment level (3-4 mm) in the poorly controlled diabetic patients as compared to the better-controlled group. Fasting blood glucose and 2-hours post-load plasma glucose are considered important tests for the diagnosis of diabetes. In a patient with diagnosed diabetes, the HbAlc level is used to monitor the patient's overall glycemic control. Hemoglobin A1c reflects the mean glucose level over the preceding 2-3 months. Thus, the interval between the 2 consecutive HbAIc tests should be at least 2 months, if any relevant changes are to be observed.

The most important findings of this study are that diabetics with poor control had more periodontitis, represented by a higher percentage of PD ≥4 mm and 3-4 mm attachment loss, as well as more calculus.

Tables 3 and 4 show the differences in the distribution of CAL (clustered as 1-2 mm, 3-4 mm) between the groups to be statistically significant; however, the real clinical significance is questionable. In comparing these findings with those of other studies, our results exhibit similar outcomes to previous studies.[18-22] This trend indicates an association between poor control of diabetes and periodontitis; however, the other authors did not assess the calculus. The present study was not in the agreement with Safkan-Seppälä and Ainamo,[23] regarding the duration of diabetes. The present study found no relationship between periodontitis and duration of diabetes, because the duration was similar between the 2 groups. Smoking was not used as a variable in the present study by reason of only one patient was a former smoker. The contribution of this study is the finding that metabolic control (in this study, represented by glaciated HbAlc) is a very important factor. Diabetics with better control had less risk of severe periodontitis; in contrast, poor control patients had increased risk of PD. Whatever was the cause or effect, the present study agree with the previous studies that successful management of periodontal infection would lead to a reduction of the local disease symptoms and better control of glucose metabolism.[24-27]

The results showed a significant association between the percentage of PD ≥4 mm and loss of attachment level (3-4 mm) in poorly controlled diabetic patients with PD as compared to better-controlled patients. However, further studies of large populations including different level of metabolic control with more sever PD before and after treatment should be investigated.

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