**Original Research Article**

# The Influence of Periodontal Disease on Changes of Glycated Hemoglobin Levels in Type 2 Diabetics

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## Abstract

**Background:** Little evidence is available regarding the effects of long-term periodontal infection on diabetes control. The aim of this study was to evaluate the influence of periodontal status on changes of glycated hemoglobin (HbA1c) levels of type 2 diabetics.

**Materials and methods:** 30 Patients (35 years or older) with type 2 diabetes were included. Patients were non-smokers, and were under use of anti-diabetic drugs. Demographics, health history and HbA1c levels were retrieved from medical charts. Probing depth (PD) and relative attachment loss (AL) were recorded at baseline and after 3 months.

**Results:** The level of HbA1c was found to positively correlate with the severity of periodontitis. In case of patients with severe periodontitis it was seen that there was a concomitant increase in Hba1c level at 3 month recall.

**Conclusion:** The progression of periodontitis was associated with increases in HbA1c in type 2 diabetics. The identification of these risk factor suggests that periodontal treatment may improve glycemic control of type 2diabetic patients by eliminating periodontal infection.

## Key words

Periodontitis, Diabetes, Glycated hemoglobin.

## Introduction

Diabetes has been associated to periodontitis [1], and the higher the blood glucose levels, the more likely that the diabetic patient develops periodontitis compared with individuals without diabetes [2]. On the other hand, the inflammatory

process associated with periodontitis can interfere with the glycemic control in type 2 diabetes as diabetic patients showed a decrease between 0.3% [3] to 0.4% [4] of HbA1c levels after periodontal treatment. Some of the possible mechanisms to support this hypothesis have been recently reviewed [5].

Inflammatory cytokines, such as interleukins (IL) 1β, IL-6, and the ratio between nuclear factor kappa-B receptor ligand (RANKL) and osteoprotegerin (OPG) are elevated in diabetes and periodontitis patients, compared to those only presenting periodontitis [5]. Diabetes-associated hyperglycemia leads to alterations in the hemostasis of the alveolar bone, and formation of glycation end-products (AGEs), which plays a pro-inflammatory and pro-oxidative role on cells [5]. Periodontal infection potentiates the vicious cycle in diabetes, leading to faster periodontal destruction. In the opposite direction, supporting the bidirectional relationship of both diseases, it is suggested that elevated levels of C-reactive protein (CPR), IL-6 and tumor necrosis factor alpha (TNFα) expressed during periodontal disease can negatively interfere with glycemic control. Therefore, the aim of this study was to associate the periodontal status at baseline and the progression of periodontal disease with changes on HbA1c levels in patients with type 2 diabetes.

## Materials and methods

This study was conducted with diabetic patients attending Department of Periodontics and Oral Implantology in Government Dental College and Hospital, Srinagar. The study protocol was approved by the Ethical Committee of the Government Dental College.

30 patients of 35 years and above included in the study had to fulfil the following inclusion criteria during baseline and final assessments: patients with controlled or uncontrolled type 2 diabetes, with at least six teeth, non-smokers, and use of anti-diabetic medication (i.e. metformin, glibenclamide or insulin). Patients that were bedridden during the follow-up period, received scaling and root planning, did not present medical records of blood analysis at follow up, refused to participate, deceased and had changed the address or could not be contacted were excluded from the study. Informed consent was obtained from all participants.

Demographics, health history were retrieved from medical charts. Probing depth (PD) and relative attachment level (CAL) were recorded at baseline using an acrylic stent and oral hygiene instructions were given. A full-mouth periodontal examination was performed, examination was done with a 15 mm UNC 15 periodontal probe. Periodontal probing depth (PD) was measured in six sites per tooth (mesiobuccal, buccal, distobuccal, mesiolingual, lingual, distolingual) in all present teeth excluding third molars. Gingival recession (GR) was measured in sites where the gingival margin was located apical to the cementum-enamel junction. Relative attachment level (RAL) was calculated for these sites by measuring the distance from a specific point on customised acrylic stent to bottom of probing pocket depth. Patients were categorized into mild, moderate and severe periodontitis on the basis of attachment level (RAL) and probing depth [7]. The number of missing teeth and the number of teeth with records for RAL were registered. Teeth that were lost during the follow-up were excluded from the analyses.

Fasting HbA1c levels were obtained by the ion-exchange high-performance liquid chromatography method at baseline. Patients returned after 3 months when the clinical parameters and HbA1c levels were re-evaluated.Correlation of HBA1c with severity of periodontitis was done at baseline and 3 months subsequently.

The primary outcome of the present study comprised the glycemic control using the change in HbA1c over the follow-up period. Cut-off point used was <6.5% [6]. Periodontal disease comprised the main exposure of the study.

Periodontal disease was calculated considering only the worst site of each tooth and were further associated with changes in HbA1c.

## Results

The mean follow-up time was 3 months. The mean age of the sample was 56 years. The mean baseline concentration of HbA1c was 6.5%, with a meantime of diabetes of 6.5 years. Mean PD and AL were 3.2 mm and 5.1 mm, respectively. Four had severe periodontitis at baseline. Despite the fact that all included patients did not receive periodontal treatment over the study period, 2 patients had lost at least one tooth, 3 patients lost two teeth and four patients lost between 3 and 6 teeth.

**Table – 1** shows the baseline concentrations of HbA1c and its change over time according to independent variables. Those presenting more than 5 years of diabetes duration had significantly higher baseline levels of HbA1c. Also, uncontrolled diabetics (≥6.5%) had significantly baseline levels of HbA1c than controlled diabetics (<6.5%) as expected. No other significant differences were observed for baseline values of HbA1c, including for the two periodontal variables and tooth loss over time. Changes in HbA1c levels over time were significantly higher in patients with severe periodontitis at baseline than the comparison group of periodontal status. Similarly, levels of HbA1c had significantly higher increase inpatients that presented RAL progression than patients with no RAL progression. The association between periodontal status and changes in HbA1c is shown as PPD, RAL and HBA1c level changes in various patients (**Table – 2**).

**Table 1: Showing correlation of severity of diabetes with PPD at baseline and 3 months**

| HbA1c | | Mean | SD | Range | P-value |
|---|---|---|---|---|---|
| Baseline | Mild | 2.3 | 0.516 | 2-3 | <0.001* |
| | Moderate | 3.7 | 0.516 | 3-4 | |
| | Severe | 5.6 | 0.547 | 5-6 | |
| 3 Months | Mild | 2.7 | 0.516 | 2-3 | <0.001* |
| | Moderate | 4.2 | 0.752 | 3-5 | |
| | Severe | 7.0 | 0.707 | 6-8 | |

**Statistically Significant (P-value<0.05)*

## Discussion

The primary outcome of the present study comprised the glycemic control using the change in HbA1c over the follow-up period. Periodontal disease comprised the main exposure of the study. Other independent variables that were considered as possible confounders were age, gender, time of diabetes, use of anti-diabetic drugs and baseline HbA1c. The present study assessed the associations between periodontal disease and changes in HbA1c levels in diabetic individuals. It was observed that both the

periodontal status at baseline and the progression of periodontal attachment loss were able to predict changes in HbA1c.DM refers to group of common metabolic disorders that share the phenotype of hyperglycemia. Type I DM is the result of complete or near total insulin deficiency. Type II DM is a heterogenous group of disorders characterized by variable degree of insulin resistance, impaired insulin secretion and increased glucose production. Gestational diabetes Maturity onset diabetes of the young (MODY): Early onset hyperglycemia (<25 years) Cystic fibrosis related DM Acreomegaly and cushings disease that antagonise insulin action.

**Table 2: Showing correlation of severity of diabetes with RAL at baseline and 3 months**

| HbA1c | | Mean | SD | Range | P-value |
|---|---|---|---|---|---|
| Baseline | Mild | 4.7 | 0.518 | 4-5 | <0.001* |
| | Moderate | 5.3 | 0.816 | 4-6 | |
| | Severe | 7.8 | 0.447 | 7-8 | |
| 3 Months | Mild | 5.3 | 1.211 | 4-7 | <0.001* |
| | Moderate | 6.0 | 0.894 | 5-7 | |
| | Severe | 10.0 | 0.707 | 9-11 | |

**Statistically Significant (P-value<0.05)*

It is widely known that randomized controlled trials (RCT) are the best study design to evaluate the relationship between periodontal disease and diabetes. Studies have shown that significant improvement in glycemic levels can be achieved after periodontal therapy [3, 4]. However, due to methodological limitations of the RCTs published, including sample size issues, inclusion criteria, baseline patient characteristics, periodontal therapy outcomes and biases associated with the criteria used to define periodontitis, this relationship is still not clear [8, 9]. Therefore, observational studies are still necessary to help identify possible risk factors and predictors for changes in HbA1c in diabetic patients, although their strength of evidence is lower than that from RCTs [10, 11].

Only a few longitudinal studies have compared the progression of periodontitis and HbA1clevels [12, 13, 14, 15]. Some studies evaluated patients with periodontitis but without diabetes, which presented a gradual increase in their HbA1c levels [12, 13]. A cohort study with a 5-year follow-up evaluated 2,973 patients without diabetes that were distributed into five groups (healthy, edentulous, and AL >5mm divided into three groups based on the number of teeth involved). HbA1c levels increased through the follow-up years in those patients presenting worse periodontal condition. The authors concluded that worsening in glycated hemoglobin levels was related to a worse periodontal condition [15]. Another study evaluated 9,296 non-diabetic dentate and edentulous patients from NHANES I with and without periodontal disease who were followed

for 10 to 20 years. An increase in the incidence of diabetes by 50% was observed in those patients with periodontitis compared to patients without periodontitis at baseline [15]. Another study followed 5,848 patients without diabetes for seven years and found no apparent association between periodontitis and diabetes incidence, even though a tendency for the increase in risk was noted. It is important to emphasize that in the present study patients were required to have at least 24 months between examinations. Thirty patients presented severe periodontitis at baseline and were referred for periodontal treatment as well as the others presenting mild or moderate periodontitis. However, none of them followed the recommended treatment or didn't have the chance to be treated due to the overcrowd in the public health clinics. This has allowed a long term evaluation of their periodontal status.

## Conclusion

The progression of periodontitis was associated with increases in HbA1c in type 2 diabetics. The identification of these risk factor suggests that periodontal treatment may improve glycemic control of type 2diabetic patients by eliminating periodontal infection.

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