

ASSOCIATION OF PERIODONTITIS AND TYPE 2 DIABETES MELLITUS IN PATIENTS VISITING KHYBER COLLEGE OF DENTISTRY: A CASE CONTROL STUDY

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ABSTRACT

Objective: This study aimed to evaluate the association between periodontitis and type 2 diabetes mellitus (T2DM) among adult patients visiting the outpatient department of Khyber College of Dentistry (KCD), Peshawar, and to investigate the relationship between glycemic control, duration, and intensity of periodontitis.

Methodology: This case-control study was carried out at Khyber College of Dentistry (KCD) KCD, Peshawar, from November 2024 to January 2025. The study sample consisted of 100 participants, which included 50 patients diagnosed with periodontitis. (cases) and 50 non-periodontitis individuals (controls), aged ≥ 30 years. Periodontal examination was performed to assess probing pocket depth (PPD) and clinical attachment loss (CAL) of the index teeth. Glycemic control was evaluated using fasting blood glucose levels and HbA1c levels. Analysis was performed by SPSS (22). Logistic regression was applied to assess the association between periodontal parameters & T2DM, controlling for age, gender, and brushing frequency as confounders.

Results: Periodontitis cases exhibited a significantly higher frequency of T2DM than non-periodontitis controls ($p < 0.001$). A significant positive relationship was observed between increasing HbA1c levels and periodontal destruction. Participants with poor glycemic control ($\text{HbA1c} \geq 8\%$) had markedly higher PPD and CAL values than those with better glycemic control. Participants with poor glycemic control ($\text{HbA1c} \geq 8\%$) had markedly higher PPD and CAL values than those with better glycemic control. Furthermore, a longer disease duration of diabetes mellitus (≥ 10 years) was associated with more severe periodontal breakdown. Analysis using logistic regression indicated that T2DM was statistically significantly associated with periodontitis. An adjusted odds ratio of 2.45 with a 95% confidence interval ranging from 1.28 to 4.70.

Conclusion: The present study confirms a statistically significant relationship between periodontitis and T2DM; periodontal damage was greater with poor glycemic control and longer disease duration. These findings highlight the need for integrated oral and systemic healthcare approaches in periodontal management among diabetic patients.

Keywords: Periodontitis, Type 2 Diabetes Mellitus, HbA1c, Glycemic Control, Clinical Attachment Loss, Probing Pocket Depth

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INTRODUCTION

Periodontitis is one of the most common chronic inflammatory diseases, characterized by destruction of the periodontium, which supports the teeth, leading to advanced clinical attachment loss, alveolar bone resorption, and subsequent tooth loss.¹ Due to its high burden and its worse impact on oral health, it is a great public health issue. Over the past twenty years there has been growing evidence globally about the interrelationship between periodontitis and type 2 diabetes mellitus.^{2,3}

Type 2 diabetes mellitus (T2DM) is a metabolic disorder characterized by insulin resistance and impaired insulin secretion. There is an increased blood sugar level. As reported by the International Diabetes Federation in 2021, the global prevalence of diabetes among adults was approximately 537 million and is anticipated to increase to 643 million by the year 2030. In Pakistan, the prevalence of diabetes is distressingly high, with recent estimates suggesting that over 33 million people are affected. Because of this high magnitude of diabetes burden, Pakistan is among the top ten countries globally.

A bidirectional relationship exists between periodontitis and T2DM. Diabetes increases susceptibility to periodontal disease due to impaired immune response, increased inflammatory mediators, and delayed wound healing. Conversely, periodontitis may negatively affect glycemic control by increasing systemic inflammation and insulin resistance.^{6,7}

Although several international studies, as well as a study conducted by Sharjeel et al.⁸ in Pakistan, have reported a significant association between periodontitis and type 2 diabetes mellitus, there remains limited evidence in the local context, particularly from public-sector dental institutions. Given the high burden of both conditions and their potential bidirectional relationship, it is important to generate context-specific data. Therefore, the present study was conducted to provide local evidence and to support the development of integrated oral and systemic healthcare strategies. In view of the increasing burden of both periodontitis and T2DM, this study was conducted to generate local evidence to support the implementation of collaborative oral and systemic health care strategies. The present study was designed to investigate the association between periodontitis & type 2 diabetes mellitus among patients visiting Khyber College of Dentistry, Peshawar; to evaluate the relationship between blood sugar level (HbA1c) and Periodontal clinical indices, including probing pocket depth (PPD) and clinical attachment loss (CAL); and to assess the effect of duration of diabetes on Periodontal disease severity.

METHODOLOGY

The present case-control study was carried out at the OPD of Khyber College of Dentistry (KCD), Peshawar, from November 2024 to January 2025. This research aimed to assess the relationship between periodontitis and type 2 diabetes mellitus (T2DM). The study received ethical approval from the Research Review Board of Khyber College of Dentistry (Certificate No. 191/ADR/KCD). Written informed consent was obtained from all participants prior to data collection. Participants were informed about the purpose of the study, and confidentiality and anonymity of their information were strictly maintained. Participation was voluntary, and

participants had the right to withdraw from the study at any stage without any consequences.

Study Sample

The study population included patients aged 30 years and above attending the outpatient department of KCD. Participants were categorized into two groups:

- Cases: Patients diagnosed with periodontitis (based on clinical parameters).
- Controls: Patients with clinically healthy periodontium and no signs of periodontitis.

Inclusion Criteria

- Cases: Presence of periodontitis defined as probing pocket depth (PPD) ≥ 4 mm and clinical attachment loss (CAL) ≥ 2 mm, assessed on index teeth (Ramfjord teeth: 16, 21, 24, 36, 41, 44). Although the 2015 AAP classification was used for case definition, it remains comparable with the updated 2017 AAP/EFP classification in identifying clinical attachment loss and probing depth thresholds
- Controls: Absence of periodontal pockets and clinical attachment loss.⁹

Exclusion Criteria

- Presence of systemic diseases other than T2DM (such as cardiovascular diseases, immunocompromised conditions, chronic kidney disease, and other metabolic disorders).
- History of periodontal treatment within the last six months.
- Use of medications affecting periodontium (e.g., immunosuppressants, anticoagulants).
- Pregnant women.

Sample Size

Using OpenEpi (version 3.01), the required sample size was calculated for this research, based on the following parameters: power of the study 80%, CL 95%, a case-control ratio 1 to 1, an expected odds ratio (OR) of 3.20, 10 and an exposure rate of 40% among controls. The total sample size was 100 participants, including 50 cases and 50 controls.

Data Collection Procedure

A questionnaire was used to collect data on demographics and medical history (i.e., presence or absence of Diabetes), fasting blood sugar level, HbA1c level, and all clinical measurements were performed by the principal investigator using a standardized periodontal probe under consistent conditions to evaluate PD and CAL. The examiner was trained prior to data collec-

tion, and a standardized measurement protocol was followed to ensure reliability and consistency. Blinding of the examiner to participants' diabetic status was not feasible during data collection.

Assessment of Periodontitis

A periodontal examination was performed in accordance with the inclusion criteria.

Assessment of Type 2 Diabetes Mellitus

T2DM status was confirmed using multiple criteria, including self-reported history of physician diagnosis, biochemical assessment (fasting plasma glucose ≥ 126 mg/dL or HbA1c $\geq 6.5\%$), and/or current use of antidiabetic medications.¹⁰

Statistical Evaluation

Data entry and statistical evaluation were performed using SPSS version 22. Descriptive analyses comprise participants' demographic and clinical characteristics. A binary logistic regression analysis was employed to investigate the relationship between periodontitis and T2DM, controlling for confounders: age, gender, and brushing frequency. The findings were expressed as ORs with 95% CIs, with statistical significance defined as $p < 0.05$.

RESULTS

The present study comprises 100 participants: 50 cases (patients with Periodontitis) and 50 controls (without Periodontitis). The participants had a mean age of 49.6 ± 8.4 years, with no significant difference observed between the two groups ($p = 0.432$). The study sample included 29 (58%) males and 21 (42%) females in Cases, while 28 (56%) males and 22 (44%) females in controls. Data on clinical demographics and participant features are shown in Table 1.

Descriptive Statistics

Patients with periodontitis exhibited a significantly higher prevalence of T2DM (56%) than those without periodontitis. (32%) ($p = 0.001$). The frequency of

toothbrushing was higher in Controls than in cases. Smoking was more prevalent among cases than controls ($p = 0.048$).

In Table 2, Binary logistic regression was used to assess the association between periodontitis and type 2 diabetes mellitus (T2DM), adjusting for age, gender, and brushing frequency. Before adjustment, periodontitis was associated with significantly higher odds of T2DM (unadjusted OR = 2.57; 95% CI: 1.14–5.80; $p = 0.023$). After adjustment for age, gender, and brushing frequency, periodontitis remained significantly associated with T2DM (adjusted OR = 2.45; 95% CI: 1.28–4.70; $p = 0.007$).

Table 3 and Figure 1 present the relationship between HbA1c categories and periodontal parameters (Probing Pocket Depth and Clinical Attachment Loss) in index teeth. It shows that as HbA1c levels increase from controlled ($<7.0\%$) to moderate (7.0 – 8.5%) to poor control ($>8.5\%$), both mean PPD and mean CAL increase progressively. The corresponding values are for HbA1c $<7.0\%$ – PPD 2.7 ± 0.2 mm, CAL 3.0 ± 0.2 mm; for HbA1c 7.0 – 8.5% – PPD 3.4 ± 0.1 mm, CAL 4.0 ± 0.1 mm; for HbA1c $>8.5\%$ – PPD 4.1 ± 0.2 mm, CAL 5.1 ± 0.2 mm. The overall comparison across the three groups was statistically significant ($p < 0.001$).

One-way ANOVA demonstrated a significant linear relationship between increasing HbA1c levels and the extent of periodontal destruction ($p < 0.001$). Mean PPD and CAL increased progressively with worsening HbA1c levels. As HbA1c increases, both Probing Pocket Depth (PPD) and Clinical Attachment Loss (CAL) also increase. Patients with uncontrolled diabetes (HbA1c $> 8.5\%$) exhibited the highest mean PPD (4.1 mm) and CAL (5.1 mm) compared to those with controlled diabetes (HbA1c $< 7.0\%$; PPD = 2.7 mm, CAL = 3.0 mm) ($p < 0.001$). In Figure 2, a longer duration of Type 2 diabetes was associated with progressively higher mean PPD and CAL. Patients with diabetes duration ≥ 10 years exhibited the highest values (PPD = 4.1 mm; CAL = 5.0 mm), compared to those with ≤ 6 years of diabetes (PPD = 2.8 mm; CAL = 3.1 mm).

TABLE 1: DEMOGRAPHIC AND CLINICAL DATA OF PARTICIPANTS (N = 100)

Variable	Study cases (Participants with Periodontitis) (n = 50)	Study controls (Participants without Periodontitis) (n = 50)	Significance (p-value)
Age (mean $\pm$ SD)	49.8 $\pm$ 7.7	49.5 $\pm$ 6.5	0.432
Gender (%)			0.615
Male	29 (58%)	28 (56%)	
Female	21 (42%)	22 (44%)	
T2DM (%)	28 (56%)	16 (32%)	0.001
Smoking Status (%)	16 (32%)	10 (20%)	0.048
Brushing Twice Daily (%)	11 (22%)	14 (28%)	0.308

TABLE 2: BINARY LOGISTIC REGRESSION ANALYSIS OF THE ASSOCIATION BETWEEN PERIODONTITIS AND T2DM

Parameter	Crude odds ratio (95% CI)	p-value	Adjusted OR* (95% CI)	p-value
Periodontitis	2.57 (1.14 – 5.80)	0.023	2.45 (1.28 – 4.70)	0.007
Age of participants (years)	—	—	1.02 (0.98 to 1.07)	0.218
Gender of participants (male)	—	—	1.11 (0.63 – 1.96)	0.713
Brushing Twice Daily	—	—	0.38 (0.16 – 0.91)	0.030

TABLE 3: RELATIONSHIP OF HbA1c WITH PROBING POCKET DEPTH (PPD) AND CLINICAL ATTACHMENT LOSS (CAL) IN INDEX TEETH

HbA1c Category (%)	PPD (mm), mean $\pm$ SD	CAL (mm), mean $\pm$ SD	p-value
< 7.0 (Controlled)	2.7 $\pm$ 0.2	3.0 $\pm$ 0.2	<0.001
7.0 – 8.5 (Moderate)	3.4 $\pm$ 0.1	4.0 $\pm$ 0.1	
> 8.5 (Poor Control)	4.1 $\pm$ 0.2	5.1 $\pm$ 0.2	

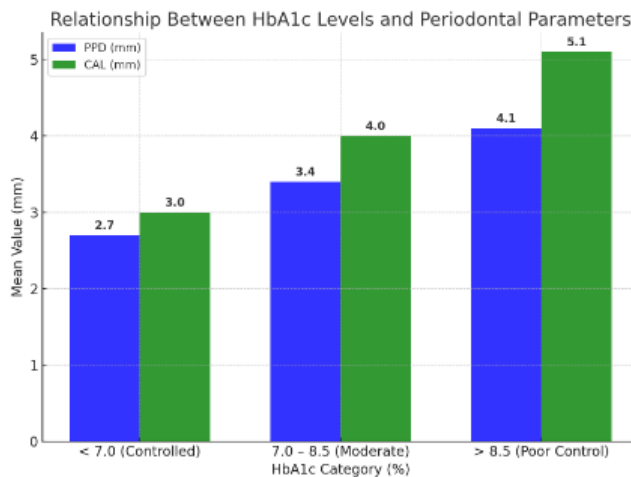


Fig 1: Relationship between HbA1c levels and periodontal parameters (PPD and CAL)

DISCUSSION

The present study was conducted to investigate the association between periodontitis and type 2 diabetes mellitus (T2DM) among patients attending the outpatient department of Khyber College of Dentistry. The findings demonstrated a statistically significant association between the two conditions, with a higher frequency of T2DM among patients with periodontitis than among non-periodontitis controls. These findings are consistent with local research by Sharjeel et al.⁸ which similarly reported a significant association between periodontitis and type 2 diabetes mellitus in a Pakistani population. These findings are also consistent with those reported by Bascones-Martínez et al.¹¹ which emphasized the reciprocal relationship between diabetes and periodontal disease. Similar associations were also found in other studies^{12,13} highlighting the

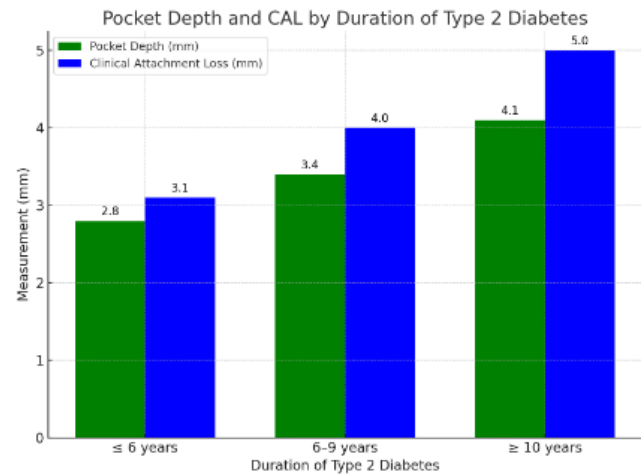


Fig 2: Association of duration of T2DM with probing pocket depth and clinical attachment loss

link between these chronic inflammatory conditions. The present study further contributes to the existing literature by providing context-specific evidence from a Pakistani population, where limited data are currently available. However, Arowojolu et al.¹⁴ contradicted these results in their study in 2010; this study did not find an association between T2DM and periodontitis. This variation could be due to methodological differences, including the use of a strict case definition, standardized periodontal assessments, and rigorous control of potential confounders in Arowojolu's study.

The present study results demonstrated a significant association between HbA1c level and both PD and CAL in index teeth. Our findings are consistent with Borgnakke et al.¹⁵ who reported a strong association between poor glycemic control and periodontal destruction. However, differences in study design and

population characteristics may explain variations in effect size across studies. Similarly, Sanz et al.¹⁶ in their 2018 meta-analysis, concluded that T2DM patients are nearly twice as likely to develop periodontitis (OR = 1.86), and that this severity correlates with glycemic control.

Regarding the variable of duration of diabetes, the present study further demonstrated that patients with a longer history of diabetes (≥ 10 years) exhibited greater periodontal breakdown. These findings are consistent with earlier work by Taylor and Borgnakke¹⁷ who found that prolonged hyperglycemia contributes to periodontal tissue destruction through the accumulation of advanced glycation end products. More recent evidence also supports this relationship; a 2024 population-based study by Kim et al.¹⁸ demonstrated that individuals with type 2 diabetes had nearly twice the prevalence of severe periodontitis, reinforcing the role of glycemic status in periodontal disease progression.

The association between periodontitis and T2DM can be explained by a bidirectional relationship. Chronic hyperglycemia leads to the formation of advanced glycation end products (AGEs), which enhance inflammatory responses and destruction of periodontal tissues. Conversely, periodontal infection contributes to systemic inflammation through increased levels of cytokines such as interleukin-6 and tumor necrosis factor-alpha, which may worsen insulin resistance and glycemic control.

The present study includes the use of a well-defined case-control design, clinical assessment by the principal investigator, and adjustment for major confounders such as age, gender, and brushing frequency. This study has certain limitations. It was conducted in a single hospital-based setting with a relatively small sample size, which may limit the generalizability of the findings. The case-control design is also prone to selection bias. In addition, some potential confounders, such as smoking, were not included in the final regression model, and variation in the availability of HbA1c data may have introduced minor misclassification. Lack of blinding may also have introduced minor measurement bias.

Additionally, as this was a hospital-based study, there is a possibility of selection bias, since participants attending the outpatient department may not be representative of the general population. Recall bias may also be present due to reliance on self-reported information such as medical history and oral hygiene practices.

Clinical implications

Despite these limitations, the findings have important clinical implications. Dental professionals should be aware of the strong association between periodontitis and T2DM and emphasize early periodontal screen-

ing in diabetic patients. Similarly, physicians should consider oral health status as part of comprehensive diabetes management.

Future studies with larger, multicenter samples and longitudinal designs are recommended to further explore the causal relationship and underlying mechanisms between periodontitis and T2DM. Inclusion of additional confounding variables, such as smoking and socioeconomic status, is also suggested. Furthermore, research should expand to community based, multicenter cohort studies to enhance external validity.

CONCLUSION

The present study provides evidence of a significant relationship between periodontitis and type 2 diabetes mellitus; participants with periodontitis had a higher frequency of T2DM. These results highlight the role of integrating periodontal care in diabetes management.

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