



ORIGINAL ARTICLE

Periodontal health in adequately controlled and inadequately controlled type 2 diabetes: A cross-sectional study.

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ABSTRACT... Objective: To compare health status in term of clinical attachment loss and pocket depth adequately-controlled vs. inadequately-controlled type 2 diabetes. **Study Design:** Cross-Sectional study. **Setting:** Department of Periodontology, Khyber College of Dentistry, Peshawar. **Period:** 1st May 2021 to 30th January 2022. **Material & Methods:** A total of 142 participants with Type 2 diabetes mellitus (DM), aged between 35 and 65 years, and with a DM duration exceeding 3 years, along with a minimum of seven teeth per arch determined through clinical examination, were included. Participants with type 1 diabetes mellitus, smokers, pregnant women, those on medications inducing gingival enlargement, those who underwent periodontal therapy in the last six months, and patients undergoing orthodontic treatment were excluded. Pocket depth and clinical attachment loss at six points on each reference tooth (including upper and lower first molars, first premolars, and central incisors) were measured using a Michigan 'O' Probe featuring William markings on a periodontal pocket chart. The arithmetic mean value was then calculated. To compare the two groups (adequately controlled diabetics and inadequately controlled diabetics), the mean pocket depth and mean clinical attachment loss were analyzed separately using an independent samples t-test. **Results:** The mean duration of DM, age, periodontal pocket depth, clinical attachment were 6.42 ± 2.76 years, 50.77 ± 9.50 years, 4.03 ± 0.74 mm, and 4.74 ± 0.74 mm. The males were 80(56%) and females were 62(44%). The mean PPD was less in well controlled (3.45 ± 0.36 mm) than poorly controlled diabetes (4.76 ± 0.36 mm) statistically significantly ($p < 0.001$). Similarly mean CAL was less in adequately controlled (4.16 ± 0.36 mm) than inadequately controlled diabetes (5.47 ± 0.36 mm) statistically significantly ($p < 0.001$). **Conclusion:** Inadequately controlled diabetes mellitus is associated with adverse periodontal health status.

Key words: Clinical Attachment Loss, Diabetes Mellitus, Probing Pocket Depth.

INTRODUCTION

Diabetes mellitus is a variety of chronic metabolic disorders characterized by abnormal glucose metabolism caused by inadequate insulin production, impaired insulin action or both leading to high blood sugar levels.¹ Worldwide, around 285 million adults were estimated to have diabetes in 2010, and this number is projected to rise to approximately 438 million by 2030, particularly within the least developed countries.¹ Type 2 diabetes incapacitates 90–95% of all diabetes. This involves particulars who have insulin insufficiency and have insulin impedance.² High blood glucose, the trademark of diabetes mellitus, is a major concern which leads to variety of complications and can affect all organs in the

body, including the periodontium that surround and support the teeth.¹ Periodontitis, a chronic and multifactorial inflammatory condition, is distinguished by the degradation of the supporting structures of teeth. The occurrence of severe periodontitis is observed to range between 10% and 15%.³

Literature has been documented that periodontal infection might have the capacity to disrupt the regulation of blood sugar by elevating insulin resistance. Consequently, the application of non-surgical periodontal treatment, with the aim of disrupting the buildup of bacterial plaque and eradicating gingivitis, holds the potential to bring about an enhancement in blood sugar levels. This

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proposition gains support from studies that have identified a favorable alteration in diabetes sugar levels subsequent to undergoing periodontal intervention.⁴ It's noteworthy, however, that specific alternate studies have yet to firmly establish a direct cause-and-effect relationship, possibly attributed to inadequate time for the complete healing of periodontal tissues or an incomplete resolution of periodontitis. An additional factor could be the influence of variables like dietary choices, physical activity, or the usage of antidiabetic medications, which have the potential to considerably modify HbA1c levels. This, in turn, could pose challenges in discerning the metabolic impact of periodontal treatment.⁵

Follow up studies reveal that severe periodontitis is linked to poorly controlled diabetes, elevated HbA1c levels, and systemic complications. It's also suggested that periodontitis might lead to a slight rise in HbA1c among non-diabetics, hinting at a potential link to increased diabetes risk, though a clear cause-and-effect relationship remains uncertain.⁶

Epidemiological research confirms diabetes as a contributor to periodontitis, with higher occurrence and severity in those with diabetes. Termed the "sixth complication of diabetes," periodontitis is significant for diabetic health.⁷ Among diabetics, the risk of developing periodontitis is nearly three times higher.⁸ A clear connection between blood glucose levels (HbA1c) and the severity of periodontitis has been established. Research suggests a 0.13% increase in HbA1c for each additional millimeter of mean pocket depth (PPD).⁹ Remarkably, treating periodontitis has been associated with a decrease of about 0.4% in HbA1c levels, highlighting a mutual relationship.³

The existing literature establishes a strong link between Diabetes Mellitus and periodontal disease. Diabetes Mellitus is widely recognized as a significant risk factor for periodontitis, leading to higher prevalence and severity. Research by Tsai et al.¹⁰ highlights a substantial increase in severe periodontitis cases among inadequately controlled diabetes patients (with an odds ratio

of 2.90), compared to those without diabetes. Additionally, a study by Haseeb et al. in 2012 demonstrated that patients with poorly controlled diabetes had deeper pockets than well-controlled diabetics and non-diabetic individuals (4.21 mm versus 3.72 mm and 2.93 mm respectively).^{10,11}

Periodontitis is one of the principal causes of dental loss in adult population. The incidence of periodontitis is on the rise due to known systemic risk factors such as diabetes. To the best of my knowledge and literature search scarce data available in our population regarding association of periodontitis and diabetes. This study provided data that helped to form basis for prospective and interventional studies, helped in raising awareness among patients and health care providers, guided dental professionals to recommend preventive measures and a collaboration among periodontists and endocrinologists regarding interdepartmental management of diabetic patient.

MATERIAL & METHODS

The study was conducted at Khyber College of dentistry, Peshawar from 1st May 2021 to 30th January 2022 after the approval of the institutional ethics review board of Khyber College of Dentistry Peshawar (1246/AD/PG/R/KCD), the purpose, nature, risks and benefits were briefed to all the patients. Written informed agreement was taken from all the patients participating in the study while assuring them of confidentiality.

The participants who are Type 2 diabetics with more than 3 years of duration having age groups of 35-65 years and presence of at least seven teeth per arch were included in the study while patients that were already diagnosed with type 1 diabetes, current smokers or with history of smoking in the past 3 years, Pregnant women, taking medications that can alter study outcomes (calcium channel blockers, phenytoin, cyclosporine), history of periodontal therapy in the last six months and patient undergoing orthodontic treatment were excluded.

Detailed history followed by examination was done. Pocket depth and clinical attachment loss on

six points (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual and distolingual) of each reference tooth was recorded by using Michigan 'O' Probe with William markings on periodontal pocket chart and Arithmetic mean value were calculated. The reference teeth include right maxillary first molar(16), right maxillary first premolar(14) right maxillary central incisor(11), left maxillary first premolar(24), left maxillary first molar(26), left mandibular first molar(36), left mandibular first premolar(34), left mandibular central incisor(31) right mandibular first premolar(44) and right mandibular first molar(46). In case of missing reference tooth adjacent or contra-lateral tooth was considered.

To check glycemic status, HbA1c was advised. This was done after examination to avoid bias. Based on HbA1c levels patients were ranked into groups i.e. adequately controlled ($HbA1c \leq 7$) and inadequately controlled ($HbA1c > 7.0\%$).

All data were collected by a post-graduate FCPS resident on a pre-designed proforma and were checked by a senior consultant. Inclusion and Exclusion criteria were strictly followed, to avoid biases and confounders.

Data were dissected using SPSS version 22.0. For categorical variables such as gender and types of medication frequency and percentages were reported while for continuous variables like age, duration of diabetes (years), pocket depth and clinical attachment loss mean and standard deviation were calculated. For comparison among two groups (adequately controlled diabetic and inadequately controlled diabetic), the mean pocket depth and mean clinical attachment loss were separately analyzed by using independent sample t-test. Gender, age and types of medication were stratified for effect modifiers among both groups by using independent sample t-test. P value ≤ 0.05 were taken as significant.

RESULTS

The mean duration of DM, age, pocket depth, clinical attachment were 6.42 ± 2.76 years, 50.77 ± 9.50 years, 4.03 ± 0.74 mm, and 4.74 ± 0.74 mm. (Table-I)

The males were 80(56%) and females were 62(44%). Most of the participants were on oral hypoglycemic ($n=80, 56\%$) followed by insulin in 44 (31%). In 63 (44%) the DM was poorly controlled and in 79(56%) well controlled. (Table-II)

The mean PPD was less in adequately controlled (3.45 ± 0.36 mm) than inadequately controlled diabetes (4.76 ± 0.36 mm) statistically significantly ($p < 0.001$). Similarly mean CAL was less in adequately controlled (4.16 ± 0.36 mm) than inadequately controlled diabetes (5.47 ± 0.36 mm) statistically significantly ($p < 0.001$). Table-III

In both males and females the mean periodontal pocket depth and clinical attachment loss were less in adequately controlled diabetes mellitus than inadequately controlled statistically ($p < 0.001$). The detailed statistics are given in Table-IV.

In all age groups the mean pocket depth and clinical attachment loss were less in adequately controlled diabetes mellitus than inadequately controlled statistically ($p < 0.001$). (Table-V)

All results were statistically significant ($p < 0.001$); the mean PD and CAL were less in adequately controlled DM than inadequately controlled DM.

Similar results were found for comparison of pocket depth and clinical attachment loss between inadequately controlled and adequately controlled DM stratified by type of medications. Table-VI

Variable	Mean(SD)
Duration of diabetes (year)	6.42 (2.76)
Age(year)	50.77 (9.50)
PD (mm)	4.03 (0.74)
CAL(mm)	4.74 (0.74)

Table-I. Mean and SD of continuous data

Variable	Characteristic	N (%)
Gender	Female	62 (44)
	Male	80 (56)
Type of Medication	Insulin	44 (31)
	No medication	18 (13)
	Oral hypoglycemic	80 (56)
Type of DM	Inadequately controlled	63 (44)
	Adequately controlled	79 (56)

Table-II. Frequency of categorical data

Characteristic	Inadequately Controlled, n=63 ¹	Adequately Controlled, n=79 ¹	P-Value ²
Periodontal pocket depth (mm)	4.76 (0.36)	3.45 (0.36)	<0.001
Clinical attachment loss (mm)	5.47 (0.36)	4.16 (0.36)	<0.001

Table-III. Comparison of pocket depth and clinical attachment loss between inadequately controlled and adequately controlled DM
¹ Mean (SD), ² Two Samples t-test

Gender	Characteristic	Inadequately Controlled ¹	Adequately Controlled ¹	P-Value ²
Male	PD	4.76 (0.36)	3.43 (0.35)	<0.001
	CAL	5.47 (0.36)	4.14 (0.35)	<0.001
Female	PD	4.76 (0.36)	3.49 (0.37)	<0.001
	CAL	5.47 (0.36)	4.20 (0.37)	<0.001

Table-IV. Comparison of pocket depth and clinical attachment loss between inadequately controlled and adequately controlled DM stratified by gender
¹Mean (SD), ² Two Samples t-test

Age Group	Characteristic	Inadequately Controlled ¹	Adequately Controlled ¹	P-Value ²
35-45	PD	4.74 (0.38)	3.44 (0.35)	<0.001
	CAL	5.45 (0.38)	4.15 (0.35)	<0.001
46-55	PD	4.72 (0.35)	3.43 (0.37)	<0.001
	CAL	5.43 (0.35)	4.14 (0.37)	<0.001
56-65	PD	4.81 (0.35)	3.49 (0.37)	<0.001
	CAL	5.52 (0.35)	4.20 (0.37)	<0.001

Table-V. Comparison of pocket depth and clinical attachment loss between inadequately controlled and adequately controlled DM stratified by age groups
¹Mean (SD), ² Two Samples t-test

Type of Medication	Characteristic	Inadequately Controlled ¹	Adequately Controlled ¹	P-Value ²
No Medication	PD	4.80 (0.39)	3.32 (0.32)	<0.001
	CAL	5.51 (0.39)	4.03 (0.32)	<0.001
Oral Hypoglycemics	PD	4.74 (0.35)	3.49 (0.38)	<0.001
	CAL	5.45 (0.35)	4.20 (0.38)	<0.001
Insulin	PD	4.78 (0.37)	3.44 (0.34)	<0.001
	CAL	5.49 (0.37)	4.15 (0.34)	<0.001

Table-VI. Comparison of pocket depth and clinical attachment loss between inadequately controlled and adequately controlled DM stratified by type of medications
¹Mean (SD), ² Two Samples t-test

DISCUSSION

The objective of this study was to assess the average pocket depth and clinical attachment loss in patients with type-2 diabetes, while comparing these measures between adequately controlled and inadequately controlled type 2 diabetes. Our

results indicated that individuals with inadequately controlled diabetes exhibited higher mean pocket depth and clinical attachment loss compared to those with adequately controlled diabetes. Notably, interactions were observed with age, gender, and the type of medication used.

In this study, we utilized HbA1c levels to assess the blood sugar levels of participants. HbA1c presents several advantages in comparison to Fasting Blood Sugar (FBS) and Oral Glucose Tolerance Test (OGTT), including improved convenience (no fasting required), heightened pre-analytical stability, and decreased interruptions during times of stress and illness. Nonetheless, these advantages must be weighed against higher costs, limited access to HbA1c testing in certain regions, and occasional discrepancies between HbA1c and mean blood glucose levels in certain individuals.⁶

A comprehensive evaluation was undertaken to investigate the influence of blood glucose levels on the severity of periodontal disease. The study delved into the interplay between probing depth (PD) and attachment loss (CAL) in relation to glycated hemoglobin levels (HbA1C > 7). Periodontitis is acknowledged as a consequential complication of diabetes. The propensity for periodontitis is nearly tripled among individuals with diabetes.⁸ A direct correlation exists between blood glucose levels (HbA1c) and the degree of periodontitis severity.⁹ A documented 0.13% elevation in HbA1c corresponds to each additional millimeter of mean pocket depth (PPD). Moreover, the treatment of periodontitis is correlated with a decrease of approximately 0.4% in HbA1c levels, indicating a reciprocal connection. Scholarly literature emphasizes the correlation between Diabetes Mellitus and periodontal disease.³ Diabetes mellitus is now unequivocally established as a key risk factor for periodontitis, amplifying its prevalence and gravity.

Our findings showed that mean PD was less in adequately controlled (3.45 ± 0.36 mm) than inadequately controlled diabetes (4.76 ± 0.36 mm) statistically significantly ($p < 0.001$). Similarly mean CAL was less in adequately controlled (4.16 ± 0.36 mm) than inadequately controlled diabetes (5.47 ± 0.36 mm) statistically significantly ($p < 0.001$).

Research by Tsai et al.¹⁰ highlights a substantial increase in severe periodontitis cases among

inadequately controlled diabetes patients (with an odds ratio of 2.90), compared to those without diabetes. Additionally, a study by Haseeb et al. in 2012 demonstrated that patients with poorly controlled diabetes had deeper pockets than well-controlled diabetics and non-diabetic individuals (4.21 mm versus 3.72 mm and 2.93 mm respectively).^{10,11}

Our finding shows that males were more than females. This shows that diabetes mellitus is more common in males than females. Similar results were found in previous studies.¹²

The increase in CAL corresponding to elevated glycemic levels, as demonstrated by our findings, indicates that insufficiently controlled diabetes indeed influences the extent and severity of periodontal disease. While this conclusion isn't novel, most prior studies showcasing the positive relationship between glycemic control and periodontal disease have not effectively accounted for confounding factors, particularly significant ones like smoking and inadequate oral hygiene.¹⁴ Moreover, a majority of these studies have presented their results as collective means or total percentages for each periodontal disease parameter. In contrast, our current study evaluated the disease status of each tooth individually and then calculated the average across all teeth within each case.¹⁵

Despite that this is a one center and small sample size study more studies on large sample size and multi-centers of case control design can better scrutinize this area.

CONCLUSION

Within the confines of this study it can be concluded that mean pocket depth and clinical attachment loss were more in case with inadequately controlled DM than adequately controlled DM. There were no interactions with age, gender and type of medication.

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2	Sadaf Saeed	Revision and corresponding authors, Data collection and analysis.	
3	Tariq A. Khan	Critical review of manuscript, Expert research opinion.	
4	Somia Gul	Introduction writing.	
5	Afnan Rehman	Discussion writing.	
6	Anhum Jadoon	Abstract writing.	