ORIGINAL RESEARCH

Impact of Type 2 Diabetes Mellitus on Periodontal Disease Prevalence: A Comparative Observational Study

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ABSTRACT

Background: Periodontitis is a multifactorial inflammatory disease that affects the supporting structures of the teeth leading to progressive alveolar bone loss. If left untreated it can result in tooth loss.Various studies have reported the incidence of periodontitis to be more in patients with diabetes mellitus as compared to their healthy counterparts. routine periodontal evaluations in patients with diabetes mellitus is important both oral health and glycemic control.**Materials and methods:** This was a comparative observational study of 120 individuals out of which 60 were having type 2 diabetes mellitus (cases group) and 60 healthy individuals (control group). Gender distribution and age was compared in both the groups. Mean random blood sugar levels and HBA1C levels were also compared. In both the groups the patients were divided into those having healthy periodontal tissue, early periodontal disease, moderate periodontal disease and severe periodontal disease (as per Fernandez classification). Prevalence of periodontal disease in both the groups was compared. p value less than 0.05 was taken as statistically significant.**Results:**Gender Distribution was found to be comparable in both the groups with no statistically significant difference in gender distribution amongst both the groups. The mean age of cases in group D and group H was found to be 42.64 +/- 13.22 and 40.92 +/- 13.98 years respectively. The mean random blood sugar levels as well as mean HbA1c levels were high in group D as compared to Group H and the difference was found to be statistically highly significant (P<0.0001). The incidence of periodontal disease was more common in patients with diabetes mellitus as compared to their healthy counterparts and the difference was found to be statistically highly significant (P=0.0001).**Conclusion:**Incidence of periodontitis is more in patients with Type2 Diabetes Mellitus as compared to the healthy individuals, therefore routine periodontal evaluations in patients with diabetes mellitus is important for both oral health as well as glycemic control.

Keywords: Diabetes Mellitus, Periodontitis, HbA1c, Periodontal health.

INTRODUCTION

Periodontitis is a multifactorial inflammatory disease that affects the supporting structures of the teeth leading to progressive alveolar bone loss. If left untreated it can result in tooth loss. It is characterized by the destruction of the periodontal ligament, resorption of the alveolar bone, and the formation of periodontal pockets due to the inflammatory response to bacterial biofilms adherent to the tooth surface. Periodontitis is typically classified into two main categories acute and chronic each with distinct clinical features and pathophysiological mechanisms.[1]

Acute periodontitis manifests rapidly, featuring pronounced pain, swelling, and often, suppuration. It is usually a consequence of the exacerbation of a pre-existing chronic condition or an acute infection superimposed on a chronic periodontal background. In contrast, chronic periodontitis progresses more slowly and can be asymptomatic for long periods. It is the most common form of periodontitis, characterized by gradual tissue destruction and if not adequately managed, can lead to severe oral and systemic health issues over time.[2]

The etiology of periodontitis is complex, involving a combination of bacterial infection and the host's immune-inflammatory response. Several predisposing factors contribute to the development and progression of periodontitis, including but not limited to poor oral hygiene, smoking, genetic predisposition, stress, age, and systemic conditions such as diabetes mellitus. These factors can affect the host's response to periodontal pathogens, alter the composition of the

subgingival microbiota, and ultimately influence the severity and progression of periodontal disease.[3]

Diabetes mellitus, particularly uncontrolled diabetes, significantly increases the risk of developing periodontitis. Not only does diabetes increase the risk of periodontitis, but periodontitis can also exacerbate the glycemic control in diabetic patients creating a vicious cycle. Hyperglycemia in diabetes patients can lead to advanced glycation end product (AGE) formation which can stimulate the production of pro-inflammatory cytokines and increase oxidative stress thereby enhancing the inflammatory response in periodontal tissues. Furthermore, the altered immune response in diabetics can impair wound healing and increase susceptibility to infections, including periodontal infections.[4]

Preventing periodontitis in individuals with diabetes involves a multifaceted approach that includes optimal control of blood glucose levels, meticulous oral hygiene practices, regular dental check-ups, and professional cleanings. Smoking cessation and dietary modifications can also play a crucial role in reducing the risk of periodontitis. Education and awareness about the importance of periodontal health in diabetes management are essential for both patients and healthcare providers. Periodontal therapy, including scaling and root planning, may be necessary to remove plaque and calculus deposits and to reduce periodontal pockets. Adjunctive therapies, such as local or systemic antibiotics and host-modulation therapy, may also be considered based on individual patient needs.[5]

Despite the extensive research on the relationship between diabetes mellitus and periodontitis, significant gaps in knowledge remain, particularly regarding the most effective preventive and therapeutic strategies for managing periodontitis in diabetic patients. Many studies have focused on the epidemiological and mechanistic aspects of the diabetes-periodontitis relationship, yet there is a lack of comprehensive, evidence-based guidelines for the clinical management of periodontal health in diabetes. Additionally, the impact of glycemic control on periodontal treatment outcomes and the potential benefits of periodontal therapy on glycemic control are areas that require further investigation.[6]

We undertook this case control study to compare the incidence of periodontitis in patients with diabetes and age matched healthy individuals.

MATERIALS AND METHODS

This was a case control study in which 60 patients with type 2 diabetes were included on the basis of a predefined inclusion and exclusion criteria. Similar number of age matched healthy individuals were included as control group. The study period 1 year extending from Feb 2022 to January 2023.

Sample size calculation was calculated on the basis of pilot studies done on diabetes mellitus and periodontal health. The formula used was $N = (Z\ \alpha^2)\ X\ SD^2 / Precision^2$. The minimum sample size required in each group was 60 patients; therefore, we included 60 patients in each group.

The patients were divided into 2 groups

Group D (Diabetes Group) : 60 patients having type 2 Diabetes Mellitus.

Group H (Healthy Individuals) : 60 healthy individuals with no systemic illnesses.

Demographic details such as age, gender and socioeconomic status was noted in all the cases. In cases of diabetes mellitus duration of the disease as well as the anti-diabetic treatment they are receiving was also noted. Since it was a purely observational study and no ethical issues were involved hence ethical clearance was not required. Informed consent was obtained from the cases.

The evaluation of the patients' periodontal health involved a comprehensive oral examination, focusing on measuring the probing pocket depth (PPD; the millimeter distance from the marginal gingiva to the periodontal pocket's base), occurrence of bleeding on probing (BOP; bleeding triggered by softly probing the gingival sulcus tissue), clinical attachment loss (CAL; the millimeter distance from the cemento-enamel junction to the pocket's base), and the presence of dental plaque. These measurements were taken at six sites around each tooth (the mesiobuccal, buccal, distobuccal, distolingual, lingual, and mesiolingual areas), excluding the wisdom teeth, which were not included in this study.

In both the groups the patients were divided into those having healthy periodontal tissue, early periodontal disease, moderate periodontal disease and severe periodontal disease. This classification was based upon the classification as described by Fernandez JK et al[7] and included factors such as Clinical Attachment Loss (CAL) and Probing Pocket Depth (PPD).

Severity Level	Criteria
Healthy	No CAL or BOP detected
Early Periodontal Diseases (PD)	CAL ≥ 1 mm at ≥ 2 teeth
ModeratePeriodontal Diseases (PD)	CAL ≥ 4 mm at 3 locations and PPD ≥ 3 mm at ≥ 2 locations
Severe Periodontal Diseases (PD)	CAL ≥ 6 mm at ≥ 2 teeth and PPD ≥ 5 mm at ≥ 1 location

Quantitative data was presented as mean and standard deviation. Qualitative data was presented with incidence and percentage tables. For quantitative data, unpaired t-test was applied and for qualitative data, Chi-square test was used. p value less than 0.05 was taken as statistically significant."

INCLUSION CRITERIA

1. Adult patients (cases) having Type 2 Diabetes Mellitus and age matched healthy adult individuals (control group).
2. Age Above 18 years.
3. Patient gave written informed consent to be part of study.

EXCLUSION CRITERIA

1. Age less than 18 years.
2. Those who refused consent.
3. Severe blood dyscrasias likely to cause local bleeding.
4. Patients having bleeding or clotting disorders, autoimmune disorders.
5. Patients with oropharyngeal malignancies.

RESULTS

The analysis of the cases on the basis of gender distribution showed that in group D there were 35(58.33%) males and 25 (41.67%) females. Whereas in group H there were 26 (43.33%) males and 34 (56.67%) females. The overall M:F ratio in this study was found to be 1:0.96 (Table 1). Gender Distribution was found to be comparable in both the groups with no statistically significant difference in gender distribution amongst both the groups (P=0.143) (Table 1).

	Group D		Group H	
	No of cases	**Percentage**	**No of cases**	**Percentage**
Males	35	58.33%	26	43.33%
Females	25	41.67%	34	56.67%
Total	60	100.00%	60	100.00%
P = 0.143 (Not significant)				

Table 1: Gender Distribution of the studied cases.

The analysis of cases on the basis of age groups showed that the most common age group in group D was between 31-40 years (40%) followed by 51-60 years (26.67%). Whereas in group H the most common age group was 31-40 years (35%) followed by 41-50 years (25%). The mean age of cases in group D and group H was found to be 42.64 +/- 13.22 and 40.92 +/- 13.98 years respectively (P=0.473) (Table 2).

Age Groups	**Group D**		**Group H**	
	Number Of Cases	**Percentage**	**Number Of Cases**	**Percentage**
20-30 years	9	15.00%	7	11.67%
31- 40 years	24	40.00%	21	35.00%
41-50 years	11	18.33%	15	25.00%
51-60 years	16	26.67%	13	21.67%
Total	60	100.00%	60	100.00%
Mean Age (years)	**42.64 +/- 13.22**		**40.92 +/- 13.98**	
P=0.473 (Not significant)				

Table 2: Age groups of the individuals in both the groups.

The mean random blood sugar levels in group D was found to be 184.12 +/- 38.64 mg/dl whereas the mean random blood sugar level in group H was found to be 102.64 +/- 16.36. The mean HbA1c levels in both the groups were compared. The mean HbA1c level in group D was found to be 8.56 +/- 3.12 whereas in group H the mean HbA1c levels were found to be 5.2 +/- 1.12. The mean random blood sugar levels as well as mean HbA1c levels were high in group D as compared to Group H and the difference was found to be statistically highly significant (P<0.0001) (Table 3).

Mean RBS and HbA1c levels	**Group D**	**Group H**	**P Value**
	No of cases	**No of cases**	
Mean RBS	184 +/- 38.64mg/dl	102 +/- 16.36	P < 0.0001 (Highly significant)
Mean HbA1c	7.56 +/- 2.12	5.24 +/- 1.34.	P < 0.0001 (Highly significant)

Table 3: Comparison of Mean RBS and Mean HbA1c levels in both the groups.

Patients were examined thoroughly for periodontal disease. Patients in both the groups were assessed for presence of healthy periodontal tissue, Early Periodontal Diseases (PD), moderate Periodontal Diseases (PD) and severe Periodontal Diseases (PD). In group D out of 60 individuals only 15 (25%) had healthy periodontal tissue. Remaining 45 (75%) individuals were found to have some form of periodontitis. In group H 42 (70.00%) were not having any form of periodontal disease (Figure 1).

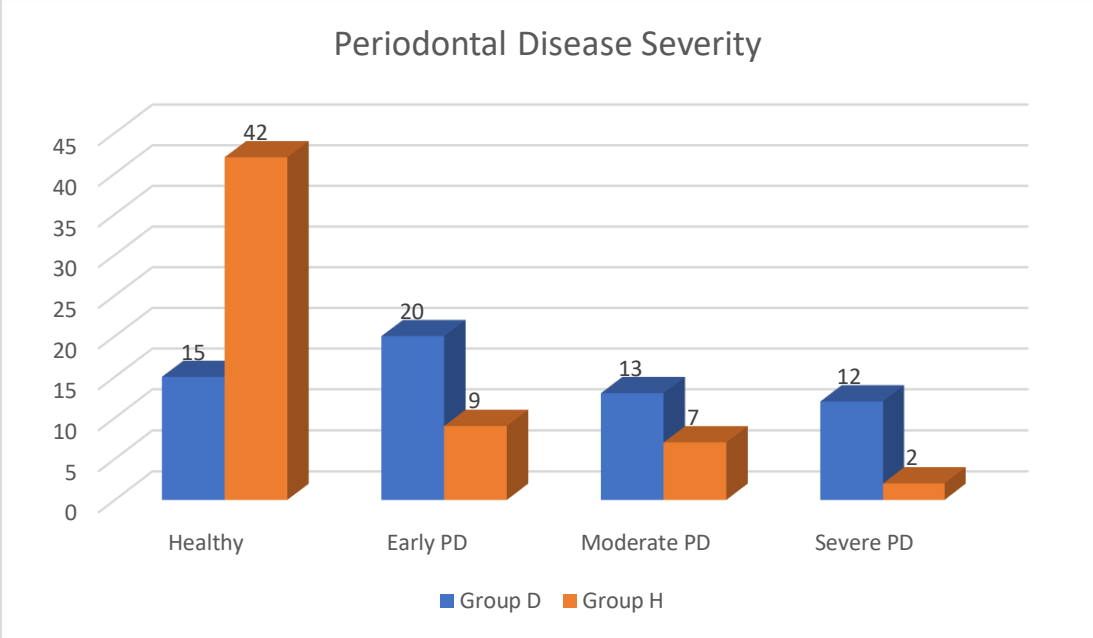

Figure 1: Comparison of periodontitis and its severity in both the groups.

The comparison of Group D and group H for the presence of periodontal disease showed that in group D out of 60 patients 45 (75%) patients had periodontal involvement whereas in group H in only 18 (30%) patients periodontal disease was found and remaining 42 (70%) patients were not having any kind of periodontal diseases. The incidence of periodontal disease was more common in patients with diabetes mellitus as compared to their healthy counterparts and the difference was found to be statistically highly significant (P=0.0001)(Table 4).

	Periodontitis Present	Periodontitis Absent	Total
Group D	45 (75%)	15 (25%)	60
Group H	18 (30%)	42 (70%)	60
P Value = 0.0001 (Highly significant)			

Table 4: Prevalence of periodontitis in both the groups.

DISCUSSION

Diabetes, a chronic metabolic disorder characterized by elevated blood glucose levels, is a well-established risk factor for periodontitis, a severe gum infection that can lead to tooth loss and other serious health complications. Research indicates that individuals with poorly controlled diabetes are at a higher risk of developing periodontal disease, as hyperglycemia can lead to increased levels of inflammatory cytokines, oxidative stress, and advanced glycation end products (AGEs), which in turn exacerbate the inflammatory response in periodontal tissues. Conversely, periodontitis can impact glycemic control by increasing systemic inflammation and insulin resistance, thereby contributing to the progression of diabetes.[8]

Emerging evidence suggests that periodontal therapy can lead to improvements in glycemic control in individuals with diabetes, highlighting the potential benefits of periodontal treatment as an adjunct to diabetes management. This underscores the need for a collaborative approach between dental and medical professionals to optimize health outcomes for patients with diabetes and periodontitis. Early detection, regular monitoring, and comprehensive management strategies that address both oral health and glycemic control are essential for mitigating the impact of these interrelated conditions on patient health.[9]

In our study the mean random blood sugar levels as well as mean HbA1c levels were high in group D as compared to Group H and the difference was found to be statistically highly significant. Many studies have reported that there exists a correlation between high HBA1C and periodontal disease. Zhao D et al conducted a study to evaluate the association between periodontitis and glycated hemoglobin (HbA1c) levels.[10] For this purpose the authors undertook an extensive review. In total, 29 case-control and 5 cross-sectional studies were selected from 2583 potentially eligible articles. Among them, sixteen case-control and three cross-sectional studies with moderate to high quality were selected for the meta-analyses. The HbA1c levels in periodontitis patients were significantly higher than those in individuals with healthy periodontal conditions (WMD = 0.16; $p <$ 0.001) among the non-diabetic populations. On the basis of these findings the authors concluded that there exist a significant association between periodontitis and HbA1c levels. Similar correlation between HbA1c levels and periodontitis has also been

reported by the authors such as Cairo F et al[11] and Teshome Aet al[12].

In our study in diabetic individuals out of 60 patients only 15 (25%) had healthy periodontal tissue. Remaining 45 (75%) individuals were found to have some form of periodontitis. In group H 42 (70.00%) patients were not having any form of periodontal disease. Battancs E et al conducted a study to analyze the prevalence of periodontitis in diabetic individuals who smoke and the diabetics who don't smoke. [13] For this purpose a total of 128 participants were recruited to this study and their data analyzed. They were assigned to four groups: smoking patients with DM (SDM); non-smoking patients with DM (NSDM); smokers without DM (control group, SC) and (4) non-smokers without DM (control group, NSC). The study found that A significant difference in the severity of PD was present between the SC and NSC groups ($p = 0.027$) and between the NSC and SDM groups ($p = 0.000$), while the difference between the NSDM and SDM groups approached significance ($p = 0.052$). No person in the smoker groups could be classified as having a healthy periodontal status. The four-stage classification followed a normal distribution in the healthy, non-smoking controls (NSC). Smoking caused a shift toward medium-severe PD, while a marked shift toward the most severe stage was observed when both smoking and DM were present (SDM). On the basis of these findings the authors concluded that Smoking damages the periodontium of even healthy individuals, but the damage is multiplied in a smoker who has DM, even though the effect of DM alone on periodontium health is relatively mild. Similar adverse impact of diabetes mellitus on periodontal health was reported by the authors such as Campus G et al[14] and Casarin RC et al.[15]

CONCLUSION

Periodontal health is a critical component of diabetes management. The incidence of periodontitis is significantly high in patients with diabetes as compared to their healthy peers. Our study suggests that routine periodontal evaluations in patients with diabetes mellitus is important for both oral health and glycemic control.

Conflict Of interest: None

REFERENCES

1. Papapanou PN, Sanz M, Buduneli N, et al. Periodontitis: Consensus report of workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Periodontol. 2018;89 Suppl 1:S173-S182. doi:10.1002/JPER.17-0721
2. Persson GR. Periodontal complications with age. Periodontol 2000. 2018;78(1):185-194. doi:10.1111/prd.12227
3. Genco RJ, Borgnakke WS. Risk factors for periodontal disease. Periodontol 2000. 2013;62(1):59-94. doi:10.1111/j.1600-0757.2012.00457.x
4. Grant-Theule DA. Periodontal disease, diabetes, and immune response: a review of current concepts. J West Soc Periodontol Periodontal Abstr. 1996;44(3):69-77.
5. Balta MG, Papathanasiou E, Blix IJ, Van Dyke TE. Host Modulation and Treatment of Periodontal Disease. J Dent Res. 2021;100(8):798-809. doi:10.1177/0022034521995157
6. Dhingra K, Jeng JH. Does periodontal treatment improve glycaemic control in periodontitis patients with diabetes mellitus?. Evid Based Dent. 2023;24(1):12-14. doi:10.1038/s41432-023-00863-x
7. Fernandes JK, Wiegand RE, Salinas CF, et al. Periodontal disease status in gullahafricanamericans with type 2 diabetes living in South Carolina. J Periodontol. 2009;80(7):1062-1068. doi:10.1902/jop.2009.080486
8. Llambés F, Arias-Herrera S, Caffesse R. Relationship between diabetes and periodontal infection. World J Diabetes. 2015;6(7):927-935. doi:10.4239/wjd.v6.i7.927
9. Borgnakke WS, Genco RJ, Eke PI, Taylor GW. Oral Health and Diabetes. In: Cowie CC, Casagrande SS, Menke A, et al., eds. Diabetes in America. 3rd ed. Bethesda (MD): National Institute of Diabetes and Digestive and Kidney Diseases (US); August 2018.
10. Zhao D, Sun Y, Li X, et al. Association between Periodontitis and HbA1c Levels in Non-Diabetic Patients: A Systematic Review and Meta-Analysis. Healthcare (Basel). 2023;11(19):2649. Published 2023 Sep 28. doi:10.3390/healthcare11192649
11. Cairo F, Dicembrini I, Serni L, et al. Periodontitis predicts HbA1c levels and glucose variability in type 1 diabetic patients: the PARODIA Florence Project study. Clin Oral Investig. 2022;26(4):3585-3591. doi:10.1007/s00784-021-04326-4
12. Teshome A, Yitayeh A. The effect of periodontal therapy on glycemic control and fasting plasma glucose level in type 2 diabetic patients: systematic review and meta-analysis. BMC Oral Health. 2016;17(1):31. Published 2016 Jul 30. doi:10.1186/s12903-016-0249-1
13. Battancs, E., Gheorghita, D., Nyiraty, S. et al. Periodontal Disease in Diabetes Mellitus: A Case–Control Study in Smokers and Non-Smokers. Diabetes Ther **11**, 2715–2728 (2020). https://doi.org/10.1007/s13300-020-00933-8
14. Campus G, Salem A, Uzzau S, Baldoni E, Tonolo G. Diabetes and periodontal disease: a case-control study. J Periodontol. 2005;76(3):418-425. doi:10.1902/jop.2005.76.3.418
15. Casarin RC, Barbagallo A, Meulman T, et al. Subgingival biodiversity in subjects with uncontrolled type-2 diabetes and chronic periodontitis. J Periodontal Res. 2013;48(1):30-36. doi:10.1111/j.1600-0765.2012.01498.x