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Original Research Article

Correlation between glycemic control and chronic periodontitis severity: A cross-sectional study

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Abstract

Background: Chronic periodontitis (CP) and diabetes mellitus (DM) share a bidirectional relationship. Poor glycemic control accelerates periodontal destruction, while periodontitis exacerbates systemic inflammation, impacting glycemic regulation. This study evaluates the correlation between glycemic control, measured by fasting blood sugar (FBS) and glycated hemoglobin (HbA1c), and the severity of periodontitis. Additionally, it examines the prevalence of undiagnosed diabetes among periodontitis patients.

Materials and Methods: A cross-sectional observational study was conducted on 150 patients diagnosed with chronic periodontitis. Participants underwent a comprehensive periodontal examination, including Plaque Index (PI), Gingival Index (GI), Probing Pocket Depth (PPD), Clinical Attachment Loss (CAL), and radiographic assessment. Blood samples were collected for FBS and HbA1c measurements. Patients were categorized into diabetic (HbA1c ≥6.5%), prediabetic (HbA1c 5.7%–6.4%), and non-diabetic (HbA1c <5.7%) groups. Statistical analysis assessed the correlation between glycemic markers and periodontal disease severity.

Results: The study revealed a significant positive correlation between poor glycemic control and chronic periodontitis severity. The mean PPD and CAL values were highest in the diabetic group (4.98±0.64 mm and 5.42±1.12 mm, respectively), followed by the prediabetic (4.23±0.52 mm and 4.76±0.98 mm) and non-diabetic groups (3.65±0.48 mm and 3.92±0.86 mm) ($p<0.001$). HbA1c levels showed a strong correlation with PPD ($r=0.72$) and CAL ($r=0.69$), indicating that as glycemic levels worsened, periodontal destruction increased. Additionally, 18% of participants were found to have undiagnosed diabetes, emphasizing the potential role of periodontal health in diabetes screening.

Conclusion: Poor glycemic control is strongly associated with increased periodontitis severity. The high prevalence of undiagnosed diabetes among periodontitis patients underscores the need for routine glycemic screening in dental settings. Interdisciplinary collaboration between periodontists and physicians is essential for early detection and integrated management of diabetes and periodontal disease.

Keywords: Chronic Periodontitis, Diabetes Mellitus, Glycemic Control, HbA1c, Periodontal Disease, Fasting Blood Sugar

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1. Introduction

Diabetes mellitus and chronic periodontitis are two of the most prevalent chronic conditions affecting adults globally, significantly contributing to morbidity and a diminished quality of life. Diabetes mellitus is a complex metabolic disorder characterized by persistent high blood sugar levels, arising due to various factors such as autoimmune destruction of pancreatic β-cells (Type 1 diabetes), insulin resistance

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coupled with β-cell dysfunction (Type 2 diabetes), or secondary causes like hormonal imbalances or medication side effects. Chronic hyperglycemia in diabetes is associated with severe long-term complications, including cardiovascular diseases, kidney dysfunction, nerve damage, and a weakened immune system, which heightens susceptibility to infections and delays wound healing.[1]

Periodontitis, a progressive inflammatory disease, affects the supporting structures of the teeth, including the periodontal ligament and alveolar bone. It develops due to an exaggerated immune response to bacterial biofilms, leading to chronic inflammation, deep periodontal pockets, gum recession, and eventual tooth loss. India bears a particularly heavy burden of diabetes, having one of the highest numbers of diabetic patients in the world. According to the International Diabetes Federation (IDF), the number of diabetes cases in India is projected to rise from 40.9 million to 69.9 million by 2025. Due to its often asymptomatic nature in the early stages, diabetes frequently goes undiagnosed for years, increasing the likelihood of complications such as periodontitis. While much attention is given to diabetes-related complications affecting organs like the heart and kidneys, its link to periodontal disease remains underrecognized, despite its significant impact on overall health.

A well-established bidirectional relationship exists between diabetes and periodontal disease, with each condition exacerbating the other. Poor blood sugar control has been shown to increase the severity and progression of periodontitis through multiple pathways.[2] Chronic hyperglycemia triggers an excessive inflammatory response, leading to elevated levels of pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF-α), interleukin-1β (IL-1β), and interleukin-6 (IL-6), all of which contribute to the breakdown of periodontal tissues. Additionally, the accumulation of advanced glycation end products (AGEs) in diabetic patients leads to oxidative stress and chronic inflammation, impairing the healing capacity of periodontal tissues and accelerating collagen degradation.[3-4] Furthermore, diabetes negatively impacts immune function by altering neutrophil activity and impairing macrophage responses, making it harder for the body to combat periodontal infections and leading to uncontrolled bacterial growth. The microvascular complications commonly seen in diabetes also reduce blood supply to the periodontal tissues, further delaying healing and increasing susceptibility to infections.[5-6]

Conversely, periodontitis itself can negatively impact diabetes by acting as a persistent source of systemic inflammation, which contributes to insulin resistance and poor blood sugar control. Chronic inflammation from periodontal disease disrupts insulin signaling pathways, making glucose regulation more difficult. Several studies have demonstrated that effective periodontal therapy can help lower HbA1c levels, highlighting the potential of periodontal treatment as an additional strategy for diabetes management.[7-8] Despite such evidence, periodontal disease remains an overlooked complication in routine diabetes care.

Given the rising diabetes prevalence in India and the growing body of research linking it to periodontal disease, there is an urgent need to enhance awareness, promote early detection, and encourage greater collaboration among healthcare professionals.9[9] Many individuals with diabetes are unaware of their heightened risk for periodontitis, and medical practitioners often do not emphasize oral health as a crucial component of diabetes management. This study underscores the importance of recognizing the connection between diabetes and periodontitis, advocating for early diagnosis, integrated treatment approaches, and preventive strategies. Addressing periodontal health in diabetic patients can help control systemic inflammation, improve blood sugar regulation, and reduce the risk of diabetes-related complications, ultimately leading to better health outcomes. A multidisciplinary approach involving endocrinologists, diabetologists, and dental professionals can facilitate early screening, enhance patient education, and improve management strategies for both conditions. As India continues to face a growing diabetes epidemic, acknowledging the role of periodontal disease in systemic health could drive the development of more comprehensive healthcare policies, ultimately improving the well-being of millions affected by these chronic conditions.

2. Materials and Methods

2.1. Study design and population

A cross-sectional study was conducted in the Department of Periodontology to evaluate the association between glycemic control and periodontal health. The study population comprised 150 patients diagnosed with chronic periodontitis.

2.2. Inclusion criteria

Participants were selected based on the following inclusion criteria:

Clinically and radiographically confirmed diagnosis of chronic periodontitis. Age of 30 years or older.,No history of periodontal treatment within the past six months.

2.3. Exclusion criteria

Patients were excluded if they met any of the following criteria:

Presence of systemic conditions known to affect periodontal health, such as osteoporosis or immunodeficiency disorders., Pregnancy or lactation., Current use of medications that influence glycemic control or periodontal status, including corticosteroids and immunosuppressants.

3. Clinical Examination

Each participant underwent a comprehensive periodontal evaluation performed by a calibrated examiner. The assessment included:

Plaque Index (PI) and Gingival Index (GI) to assess oral hygiene status and gingival inflammation., Probing Pocket Depth (PPD) and Clinical Attachment Loss (CAL), recorded at six sites per tooth using a standardized periodontal probe., Radiographic Analysis: Orthopantomograms (OPG) were obtained for each patient to evaluate alveolar bone loss.

3.1. Biochemical analysis

Venous blood samples were collected from all participants after an overnight fasting period of 8-12 hours. The fasting blood glucose (FBS) and glycated hemoglobin (HbA1c) levels were measured to categorize participants into three glycemic groups:

1. **Diabetic:** HbA1c ≥6.5%.
2. **Prediabetic:** HbA1c 5.7%-6.4%.
3. **Non-diabetic:** HbA1c <5.7%.

3.2. Statistical analysis

Descriptive statistics were used to summarize demographic, clinical, and biochemical data. Group comparisons of periodontal parameters (PPD, CAL) among different glycemic categories were conducted using one-way analysis of variance (ANOVA) followed by post-hoc Tukey's test. The correlation between HbA1c levels and periodontal parameters was assessed using Pearson's correlation coefficient. A p-value <0.05 was considered statistically significant.

4. Results

4.1. Demographic characteristics and glycemic status

The study included 150 patients, categorized based on glycemic status as follows:

1. **Diabetic:** 56 participants (37.3%).
2. **Prediabetic:** 47 participants (31.3%).
3. **Non-diabetic:** 47 participants (31.3%).

The mean age of the diabetic group was significantly higher than that of the prediabetic and non-diabetic groups (p=0.01).

4.2. Periodontal parameters across glycemic categories

Periodontal health deteriorated significantly with worsening glycemic control. The mean values for key periodontal parameters across the three groups were as follows:

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Table 1: Periodontal parameters across glycemic categories

Glycemic Group	PPD (mm)	CAL (mm)	PI (Plaque Index)	GI (Gingival Index)
Diabetic	4.98 ± 0.64	5.42 ± 1.12	2.54 ± 0.35	2.29 ± 0.42
Prediabetic	4.23 ± 0.52	4.76 ± 0.98	2.12 ± 0.31	2.03 ± 0.39
Non-diabetic	3.65 ± 0.48	3.92 ± 0.86	1.68 ± 0.28	1.71 ± 0.36

The analysis showed statistically significant differences in PI and GI scores across the three groups ($p < 0.001$). Diabetic patient's demonstrated poorer oral hygiene and greater gingival inflammation compared to prediabetic and non-diabetic groups. This suggests that compromised oral hygiene may compound periodontal destruction in individuals with poor glycemic control. Correlation Analysis.

Pearson's correlation analysis indicated a strong positive correlation between HbA1c levels and both periodontal parameters:

1. HbA1c vs. PPD: $r = 0.72$, $p<0.001$.
2. HbA1c vs. CAL: $r = 0.69$, $p<0.001$.

These findings reinforce that poor glycemic control is associated with increased periodontal disease severity.

5. Undiagnosed Diabetes Prevalence

Notably, 18% of the participants were identified as having previously undiagnosed diabetes based on their HbA1c levels, highlighting the need for routine glycemic screening among periodontitis patients.

6. Discussion

The present study provides compelling evidence of a significant association between glycemic control and periodontal disease severity. Patients with diabetes exhibited the highest mean values for PPD, CAL, PI, and GI, followed by prediabetic and non-diabetic individuals. These findings reinforce the multifactorial etiology of periodontal disease in diabetic patients, where both systemic metabolic dysregulation and local inflammatory factors contribute to disease progression.

The inclusion of Plaque Index and Gingival Index data provides a more nuanced understanding of oral hygiene and inflammatory status. Elevated PI and GI scores among diabetic patients suggest that local factors, in addition to hyperglycemia, exacerbate periodontal destruction. Thus, targeted oral hygiene interventions may be especially beneficial in diabetic populations.

Patients with diabetes exhibited the highest mean values for PI, GI index PPD and CAL, followed by prediabetic and non-diabetic individuals. These findings align with existing literature[10] emphasizing the bidirectional relationship between diabetes and periodontitis, where chronic hyperglycemia exacerbates periodontal destruction through inflammatory and immunological mechanisms.

The strong correlation between HbA1c levels and periodontal parameters further underscores the impact of glycemic status on periodontal health. Poorly controlled diabetes has been shown to impair neutrophil function, alter collagen metabolism, and increase oxidative stress, all of which contribute to greater periodontal tissue breakdown.[11]

Patients with diabetes exhibited the highest mean values for PI and GI index, PPD and CAL, followed by prediabetic and non-diabetic individuals, consistent with findings reported by Chávarry et al. (2009).[12] Their meta-analysis demonstrated that diabetic patients had a higher prevalence and severity of periodontal disease, with increased periodontal attachment loss and pocket depth, likely due to hyperglycemia-induced alterations in immune responses.

The strong correlation between HbA1c levels and periodontal parameters underscores the impact of glycemic status on periodontal health. Poor glycemic control contributes to periodontal deterioration through various mechanisms, including impaired neutrophil function, altered collagen metabolism, and oxidative stress, as highlighted by Taylor (2001).[13] Advanced glycation end products (AGEs) further exacerbate periodontal breakdown by interacting with their receptors (RAGE), leading to increased oxidative stress and pro-inflammatory cytokine production. This cascade results in alveolar bone resorption and impaired tissue repair, as supported by studies emphasizing the role of AGEs in inflammatory responses.

Conversely, the impact of periodontal disease on glycemic control has been increasingly recognized. Periodontal infections serve as a persistent source of systemic inflammation, exacerbating insulin resistance and complicating diabetes management. Taylor (2001) discussed this reciprocal effect, suggesting that inflammatory mediators from periodontal lesions enter the systemic circulation, disrupting insulin signaling pathways and worsening glycemic control. The significance of periodontal therapy in diabetes management has been further supported by Simpson et al. (2015),[14] whose systematic review found that non-surgical periodontal therapy was associated with a modest but significant reduction in HbA1c levels at three months post-treatment.

A noteworthy finding of this study was the detection of undiagnosed diabetes in 18% of participants, reinforcing the role of periodontal evaluation as an adjunctive screening tool for identifying individuals at risk for diabetes. Given the established systemic and oral health implications of diabetes, integrating routine periodontal assessments into diabetes screening programs could facilitate early diagnosis and intervention, ultimately improving patient outcomes.

Despite the well-documented interrelationship between diabetes and periodontitis, interdisciplinary collaboration between medical and dental professionals remains insufficient. Poudel et al. (2020)[15] reported that only 50% of medical professionals were aware of this bidirectional link, and a mere 30% referred their diabetic patients for periodontal evaluation. This highlights the urgent need for enhanced inter professional education and collaboration between periodontists and physicians to ensure holistic patient care.

Overall, our study underscores the necessity of interdisciplinary collaboration for the comprehensive management of periodontitis and diabetes.

7. Conclusion

Future research should focus on longitudinal studies to further elucidate the causal relationship between glycemic control and periodontal disease progression. Additionally, evaluating the effectiveness of targeted periodontal interventions in improving glycemic outcomes remains a crucial area of investigation. A structured, integrated approach involving both medical and dental practitioners is essential to mitigate the impact of these interconnected conditions and enhance patient quality of life.

8. Source of Funding

None.

9. Conflict of Interest

None.

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