Original Research

An Overview Of The Relationship Between Diabetes And Periodontitis

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Abstract:

This article discusses the association between periodontitis and diabetes. Periodontitis is a chronic inflammatory disease that leads to tooth loss and is caused by a bacterial biofilm formation that matures and triggers gingivitis, which can progress to periodontitis. There is mounting evidence that suggests a connection between periodontitis and diabetes, which can lead to a harmful cycle of diabetes and periodontitis. Epidemiological studies have found that the prevalence and incidence of periodontitis are greater in individuals with type 2 diabetes than in those without diabetes. The management of periodontitis in individuals with diabetes has been demonstrated to enhance glycaemic control, leading to reductions in HbA1c levels in the short term. The chronic inflammatory disease, periodontitis, is caused by the presence of dental plaque in the periodontal tissues, leading to a dysregulated secretion of inflammatory mediators and tissue breakdown. The cytokine network in the development of periodontitis is complex and diverse, with significant variability between individuals. The total inflammatory response in the periodontal tissues determines the pattern and rate of disease progression. Diabetic patients have increased susceptibility to infections, which can lead to the high incidence of periodontitis in diabetic patients. The article highlights the crucial role that dental teams play in the care of diabetic patients, as the management of periodontitis in individuals with diabetes has been demonstrated to enhance glycaemic control. Despite this, interprofessional collaboration between dental and medical professionals for the management of diabetes and periodontitis is challenging to implement due to practical and systemic obstacles.

Keywords: Periodontal Disease, Diabete, Teeth, Dentistry.

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Introduction

Periodontitis is a chronic inflammatory disease that results in periodontal pocket formation, loss of connective tissue attachment, and alveolar bone resorption, leading to tooth loss. Insufficient oral hygiene enables the formation of a bacterial biofilm, which is resistant to immune cells and chemicals. In the absence of mechanical removal, the biofilm matures within a few days and triggers gingivitis, a reversible chronic inflammation that can be controlled with proper plaque management. It often takes several months or years for gingivitis to progress to irreversible periodontitis. Recent research suggests that there might be a connection between periodontitis and obesity, potentially leading to a harmful cycle of diabetes and periodontitis. This highlights the close relationship between periodontitis and diabetes mellitus in many ethnic groups (1). Cohort studies in Japan have found that both upper body obesity (2) and metabolic syndrome (3) have a significant positive association with periodontal diseases.

There is mounting evidence supporting a connection between periodontitis and diabetes. In this review, we have consolidated the existing evidence regarding the association between periodontitis and diabetes.

Epidemiological association between periodontitis and diabetes

According to a study by Loe *et al.*, periodontitis is listed as the sixth complication of diabetes (4). In a study involving 2,273 Pima Indians, the age- and gender-adjusted prevalence of periodontal disease was found to be 60% in patients with type 2 diabetes and 36% in those without diabetes at the initial examination (5). Among 701 subjects who had little or no evidence of periodontal disease at the start of the study, 22 developed periodontitis, and the rate of disease in those with diabetes was 2.6 times greater than in those without diabetes (5). A study conducted on Japanese individuals revealed that the prevalence of periodontitis was significantly higher in both type 1 and type 2 diabetic patients than in non-diabetic subjects (6), indicating that both types of diabetes are risk factors for periodontitis. The high incidence of periodontitis in diabetic patients is believed to be primarily due to their increased susceptibility to infections (7). The level of glycemic control plays a crucial role in determining the increased risk of periodontitis. In the US National Health and Nutrition Examination Survey (NHANES) III, adults with an HbA1c level greater than 9% had a significantly higher prevalence of severe periodontitis compared to those without diabetes (8). Several cross-sectional and longitudinal studies on the Pima Indian population conducted in the 1990s revealed that the prevalence and incidence of periodontitis were greater in individuals with type 2 diabetes mellitus (5, 9). The majority of research has focused on type 2 diabetes mellitus as a risk factor for periodontitis due to both diseases developing in patients in their 40s and 50s. However, type 1 diabetes mellitus also increases the risk of periodontitis, and all patients with diabetes, including children and young adults, should be considered to be at increased risk Studies have shown that children with type 1 diabetes mellitus have increased attachment and bone loss compared to controls, despite comparable plaque scores(10). More recently, a study found that a greater proportion of periodontal sites showed evidence of periodontitis in diabetic children than in non-diabetic controls (11). Dentists have recognized for a long time that diagnosing diabetes in their patients is critical, and diabetes is linked to various oral problems such as candidal infections, xerostomia, and periodontitis. In the 1990s, periodontitis was even dubbed the "sixth complication of diabetes," (4) and in 2003, the American Dental Association (ADA) recognized that periodontal disease is often found in individuals with diabetes (12). The management of periodontitis

in individuals with diabetes has been demonstrated to enhance glycaemic control, leading to reductions of 3-4 mmol/mol (0.3-0.4%) in HbA1c levels in the short term (3-4 months) following treatment. As a result, the dental team plays a crucial role in the care of diabetic patients. Despite the promotion of improved interprofessional collaboration between dental and medical professionals for the management of diabetes and periodontitis by scientific and professional organizations, it is difficult to implement due to practical and systemic obstacles (13).

Pathologic mechanisms between periodontitis and diabetes

The chronic inflammatory disease, periodontitis, is caused by the presence of dental plaque in the periodontal tissues, leading to a dysregulated secretion of inflammatory mediators and tissue breakdown. The major mediators studied include IL-1β, IL-6, PGE2, TNF-α, RANKL, MMP-8, MMP-9, MMP-13, T cell regulatory cytokines such as IL-12 and IL-18, and chemokines (14). It is now evident that the cytokine network in the development of periodontitis is complex and diverse, with significant variability between individuals. This variability is due to genetic, epigenetic, and environmental factors that influence the nature of the inflammatory response, both between and within individuals. The total inflammatory response in the periodontal tissues determines the pattern and rate of disease progression (15).

According to Taylor *et al.* (16), in a study that tracked glycemic control in individuals with type 1 diabetes for 2 years, those with periodontitis had a higher likelihood of experiencing deterioration in glycemic control. The study also found that patients with periodontitis had greater chances of developing ketoacidosis, retinopathy, and neuropathy compared to diabetic patients without periodontitis. Patients with neurological complications were found to have more severe gingivitis than those without this complication (17). The build-up of AGEs in the periodontal tissues is likely to have a role in increasing inflammation in people with diabetes. The binding of AGE to its receptor, RAGE, stimulates the production of inflammatory substances like IL-1β, TNF-α, and IL-6. This process leads to increased oxidative stress due to the production of ROS, which contributes to the vascular injury linked to several diabetes complications. AGEs also increase the respiratory burst in PMNs, leading to significant local tissue damage in periodontitis (18-20).

Oral microbiota and diabetes

Compared to the numerous studies investigating the connection between periodontitis and diabetes via inflammatory mechanisms, few studies have focused on the link between diabetes and the oral microbiota. One study (21) discovered that individuals with diabetes had a higher prevalence of P. gingivalis than non-diabetic participants, but no significant differences were found in other periodontal pathogens. Similarly, a study of young Japanese (22) individuals with type 1 diabetes found that those with periodontitis had a higher proportion of P. gingivalis and P. intermedia. These studies suggest that there may be subtle variations in the microbial composition of the subgingival biofilm in individuals with diabetes, possibly caused by the influence of diabetes on the local periodontal pocket environment. However, the clinical importance of these differences is uncertain. However, it is important to note that the relationship between the oral microbiota and diabetes is complex and multifactorial. Diabetes is known to affect the immune response and alter the local environment within the periodontal pocket, and this may in turn affect the composition of the subgingival biofilm. Additionally, factors such as age, smoking, and medication use may also influence the composition of the oral

microbiota in individuals with diabetes. Overall, while there is some evidence to suggest that the oral microbiota may play a role in the link between periodontitis and diabetes, further research is needed to better understand the mechanisms underlying this relationship and the clinical implications for the management of these conditions.

Periodontal treatment and diabetes

A number of studies have indicated that treatment of periodontitis can have a positive impact on glycemic control in individuals with diabetes (23-25). A meta-analysis conducted recently evaluated the effectiveness of periodontal treatment on glycemic control among diabetic patients and suggested that it can lead to considerable decreases in HbA1c levels (26). Nevertheless, the authors of the meta-analysis warned that the results should be approached with care due to a lack of consistency and constraints in the methodologies used in some of the studies examined.

Conclusion

In conclusion, there is a connection between periodontitis and diabetes that could create a harmful cycle, but treating periodontitis could potentially break this cycle. However, it is necessary to conduct more intervention studies to establish the impact of periodontal treatment on glycemic control in diabetic patients.

References

1. Katz PP, Wirthlin MR, Jr, Szpunar SM, Selby JV, Sepe SJ, Showstack JA. Epidemiology and Prevention of Periodontal Disease in Individuals With Diabetes. Diabetes Care. 1991;14(5):375-85.
2. Saito T, Shimazaki Y, Koga T, Tsuzuki M, Ohshima A. Relationship between Upper Body Obesity and Periodontitis. Journal of Dental Research. 2001;80(7):1631-6.
3. Shimazaki Y, Saito T, Yonemoto K, Kiyohara Y, Iida M, Yamashita Y. Relationship of Metabolic Syndrome to Periodontal Disease in Japanese Women: The Hisayama Study. Journal of Dental Research. 2007;86(3):271-5.
4. Löe H. Periodontal disease: the sixth complication of diabetes mellitus. Diabetes care. 1993;16(1):329-34.
5. Nelson RG, Shlossman M, Budding LM, Pettitt DJ, Saad MF, Genco RJ, et al. Periodontal disease and NIDDM in Pima Indians. Diabetes care. 1990;13(8):836-40.
6. Nishimura F, Kono T, Fujimoto C, Iwamoto Y, Murayama Y. Negative effects of chronic inflammatory periodontal disease on diabetes mellitus. Journal of the International Academy of Periodontology. 2000;2(2):49-55.
7. Genco RJ. Current view of risk factors for periodontal diseases. Journal of periodontology. 1996;67:1041-9.
8. Tsai C, Hayes C, Taylor GW. Glycemic control of type 2 diabetes and severe periodontal disease in the US adult population. Community dentistry and oral epidemiology. 2002;30(3):182-92.
9. Taylor GW, Burt BA, Becker MP, Genco RJ, Shlossman M. Glycemic control and alveolar bone loss progression in type 2 diabetes. Annals of Periodontology. 1998;3(1):30-9.
10. Cianciola L, Park B, Bruck E, Mosovich L, Genco R. Prevalence of periodontal disease in insulin-dependent diabetes mellitus (juvenile diabetes). The Journal of the American Dental Association. 1982;104(5):653-60.
11. Lalla E, Cheng B, Lal S, Kaplan S, Softness B, Greenberg E, et al. Diabetes mellitus promotes periodontal destruction in children. Journal of clinical periodontology. 2007;34(4):294-8.
12. Diagnosis TECot, Mellitus CoD. Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Diabetes Care.

2003;26(suppl_1):s5-s20.
13. Preshaw PM, Bissett SM. Periodontitis and diabetes. British Dental Journal. 2019;227(7):577-84.
14. Preshaw PM, Taylor JJ. How has research into cytokine interactions and their role in driving immune responses impacted our understanding of periodontitis? Journal of clinical periodontology. 2011;38:60-84.
15. Kinane DF, Preshaw PM, Loos BG, Periodontology WGotSEWo. Host-response: understanding the cellular and molecular mechanisms of host-microbial interactions–consensus of the Seventh European Workshop on Periodontology. Journal of clinical periodontology. 2011;38:44-8.
16. Taylor GW, Burt BA, Becker MP, Genco RJ, Shlossman M, Knowler WC, et al. Severe periodontitis and risk for poor glycemic control in patients with non-insulin-dependent diabetes mellitus. Journal of periodontology. 1996;67:1085-93.
17. Rosenthal I, Abrams H, Kopczyk R. The relationship of inflammatory periodontal disease to diabetic status in insulin-dependent diabetes mellitus patients. Journal of Clinical Periodontology. 1988;15(7):425-9.
18. Lalla E, Lamster IB, Stern DM, Schmidt AM. Receptor for Advanced Glycation End Products, Inflammation, and Accelerated Periodontal Disease in Diabetes: Mechanisms and Insights Into Therapeutic Modalities. Annals of Periodontology. 2001;6(1):113-8.
19. Wong RKM, Pettit AI, Quinn PA, Jennings SC, Davies JE, Ng LL. Advanced Glycation End Products Stimulate an Enhanced Neutrophil Respiratory Burst Mediated Through the Activation of Cytosolic Phospholipase A₂ and Generation of Arachidonic Acid. Circulation. 2003;108(15):1858-64.
20. Rosenthal IM, Abrams H, Kopczyk RA. The relationship of inflammatory periodontal disease to diabetic status in insulin-dependent diabetes mellitus patients. Journal of Clinical Periodontology. 1988;15(7):425-9.
21. Thorstensson H, Dahlen G, Hugoson A. Some suspected periodontopathogens and serum antibody response in adult long-duration insulin-dependent diabetics. Journal of Clinical Periodontology. 1995;22(6):449-58.
22. Takahashi K, Nishimura F, Kurihara M, Iwamoto Y, Takashiba S, Miyata T, et al. Subgingival microflora and antibody responses against periodontal bacteria of young Japanese patients with type 1 diabetes mellitus. Journal of the International Academy of Periodontology. 2001;3(4):104-11.
23. Rodrigues DC, Taba Jr M, Novaes Jr AB, Souza SL, Grisi MF. Effect of non-surgical periodontal therapy on glycemic control in patients with type 2 diabetes mellitus. Journal of periodontology. 2003;74(9):1361-7.
24. Grossi SG, Skrepcinski FB, DeCaro T, Robertson DC, Ho AW, Dunford RG, et al. Treatment of periodontal disease in diabetics reduces glycated hemoglobin. Journal of periodontology. 1997;68(8):713-9.
25. Kıran M, Arpak N, Ünsal E, Erdoğan MF. The effect of improved periodontal health on metabolic control in type 2 diabetes mellitus. Journal of clinical periodontology. 2005;32(3):266-72.
26. Darré L, Vergnes J-N, Gourdy P, Sixou M. Efficacy of periodontal treatment on glycaemic control in diabetic patients: a meta-analysis of interventional studies. Diabetes & metabolism. 2008;34(5):497-506.