Review Article

Periodontitis and Diabetes: A Bidirectional, Cyclical Relationship - A Brief Review

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Abstract

Diabetes mellitus and periodontitis have been said to have a bidirectional cyclical relationship, with diabetes leading to oral disease, and periodontitis, in turn, exacerbating hyperglycemia. Periodontitis is recognized as the sixth major complication of diabetes, having increased prevalence and severity in patients with diabetes. Early diagnosis of diabetes in patients with periodontitis can lead to the prevention of major morbidity and mortality associated with the disease. Therapy for diabetes may also lead to the improvement of periodontitis. In this review, we are presenting the current knowledge of the interplay and interaction between these two entities and the available data regarding treatment of the two entities together.

Keywords: Oral health in diabetes, Periodontitis and diabetes, periodontitis

Introduction

The oral cavity is home to a vivid milieu of infectious agents, and its condition more often reflects the progression of systemic pathologies. There has been recently a shift in the paradigm from a traditional "oral cavity only" thought process to a systemic connection between the oral cavity and the internal milieu.[1]

Periodontitis is a chronic inflammatory disease characterized by the destruction of supporting structures of the teeth (periodontal ligament and alveolar bone).[2] Severe periodontitis has a prevalence of 10%–15% in the general population and has been shown to increase the risk of a first myocardial infarction as well as subclinical atherosclerotic heart disease.[1,3,4] It has been associated with the future cognitive decline, with poor control of hypertension, and with chronic obstructive pulmonary disease.[5-7] Periapical periodontitis has been shown to affect insulin sensitivity and exacerbate nonalcoholic steatohepatitis.[8,9]

Diabetes affects more than 415 million people worldwide and 69 million people in India.[10,11] It has reached an epidemic status and is predicted to affect 592 million people by 2035.[12] The prevalence of diabetes is likely to increase more in India compared to other countries.[12] An upsurge in diabetes has also led to an increase in various complications due to longer disease duration; neuropathy being the most common, followed by cardiovascular, renal, ocular, and foot complications.[13-15] Furthermore, Indians are more prone to the earlier development of diabetic complications (20–40 years) than Caucasians (>50 years) which means diabetes must be carefully screened in the Indian population.[16]

Complications of diabetes pose a severe problem and cause the majority of morbidity and mortality in this population. Diabetes is associated with an increased susceptibility to infections, poor wound healing, and is hailed as a major risk factor for more severe and progressive periodontitis, leading to the destruction of tissues and supporting bone that forms the attachment around the tooth.[4]

In this brief review, we are going to discuss the interrelationship between these two closely linked diseases based on available literature.

Effect of Diabetes on Periodontium

The influence that diabetes exerts on oral health has been extensively studied. Aggressive periodontitis was found as the sixth serious complication of diabetes as early as 1993.[17]

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Available data show a strong evidence in favor of considering diabetes as a risk factor for gingivitis and periodontitis. The risk of periodontitis is increased by threefold in patients with diabetes compared to nondiabetics.[18,19] Studies on the Pima Indian population in the 1990s showed that the prevalence and incidence of periodontitis were higher in patients with type 2 diabetes mellitus (DM) compared to those who did not.[20] Tooth loss in Pima Indians with type 2 diabetes was reported to be 15 times higher than in those without diabetes.[19-21]

Furthermore, the level of glycemic control appears to be particularly significant and must be taken into account.[22,23] Higher values of glycated hemoglobin (HbA1C) are reported in children and adolescents with periodontitis.[24,25] Type 1 diabetic patients with poor glycemic control over preceding 2–5 years have a significantly greater prevalence of deep probing depths and advanced attachment loss compared to those with good metabolic control.[26] Indian studies have also shown increased gingival inflammation, more dental plaque, increased PPDs, and attachment loss in patients with HbA1c >8, compared to those with HBA1c ≤7 and HBA1c = 7–8.[27] Poor glycemic control leads to 11-fold increased risk for alveolar bone loss over 2 years period compared to controls.[28]

However, this association appears to be similar to the association between glycemic control and other classic diabetes complications such as retinopathy and nephropathy. Thus, while poor control of diabetes clearly increases the risk of diabetes complications including periodontitis, not all patients with poor glycemic control develop major complications. Conversely, some well-controlled diabetics may as well suffer some major diabetic complications. Many well-controlled patients with diabetes have excellent periodontal health, others do not.[29] However, this assumption should not deter one from aggressive treatment of either within the limits of the patient's clinical status. Most certified diabetes educators agree that there is a link between oral and systemic health and that collaboration with the dental profession would be a positive outcome for patients.[30]

Some evidence has shown a varying response to the therapy of periodontal disease in patients with diabetes. In general, how diabetes adversely affects outcomes of periodontal disease has not been a much-researched topic. Most studies evaluating such are old, done in the 1990s. Well-controlled patients with diabetes have a similar response to the standard response protocol (SRP) like that of nondiabetics. However, those with poor control have a rapid recurrence of deep pockets and a poorer long-term prognosis.[31] On the contrary, a recent study on 41 patients with diabetes and 21 nondiabetic individuals did not show statistically significant differences in treatment success of chronic periodontitis in the two arms. The study concluded that the researchers "did not absolutely support the assumption that the level of glycemic control significantly affected the periodontal therapy outcome in diabetics."[32]

Poorly controlled diabetes has in general been considered as a relative contraindication to dental implant treatment because of higher failure rates.[33] However, whether this logic extends to periodontal treatment remains to be studied. Considering the role of poor glycemic control in severe periodontal disease, and the fact that periodontal disease tends to act like other complications of diabetes, it would only be logical to assume that poor glycemic control might portend poorer prognosis of the periodontal disease. However, well-conducted larger studies to substantiate this observation are currently lacking.

Effect of Odontium on Diabetes

A two-way interrelationship between diabetes and periodontitis is said to exist.[2,18]

Periodontitis is characterized by chronic inflammation, and inflammation can promote insulin resistance and dysregulate glycemia. In fact, the prevalence of periodontitis is higher in patients with albuminuria as well.[34] A 2-year longitudinal trial showed that diabetic patients with severe periodontitis at baseline had 6 times higher risk of worsening glycemic control.[28] Periodontitis has been shown to increase the mortality rate in individuals with chronic kidney disease from 32% to 41%. For patients also having diabetes, the 10-year all-cause mortality rate increases to 43%.[35]

Back in 2009, a review of 25 studies suggested a small but significant 0.79% reduction in the HbA1c level after proper periodontal treatment.[36] However, subsequent large systematic reviews and meta-analyses have failed to support this observation.

In 1999, a review showed inconclusive evidence that periodontal therapy could improve glycemic control.[37] A Cochrane database systemic review done in 2010 showed some evidence in the improvement of metabolic control after treating periodontal disease although the authors concluded that the individual studies included, lacked the power to detect a significant effect.[38] An absolute difference of 0.27% in HbA1c was recently reported with treatment.[39]A recent Cochrane Database systemic review included 35 studies and 2565 participants to investigate the effect of periodontal therapy on glycemic control in people with DM. The review found low-quality evidence that the treatment of periodontal disease by SRP improves glycemic control with a mean HbA1C reduction of only 0.29% at 3–4 months. Furthermore, there was insufficient evidence that this is maintained beyond 4 months. Ongoing periodontal treatment may be required to maintain clinical improvement beyond 6 months.[40]

Another very recent overview of systematic reviews on the effectiveness of periodontal treatment in improving glycemic control have identified 11 systematic reviews with meta-analyses and did not support the theory that periodontal treatment improves glycemic control. An average reduction of 0.46% in HbA1c with median 0.40% was identified in patients with diabetes who received periodontal treatment.[41]

Chronic inflammation has been proposed as the underlying mechanism linking poor odontal health to glycemic control.[2,25]

Chronic periodontal infections with Gram-negative organisms may exacerbate insulin resistance. Organisms such as *Porphyromonas gingivalis, Tannerella forsythensis*, and *Prevotella intermedia* lead to higher C-reactive protein (CRP), interleukin-6 (IL), and fibrinogen levels.[42] Furthermore, systemic bacteremia or toxemia might play an independent part in exacerbating the inflammatory process. It is already known that obesity, atherosclerosis, diabetes and insulin resistance all are linked with chronic inflammation. For example, blocking tumor necrosis factor alpha (TNF-α) improves insulin sensitivity and production of IL-6, TNF-α, and CRP are interlinked.[43]

A ligature model of alveolar bone loss in Zucker fatty rats showed that periodontitis was associated with deterioration in glucose metabolism.[44]

A shift in the monocyte/macrophage phenotype may result in the overproduction of pro-inflammatory cytokines in response to periodontal infection, in patients with diabetes.[45]

TNF-alpha has been proposed as the culprit to interlink periodontal disease and diabetes. Elevated TNF-a levels stimulate fibroblasts leading to the synthesis of matrix-degrading enzymes and stimulate osteoclasts leading to active bone resorption.[45,46]

Conclusion

The association between diabetes and inflammatory periodontal disease has been studied extensively. The relationship between these two conditions appears not only bidirectional but cyclical. Not only does diabetes predisposes the individual to oral disease but also periodontitis once established exacerbates diabetes and worsens the metabolic control.

It has been shown that the undiagnosed diabetics and prediabetics can be diagnosed in the dental office by chair-side HbA1c readings. Over 30% of patients with periodontitis could be harboring a yet unknown prediabetes or diabetes.[47] Longer the time they stay undiagnosed, easier they develop the complications. Furthermore, untreated diabetes may be associated with greater complications related to the management of periodontitis itself, including infections which might account for studies showing better benefit with antibiotics along with SRP for periodontitis management.

Some of the patients could have benefitted from a routine periodontal examination early in the course of their diabetes, and this could perhaps have prevented grave complications. Furthermore, it might be the time that diabetologists, internists, and endocrinologists refer their patients more often to periodontists before finalizing the treatment plans.

Proper management of the blood sugar levels may improve the oral health of DM patients. Routine evaluation for diabetic status in patients with undiagnosed diabetes may identify such patients at early stages of the disease, preventing the future complications.

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Conflicts of interest

There are no conflicts of interest.

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