# Diabetes Mellitus – A Risk Factor For Periodontal Disease

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**Abstract**

Diabetes mellitus is a systemic disease with several major complications affecting both the quality and length of life. Periodontitis is a recognised complication of diabetes, and is much more than a localized oral infection. In addition to elevated glucose levels, many other pathophysiological changes in diabetics predispose the diabetic to periodontal disease. This paper reviews the various factors leading to periodontal disease, analyzes the two-way theory of Grossi and Genco, and the treatment options available.

## INTRODUCTION

Over the past 50 years, researchers have explored the relationship between periodontal disease and diabetes mellitus.[1] Periodontal disease has been identified as a major complication of diabetes, along with cardiopathy, nephropathy, neuropathy, retinopathy and loss of distal extremities.[2,3] An increased level of glucose in the blood, along with the metabolic products of glucose, is thought to contribute to these complications.[4,5]

Periodontal disease results from an immune response of an individual to chronic infection of gram-negative bacteria, which leads to the destruction of the periodontal tissues, including the gingiva, periodontal ligament and alveolar bone.[6] Risk factors for periodontal disease include the presence of specific subgingival microorganisms, smoking and diabetes mellitus.[7]

Diabetes mellitus is the most common endocrine disorder. It is the result of a malfunction of insulin-dependent glucose and lipid metabolism.[8,9]

There are two major forms of diabetes mellitus:

- Type 1, which is caused by the destruction of pancreatic beta cells that produce insulin.
- Type 2, in which target tissues do not respond to insulin.8

Type 1 diabetes is considered an absolute deficiency of insulin and is commonly diagnosed at a young age. Type 2 diabetes is associated with insulin resistance and deficiency both, and is commonly diagnosed later in life.

Individuals with diabetes are more likely than non-diabetics [7,10,11,12] to develop gingivitis and periodontal disease. This holds true for both type 1 and type 2 diabetes.[8]

Indicators of periodontal disease, which are seen more frequently in diabetic individuals, include increased gingival pocket depth, loss of alveolar bone and loss of dentition.[13] Furthermore, diabetics with poor glycemic control have more attachment loss than well-controlled diabetics with similar oral hygiene.[14] Maintaining glycosylated hemoglobin (HbA1c) levels at 7% is considered the target for glycemic control and has been associated with fewer long-term complications.[15]

## PATHOPHYSIOLOGY

Diabetics have an oral bacterial flora similar to that found in nondiabetics, but their response to infection is not the same.[1,5] Diabetics have been shown to have markers of systemic inflammation, and it has been postulated that this inflammatory state can lead to increased destruction of the chronically infected periodontium. These markers include elevated C-reactive protein, fibrinogen and decreased albumin.[5] Not only do diabetics have increased levels of systemic pro-inflammatory mediators, the local environment of the periodontium is also affected by higher levels of inflammation. An example of local inflammation occurs when monocytes increase production of inflammatory cytokines in response to insult; this increase in inflammatory mediators remains even after removal of the offending stimulus.[5,16] Diabetics, therefore, have increased systemic

and local inflammation, which contributes to increased destruction of the periodontium.

Furthermore, diabetics have an altered response to wound healing and an abnormal immune response. Fibroblast function is impaired due to the high levels of glucose, and collagen availability is decreased by higher levels of the proteins that degrade collagen, that is, matrix metalloproteinases.[1] The decreased fibroblast function and collagen availability alter the healing response in diabetics. The immune response, which is considered a characteristic trait of diabetes, includes abnormal chemotaxis; adherence and phagocytosis of neutrophils.[1] This provides an altered environment in which oral bacteria can thrive; therefore, systemic and local inflammation, altered wound healing and an abnormal immune response contribute to destruction of the periodontium in diabetic individuals.

The structural and microvascular damage resulting from advanced glycosylation end products (AGE) has an impact on the rate of wound healing following any insult. Prolonged exposure to elevated levels of glucose leads to an irreversible glycosylation of blood and tissues called AGE products. AGE is thought to be the primary cause of major diabetic complications, such as vascular lesions, neuropathy and immunologic dysfunction. The products of AGE affect capillary function,blood perfusion of tissues and organs, and cytokine levels. This, in turn, affects the inflammatory response and directly affects cellular function.[1,5] AGE acts through its interaction with cell receptors for AGE, or RAGE. The RAGE receptors are increased at sites where AGEs accumulate. The cellular response to the AGE-RAGE interaction results in the gene expression of cytokines, growth factors, adhesion molecules, immunoregulatory and acute phase proteins. These are the very molecules responsible for inflammation and recruiting inflammatory cells. In fact, they are necessary for a maximal inflammatory response.[5]

Bacterial byproducts from periodontal infections, such as lipopolysachharide (LPS), act through distinct pathways to increase inflammation.[5] The synergistic effect of impaired fibroblasts and neutrophils, decreased levels of collagen and hyperresponsive inflammatory cells, coupled with the effects of AGE-RAGE and LPS, impairs wound healing in the periodontium of diabetics. Ultimately, this results in destruction of the periodontium.

Grossi and Genco proposed a model in which severe periodontal disease increases the severity of diabetes mellitus.[17] They describe a “two-way relationship,” where both periodontal disease and diabetes mellitus interact to increase tissue destruction in periodontitis. Chronic infection, LPS and AGE result in an increased inflammatory response that accounts for tissue destruction in the periodontium of diabetics. However, they also propose that periodontal infection induces a state of chronic insulin resistance that alters the metabolic control of glucose. Thus, a degenerative cycle ensues in which diabetes leads to a decline in the periodontal condition, which, in turn, affects metabolic control of glucose and has a negative impact on the diabetic state.

The mechanisms by which periodontal diseases may affect the diabetic state have been elucidated only recently. Similar to systemic bacterial and viral infections, which result in increased systemic inflammation and subsequent insulin resistance that makes control of blood glucose levels difficult, chronic periodontal diseases also have the potential to exacerbate insulin resistance and worsen glycemic control. While periodontal treatment that decreases inflammation has been shown to diminish insulin resistance. In patients with diabetes, hyperinflammatory immune cells can exacerbate the elevated production of proinflammatory cytokines resulting in elevated serum levels of proinflammatory cytokines. This has the potential to increase insulin resistance and make it more difficult for the patient to control his or her diabetes. It also may explain the research showing a greater risk of poor glycemic control in patients with diabetes who have periodontitis compared with that in patients with diabetes who do not have periodontitis, as well as the research showing improvement in glycemic control after periodontal therapy in some patients with diabetes.[18]

## CLINICAL FEATURES

The common oral manifestations of diabetes include the following: gingivitis; periodontal disease; multiple periodontal abscesses, xerostomia and salivary gland dysfunction; recurring bacterial,viral and fungal (Candida) infections; dental caries; periapical abscesses; loss of teeth; delayed wound healing; burning mouth syndrome; taste impairment; and oral lichen planus.[19]

Gingivitis & Periodontitis[20]: Persistent poor glycemic control has been associated with the incidence and progression of gingivitis, periodontitis and alveolar bone loss. A clinician can easily observe these diseases in the oral cavity. Common signs being bleeding gums, mobility of teeth, bad taste, receding gingivae exposing roots of the teeth, migration of

teeth from their original position and development of spacing between teeth.

Xerostomia & Salivary gland dysfunction[20]: People with diabetes have been reported to complain of dry mouth, or xerostomia, and experience salivary gland dysfunction. The cause is unknown, but may be related to polyuria or to alterations in the basement membranes of salivary glands. Xerostomia can lead to further complications like increased caries & oral candidiasis as discussed below.

Oral infections[20]: Another manifestation of diabetes and an oral sign of systemic immunosuppression is the presence of opportunistic infections, such as oral candidiasis. Candida pseudohyphae, a cardinal sign of oral Candida infection, can be easily identified in patient mouth. It usually appears as which curd like deposit on the oral mucosal surface which can be easily removed from the underlying surface.

Dental caries & periapical pathologies[20]: The relationship between diabetes and dental caries has been investigated, but no clear association has been clarified. It is important to note that patients with diabetes are susceptible to oral sensory, periodontal and salivary disorders, which could increase their risk of developing new and recurrent dental caries. These caries can in turn lead to periapical pathologies like periapical abscess, which is an acute condition presenting as a round to oval pus filled swelling in the alveolar mucosa. It is an extremely painful condition and should be treated immediately, otherwise leading to complications like space infections & cellulitis.

Neurosensory disorders[20]: Patients with diabetes have reported increased complaints of glossodynia and stomatopyrosis. A poorly understood orofacial neurosensory disorder called burning mouth syndrome has been allied with diabetes mellitus. Long-lasting oral dysesthesias experienced by patient could adversely affect oral hygiene maintenance.

Taste disturbances[20]: Taste is a critical component of oral health that is affected adversely in patients with diabetes. Hypogeusia or diminished taste perception could result in hyperphagia and obesity. This sensory dysfunction can inhibit the ability to maintain a proper diet and can lead to poor glycemic regulation.

Oral mucosal diseases[20]: There are reports of greater prevalences of lichen planus and recurrent aphthous stomatitis in diabetic patients. They may be due to chronic immunosuppression and require continued follow-up by health care practitioners. Oral mucosal disorders represent an opportunity to coordinate diabetes care between physicians and dentists, which can improve the referral of patients to oral health practitioners. Lichen planus presents itself as white radiating lines called Wickhams stria on the oral mucous sometimes with similar lesions on the extremities.

Halitosis/Bad breath[20]: Diabetic patient may also present with halitosis because of the xerostomia in controlled diabetics and acetonic breath in the uncontrolled diabetics. Halitosis in such patients can be controlled and treated with proper guidelines given by oral health practioner.

The gingival and periodontal signs which may alert the clinician that the patient has previously undiagnosed diabetes or that the patient's diabetes is poorly controlled, include:

persistence of gingival inflammation after standard periodontal treatment (thorough supra-and subgingival scaling and cleaning, oral hygiene instruction)

severe gingival inflammatory response to plaque and proliferation of gingival tissues at the gingival margin

continuing alveolar bone loss despite periodontal treatment

severe, aggressive periodontitis in people 20 - 45 years of age (deep periodontal pocketing, increased tooth mobility and tooth migration, causing teeth to over-erupt or spaces to open between teeth, and radiographic evidence of advanced bone loss) simultaneous formation of multiple periodontal abscesses. [21]

This extensive list of potential oral conditions signifies the importance of proper dental management for diabetic patients.

## TREATMENT CONSIDERATIONS FOR DIABETIC PATIENT

Treatment considerations for diabetic patients emphasize the importance of soft tissue management to reduce the risk of infection.

Acute oral infections should be treated aggressively because of the altered healing response of diabetic patients. Recall appointments should be provided more frequently. Emphasis on proper home care and oral hygiene is essential and should include instruction to brush twice daily and use dental floss regularly. Short morning appointments with treatment breaks are beneficial.

When surgery is necessary, consultation with the patient’s

physician should be considered to properly manage medication, insulin dosage and timing, and meal schedules. Therefore, comprehensive diabetes treatment is a team-oriented approach. HbA1c levels provide an excellent indication of glycemic control. A glucometer finger stick can also be used to provide a fast and effective measure of current blood glucose levels.[20] Both HbA1c and glucose testing can be done in the dental office via simple finger sticks.

Antibiotic coverage may be indicated for surgical procedures, especially for patients with poor glycemic control.[19,20]

If the patient has poor glycemic control and surgery is absolutely needed, prophylactic antibiotics may be given. Penicillins are most often used for this purpose. Therapy should be initiated 1 hour before procedure with a 2g dose of amoxicillin. If the patient is allergic to penicillin then clindamycin 600 mg or azithromycin 500mg can be given 1 hr before procedure. Anticipation of dentoalveolar surgery with antibiotic coverage may help prevent impaired and delayed wound healing. Cultures should be performed for acute oral infections, antibiotic therapy initiated and surgical therapies contemplated if appropriate. In cases of poor response to the first antibiotic administered, dentists can select a more effective antibiotic based on the patient's sensitivity test results.

Systemic antibiotics are not needed routinely, although recent evidence indicates that tetracycline antibiotics in combination with scaling and root planing may positively influence glycemic control. Systemic antibiotics may eliminate residual bacteria following scaling and root planing, further decreasing the bacterial challenge to the host. Tetracyclines are also known to suppress glycation of proteins and to decrease activity of tissue-degrading enzymes such as matrix metalloproteinases. These changes may contribute to improvement in metabolic control of diabetes.

Diabetic patients may experience a hypoglycemic episode, most commonly as a result of delayed meals, or excess circulating insulin, in the OPD, while waiting for an appointment. It is, therefore, essential to have sources of glucose readily available in case of a hypoglycemic episode.

## ROLE OF THE PERIODONTIST

There are large numbers of undiagnosed individuals with diabetes. The dental professional is, therefore, in a prime position to recognize those patients at risk and to inform and provide them with the best possible course of therapy.[22] The oral signs and symptoms of the diabetic patient can be important indicators of the risk of both periodontal disease and future diabetic complications. and symptoms related to dental structures may furnish clues about the presence of diabetes.

Dry mouth and thirst are classic symptoms of diabetes mellitus, and an increased incidence of thrush is considered a complication of diabetes. Rapid alveolar bone loss and acute or multiple periodontal abscesses suggest the presence of uncontrolled diabetes.

The relationship between diabetes and periodontal disease has led to important treatment planning considerations for the diabetic patient. A current theoretical concept is that periodontal treatment can have a positive effect on glycemic control of the diabetic patient and is based on the relationship between the mechanisms of periodontitis and diabetes. Patients should be informed that periodontal infection may make it more difficult to control diabetes and conversely, poor diabetic control may increase susceptibility to periodontal infection.

## ROLE OF THE DIABETOLOGIST

Regular communication of dentist with diabetologist is a critical component of safely treating patients with diabetes.Communication must be bidirectional, diabetologist must be apprised of oral manifestations of the disease and dentists must be updated on glycemic control to help them maintain a patient's oral health. Diabetologist should be well aware of the signs & symptoms of periodontitis, making a prompt diagnosis of the condition, as periodontitis can also lead to poor control of diabetes.

Treating patients with diabetes also represents an opportunity to expand a dentist's referral base. Physicians who treat children and adults with diabetes could be a good referral source of patients whose oral health care needs may not be satisfied adequately.

Most forms of dental therapy should not interfere with the medical control of diabetes. However, dentoalveolar surgery, orofacial infections and the stress of dental procedures can increase serum glucose levels and metabolic insulin requirements. Therefore, dentists must consider modifying medical therapy in consultation with the patient's diabetologist.

Medications used by dental professionals may require adjustment of diabetes-associated therapies. For example, small amounts of systemic corticosteroids can severely worsen glycemic control; patients taking oral hypoglycemic agents who are placed on steroid therapy may require short-term insulin therapy to maintain glycemic control.

## CONCLUSION

Diabetes is a medical condition with distinct oral manifestations, including the potential for severe periodontal disease. An extensive amount of research has examined the relationship between periodontal disease and diabetes, and it is clear that they share many biological mechanisms.Careful management of the diabetic patient may greatly reduce the potential for a decline in oral health as well as overall glycemic control. Therefore, preventing infection through local measures and reducing susceptibility to infection by maintaining good control of diabetes are primary steps in the prevention of periodontal complications. Medical and dental practitioners need to be aware of the interrelationship between poorly controlled or undiagnosed diabetes mellitus and chronic gingivitis and periodontitis. This is particularly important because of the rising prevalence of diabetes in the Indian population.

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