

# Diabetes Mellitus and its Impact on Dental Treatment: An Overview

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## Abstract

Diabetes is a common disease with concomitant oral manifestations that impact dental care. The purpose of this review is to summarize the prevalence, signs, symptoms, diagnosis and treatment of diabetes, as well as dental treatment considerations for the patient with diabetes. Safely managing the patient with diabetes requires effective communication among multiple health care providers. Dentists must be familiar with techniques to diagnose, treat and prevent stomatological disorders in patients with diabetes.

**Keywords:** Diabetes; Oral manifestations; Dental treatment; Stomatological disorders.

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## Introduction

Diabetes mellitus is a syndrome of abnormal carbohydrate, fat and protein metabolism that results in acute and chronic complications due to the absolute or relative lack of insulin. There are three general categories of diabetes: type 1, which results from an absolute insulin deficiency; type 2, which is the result of insulin resistance and an insulin secretory defect; and gestational, a condition of abnormal glucose tolerance during pregnancy.

According to the (WHO), at least 220 million people or 2.8% of the population worldwide suffer from diabetes. Its incidence is increasing rapidly, and is estimated that by the year 2030, this number will almost double. The increase in incidence of diabetes in developing countries follows the trend of urbanization and lifestyle changes.[1]

Research suggests that people with diabetes are at higher risk for oral health problems, such as gingivitis (an early stage of gum disease)

and periodontitis (serious gum disease). People with diabetes are at an increased risk for serious gum disease because they are generally more susceptible to bacterial infection, and have a decreased ability to fight bacteria that invade the gums. Therefore, dental professionals can play an important role in diagnosing and managing patients with diabetes.

Unfortunately, caring for the oral cavity is often overlooked when trying to control other problems associated with diabetes which may contribute to hidden morbidity and undue suffering from oral health problems. Owing to the growing prevalence of diabetes, as well as the increased effectiveness of diagnostic and therapeutic protocols, researchers have predicted that dental practitioners will be treating more patients with this disease.[2]

### *Systemic Aspects of Diabetes*

1. *Signs and Symptoms:* The classical symptom of Type 1 diabetes is very rapid and includes: polyuria (frequent urination), polydipsia (increased thirst), Xerostomia (dry mouth), polyphagia (increased hunger), fatigue, and weight loss. Symptoms of type 2 diabetes develop more slowly, and frequently without the classic symptoms. Diabetes can damage and affect eyes (retinopathy, cataracts), kidneys (nephropathy), nervous system (neuropathy and paresthesias), and

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heart (accelerated atherosclerosis), as well as recurrent infections and impaired wound healing.[3]

An insulin-deficient patient with acute hyperglycemia often may have a “fruity” breath. It is less common to encounter a dental patient with acute signs and symptoms of hyperglycemia. Signs and symptoms of hypoglycemia include confusion, sweating, tremors, agitation, anxiety, dizziness, tingling or numbness, and tachycardia. Severe hypoglycemia may result in seizures or loss of consciousness. It is the major issue that confronts dental practitioners when treating diabetic patients, particularly if patients are fasting.

2. *Diagnosis:* Blood tests are used to diagnosis diabetes and prediabetes because early in the disease type 2 diabetes may have no symptoms. It is characterized by recurrent or persistent hyperglycemia, and is diagnosed by demonstrating any one of the following[4]:

- Fasting plasma glucose level<sup>3</sup> 7.0 mmol/l (126 mg/dl)
- Plasma glucose <sup>3</sup> 11.1 mmol/l (200 mg/dL) two hours after a 75 g oral glucose load as in a glucose tolerance test
- Symptoms of hyperglycemia and casual plasma glucose <sup>3</sup> 11.1 mmol/l (200 mg/dl)
- Glycated hemoglobin (Hb A1C) <sup>3</sup> 6.5%. [5]

People with fasting glucose levels from 110 to 125 mg/dl (6.1 to 6.9 mmol/l) are considered to have impaired fasting glucose.[6] Patients with plasma glucose at or above 140 mg/dL (7.8 mmol/L), but not over 200 mg/dL (11.1 mmol/L), two hours after a 75 g oral glucose load are considered to have impaired glucose tolerance. The measurement of glycosylated Hemoglobin or HbA1c is a good measure of long term (6-12 weeks) glucose regulation.

3. *Treatment:* Diabetes is not a curable disease, and therapy has four goals:

- Dietary and exercise modifications
- Medications

- Appropriate self-monitoring of blood glucose (SMBG)
- Regular monitoring for complications

Oral hypoglycemic medications depend on functioning pancreatic beta cells to stimulate insulin secretion and, therefore, are used to treat many patients with type 2 diabetes. Insulin is required for patients with type 1 diabetes, as well as for patients with type 2 diabetes who do not respond to dietary therapy alone or in combination with oral hypoglycemic therapy. Diet and physical exercise are a necessary component of therapy for patients with both type 1 and type 2 diabetes.

Blood glucose or glycemic control is fundamental to the medical management of diabetes; prolonged and severe hyperglycemia is associated with systemic and oral complications. Thus, a management plan is needed. This plan should be formulated as an individualized therapeutic alliance among the patient and family, the physician and other members of the health care team, including the family dentist and dental hygienist, and the nutritionist. Acute hyperglycemia after meals is associated with increased free-radical production that can lead to tissue toxicity and damage, and, ultimately, may be associated with renal failure. Acute hyperglycemic spikes (or excursions) after a two-hour postload are associated with an increased risk of death, independent of fasting blood glucose. The risk of microvascular disease increases with the progression in postprandial glucose levels from 180 to 260 mg/dL.[7] Thus, tight control in current medical therapy now includes a shift to a new focus: constant, daily self-monitoring of blood glucose with a glucometer, four to six times per day, and often before and after meals to target postprandial levels and to minimize the occurrence of acute hyperglycemia and acute tissue toxicity. The glycosylated hemoglobin, or HbA1c, test is used widely to assess glycemic control over a three to four month period. The goal of medical management is to target HbA1c values to less than 7.0 percent, or less than 150 milligrams/

deciliter of blood glucose on average, every three to six months.

Nutritional supervision is a critical component of diabetes management, and dentists can assist in this endeavor. Risk factors for impaired nutritional intake include gingivitis and periodontitis, oral microbial infections, poorly fitting or lack of removable prostheses, dysphagia and salivary dysfunction. A realistic nutritional plan that includes regular oral hygiene and requisite dental treatment can help patients maintain good blood glucose control and nutritional status.[8]

#### *Oral Aspects of Diabetes*

Several soft tissue abnormalities have been reported to be associated with diabetes mellitus in the oral cavity. These may include, but are not necessarily limited to, gingivitis and periodontal disease; xerostomia and salivary gland dysfunction; oral candidiasis (that is increased susceptibility to bacterial, viral and fungal infections); caries; periapical abscesses; loss of teeth; impaired ability to wear dental prostheses (related in part to salivary dysfunction); taste impairment; lichen planus; and burning mouth syndrome.[9]

- *Gingivitis and periodontal disease:* The susceptibility to periodontal disease is the most common oral complication of diabetes. The patient with poorly controlled diabetes is at greater risk of developing periodontal disease. The mechanism by which hyperglycaemia can induce periodontal destruction is not yet fully understood. However, there are many theories which propose factors such as advanced glycation end products, changes in collagen statue, and altered immune function that causes impaired polymorphonuclear leukocyte function which may facilitate bacterial persistence in the tissue and the accumulation of advanced glycation end products, which results from prolonged and chronic hyperglycaemia and increased secretion of pro-inflammatory cytokines such as

tumour necrosis factor- $\alpha$  and prostaglandin E-210.[10,11] The increase in collagenase activity together with the reduction in collagen synthesis will adversely influence collagen metabolism. This would result in compromised wound healing as well as periodontal tissue destruction. Recent studies indicate that periodontitis has a bidirectional effect on glycaemic control in patients with diabetes.[12] There is a cluster of research studies, which support the hypothesis of periodontitis occurring more frequently in patients with diabetes with poor glycaemic control.[12-17] In addition, there is enough evidence to support the hypothesis that poor periodontal conditions could worsen glycaemic control as well. Many studies report that diabetes is a risk factor for gingivitis and periodontitis and it is more severe with poor glycaemic control.[18] The risk of developing periodontitis in patients with diabetes has been reported to be three times higher than the general population.[19]

In addition, evidence supports the observation that periodontal infections contribute to problems with glycemic control.[20] For example, adults with diabetes who received ultrasonic scaling and curettage in combination with systemically administered doxycycline therapy demonstrated, at three months, significant reductions in mean HbA1c, reaching nearly 10 percent from the pretreatment values.[21] The mechanisms for this relationship are undergoing investigation and require validation.[22] However, evidence suggests that periodontitis-induced bacteremia will cause elevations in serum proinflammatory cytokines, leading to hyperlipidemia, and ultimately causing an insulin-resistance syndrome and contributing to destruction of pancreatic beta cells.[23] Treating chronic periodontal infections is essential for managing diabetes.[24]

- *Xerostomia and Salivary gland*

*dysfunction*: People with diabetes have been reported to complain of dry mouth, or xerostomia[25], and experience salivary gland dysfunction[26-28]. There are reports of dry mouth complaints (xerostomia) and salivary hypofunction in patients with diabetes[29-31], which may be due to polyuria, or an underlying metabolic or endocrine problem. When the normal environment of the oral cavity is altered because of a decrease in salivary flow or alteration in salivary composition, a healthy mouth can become susceptible to dental caries and tooth deterioration. Dry, atrophic and cracking oral mucosa is the eventual complication from insufficient salivary production. Difficulty in lubricating, masticating, tasting and swallowing are among the most devastating complications from salivary dysfunction and may contribute to impaired nutritional intake.

- *Candidiasis*: Another manifestation of diabetes and an oral sign of systemic immunosuppression is the presence of opportunistic infections, such as oral candidiasis.[32,33] Oral lesions associated with candidiasis include median rhomboid glossitis (central papillary atrophy), atrophic glossitis, denture stomatitis, pseudomembranous candidiasis (thrush) and angular cheilitis. *Candida albicans* is a constituent of the normal oral microflora that rarely colonizes and infects the oral mucosa without predisposing factors. These include immunologically compromised conditions (for example, AIDS, cancer or diabetes), the wearing of dentures in conjunction with poor oral hygiene and the long-term use of broad-spectrum antibiotics. Salivary dysfunction, compromised immune function and salivary hyperglycemia that provide a potential substrate for fungal growth are the major contributing factors for oral candidiasis in patients with diabetes.
- *Dental Caries*: It is well known that patients with diabetes are susceptible to oral infections that lead to tooth decay and

loss.[34] 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. For example, several studies have reported a greater history of dental caries in people with diabetes.[35,36] Factors for caries development include the traditional elements (for example, *Streptococcus mutans* levels, previous caries experience), as well as poor metabolic control of diabetes[37], underscoring the need for dental professionals to follow up all patients with diabetes on a regular basis for new and recurrent dental decay.

- *Neurosensory and Visual Disorders*: Neurosensory disorders of the oral and perioral tissues, including burning mouth syndrome and dysphagia, have been reported in patients with diabetes.[38] Prevalence data are not available. Retinopathy and peripheral neuropathy that affects patients' hands may severely limit a patient's ability to perform oral hygiene procedures.

*Treatment*: Patients with poorly controlled diabetes are at risk of developing oral complications because of their susceptibility to infection and will likely require supplemental antibiotic therapy.[39] Medications used by dental professionals may require adjustment of diabetes-associated therapies. General management for dental patients should include assessing glycemic control, referring those patients who have signs of uncontrolled diabetes to a physician for diagnosis and treatment, consulting with patients' physicians when systemic complications exist, aggressively treating oral infections and encouraging patients who smoke to stop smoking, scheduling patients' for frequent dental visits and using a glucometer to avoid diabetes-related emergencies. Though patients with controlled diabetes can usually tolerate dental surgical procedures, it is important that they consume a normal diet following surgery to avoid low blood sugar and insulin shock.

## Conclusion

Diabetes mellitus affects people of all ages, and its prevalence has been increasing. Dentists can play a key role in helping diabetic patients achieve and maintain glycemic control by treating oral infections and educating patients about the importance of maintaining unstinting oral hygiene. Patients with well-controlled diabetes who are maintaining appropriate glycemic levels can usually undergo any dental treatment that a healthy patient can. However, in patients with poorly managed or uncontrolled diabetes, consulting with the treating physician is necessary to avoid complications, contraindications and litigation. Of course, this works both ways—the physician must regularly refer diabetic patients for dental check-ups to maintain proper oral care, leading to overall optimal health management

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