Periodontal Management of the Diabetic Patient

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Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

Conflict of Interest Disclosure Statement
• The author reports no conflicts of interest associated with this course.

Introduction – Diabetic Patient
Periodontal Management of the Diabetic Patient provides information to assist clinicians in understanding the diabetes mellitus disease state and how it affects the course and treatment of periodontal diseases. The course reviews the manifestations and epidemiology of diabetes mellitus, its control and measures. It also reviews periodontal risk factors and indicators and the goals of periodontal therapies. Finally, the effects of uncontrolled diabetes on periodontal disease are discussed, as well as the effects of uncontrolled periodontal disease on diabetes mellitus. The objective of the course is to review the rationale for the importance of diagnosing and treating periodontal disease as a necessary part of the diabetic patient’s overall healthcare.
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Overview
This course reviews the management of periodontal patients with diabetes mellitus. Epidemiology, disease states, risk factors and treatment considerations are discussed and the relationship between type 1 and type 2 diabetes is reviewed. The interactions and effects of each disease upon the other are considered.

Learning Objectives
Upon completion of this course, the dental professional should be able to:
• Discuss the manifestations and epidemiology of diabetes mellitus.
• Summarize diabetic control and its measures.
• Identify periodontal risk factors and indicators.
• List the goals of periodontal therapy.
• Explain the potential consequences of uncontrolled diabetes mellitus on periodontal disease.
• Explain the potential consequences of uncontrolled periodontal disease on diabetes mellitus.
• Discuss the effects of diabetes to the response to periodontal therapies.

Manifestations and Epidemiology of Diabetes Mellitus
Diabetes mellitus is a group of diseases that is characterized by high levels of blood glucose (hyperglycemia). The high glucose levels can result from defects in insulin production, insulin action, or both. This hyperglycemia may be caused by a deficiency of insulin secretion due to pancreatic beta cell dysfunction and/or insulin resistance in the liver and muscle. Diabetes potentially can lead to serious complications including damage to the heart, eyes, kidneys, nerves and vascular system, but there are strategies to control the disease and reduce the risk of complications. Universal simplified terminology of the diabetes classifications occurred in 1997 by consensus of the American Diabetes Association and The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Diabetes classification is no longer based on the treatment or age at onset.¹

Type 1 diabetes or insulin-dependent diabetes mellitus (IDDM), previously referred to as juvenile-onset diabetes, develops when the body's immune system destroys pancreatic beta cells, the only cells in the body that make the hormone insulin that regulates blood glucose.¹ Type 1 diabetes usually occurs in children and young adults, although its onset can occur at any age. It may account for about 5% of the diagnosed cases of diabetes.²,³,⁵ Risk factors for type 1 diabetes may include autoimmune, genetic, and environmental factors.

Type 2 diabetes or non-insulin-dependent diabetes mellitus (NIDDM), previously referred to adult-onset diabetes, may account for approximately 90% to 95% of all diagnosed cases of diabetes.²,³ It usually begins as insulin resistance, a disorder in which the cells do not use insulin properly. As the need for insulin rises, the pancreas gradually loses its ability to produce insulin. Type 2 diabetes is associated with increased age, obesity, family history of diabetes,
history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity. For example, African Americans, Hispanic/Latino Americans, American Indians, and some Asian Americans and Native Hawaiians or Other Pacific Islanders have a particularly high risk for type 2 diabetes. Its incidence is increasing in children and adolescents. 2,4

Gestational diabetes is a form of glucose intolerance that can occur during pregnancy. Gestational diabetes occurs in approximately 4% of all pregnancies in the United States, but it is diagnosed more frequently among African Americans, Hispanic/Latino Americans, and American Indians. It is also more common among obese women and women with a family history of diabetes. 2,3 During pregnancy, gestational diabetes requires treatment to avoid complications in the infant. After pregnancy, 5% to 10% of women with gestational diabetes are found to have type 2 diabetes. 4 Women who have had gestational diabetes have a 20% to 50% chance of developing diabetes in the next 5-10 years. 4

Other specific types of diabetes result from specific genetic conditions (such as maturity-onset diabetes of youth), surgery, drugs, malnutrition, infections, pancreatic diseases, 5 and other illnesses. Such types of diabetes may account for 1% to 5% of all diagnosed cases of diabetes. 4

Diagnosis
There are three clinical assessments used to identify diabetes and/or risk level. A single abnormal test result is not reliable; the same test must be confirmed by repeating it on a subsequent day:

1. Diabetic symptoms including polyuria, polydipsia and unexplained weight loss + plus a casual (any time of day w/o regard to time since last meal) plasma glucose test that is (=) or (>) 200 mg/dl. 5
2. Fasting (no caloric intake for at least 8 hrs) plasma glucose test that is (=) or (>) 126 mg/dl. Normal fasting plasma glucose level is (<) 100 mg/dl. Impaired fasting glucose is defined by levels appearing between 100 and 125 mg/dl. 5
3. Two-hour postload glucose (=) or (>) 200 mg/dl during an oral glucose tolerance test (OGTT) of 75 grams of anhydrous glucose dissolved in water. Normal levels are (<) 140 mg/dl. Impaired glucose tolerance is defined by levels appearing between 140 and 199 mg/dl. 5
4. The use of a standardized A1C test for diagnosis is under consideration. 5,4

Prediabetes: Impaired Glucose Tolerance and Impaired Fasting Glucose
Prediabetes forms an intermediate stage of diabetes mellitus and presents as impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT). People assessed with these conditions have a relatively high risk of developing diabetes as well as cardiovascular and cerebrovascular disease. 2 IFG following an overnight fast, as defined in the clinical assessments, is not high enough to be classified as diabetes. Likewise, IGT in its defined range after a two-hour oral glucose tolerance test is also not high enough to be classified as diabetes.

The third national health and nutrition examination survey (NHANES III) examined a cross-section of U.S. adults aged 40-74 years from 1988 to 1994. The Center for Disease Control and Prevention (CDC) reported in 2005 of those tested in this study that 40% had pre-diabetes based on the recorded IGT or IFG or both. 5 IFG and IGT are associated with abdominal obesity, high triglycerides and/or low HDL (good cholesterol), and hypertension. Therefore, progression to diabetes among those with pre-diabetes is not inevitable as weight loss and increased physical activity can prevent or delay diabetes and may return blood glucose levels to normal. 2,3,5

Prevention or Delay of Diabetes
The results of a randomized three-year clinical trial of 3,234 adults (USA), named the Diabetes Prevention Program (DPP), supports the premise that lifestyle changes can prevent or delay the onset of type 2 diabetes among high-risk adults, including people with IGT and other risk factors. Lifestyle interventions include diet and appropriate physical activity such as walking for 2 ½ hours each week. The Diabetes Prevention Program showed a reduction in the incidence of diabetes by 58% with a systematic and intensive lifestyle intervention (150 minutes/week), which demonstrates that in a three-year period an
effect is seen of one case of diabetes prevented for every seven persons treated.\textsuperscript{5,7}

As medications have also been shown to prevent diabetes in some population groups, the second of the three random groups in the DPP studied the effect of metformin (Glucophage), a biguanide class of oral antidiabetic drugs, in the prevention/delay of type 2 diabetes. People treated with metformin showed a reduction in their risk of developing diabetes by 31% over three years. This protocol was most effective among younger, heavier people (those 25-40 years of age at 50 to 80 pounds overweight) and less effective among older people and people who were not as overweight.\textsuperscript{5,7} In a similar study, the STOP-NIDDM Trial, treatment of people with IGT with the drug acarbose (Precose) reduced the risk of developing diabetes by 25% over three years.\textsuperscript{5,8,9}

In addition to preventing progression from IGT to diabetes, both lifestyle changes and medication have also been shown to increase the probability of reverting from IGT to normal glucose tolerance.\textsuperscript{5} Bariatric surgery may be part of a comprehensive approach to diabetic prevention and/or management. Risks, costs and benefits for various patient populations are currently under study.\textsuperscript{54} However, there are currently no known methods to prevent type 1 diabetes.

**Prevention of Diabetes Complications**

Long-term diabetes can affect many parts of the body and can lead to serious complications. Vascular complications that affect small (microvascular) and large (macrovascular) vessels are linked to the duration of hyperglycemia and hypertension with the three most common microvascular disease manifestations being diabetic retinopathy, nephropathy and neuropathy.\textsuperscript{10} All three complications are prevalent in longstanding type 1 and 2 diabetes influenced by the degree of glycemic control and remain relatively asymptomatic especially in the first 10 to 20 years after the diabetes diagnosis. Prevention is essential in reducing the potential for systemic dysfunctions.

Diabetic retinopathy by macular edema, i.e., retinal thickening by capillary leakage, is the most common cause of adult blindness in the USA. The disease follows a two-stage progression starting with background retinopathy (non-proliferative) and develops into a more severe proliferative retinopathy that features rapid, abnormal new vessel formation along with perceptible focal blurring with partial or total vision loss.\textsuperscript{10,11}

Diabetic nephropathy is a progressive kidney disease where fluid filtration by the kidneys becomes impaired as the vessels within the functional units (nephrons) become weak and leak plasma proteins (serum albumin) into the urinary excretion. This sets off a cascade of fluid retention (edema) that exacerbates hypertension, which can lead to accelerated renal failure.\textsuperscript{10,12}

Neuropathy refers to nerve damage and is the most common complication and implicated in 50-75% of non-traumatic amputations. The absence of ankle reflexes is a revealing sign with most diabetics developing peripheral neuropathy as a result of impaired blood flow to nerves governing movement of the arms and legs, affecting especially the feet and hands. The loss of sensation to touch, vibration, proprioception or temperature can lead to foot ulceration, infection and destruction of normal foot architecture by the dulled perception to ill-fitting shoes and abnormal weight bearing.\textsuperscript{10,13}

Macrovascular disease manifests as coronary disease (atherosclerosis), cerebrovascular disease (stroke) and peripheral arterial disease.\textsuperscript{10} The occurrence of these and other diabetes complications can be reduced by controlling the levels of blood glucose, blood pressure, and blood lipids and by receiving and participating in preventive care practices in a timely manner.

**Glucose Control**

Research studies have found that improved glycemic control benefits people with both type 1 and type 2 diabetes. Diabetics monitor their glycemic control on a daily basis using a home glucose monitor. To assess the overall blood glucose control as an average over a three month time period, a glycated hemoglobin or A1C test is performed by a medical laboratory. The A1C test measures glucose that over time
has attached to the hemoglobin protein bound on the red blood cells with the results expressed as a percentage of glucose. In general, for every 1% reduction in the results of A1C blood tests (e.g., from 8.0% to 7.0%), the risk of developing microvascular diabetic complications (eye, kidney, and nerve disease) is reduced by 40%. Elevated HbA1c levels above 7% can increase the risk of long-term complications, given that such a reading is correlated with poorly controlled hyperglycemia.

Blood Pressure Control
Blood pressure control can reduce cardiovascular disease (heart disease and stroke) by approximately 33% to 50% and can reduce microvascular disease (eye, kidney, and nerve disease) by approximately 33%. In general, for every 10 millimeters of mercury reduction in systolic blood pressure, the risk for any complication related to diabetes is reduced by 12%. Control of Blood Lipids
Improved control of cholesterol or blood lipids, including HDL (high density lipoprotein – “good” cholesterol, carries cholesterol back to the liver for removal from the body), LDL (low density lipoprotein – “bad” cholesterol, most abundant and tends to accumulate on artery walls) and triglycerides, can reduce cardiovascular complications by 20% to 50%.

Preventive Care Practices for Eyes, Kidneys, and Feet
Detecting and treating diabetic eye disease with laser therapy can reduce the development of severe vision loss by an estimated 50% to 60%. With regards to hypertension as the second leading attributable cause of end-stage renal disease in the USA, detecting and treating early diabetic kidney disease by lowering blood pressure has been shown to reduce the decline in kidney function by 30% to 70%. Treatment with angiotensin converting enzyme (ACE) inhibitors (e.g., Ramipril) and angiotensin II receptor blockers (ARBs – e.g., Atacand® (candesartan cilexetil) are more effective in reducing the decline in kidney function than other blood pressure lowering drugs, but only in the absence of severe kidney failure. Consultation with a physician is strongly advised on the casual use of acetaminophen (Tylenol™) and to a lesser degree with aspirin as studies have shown an association with the cumulative lifetime dose and the exacerbation of chronic renal failure.

Comprehensive foot care programs can reduce amputation rates by 44% to 85% through a systematic assessment, treatment and tracking protocol. Simple measures such as routine foot inspection (at least yearly), fitting of appropriate shoes and orthotics, and management of simple foot problems, combined with patient education about the importance of self-care, lends toward decreasing the incidence of wounds in the diabetic population.

Prevalence and Incidence
The prevalence figures by the CDC are estimates compiled from their own data systems, outpatient databases (Indian Health Services – HIS), US Renal Data Systems (NIH), US Census Bureau and published studies. A question on pre-diabetes was included for the first time in the 2006 National Health Interview Survey given to a representative sample of households; approximately 24,300 adults of the ages 18 and older.

In 2015, approximately 30.3 million Americans or 9.4% of the population, have diabetes: increased from 5.1% in 1997. Of these, 23.1 million people are diagnosed with diabetes and 7.2 million people are undiagnosed. Pre-diabetes is becoming more common in the United States: the U.S. Department of Health and Human Services estimates one in three U.S. adults aged 18 years or older, or 84.1 million people, had pre-diabetes in 2015. In addition, 1.5 million new cases of diabetes were diagnosed in people aged 18 years or older in 2015.

In 2015, approximately 193,000, or 0.24% of all people under 20 years of age have diagnosed diabetes. About one in every 400 children and adolescents has diabetes.

Although type 2 diabetes can occur in youth, the national representative data necessary to monitor diabetes trends in youth by type is not available. Clinically-based reports and regional studies suggest that type 2 diabetes, although
still rare, is being diagnosed more frequently in children and adolescents, particularly in American Indians, African Americans, and Hispanic/Latino Americans.\textsuperscript{4,5,3,51}

As of 2015, approximately 23.1 million, or 7.2% of all people aged 20 years and older have either diagnosed or undiagnosed diabetes, and 11.2 million, or 25.9% of all people 65 years or older have diabetes.\textsuperscript{4,5,3,51}

As of 2015, approximately 15.3 million, or 12.7% of all men aged 20 years or older have diabetes although nearly one third of them are unaware of their condition.\textsuperscript{4,5,3,51}

And as of 2015, approximately 14.9 million, or 11.7% of all women aged 20 years or older have diabetes and again nearly one-third are unaware. The prevalence of diabetes is higher among non-Hispanic Black, Hispanic/Latino American, American Indian, and Asian/Pacific Islander women than among non-Hispanic white women.\textsuperscript{4,5,3,51}

Complications in US

Data from epidemiology studies demonstrates that hyperglycemia is associated with increased risks in the incidence and progression of microvascular and macrovascular complications. Adults with diabetes have a two to four times higher incidence of heart disease and stroke than adults without diabetes. Diabetes leads as the primary cause of blindness in adults 20-74,\textsuperscript{4} as well as the leading cause of kidney failure,\textsuperscript{12} while approximately 60-70% of diabetics have mild to severe nervous system disease.\textsuperscript{13} Additionally, diabetes is implicated in pregnancy complications, amputations, and nearly one-third of diabetics have severe periodontal disease.\textsuperscript{22,23,26-28} Diabetics also experience biochemical imbalances such as diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS), which are life threatening events.\textsuperscript{4} Ketones are one of two byproducts of fat metabolism, which build up in the body when glucose is not available as a fuel source due to insulin deficiencies; acid is another. DKA can occur when type 1 diabetics miss dose(s) of insulin, and HHS occurs more commonly in type 2 diabetics from very high blood glucose levels causing fluid imbalances that lead to systemic dehydration.\textsuperscript{26,30}

Diabetic Control and its Measures

Testing

The American Diabetes Association recommends that all insulin-treated diabetics (multiple insulin injections or insulin pump therapy), regardless of the affliction with type 1 or type 2 diabetes, should optimally perform self-monitoring of blood glucose (SMBG) three or more times daily. For patients using less frequent insulin injections, noninsulin therapies, or medical nutrition therapy (MNT) alone, SMBG may be useful in achieving glycemic goals by monitoring at least two times daily and over the course of a week monitor at different times of the day.\textsuperscript{31} Glucose levels peak at approximately one hour after the start of a meal and the return to pre-prandial (e.g., prior to eating a meal) levels within two to three hours. To achieve post-prandial (e.g., after eating a meal) glucose targets, post-prandial SMBG may be appropriate to determine the insulin response, which can be diminished or absent in type 2 diabetes.\textsuperscript{32} Continuous glucose monitoring may be a supplemental tool to SMBG for selected patients with type 1 diabetes, especially those with hypoglycemia unawareness.\textsuperscript{31,32} The hemoglobin A1C test (HbA1c) is recommended at least two times a year in patients who are meeting treatment goals and who have stable glycemic control. It is performed more frequently for patients

\textbf{Figure 1. American Diabetic Status.}
whose therapy has changed or who are not meeting glycemic goals. The binding of glucose to hemoglobin is irreversible allowing the test to provide an average blood glucose level over the four month lifespan of the red blood cells, which equates to the preceding 60 – 90 day period. Normal HbA1c is (<) 6%. Increasing levels correlate with the development of diabetic complications. The 2008 American Diabetes Association recommendations for diabetics are A1C levels (<) 7% for non-pregnant adults in general. Epidemiologic studies have suggested there may be an incremental benefit to lowering A1C from 7% into the normal range of (<) 6%. Therefore, the A1C goal for selected individual patients is as close to normal (<) 6% as possible without significant hypoglycemia. The A1C goals are less stringent for children and patients with a history of severe hypoglycemia, limited life expectations, or longstanding diabetes and minimal microvascular complications. Lowering A1C to an average of 7% has clearly been shown to reduce microvascular and neuropathic complications of diabetes and, possibly, macrovascular disease.

**Primary Prevention of Type 2 Diabetes**

To reduce the risk of developing diabetes, individuals at high risk for developing type 2 diabetes are recommended to engage in lifestyle changes that lead toward moderate weight loss (7% body weight), regular physical activity (150 minutes per week), dietary strategies of reduced calories and reduced intake of dietary fat, as well as achieving the U.S. Department of Agriculture recommendation for dietary fiber (14 g fiber/1,000 kcal) and foods containing whole grains. Physical activity and behavior modifications are important components of weight loss programs and are essential towards achieving and/or maintaining a desired weight.

**Medical Nutrition Therapy**

Individuals who have pre-diabetes or diabetes should receive individualized medical nutrition therapy (MNT), preferably administered by a registered dietitian, in order to achieve the treatment goals of energy balance and weight control. A modest weight loss can reduce insulin resistance, which is recommended for all overweight or obese insulin-resistant individuals; characteristics of high risk for diabetes. Low-carbohydrate or low-fat calorie-restricted diets are effective for weight loss in the short-term (up to one year), but lipid profiles, renal function and protein intake must be closely monitored on patients with diabetic nephropathy (deficient kidney filtration) while on low-carbohydrate diets.

Glycemic control, the maintaining of normal blood sugar levels, can be achieved using carbohydrate counting, exchanges, or experience-based estimation: the latter utilizes patterns established through pre- and post-prandial glucose testing. Dietary fats should be minimized at less than 7% of total calories from saturated fats and little to none from trans fat, the highly damaging type of fat produced when unsaturated fat is subjected to the process of hydrogenation. For individuals with diabetes, the use of the glycemic index and glycemic load may provide a modest additional benefit for glycemic control over that observed when total carbohydrate is considered alone.

The glycemic index, or GI, is a numerical system of measuring how fast a food or ingredient triggers a rise in circulating blood glucose within two to three hours after eating. The concept is that the higher the GI, the greater the blood sugar response reflecting a small rise from a low GI food and a spike from a higher GI food. A GI over 70 is considered high and a GI of 55 or less is low. The glycemic load, or GL, is a newer way to measure the impact of carbohydrate consumption. It gives a more practical approach than the glycemic index alone because it also tells you how much of that carbohydrate is in a specific food. For example, the carbohydrate in watermelon has a high GI. But since there isn't a lot of the carbohydrate in the watermelon, its glycemic load is relatively low. A GL of 20 or more is high and a GL of 10 or less is low. It's interesting to note that foods that have a low GL almost always have a low GI. Foods with an intermediate or high GL range from very low to very high GI. Additionally, sugar alcohols and non-nutritive sweeteners are generally considered to be safe when consumed within the acceptable daily
intake levels established by the Food and Drug Administration (FDA). Daily intake of alcohol should be limited to a moderate amount of approximately one drink per day or less for adult women and two drinks per day or less for adult men.35

Periodontal Risk Factors and Indicators
The American Academy of Periodontology (AAP) has established a protocol toward standardizing a comprehensive approach in the assessment, diagnosis and treatment of periodontitis associated with systemic conditions. The imperative implication of this parameter is to ensure that patients are informed about the significance of their systemic condition(s) and the probable impact it can have to the periodontal disease process. A conscientious effort should be made in presenting therapeutic choices and alternatives, potential complications, and expected outcomes. An informed patient has a thorough understanding of their rights and responsibilities as an active participant in the treatment decision, applications and successful outcomes within their periodontal therapy or in declining to proceed with the prescribed treatment.38,39

It is important to consider periodontal risk factors because they can affect periodontal disease onset, progression and severity. Risk factors include genetics, ethnicity, advancing age, smoking, diabetes, specific medications, impaired nutrition, poor oral hygiene, poor dental restorations, hormonal variations, immunocompromised status, connective tissue diseases and previous history of periodontal disease.26-28

A comprehensive periodontal evaluation should include a review of systemic disorders, oral signs and symptoms, medication history, addictive habits, familial factors, psychological issues and disease states. Signs and symptoms of undiagnosed or poorly controlled diabetes need to be identified. Consultation with the patient’s physician should be included and deemed necessary. The patient should receive instructions on medications and diet during periodontal therapy as well as education regarding the possible impact of periodontal infection on their glycemic control. The office needs to be prepared to manage diabetic and other medical emergencies.26-28,38-44

The Goals of Periodontal Therapy
The primary goal in periodontal therapy is to achieve periodontal health consistent with overall health and to reduce any future risk in disease recurrence and/or progression. Early diagnosis and prevention of periodontal disease is paramount to lessening the impact of diabetes on the outcome of periodontal therapy.

A periodontal treatment plan for the diabetic patient should encompass the following goals:40

- Complete periodontal assessment, even in children
- Identify level and consistency of diabetic control
- Consultation with primary care provider
- Complete medical history of diabetic state (updated at each visit)
- Continued appropriate diabetic control throughout treatment
- Consider systemic antibiotics if diabetes is poorly controlled
- Provide patient education and motivation
- Prepare the office for diabetic medical emergencies

The entire dental team, working together with medical colleagues, must become increasingly involved in the management of patients with diabetes and perform periodontal screening as a matter of routine of all patients diagnosed with diabetes.

Effect of Uncontrolled Diabetes on Periodontal Disease
An extensive body of literature reports that diabetes is a risk factor for gingivitis and periodontitis, and the degree of glycemic control is a determining factor in the vulnerability to oral health complications that are three to four times higher as compared to systemically healthy individuals. Glycemic control is reasoned to be an important determinant in the immunoinflammatory response to bacteria that is not readily seen in those without diabetes. Although little difference has been found in the cultures of periodontal sites of diabetes to those without diabetes, a noteworthy difference is found
in the immune defense. The diabetic patient displays impaired white blood cell functions (first line of defense), which is linked to increased periodontal destruction.\textsuperscript{26}

Most evidence also indicates diabetes is associated with an increased risk of periodontitis, as well as increased disease severity and progression. It is generally thought that poorly controlled diabetes increases the risk of complications while well-controlled diabetes reduces the risk, though some studies provide mixed results where poorly controlled patients do not develop periodontitis and well-controlled patients do.\textsuperscript{26-28,40-44}

Additional factors contributing to diabetes and associated periodontal risk concerns may include impaired connective tissue metabolism and bone healing, high glucose levels in gingival crevicular fluid hindering wound healing, microvascular changes, and changes in collagen synthesis and maturation.\textsuperscript{26-28,40,43,44}

A 1993 review of epidemiologic studies estimated that one in three diabetics have severe periodontitis. This finding asserts aggressive periodontitis as the sixth complication of diabetes.\textsuperscript{45} The net effect of the defense alterations is an increase in periodontal inflammation, attachment loss and bone loss.\textsuperscript{46}

**Effect of Uncontrolled Periodontal Disease on Diabetes Mellitus**

Severe periodontal disease often coexists with severe diabetes and the converse possibility that periodontal disease either predisposes or exacerbates the diabetic condition is in the forefront of current research. A link has been proposed that a rise in proinflammatory cytokines (proteins regulating the intensity and duration of the immune response) stimulates secretions from periodontopathic organisms that may amplify the impact on the metabolic state of the diabetic patient. This reaction can reduce glycemic control, affect insulin resistance and increase the risk of developing other diabetic complications.\textsuperscript{47}

Studies suggest a plausible link on periodontitis to the affect and pathogenesis of systemic diseases through inflammatory changes that are elicited from the onset, fuelling a chronic infection especially where periodontal treatment is lacking.\textsuperscript{48} Researchers will continue seeking evidence to define the virulence and invasiveness of periodontal disease by its mechanism of putting stress on the body through spreading bacteria, increasing the inflammatory burden, or both.\textsuperscript{49}

**Impact of Periodontal Treatment on Diabetes**

More research is emerging that suggests a bidirectional relationship between both types of diabetes and periodontal disease: the body responds to severe periodontitis with an increased blood glucose level, while periodontitis makes it more difficult for the diabetic to control their blood glucose level.\textsuperscript{50,51} It is accepted that the removal of periodontal pathogens can slow or arrest the progression of periodontitis by reducing local inflammation. However, the diabetic patient, being at a greater risk of developing periodontitis due to impaired immune responses, may not respond as well to periodontal therapy as a non-diabetic patient. An hypothesis on the basis of a direct inflammation theory in linking oral disease to systemic health is that serum levels of inflammatory mediators that cause insulin resistance may be reduced through periodontal therapies, which may improve glycemic control.\textsuperscript{51}

A conclusive meta-analysis by Janket et al. revealed that periodontal treatment does not affect glycemic control by reducing A1C levels in diabetic patients, but recognized that the study designs impacted on the results. The variety of periodontal treatments (non-surgical with and without antibiotics) and unbalanced population samples (type 1, type 2 or mixed) lend to conflicting results, and it was therefore strongly recommended that further studies, possibly restricted to type 2 diabetics not on insulin regimens, could more accurately demonstrate the significant effects of periodontal therapies on glycemic controls in diabetics.\textsuperscript{51}

Further rigorous and controlled studies of the treatment of periodontal disease in diabetics are needed to confirm the extent to which treatment enhances glycemic control. However,
there is evidence that well-controlled diabetics respond to periodontal therapies similarly as non-diabetics and diabetics continually challenged may have a less favorable outcome over the long term.\textsuperscript{50-52}

**Conclusion**

Periodontal diseases and diabetes mellitus both have similarities in their pathophysiology and high prevalence rates. The incidence of diabetes is on the rise with respect to diet, nutrition and stress, and the ever-increasing challenges to balance healthy practices into an already busy schedule in economically challenged lifestyles.

Diabetes has been shown to increase the risk of periodontal diseases, and while periodontal disease occurs in non-diabetic patients too, it is more common and more severe in diabetics.

Epidemiologic research supports an increased prevalence and severity of attachment loss and bone loss in adults with diabetes.\textsuperscript{26} The evidence, however, is less conclusive in determining the effects from periodontal treatment on glycemic control indicating that further research is necessary.

Dentistry will continue to practice under the fundamental evidence that periodontal treatment has been shown to reduce the level of inflammation in the oral tissues. In the meantime, as definitive results emerge in dentistry’s contributions to improving blood sugar control in diabetics, a primary focus should be directed toward intercepting a patient’s predisposition to diabetes (prediabetes) that includes an integrated approach (medical and dental) to assisting them in modifying their risk factors.
Course Test Preview
To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-us/professional-education/ce-courses/ce331/start-test

1. Which of the following is NOT referring to type 1 diabetes:
   A. Insulin-dependent diabetes mellitus.
   B. Maturity-onset diabetes of youth.
   C. Adult-onset diabetes.

2. Type 2 diabetes may account for what percentage of all diagnosed cases of diabetes?
   A. 1% to 5%
   B. 20% to 50%
   C. 90% to 95%

3. Gestational diabetes is a form of ___________.
   A. glucose intolerance
   B. insulin resistance
   C. pre-diabetes

4. All of the following are diagnostic signs of diabetes EXCEPT:
   A. Oral glucose tolerance test (> 140 mg/dl)
   B. Non-fasting plasma glucose (> or =) 200 mg/dl
   C. Fasting plasma glucose (< 100 mg/dl)

5. Impaired fasting glucose (IFG) is defined as:
   A. Fasting blood sugar level is elevated to 100-125 mg/dl range after an overnight fast.
   B. Fasting blood sugar level elevated to the 100-125 mg/dl range post-prandial from dinner.
   C. Fasting blood sugar level elevated to the 100-125 mg/dl range pre-prandial at dinner.

6. Impaired glucose tolerance (IGT) is defined as:
   A. Blood sugar level elevated to the 140-199 mg/dl range after a 2-hour post-prandial oral glucose tolerance test.
   B. Blood sugar level elevated to the 140-199 mg/dl range after a 2-hour pre-prandial oral glucose tolerance test.
   C. Blood sugar level is elevated to the 140-199 mg/dl range after a 2-hour oral glucose tolerance test.

7. The onset of type 2 diabetes can be prevented or delayed by ___________.
   A. lifestyle changes
   B. meticulous oral hygiene
   C. Cannot be prevented.

8. The onset of type 1 diabetes can be prevented or delayed by ___________.
   A. lifestyle changes
   B. meticulous oral hygiene
   C. Cannot be prevented.

9. The prevalence of diabetes in the U.S. is approximately _______.
   A. 3.3%
   B. 5.7%
   C. 9.3%
10. **The hemoglobin A1c test is recommended at least twice each year because __________.**
   A. the test provides an estimate of the average blood glucose level over the preceding 60 – 90 day period
   B. lowering A1C to an average of 7% has been shown to reduce some diabetic complications
   C. Both A and B

11. **The glycemic index (GI) provides a measurement of __________.**
   A. how much of a spike in blood sugar will be created by a specific carbohydrate
   B. how much of a carbohydrate is in a specific food
   C. how much total carbohydrate is consumed

12. **The glycemic load (GL) provides a measurement of __________.**
   A. how much of a spike in blood sugar will be created by a specific carbohydrate
   B. how much of a carbohydrate is in a specific food
   C. how much total carbohydrate is consumed

13. **Diabetics have been shown to be at __________.**
   A. increased risk for periodontal disease
   B. increased risk for tooth fractures
   C. increased risk for enamel erosion

14. **The data as to whether or not periodontal therapies might benefit glycemic control in diabetics is __________.**
   A. conflicting
   B. adequate to substantiate enhanced glycemic control
   C. absent with no studies undertaken on this hypothesis
References

Additional Resources
• No Additional Resources Available

About the Author

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