



Written by:

Sophia Cheung, MS, RD, LDN
Joslin Diabetes Center

William C. Hsu, MD
Joslin Diabetes Center
Harvard Medical School

George L. King, MD
Joslin Diabetes Center
Harvard Medical School

Robert J. Genco, DDS, PhD
State University of New York at
Buffalo, School of Dental Medicine

There is a bidirectional link between diabetes mellitus and periodontal disease. It is important to note that evidence is accumulating that supports the role of periodontal treatment in the improvement of poor glycemic control. Therefore, both dental professionals and primary care practitioners should understand the significance of this link, as it can impact treatment and progression of both diabetes and periodontal disease.

The Impact of Diabetes on Oral Health

Diabetes Mellitus is the chronic accumulation of elevated blood glucose resulting from the body's inability either to produce or to use insulin. While diabetes can be simply diagnosed with a fasting blood glucose level of 126 mg/dl or higher, or 200 mg/dl or higher after a 75 g oral glucose tolerance test, nearly one-third of American adults with diabetes are unaware that they have the disease. Of note, minority populations in the United States – Asian and Pacific Islander Americans, African Americans, Latino Americans – are at higher risk for developing diabetes due to both genetic predisposition and environmental changes. The most common form of diabetes is type 2, characterized by relative insulin deficiency and insulin resistance in association with obesity. People with diabetes are 2 to 3 times more likely than those without diabetes to have infectious periodontal disease. Studies demonstrate that an increase in the prevalence and severity of periodontal disease is associated especially with poorly controlled diabetes.

Periodontal disease is a chronic infection with pathogenic bacteria in a biofilm called dental plaque. These bacteria trigger chronic inflammation that, in turn, leads to gingival ulceration, destroys the connective tissue and alveolar bone support of the teeth, and ultimately leads to tooth loss if left untreated. Tooth loss, then, alters the patient's ability to masticate which often results in the consumption of a diet higher in fats and refined sugars, and lower in fiber content.

The major risk factors for periodontal disease are diabetes, smoking, genetic factors, and uncontrolled accumulation of dental plaque.

Diabetes may increase susceptibility to periodontal disease by impairing protective responses, as well as inducing a hyper-inflammatory state associated with activated PKC and advanced glycation of proteins. This likely leads to greater levels of tissue destruction by the periodontal organisms in those with diabetes as compared to those without diabetes.

The Role of Periodontal Disease in Glycemic Control

The presence of periodontal disease in persons with diabetes may also lead to poor glycemic control. Inflammatory mediators produced by the periodontal tissues, triggered by periodontal organisms, enter the systemic circulation. These mediators, including TNF-alpha and IL-6, likely contribute to insulin resistance. Also, these inflammatory mediators, as well as bacterial products such as LPS, once gaining access to the blood stream, have effects on distant organs through induction of acute phase proteins such as CRP, fibrinogen, and serum amyloid A. These factors are often elevated in the plasma of periodontal patients and can cause harmful effects on the heart, kidneys, and other organs. Significantly increased mortality and morbidity from heart and kidney disease has been documented in patients with type 2 diabetes who have periodontal disease.

Treatment of periodontal disease leads to the resolution of tissue destructive processes, and reduction of local and systemic inflammatory response and can prevent tooth loss. It is important to note that evidence is accumulating supporting the role of periodontal treatment in the improvement of poor glycemic control, especially in those treated with adjunctive antibiotics. Thus, it is reasonable to include management of periodontal disease in the complete care of patients with diabetes.



For Primary Care Providers: Identifying Patients Who May Have Periodontal Disease

Signs and Symptoms of Periodontal Disease

Most people with diabetes do not experience pain associated with periodontal disease and may be asymptomatic. However, other patients with diabetes have periodontal disease which is characterized by the following symptoms:

- Red, sore, swollen, receding or bleeding gums
- Loose or sensitive teeth
- Separation or elongation of teeth
- Presence or history of oral abscesses
- Halitosis
- Missing teeth
- Accumulation of calculus or plaque around teeth

For those many who are asymptomatic, the series of questions on the following page are useful in determining those with high risk for periodontal disease. These questions have been validated by the Centers for Disease Control (CDC) and the responses are highly suggestive

that the patient is at high risk for periodontal disease and warrants a dental referral. The full diagnosis of periodontal disease must be carried out at a dental office with radiographs and with periodontal probing.

Follow-up with Patients

Patients should be made aware that periodontal disease can result in inflamed periodontal tissues equivalent to an area as large as the adult palm. This inflamed tissue can lead to insulin resistance, making diabetes worse, and can lead to changes in the heart and kidney, making these complications of diabetes more severe.

Treatment

Periodontal disease can be successfully treated, especially in the early stages. Patients with diabetes should have a complete oral examination including periodontal probing, and thorough dental prophylaxis every 6 months. If periodontal disease is detected, it should be treated definitively by a dental professional. However, periodontal disease has a tendency to recur, particularly in patients with diabetes. To prevent recurrence, the patients should practice meticulous oral hygiene to remove the dental plaque on a daily basis, and have professional scaling and root planing on a regular basis.

Following are questions that will allow your patients to self-report periodontal disease and which can be added to the patient’s medical record:

- | | |
|---|--|
| <p>1. Do you think you might have gum disease?
<input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>2. Have you ever had treatment for gum disease, such as scaling and root planing, sometimes called deep cleaning?
<input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>3. Have any of your teeth become loose on their own without an injury?
<input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>4. Have you ever been told by a dental professional that you have lost bone around your teeth?
<input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>5. During the past 3 months, have you noticed a tooth that doesn’t look right?
<input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>6. Do you have diabetes?
<input type="checkbox"/> Yes <input type="checkbox"/> No</p> | <p>7. Are you over 50 years of age?
<input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>8. Overall, how do you rate the health of your teeth and gums?
<input type="checkbox"/> 3 or more times <input type="checkbox"/> 0 times</p> <p>9. Aside from brushing your teeth with a toothbrush in the last 7 days, how many times did you use dental floss or any other device to clean between your teeth?
<input type="checkbox"/> Excellent or good <input type="checkbox"/> Fair or poor</p> <p>10. Aside from brushing your teeth with a toothbrush in the last 7 days, how many times did you use mouthwash or other dental rinse products used to treat dental disease or dental problems?
<input type="checkbox"/> 3 or more times <input type="checkbox"/> 0 times</p> <p>Three or more “yes” answers, or a combination of 3 “yes” and “0 times” answers that total 3 or more should alert the clinician to the possibility that the patient may have periodontal disease and trigger a referral to a dentist.</p> |
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They should be advised to

- brush their teeth at least twice a day;
- clean in between the teeth at least once daily with dental floss or dental picks;
- have their teeth cleaned at least twice yearly or more often, if needed.

Any persistent gingival bleeding, abscess formation, or other sign of periodontal disease should be reported to the dentist immediately, as this may be a sign of recurrent periodontal disease, which should be treated.

For Dentists: Identifying Patients Who Are At Risk for Diabetes

Signs and Symptoms

As noted previously, minority populations such as Hispanic/Latino, African American, American Indian, Native Alaskan, Asian American, or Pacific Islander are at increased risk for developing diabetes. Type 2 diabetes is frequently not diagnosed until complications appear. Early detection and treatment can significantly reduce the complications of diabetes.

The following are the signs and symptoms of diabetes

- Frequent daytime or nighttime urination
- Excessive thirst and hunger
- Unintended weight loss
- Increased fatigue and Irritability
- Blurry vision
- Poor wound healing

The oral signs symptomatic for diabetes include:

- Red, swollen, bleeding gingivae that pull away from the teeth
- Gingival abscesses; loose teeth or tooth loss
- Dry mouth which may lead to gum-line dental decay
- Candidal infections in the oral cavity
- Persistent halitosis, bad taste, or fruity acetone oral odor

Following are questions that will allow your patients to determine their risk for diabetes:

	Yes	No
1. Body Mass Index is greater than 27*?	5 pts	0 pts
2. I am under 65 years of age and I get little or no exercise during a usual day?	5 pts	0 pts
3. I am between 45 and 64 years of age?	5 pts	0 pts
4. I am 65 years old or older?	9 pts	0 pts
5. I am a woman who has had a baby weighing more than nine pounds at birth?	1 pt	0 pts
6. I have a sister or brother with diabetes?	1 pt	0 pts
7. I have a parent with diabetes?	1 pt	0 pts

Total Points:

**For Asian descents, a lower BMI between 23-25 is used.*

Scoring 3-9 points	Scoring 10 or more points
Low risk for having diabetes	Greater risk for having diabetes

Include in the Medical Record

The questionnaire above from the American Diabetes Association for screening for diabetes should be included in the medical history of patients seeking dental therapy. This risk assessment tool will help identify patients who have diabetes or are at high risk of having diabetes and are yet undiagnosed. The risk of having undiagnosed diabetes among those with periodontal disease is unknown, although many clinicians have reported that patients with severe periodontal disease, upon evaluation, were found to have diabetes. However, since periodontal disease is



associated with diabetes, it is reasonable that the contribution of periodontal findings will increase the probability for detecting undiagnosed diabetes in the dental office, as has been suggested by recent studies.

Referral to a Physician

It is recommended that patients identified through the diabetes risk profile as being at high risk for diabetes, combined with periodontitis and other findings, should be referred by dentists to laboratories to have their fasting glucose levels checked, or referred to a physician for further diagnostic evaluation.

Patients with severe periodontitis who fail to respond to treatment or have multiple abscesses or fungal infections, or patients who fail to heal after oral surgical procedures should be considered for referral to a physician for diabetes screening. Patients already diagnosed with diabetes, but who do not have a treating physician, are at high risk for complications and should be referred to a physician by the dentist.

Other Links: Nutrition, Oral Health and Diabetes

Essential Nutrients

Nutritional intake and status play major roles in stimulating or suppressing genetic expressions, modulating the immune system, reducing inflammatory responses, improving the metabolic profile, and preventing and treating the complications of chronic diseases such as diabetes and periodontal disease.

People with poorly controlled diabetes, and especially those who smoke, often experience xerostomia (dry mouth). The consequence of decreased salivary flow combined with a diet high in simple sugars or habitual use of hard candies to treat hypoglycemia, can significantly increase risk for tooth decay, especially at the gum-line. Also, deficiencies of calcium, vitamin C, folic acid, magnesium and zinc are associated with oral tissue's decreased resistance to plaque bacteria. Tooth loss should be prevented, if possible, in patients with diabetes, since it is associated with difficulty in chewing, resulting in less fiber, and more refined sugars and fats in the diet.

Dental professionals are in a position to identify possible signs and symptoms of nutrient deficiencies. Some of these are described in the following table.

Symptom	Possible Deficiency
Glossitis	Niacin, folic acid, vitamins B6, B12
Glossodynia	B vitamins, zinc, iron
Stomatitis	Niacin, folic acid, vitamin B12
Xerostomia	Vitamin A, Vitamin B12
Bleeding gingival	Vitamin C, Vitamin K
Angular Cheilosis	Iron, B vitamins

General Nutrition Recommendations for Patients with Diabetes

Macronutrient needs

a) Carbohydrates

- 40-65% of total caloric intake (individualized by a RD).
- The total should not be <130 gm/day.
- Consistency of carbohydrate intake from meal-to-meal is of primary importance to patients with fixed medications or insulin programs. Whole grain, high fiber carbohydrates should be emphasized.
- Both the quality (glycemic index, GI) and quantity (glycemic load, GL) of carbohydrate choices are essential for optimal blood glucose control and should be taken into consideration when making daily selection of carbohydrate foods.
- Fiber: A minimum of 20-35 gm of fiber per day is recommended.

b) Protein

- 20-30% of total caloric intake.
- Consult a nephrologist for patients with renal issues.



c) Fat

- 30% or less of total caloric intake.
- Saturated fats should be limited to <10% total caloric intake or <7% for individuals with LDL-Cholesterol >100 mg/dL.
- Dietary cholesterol should be <300 mg/d or <200 mg/d in patients with LDL-cholesterol >100 mg/dL.

Micronutrient needs

The importance and benefits of a well balanced diet should be emphasized to people with diabetes and periodontal disease. They should be referred to an RD for a dietary assessment. Patients suspected of nutrient deficiencies may require dietary supplementation. Below is a list of the Recommended Dietary Allowance (RDA) and food sources of the nutrients:

Vitamin C: 75 mg/d for adult women and 90 mg/d for adult men (an additional 35 mg/d for those who smoke)

Food sources: Red bell peppers, broccoli, strawberries and citrus fruits

Folic Acid: 400 mcg/d for both adult men and women

Food sources: Lentils, cowpeas, pinto beans, chickpeas, okra, and spinach

Magnesium: 320 mg/d for adult women and 420 mg/d for adult men

Food sources: Whole grains, almonds, spinach, beans

Zinc: 8 mg/d for adult women and 11 mg/d for adult men

Food sources: Barley, kidney beans, crab, buckwheat and lean meats

Recent studies have shown that both calcium and vitamin D not only help prevent bone and tooth loss, but also play a role in reducing inflammation.

Calcium: 1000-1200 mg/d for adult men and women

Food sources: Lowfat milk, cheese, yogurt, tofu, soy-beans, kale

Vitamin D: 5-10 mcg/day or 400-600 IU for adult men and women

Food sources: Salmon, tuna, mackerel, milk, egg and lowfat Swiss cheese

Weight Reduction

- Strong evidence supports weight reduction for overweight/obese patients as a way to improve insulin sensitivity and glycemic control for those with type 2 diabetes. For those who have pre-diabetes, and among high-risk populations, weight reduction decreases the risk of developing type 2 diabetes.
- For patients who are overweight, daily caloric intake should be reduced by 250-500 calories. Total daily caloric intake should not be less than 1000-1200 for women and 1200-1600 for men, or based on the individualized assessment of a registered dietitian.
- A modest and gradual weight reduction of one pound every one to two weeks should be the optimal target.

Summary

Oral health goes hand-in-hand with good control of diabetes. If diabetes is uncontrolled, the patient will be at greater risk for severe periodontal disease. If periodontal disease is adequately treated, this may contribute to the improvement of diabetes control and to a reduced rate and severity of diabetes complications. Proper nutrition is critical to both diabetes and oral health. Medical and dental professionals should play an active role in the screening of diabetes and periodontal disease and should advocate a healthy nutrition lifestyle as a fundamental part of preventive and treatment strategy.



About Joslin Diabetes Center

Joslin Diabetes Center is the world's preeminent diabetes clinic, diabetes research center, and provider of diabetes education.

Founded in 1898, Joslin is an independent, nonprofit institution affiliated with Harvard Medical School. Joslin research is a team of more than 300 people at the forefront of discovery aimed at preventing and curing diabetes. Joslin Clinic is the world's first and most respected diabetes care facility, offering expertise in all facets of diabetes and diabetes complications. The Joslin Clinic is complimented by a nationwide network of Joslin educational programs offered each year to clinicians, researchers and patients. Through these avenues, Joslin develops, implements and shares innovations that immeasurably improve the lives of people with diabetes. For more information about Joslin, call 1-800-JOSLIN-1 or visit www.joslin.org

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