

Periodontal Disease – The Overlooked Diabetes Complication



Trisha Dunning

“He had one peculiar weakness, he had faced death in many forms but he had never faced a dentist.”

– H.G. Wells (p. 75)

Diabetes mellitus is a chronic, incurable modern epidemic that affects more than 171 million individuals globally (Wild, Roglic, Green, Sicree, & King, 2004). There are two main types of diabetes: type 1, which usually occurs in young people, but can occur at any age; and type 2, which usually occurs in people over age 40. However, there is increasing prevalence of impaired glucose tolerance (IGT) or pre-diabetes and type 2 diabetes in children and adolescents (Zimmet et al., 2007). Both type 1 and type 2 are associated with significant, long-term complications, such as microvascular and macrovascular disease, neuropathy, and depression, causing significant morbidity and mortality. In addition, many individuals also have other comorbidities, such as arthritis.

The underlying pathophysiology of diabetes-related long-term complications largely arises from the effects of chronic hyperglycemia, tissue glycosylation, changes in collagen metabolism, and oxidative stress (Brownlee 1995; Hammes et al., 1999; Nishimura, Soga, Iwamoto, Kudo, & Murayama, 2005). Diabetes is recognized as a significant risk factor for serious, progressive periodon-

Periodontal diseases are infectious processes that occur in the presence of bacteria, which trigger an inflammatory response. Periodontal disease is associated with many medical conditions, including diabetes mellitus and its complications (such as kidney disease). It has been described as the “sixth diabetes complication” but is often overlooked in routine diabetes management and complication screening processes. Proactive, preventative dental and diabetes self care, as well as regular dental and diabetes assessment, are important management strategies because periodontal disease contributes to the progression of impaired glucose tolerance to diabetes mellitus and to hyperglycemia in individuals with established diabetes.

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Goal

To provide an overview of periodontal disease and its relationship to diabetes.

Objectives

1. Identify various explanations for the association between diabetes and periodontal disease.
2. Discuss prevention strategies and management of periodontal disease.

tal disease (Southerland, Taylor, & Offenbacher, 2005). Likewise, periodontal disease may contribute to the progression of IGT to diabetes (Andersen, Flyvbjerg, & Holmstrup, 2007). Løe (1993) described periodontal disease as the “sixth diabetes complication” (p. 330). However, it could also be described as the “overlooked complication” because it is not included in most diabetes management strategies, education programs, or complication screening processes.

This article focuses on the relationship between diabetes and periodontal disease, possible underlying causal factors, and suggested management strategies.

Overview of Periodontal Disease

The condition of the oral cavity reflects and affects the overall health status of the individual. Between 60% to 65% of the U.S. population has periodontal disease; the prevalence increas-

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es to 85% to 90% in individuals with diabetes (Iacopino, 2001). The chronic effect of hyperglycemia enhances the formation of biologically active glycosylated proteins and lipids, which promote inflammation and potentiate the effects of periodontal infection (Lalla, Lamster, Drury, Fu, & Schmidt, 2000). In addition, lipopolysaccharide (LPS), a bacterial endotoxin, plays a role via the actions of Toll-like protein receptors, which stimulate the inflammatory response and the immediate immune response (Takeda & Akira, 2005). The immune response to infection is altered in the presence of hyperglycemia; white cell mobility and phagocytic capacity is reduced.

Various explanations for the association between diabetes and periodontal disease have been proposed, including:

- Microvascular disease.
- Changes in the composition of gingival cervicular fluid.
- Altered collagen metabolism.
- The formation of irreversible advanced glycated end products that are associated with oxidative stress, which in turn affects the structure and function of the basement membranes, particularly in small blood vessels: therefore, it contributes to microvascular disease.
- Altered immune response and changed white cell function during hyperglycemia that contribute to delayed wound healing and infection control.
- Changes in the flora of the oral cavity and overgrowth of anerobes, such as *Porphyromonas gingivalis* and *Actinobacillus actinomycetemcomitans*.
- Over expression of inflammatory cytokines, such as interleukin-1 β , tumor necrosis factor, and prostaglandin E₂.
- Genetic predisposition (Iacopino, 2001).

Risk Factors

Risk factors that influence the development of periodontal disease include:

- Inadequate knowledge about oral health and diabetes mellitus cou-

Table 1
General Signs and Symptoms of Periodontal Disease

There are differences in the symptoms individuals experience. Some or all of the signs and symptoms may be present, depending on the severity of the disease. Many symptoms are similar to those caused by other diseases and can be overlooked or misdiagnosed, and treatment can be delayed. All healthcare providers should ask relevant questions and perform an oral examination to detect these signs and symptoms and refer the individual to a dentist.

- Swollen, tender, red gums
- Bleeding while brushing the teeth or flossing, or when eating hard foods
- Receding gums due to the destruction of ligaments and gingival tissues around the teeth and bone.
- Loose teeth or wide spaces between the teeth that develop over time
- Persistent halitosis
- Ill-fitting dentures (can rub on the gums and lead to ulceration; consequently, the individual may avoid wearing their dentures or avoid eating hard foods)
- Worn or chipped teeth
- Plaque
- Caries
- Pus around the teeth and gums
- Changes in jaw alignment, which affect the bite
- Difficulty eating
- Oral candida

pled with inadequate oral health care and none or irregular dental assessments.

- Smoking.
- Hormone changes in girls and women.
- IGT and diabetes mellitus and their associated complications, such as cardiovascular disease and kidney disease. Diabetes mellitus is a primary cause of end stage renal disease (ESRD). ESRD is associated with severe stomatitis, and the majority of ESRD patients on dialysis develop serious gingivitis and periodontal disease (Choudhury & Luna-Salazar, 2008).
- Obesity.
- Poor nutrition, which often has many inter-related causal factors, such as obesity, excess alcohol intake, changed taste sensation, eating disorders, gastrointestinal disease, cancer, increasing age, cognitive decline, depression, and socioeconomic factors (cost).

- Persistent stress, which lowers immunity and reduces resistance to infection. Stress also affects an individual's ability for self care.
- Some medicines, such as antidepressants and antihypertensive agents, reduce saliva secretion and lead to xerostomia. Other medicines, such as phenytoin, cyclosporine, and nifedipine, may cause gum enlargement, which increases plaque deposition.
- Systemic illnesses, such as osteoporosis, Alzheimer's disease, AIDS, and cancer.

Once periodontal disease and diabetes occur together, a vicious cycle develops: diabetes predisposes the individual to periodontal disease, which in turn contributes to hyperglycemia, which affects other tissues and organs, including the oral cavity. Preventing and/or effectively managing periodontal disease can reduce hyperglycemia, insulin requirements, and Hb_{A1c} (Danesh, Collins, Appleby, & Peto, 1998). Periodontal infection is

Table 2
Oral Complications Associated with Diabetes, Proposed Underlying Causal Mechanisms, Common Signs and Symptoms, and Management

Regular dental examination is important to detect these complications early. Early referral to a dentist and then regular assessment is recommended. Management should be collaborative to ensure the oral problem is treated effectively and the blood glucose is adequately controlled.

Complication	Causal Mechanisms	Signs and Symptoms	Management
<p>Gingivitis or inflammation of the gums affects about 90% of the population. If untreated, it can progress to periodontitis.</p>	<ul style="list-style-type: none"> • Infection as a consequence of plaque, which harbors bacteria particularly anaerobes • Ulceration may be present, and in childhood, may be due to Herpes simplex stomatitis • Acute necrotising ulcerative gingivitis (Vincent's disease) mainly occurs in immunocompromised adults (HIV, chemotherapy), and individuals with malnutrition and poor oral hygiene 	<ul style="list-style-type: none"> • May be painless. • Bleeding may occur and is sometimes associated with oral contraceptive use by women, and during second pregnancies. It may be a sign of bleeding disorders or be associated with anticlotting medicines, which are frequently required by individuals with diabetes. • Red, swollen, gingival margins. • Halitosis, bleeding, and fever suggest acute necrotising gingivitis. 	<ul style="list-style-type: none"> • Good oral hygiene • Regular removal of plaque • Antimicrobial mouthwashes if halitosis is present • In severe cases, gingivectomy and gingivoplasty may be needed • Control hyperglycemia (initiate or adjust doses of glucose lowering oral agents/insulin) • Manage pain • Oral health and diabetes education
<p>Periodontitis is often preceded by gingivitis and may become chronic (pyorrhea).</p>	<ul style="list-style-type: none"> • Accumulation of plaque is often associated with untreated gingivitis, which leads to destruction of the periodontal ligaments, tissues, and bone around the teeth • Kidney disease, especially if inadequately treated or dialysis is required 	<ul style="list-style-type: none"> • Plaque and calculus • Red, swollen, tender gum margins. • Pockets of infection around the teeth and gums • Bleeding gums • Loose teeth • Halitosis – however, halitosis can also be caused by food, smoking, alcohol, some medicines, diabetic ketoacidosis (acetone breath), and renal and hepatic disease • Bad taste in the mouth 	<ul style="list-style-type: none"> • Improve oral health, which might require scaling and polishing • Diagnose bone involvement: X-ray • Control hyperglycemia (initiate or adjust doses of glucose lowering oral agents/insulin) • Treat the infection, which might require systemic antibiotics, such as amoxicillin or clindamycin, if the individual is allergic to penicillin (some experts suggest antibiotics “have no place in routine treatment” (Coventry et al., 2000, p. 38) • Topical antimicrobial medicines in infected periodontal pockets • Bacterial mouth rinses (such as Listerine®) to reduce halitosis and promote tissue repair • In severe disease, oral surgery may be required to remove dead tissue • Manage pain • The individual should be carefully assessed for other foci of infection, such as the feet and urinary tract <p align="right"><i>(continued on next page)</i></p>

Table 2 (continued)
Oral Complications Associated with Diabetes, Proposed Underlying Causal Mechanisms, Common Signs and Symptoms, and Management

Complication	Causal Mechanisms	Signs and Symptoms	Management
<p>Periodontitis is often preceded by gingivitis and may become chronic (pyorrhea)</p>			<ul style="list-style-type: none"> • Ongoing management involves regular oral self-care (cleaning teeth at least BID and flossing, see Table 3) • Regular dental examination and teeth cleaning • Replacing toothbrushes every 3 to 4 months • Oral health and diabetes education
<p>Candida is caused by the fungus <i>Candida albicans</i></p>	<ul style="list-style-type: none"> • Side effect of medicines, including antibiotics, chemotherapy, and antihistamines • Other underlying causes include diabetes, illicit drug use, malnutrition, low immunity due to systemic disease, side effect of some medicines (such as antibiotics), inadequate diet, increasing age, oral sex with an infected partner 	<ul style="list-style-type: none"> • Glossitis • Secondary to stomatitis from ill-fitting dentures • Pain, if severe 	<ul style="list-style-type: none"> • Manage the underlying cause • Oral hygiene • Manage hyperglycemia by commencing or adjusting glucose-lowering medicines • Refit dentures, if necessary • Soak dentures in antifungal medications • Local antifungal medicines (such as pastilles, lozenges, rinses, or troches [nystatin, clotrimazole, and fluconazole]) • Manage pain • Undertake a medicine review to determine the need for medicines that contribute to candida • Oral health and diabetes education
<p>Burning mouth syndrome, which is a chronic pain syndrome</p>	<ul style="list-style-type: none"> • The causes are largely idiopathic, but burning mouth syndrome is associated with chronic hyperglycemia, hormone therapy, neuropathy, xerostomia, and candidiasis, and can have a psychological component 	<ul style="list-style-type: none"> • Burning sensation in the tongue, lips, and oral cavity 	<ul style="list-style-type: none"> • Manage the symptoms • Manage hyperglycemia by commencing or adjusting glucose lowering medicines • Review medicine regimen • Medicines, such as benzodiazepenes, tricyclic antidepressants, and anticonvulsants, often effectively relieve pain; these medicines are also used to manage diabetic peripheral neuropathy and are not necessarily prescribed for depression • They can predispose the individual to xerostomia <p style="text-align: right;"><i>(continued on next page)</i></p>

Table 2 (continued)
Oral Complications Associated with Diabetes, Proposed Underlying Causal Mechanisms, Common Signs and Symptoms, and Management

Complication	Causal Mechanisms	Signs and Symptoms	Management
Lichen planus is a chronic inflammatory disease. It might predispose people to oral cancer	<ul style="list-style-type: none"> The cause is largely unknown There is some evidence that it is a T-cell-mediated autoimmune response, which triggers apoptosis of the oral epithelial cells (Thornhill, 2001) 	<ul style="list-style-type: none"> White striations, plaques and/or papules on the oral mucosa, tongue and gums Redness Blisters Superinfection with <i>Candida albicans</i> can occur 	<ul style="list-style-type: none"> Topical or systemic steroid medicines to control redness, ulceration, and pain If systemic steroids are used, glucose-lowering medicines/insulin may need to be increased because steroids cause hyperglycemia Manage pain Oral health and diabetes education
Xerostomia – Reduction in the amount or quality of saliva; it can lead to significant dental caries, inflamed and cracked lips, enlarged parotid glands, mouth ulcers, oral candida, infection in the salivary glands (sialadenitis), halitosis, and tooth abscesses	<ul style="list-style-type: none"> Xerostomia is associated with hyperglycemia and high-sugar diets It is a common complication of systemic diseases, head and neck radiation, and some medications Dental caries can occur when the proportion of <i>Streptococci mutans</i> is high compared to other oral flora because <i>Streptococci mutans</i> adheres to the surface of the teeth and produces a greater amount of sugar acids than other oral bacteria The combination of high levels of <i>Streptococci mutans</i>, xerostomia, hyperglycemia, and high-sugar intake significantly increases the risk of dental caries 	<ul style="list-style-type: none"> Difficulty eating, speaking, swallowing Wearing dentures Denture-induced mouth ulcers Tongue sticks to the palate or tongue depressor when examining the oral cavity Dysgeusia (taste disorders) Glossodynia (painful tongue) Increased need to drink water especially at night Signs of <i>Candida albicans</i> and/or dental caries 	<ul style="list-style-type: none"> Preventative dental care Saliva substitutes, such as xerolube, or prescription medicines, such as pilocarpine Avoiding hyperventilation, smoking, and excess alcohol intake, which exacerbate xerostomia X-ray to determine bone status may be indicated in severe, long-standing disease Treat dental caries Manage hyperglycemia by commencing or adjusting glucose lowering medicines Manage pain Oral health and diabetes education

associated with long-term diabetes complications, such as atherosclerosis (Nichols, Fischer, Deliargyris, & Baldwin, 2001) and nephropathy (Choudhury & Luna-Salazar, 2008).

Research is currently underway to determine the strength of the association among periodontal disease, hypertension, heart disease, cerebrovascular disease, and low birth weight. Signs and symptoms of periodontal disease are shown in Table 1, and oral complications of diabetes and the relevant management strategies are shown in Table 2.

Management

Primary prevention is an essential management strategy. Effective prevention and management depends on patient self-care, which is facilitated by education about appropriate oral self-care in a language and teaching style relevant to the individual. Key education messages are shown in Table 3. In addition, educating diabetes health professionals may also be needed to highlight the association between periodontal disease and diabetes. Prevention involves eating a healthy diet, which is essential to a healthy

nutritional and immune status, blood glucose and lipid management, and a healthy oral cavity. Self care also involves typical diabetes-related self-care tasks, which are shown in Table 4.

Regular dental assessment and teeth cleaning is vital. Tooth brushing does not remove plaque that accumulates below the gum line; therefore, scaling and polishing may be needed (Coventry, Griffiths, Scully, & Tonetti, 2000). Currently, dental assessment is not included in most diabetes complication screening guidelines, but it should be.

Table 3
Core Information about Oral Health Care for Individuals with Diabetes

<p><i>This information should be part of comprehensive diabetes self-care education and general health care. General information about the importance of oral health care and diabetes self care should be offered to put the following information into context.</i></p>
<p>General Advice</p>
<ol style="list-style-type: none"> 1. Bacteria can cause mouth infections and damage teeth and gums if plaque builds up. You can prevent plaque deposits and prevent mouth and gum disease by keeping diabetes under control and brushing your teeth and flossing every day. Infections in the mouth and gums can cause blood glucose to go high, and diabetes medicine doses may need to be increased until the infection settles down. 2. Ensure you have regular dental checks so any problems with your teeth can be detected early and treated. 3. Keep your blood glucose under control and visit your diabetes health professionals regularly. If your blood glucose level is persistently high, you are more likely to develop mouth and gum infections.
<p>Specific Advice about Dental Care</p>
<p>Brushing</p>
<ol style="list-style-type: none"> 1. Choose a good quality toothbrush with soft nylon bristles with rounded ends on the bristles. 2. Change your toothbrush regularly (every 3 to 4 months). Consider using an electric or battery-operated toothbrush to help prevent gums from shrinking away from the teeth. 3. Gently brush your teeth at least twice a day and after food consumption. 4. Use small, circular motions, as well as moving the toothbrush up and down, and clean all your teeth. Make sure you clean the front and the back surfaces of your teeth. Try not to scrub your teeth because it can damage the enamel and gums. 5. Gently brush your tongue. 6. Choose a good quality toothpaste that contains fluoride to help protect against tooth decay. Choose a specially formulated toothpaste if you have sensitive teeth.
<p>Flossing</p>
<ol style="list-style-type: none"> 1. Choose a good quality dental floss. 2. Break off a piece of floss about 18 inches long. 3. Floss after brushing your teeth at least once a day. 4. Insert the dental floss between each pair of teeth in turn. Gently move the floss backward and forward from the bottom to the top of the tooth. Try not to snap the dental floss against the gums. 5. Rinse your mouth after flossing with an antibacterial mouth rinse (such as Listerine®).
<p>Seek a Dentist's Advice if You Notice:</p>
<ul style="list-style-type: none"> • Persistent bad breath. • Bleeding. • Pain. • Red and/or swollen gums. • Your dentures do not fit properly. • You have difficulty eating. <p>Pay particular attention to your teeth if you are pregnant. Eat a healthy diet that contains adequate amounts of calcium and vitamin D, as well as care for your teeth and gums.</p>

Health professionals can incorporate the following strategies into routine health care to highlight the importance of oral health. They should ask individuals with diabetes the following:

- When they last visited a dentist or had their teeth and oral cavity examined by a dentist.
- About their oral health, such as the presence of any signs and symptoms presented in Table 1, and their oral self-care practices, such as brushing and flossing.
- About the medicines they are taking and provide education about managing medicines that affect oral health.
- Ensure the person is referred to their family doctor and diabetes specialist for a review of their diabetes management regimen and medications, especially if they have Hb_{A1c} greater than 7% and/or hyperlipidemia, or are using medicines that affect oral health. Regular assessment, such as retinal examination and blood pressure, and laboratory tests, such as Hb_{A1c}, lipids, and renal function, are essential.
- Perform an oral examination within their competence and scope of practice, and/or refer to a dentist if indicated.
- Provide the individual with relevant education, such as the need for regular dental assessment and diabetes self-care education, and involve family and caregivers when relevant.
- Include oral health assessment in routine complication screening procedures. These should be undertaken at least annually but may be needed more frequently for some individuals (for example individuals with ESRD and retinopathy).

Take Home Points

Dental disease is associated with impaired glucose tolerance and diabetes mellitus. In turn, chronic hyperglycemia predisposes the individual to dental disease. Controlling blood

Table 4
Diabetes-Related Self-Care Tasks

<i>These tasks need to be undertaken at appropriate times, often three or more times per day, and be maintained for a lifetime. Self care is hard, constant work.</i>
• Eat a healthy, balanced diet.
• Undertake regular physical activity.
• Manage stress.
• Monitor blood glucose levels, usually several times a day, interpreting the results and using the information to maintain the blood glucose level in the target range.
• Monitor ketones during periods of hyperglycemia, which is often associated with illnesses, especially in those with type 1 diabetes.
• Manage medicines. Many people with type 2 diabetes are on more than 12 different medicines and multiple doses per day, and sometimes complex dose intervals. Thus, any extra medicines, such as antibiotics, complicate the regimen and increase the chances of interactions and medicine mismanagement.
• Manage illnesses. Diabetes self care can be an added burden during illness.
• Prevent and manage hypoglycemic events.
• Perform foot care.
• Attend appointments with health professionals.

glucose reduces the risk of dental disease. Individuals with diabetes and health professionals have a key role in effective prevention and management of dental disease. Diabetes education and oral health education are essential to effective prevention and management. They are a holistic integrated approach to care and effective communication among health professionals and patients.

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ANSWER/EVALUATION FORM

Periodontal Disease – The Overlooked Diabetes Complication

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1.1 Contact Hours
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1. What would be different in your practice if you applied what you have learned from this activity?

GOAL To provide an overview of periodontal disease and its relationship to diabetes.

Please note that this continuing nursing education activity does not contain multiple-choice questions. This posttest substitutes the multiple-choice questions with an open-ended question. Simply answer the open-ended question(s) directly above the evaluation portion of the Answer/Evaluation Form and return the form, with payment, to the National Office as usual.

Evaluation

2. By completing this offering, I was able to meet the stated objectives
 - a. Identify various explanations for the association between diabetes and periodontal disease.
 - b. Discuss the prevention strategies and management of periodontal disease.
3. The content was current and relevant.
4. This was an effective method to learn this content.
5. Time required to complete reading assignment: _____ minutes.

	Strongly disagree			Strongly agree	
1	2	3	4	5	
1	2	3	4	5	
1	2	3	4	5	
1	2	3	4	5	

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