COMMON RISK FACTORS IN THE MANAGEMENT OF PERIODONTAL AND ASSOCIATED SYSTEMIC DISEASES: THE DENTAL SETTING AND INTERPROFESSIONAL COLLABORATION

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ABSTRACT

There is a role for dentistry in the interprofessional management of chronic diseases by addressing common risk factors

Background

A critical scientific foundation has developed for management of risk factors common to major diseases including periodontal disease, caries, diabetes, heart disease, and cancer.

Purpose

The purpose of this paper is to critically review this scientific literature. This will provide the basis for the current and future role of the dental setting in common risk factor identification and modification; with an emphasis on the role of the dental hygienist.

Methods

A systematic review of the literature and analysis of the relevant papers was undertaken to support the recommendations.

Conclusions

We propose that the appropriate risk factor management procedures be adopted in the dental setting for smoking cessation, reduction of sugar consumption, and weight control in those patients at risk for one or a combination of the following diseases: periodontal disease, caries, diabetes, heart disease and certain cancers.

Key words: Periodontal disease, diabetes, heart disease, stroke, cancer, modifiable risk factors, dental hygienist, dental office

INTRODUCTION

The goal of this chapter is to provide a rationale and the scientific basis for a strategy for controlling major chronic diseases. This strategy includes modification of risk factors common to these chronic diseases: periodontal disease, caries, cardiovascular disease, diabetes, and cancer. Periodontal disease affects about 50% of adults in the US,1 and is related to cardiovascular disease,2 diabetes3 and cancer.4 The systemic diseases related to periodontal disease, cardiovascular disease, stroke, cancer and diabetes, were 4 of the 7 leading causes of death in the US in 2010.5
Since there are several risk factors common to periodontal disease, cardiovascular disease, stroke, diabetes, and cancer, it is reasonable to propose that control of these common risk factors will markedly reduce their mortality and morbidity, as well as contribute to optimal oral health. The main common risk factors for all these include smoking, poor diet and obesity. These factors will be discussed in detail and the evidence for the effect of intervention on these diseases will be presented.

It is important to note that over 80% of children 2–17, and over 60% of adults had a dental visit in 2011. Hence we propose that contact with oral health care providers can be an important, and to date underutilized, opportunity to assist the patient in controlling risk factors for oral disease as well as an opportunity for detection and modification of risk factors for cardiovascular disease, stroke, diabetes and cancer. We propose that the dental hygienist can be a key member of the dental team in encouraging healthy lifestyle modification such as smoking cessation, advocating a healthy diet and weight control among other healthy behaviors.

**RISK FACTORS FOR PERIODONTAL DISEASE**

It is well established that gingivitis and periodontitis are chronic bacterial infections caused by dental biofilms. Periodontitis is caused by subgingival bacterial communities with virulence potential which likely directly cause tissue destruction, or trigger destructive immunopathologic host responses which in turn lead to periodontal hard and soft tissue destruction and eventually loss of teeth. Recent studies using DNA sequencing reveal that the subgingival microbiome associated with periodontal disease contains complexes of previously known pathogens as well as many other potential periodontal pathogens that were previously not detected because they are not able to be cultured, or had not been previously recognized. There is much to be clarified regarding the role of these polymicrobial complexes in periodontitis; however, it is clear that subgingival biofilms are the primary cause of periodontal disease.

The concept that the rate of progression and severity of periodontitis is often determined by systemic risk factors is fairly recent. The identification of risk factors for periodontitis and their role in disease induction and progression as well as risk modification in the management of this disease was recently reviewed by Genco and Borgnakke and will be summarized here.

**Strength of Evidence for Periodontal Risk Factors**

From epidemiologic studies, factors that occur more often or at higher levels in patients with periodontal disease as compared to those with little or no periodontal disease, are considered putative risk factors, sometimes called risk indicators or risk modifiers. Mere associations of a factor with the disease does not however prove causality. Causality is difficult to prove and requires evidence that the factor precedes the disease usually from longitudinal studies. Further evidence for causality also includes knowledge of the mechanism of action of the risk factor on the disease. Finally, the evidence that modification of the risk factor will prevent or moderate the disease is important in establishing true causation. As these lines of evidence are established, risk factor reduction in individuals or populations is often justified. We will discuss modifiable risk factors for periodontal disease, which are common to cardiovascular disease, stroke, cancer and diabetes. These will be targets for the proposed strategy of common risk intervention in the dental office.

**Smoking as a Risk Factor for Periodontitis**

Smoking has been long associated with periodontitis and tooth loss. For example, in 1947 an association was found between tobacco smoking and acute necrotizing ulcerative gingivitis. Since then many studies have also shown an association of cigarette smoking and common adult forms of periodontitis. Studies of periodontal risk factors are often confounded by other factors such as oral hygiene and dental plaque levels, however, where proper statistical correction is made for these factors, smoking is found to be a major independent risk factor for periodontal disease (Figure 1). Even mild smoking was found to increase the odds 4–5 fold for both periodontitis and alveolar bone loss.

**The Two-way Relationship Between Diabetes and Periodontal Disease**

It has been long known that diabetes mellitus, both type 1 and type 2, are risk factors for periodontal disease. A systematic review of the effects of periodontal disease on diabetes was recently published which summarizes evidence for the two-way relationship between periodontal disease and diabetes. In this review, a systematic analysis of studies show that periodontal disease worsens glycemic control as well as cardiovascular and renal complications of patients with disease. For example, a longitudinal study of Pima Indians with type 2 diabetes found those with severe periodontitis at baseline had over 6 times the risk of developing poor glycemic control over 2 years as compared to those with diabetes and little periodontal disease at baseline.

Further studies on this population showed that patients with type 2 diabetes and periodontitis are more likely to die from heart disease and kidney disease than those with diabetes and little or no periodontal disease (Figure 2).

**Effect of Periodontal Therapy on Glycemic Control in Patients With Diabetes**

Several meta-analysis have been published reviewing randomized controlled clinical trials studying the effects of
periodontal therapy on glycemic control in patients with both diabetes and periodontal disease. Although these studies varied in design, populations treated, and treatments rendered, the results of the several meta-analyses are similar (Table 1). They show a statistically significant decrease in HbA1c of 0.36–0.65% in the treated group over a short period of 3–6 months. This is comparable to the reduction of HbA1c that occurs when a second antiglycemic medication is added to metformin, and is hence clinically significant.

Not all studies have shown reduction in HbA1c in patients with diabetes who have had periodontal therapy. A recent randomized controlled trial of non-surgical therapy failed to show such an effect. Although this was a large study of over 500 patients, the scaling and root planning therapy apparently was only partially effective in resolving the periodontal disease. For example, reduction in bleeding on probing was only 19% as compared to the approximately 45% reduction previously seen in numerous studies, and 42% of sites bled after treatment and there were 10% of sites with 5 mm or greater pocket depth after treatment. Furthermore in this study 72% of the sites had residual plaque suggesting poor compliance with oral hygiene. This clinical trial failed to achieve clinical results comparable to what has been found in previous studies both on those with diabetes as well as those without diabetes, and is not clear from this study that one can conclude that non-surgical periodontal therapy does not alter HbA1c. Further research where periodontitis is successfully treated is needed to clarify this issue.

The clinical significance of reducing HbA1c levels in patients with diabetes is well documented, especially in controlling micro-vascular complications such as retinopathy and nephropathy. Also studies in the general population show that an average reduction in HbA1c of 0.2% is associated with a reduction in mortality of approximately 10%, and the numerous clinical trials of periodontal therapy summarized in Table 2 show a reduction of 0.36–0.65% in HbA1c levels.

What Are the Mechanisms That Explain the Bidirectional Relationship Between Diabetes and Periodontal Diseases?

Mechanisms which are proposed to explain why patients with diabetes suffer from more periodontal disease are reviewed by Genco and Borgnakke and they include:

A. Patients with diabetes have a hyperactive inflammatory response and the bacterial challenge of periodontal infection results in exaggerated inflammation and periodontal tissue destruction.

B. The receptors for advanced glycation end products are elevated in patients with diabetes. Periodontal infection results in increased levels of these advanced glycation end products, which activate their receptors resulting in production of increased levels of proinflammatory cytokines such as IL6 and TNFα, leading to more periodontal disease.

C. There is evidence for a reduction in healing in patients with diabetes. One such mechanism is increased fibroblast apoptosis which may result in delayed wound healing in patients with diabetes.

D. There is evidence for altered immune responses in patients with diabetes. Impaired functions such as impaired phagocytosis and neutrophil chemotaxis may predispose patients with diabetes to more severe periodontal disease.
Less is known about the mechanisms which account for the effects of periodontal disease on worsening glycemic control and increasing complications in patients with diabetes. However, systemic inflammatory responses as seen in periodontal disease may contribute to insulin resistance and hyperglycemia. For example, TNFα can promote insulin resistance by interfering with insulin signaling mechanisms, reducing intake of glucose into cells. The systemic inflammatory response associated with periodontal disease thus may account, in part, for the effects of periodontal disease on poorer glycemic control and increased cardiovascular and renal complications in patients with both diseases.

**Obesity and Risk for Periodontal Disease**

Obesity is a growing major public health problem as its prevalence has tripled since the 1980's. Furthermore, obesity is associated with diabetes, heart disease, and some cancers. These associations likely result from proinflammatory mediators produced by adipose tissues. These inflammatory mediators are thought to contribute to increased susceptibility and progression of diabetes and cardiovascular disease and cancer. For example, TNFα, IL-6, CRP and a series of adipokines are elevated in patients who are overweight or obese. These in turn are associated with increased risk of insulin resistance, diabetes and cardiovascular disease. Evidence that obesity is also a risk factor for periodontal disease is summarized in two systematic reviews and is illustrated in Figure 3.

From the meta-analysis summarized in Figure 3 it can be seen that the overall odds of having periodontal disease in obese or overweight individuals is approximately 2. The mechanisms to explain this increased susceptibility are likely the same as that for the effect of obesity on other chronic diseases, namely an increase of systemic inflammation from adipose tissue.

There are also studies which suggest that the oral flora in obese individuals have higher levels of *T. forsythia* as compared to non-obese individuals.

**Metabolic Syndrome as a Risk Factor for Periodontal Disease**

Metabolic syndrome is defined as having 3 or more of the following: obesity, increased blood pressure, hyperglycemia, and altered blood lipids. There is epidemiologic evidence that metabolic syndrome increases the risk for periodontitis.
Further study is needed to better establish the role of each of the components of metabolic syndrome and their relationship to periodontal disease. Intervention studies have begun testing the effects of periodontal therapy on components of the metabolic syndrome and vice versa. Intervention studies testing the effect of treatment of periodontal disease on metabolic syndrome reported that the treated patients had a decrease in C-reactive protein, total leukocyte counts, and serum triglycerides along with an increase in serum high density lipoproteins. These changes were seen in the treated group with metabolic syndrome which suggests that periodontal therapy has the potential to improve some of the abnormalities seen in metabolic syndrome. More research assessing the association between metabolic syndrome and periodontal disease is needed as metabolic syndrome is an important risk factor for type 2 diabetes and cardiovascular disease.

Evidence is Emerging for Several Other Potential Risk Factors Associated With Periodontal Disease Including Low Dietary Calcium, Low Plasma Vitamin D, Excessive Alcohol Consumption, Osteoporosis in Postmenopausal Women and Stress

Since these potential risk factors are not common risk factors for chronic diseases such as diabetes and cardiovascular disease, they presently are not among the common risk factors to be addressed here. Of course their identification and modification is of importance in the management of periodontal disease.

RISK FACTORS FOR DIABETES, CARDIOVASCULAR DISEASE AND CANCER

Tobacco use and poor diet are major risk factors for diabetes, cardiovascular disease, and cancer. Tobacco cessation and healthy diets are known to modify the risk for these diseases.

Risk Factors for Diabetes

The modifiable risk factors for diabetes include:

a) Having prediabetes or being at high risk for diabetes, characterized as fasting plasma glucose of >100 and 124 mg/dl, or HbA1c level of ≥5.7–6.4%.
b) Being overweight or obese, especially around the waist.
c) Having high blood pressure (≥140/90 mm Hg).
d) Having low HDL (less than 40 mg/dl for men and less than 50 mg/dl for women) and/or high levels of triglycerides (200 mg/dl or higher).
e) Smoking.

The modifiable risk factors for diabetes which are common to periodontal disease including smoking, being overweight or obese and having hyperglycemia.

Cardiovascular and Cerebrovascular Risk Factors

There are many risk factors associated with heart disease and stroke. Some such as age, ethnicity, and genetic factors which cannot be changed. However, there are modifiable risk factors for heart disease which include.
a) Tobacco exposure  

b) Obesity  

c) Unhealthy diets  

d) Physical activity  

e) Harmful use of alcohol  

Modifiable risk factors for stroke include:  

a) Cigarette smoking  
b) Diabetes  
c) Being overweight or obese  
d) Physical inactivity  
e) Obstructive sleep apnea  
f) Cardiovascular disease, including heart failure, heart defects, heart infection or abnormal heart rhythm.  
g) Use of some birth control pills or hormone therapies that include estrogen.  
h) Heavy or binge drinking  
i) Use of illicit drugs such as cocaine and methamphetamines.  

As is the case for diabetes, many of the risk factors for heart disease and stroke also increase the risk for periodontitis. These common risk factors include smoking, obesity, diabetes, unhealthy diets, and harmful use of alcohol. 

Risk Factors for Cancer  

There are many forms of cancer and many share modifiable risk factors including:  

a) Tobacco consumption, including smoking cigarettes for most cancers, and use of chewing tobacco for oral cancer.  
b) Excessive alcohol consumption  
c) Overweight and obesity increase the risk for cancer at numerous sites including breast (among postmenopausal women), endometrium, esophagus, gallbladder, liver, prostate, ovary, pancreas and kidney.  
d) Certain diets may lead to reduced risk of some of the most common types of cancer. However, components of the diet are known to increase the risk for certain cancers, however, the specific role of these dietary components is not clear.  
e) Physical activity may reduce the risk of breast and colon cancer.  
f) Infectious agents including: *Heliobacteria pylori* infection which increases risk for gastric cancer, human papilloma virus (HDV) infection which increases the risk of cervical cancer and hepatitis infection which increases the risk of liver cancer.  
g) Diabetes is associated with increased cancer of the colon, pancreas, and possibly other sites.  

There are many other risk factors for cancer including gastric abnormalities, race, age, gender, and genetic factors which are not able to be modified. There are also a large number of environment hazards associated with increased risk for cancer including environmental toxins and radiation that are not easily modified in clinical practice but are targets for public health measures. 

Again as with diabetes, cardiovascular disease and stroke, cancer shares many risk factors with periodontal diseases. These common risk factors include cigarette smoking, overweight and obesity, diabetes, diet and alcohol consumption. 

In summary, exposure to tobacco, diet, overweight and obesity, and excessive alcohol consumption are risk factors common to periodontal disease, diabetes, cardiovascular disease, stroke, and certain cancers. Certain of these common risk factors can be modified in clinical dental practice (eg. smoking, sugar intake) and others by collaboration with our medical colleagues (eg. obesity, inadequate physical activity and excessive alcohol consumption). 

The importance of identifying and treating this common set of risk factors has been emphasized by the American Cancer Society, the American Diabetes Association, and the American Heart Association. They have recommended that all health care providers assess these common risk factors and institute measures to reduce them in an effort to prevent these diseases at an early stage. Thus, there is an imperative for dentistry to actively participate in the management of these common risk factors to reduce the ravages of oral diseases and at the same time to provide expert help in the efforts to reduce major systemic diseases. 

Periodontitis and Systemic Diseases  

There is evidence accumulating that suggests that periodontal disease is independently associated with several systemic conditions including diabetes, cardiovascular disease and stroke, and cancer. Several critical and systematic reviews of these associations are found in the Workshop jointly held by the European Federation of Periodontology and American Academy of Periodontology. 

It was concluded that studies of the association of periodontal disease with cancer is hampered by the difficulty in controlling for confounders such as smoking and socioeconomic status. However, several studies find an independent association between periodontitis and cancer after controlling for these effects. 

In summary, evidence is emerging that periodontitis is a risk factor for diabetes, cardiovascular disease and some forms of
cancer. Definitive studies showing a clinically significant effect of preventing or treating periodontal disease on diabetes, cardiovascular disease or cancer are lacking. However, it is clear that modification of common risk factors will have clinically significant effects on periodontal disease, heart disease, diabetes and cancer, and hence it is important to implement common risk factor modification into dental practice.

COMMON RISK FACTOR MODIFICATION
Modification of risk factors common to dental diseases as well as other major chronic diseases can be incorporated into dental practice. Motivational interviewing is one behavior change approach being used in dentistry (see Mitchell, Forrest, and Overman, Critical Thinking Skills for Patient-Centered Care, in this publication) For example, recommending reduction of dietary sugars will likely reduce the risk of caries, but also have major impact on preventing diabetes, and heart disease through its contribution to weight loss. Treating tobacco use or dependence will have a major impact on periodontal disease, but also will be important in preventing heart disease and some cancers. Practical advice on implementing risk factor modification in a dental practice, with an emphasis on the role of the hygienist will be discussed below.

Treating Tobacco Use or Dependence in the Dental Office
A recent report on The Health Consequences of Smoking reviews evidence for a causal link of smoking to diseases affecting nearly all organs of the body (see Figure 4). Furthermore the report notes that smoking-caused illnesses will result in newly half a million deaths and cost the U.S. more than $130 billion in 2014.

Tobacco use imposes an enormous public health burden and rapid elimination of the use of tobacco products will dramatically reduce this burden. The U.S. Department of Health and Human Services presents strategies for treating tobacco use and dependency.47 It provides key recommendations for clinicians in delivery and support for treatment of tobacco use and dependence. Currently they are built around the 5A’s Brief Intervention Model (Ask, Advise, Assess, Assist, and Arrange). The U.S. Department of Health and Human Service Guidelines state: “that tobacco dependence treatment delivered by a variety of clinical types increases abstinence. Therefore all clinicians (physician, nurse, dentist, psychologist, or counselor) should provide smoking cessation interventions.”

Dentists and dental hygienists are trained to detect oral lesions, periodontal disease and failing implants that are related to tobacco use. Dentists and hygienists are also in a position to help treat and prevent tobacco dependence, and over the last several decades tobacco cessation strategies have been shown to be feasible and successful in the dental setting, with the dental hygienist playing a major role.48,49

Tobacco cessation counseling can occur naturally during a preventive appointment and recent studies show that dental hygienists are willing to learn cessation techniques.50 If tobacco cessation was not part the education of the dental hygienist, there are self-study programs and continuing education programs to help develop skills in counseling patients. Counseling programs can be successful, for example, in one study those who receive counseling achieve a 2–3 times greater stop rate as compared to those who try to stop on their own.50

Advantages of Tobacco Cessation Programs in Dental Offices

- Helping patients free themselves of tobacco addiction is rewarding to the dental team, and may extend life as well as greatly improve the patients’ quality of life.
- Oral health care professionals are often aware of patients who smoke from their medical histories and oral examination.
- Oral health professionals have interviewing and counseling skills, as well as the trust and rapport of patients which are beneficial in effecting behavioral change.
- Patients visit dental offices on a regular basis, hence follow-up with tobacco cessation programs can be incorporated into the regular recall routine.
- Tobacco-cessation protocols can be brief, and need not unduly prolong dental treatment routines.
- Professional services which include a tobacco cessation program can be an excellent practice builder.

Perceived Barriers to Tobacco Cessation Treatment in the Dental Office

Oral care professionals:

- May feel it is not their responsibility. In reality, tobacco use contributes to significant oral disease, and should be controlled as part of restoring the patients’ oral health.
- May believe it takes too much time. However, effective interventions can be brief, and made part of a routine oral hygiene visit.
- Do not feel they can charge a fee for their service. However, fees can be changed as treatment of tobacco dependence is an important component of periodontal and implant treatment, and management of a patient at risk for oral cancer. Furthermore these services are often covered by insurance.
- Are concerned about the effectiveness of the program. However studies have shown well executed tobacco cessation programs in dental offices can be effective.
The Dental Team for Treatment of Tobacco Dependence

Role of the Dentist:
- Determine plan of action for the office.
- Appoint an office coordinator for the program.
- Work with hygienists to counsel patients.
- Refer selected patients to the relevant “Tobacco Quit Line” for coaching and information about the program.
- Recommend and prescribe nicotine replacement products such as nicotine gums, patches, or lozenges. The dentist can also prescribe Bupropion (Zyban) and Varenicline (Chantix) or a combination of these drugs with nicotine replacement therapy to assist the patient in smoking cessation.
- Monitor progress of program and train new personnel as needed.

Role of the Dental Hygienist:
- Assess tobacco use for every patient, and determine for smokers their willingness to quit.
- Provide individual health information as it relates to tobacco use, pointing out actual disease and conditions associated with smoking in individual patients, such as periodontal disease, stained teeth, irritated mucous membranes, and suspected oral precancerous lesions.
- Provide quit strategies.
- Record quit date, interventions prescribed and side effects.
- Monitor compliance with nicotine replacement or other therapies recommended to patient.
- Monitor tobacco use status at each visit.
- Work with the dentist in referring certain patients for those it is difficult to quit to “Tobacco Quit Line,” a coach or physician for nicotine addiction therapy.

The dental assistant and receptionist should also support the dentist and dental hygienist in the tobacco cessation program in providing brochures and other information about tobacco cessation, making follow-up calls about quit dates, and sending appropriate patient follow-up letters and letters to the

Figure 4. The health consequences causally linked to smoking. Note: the condition in red is a new disease that has been causally linked to smoking in this report.
The patient’s physician. They also should encourage and support patients who are going through the quit program.

The 5 A’s Brief Intervention Model for Treating Tobacco Use and Dependence

The 5 A’s model includes the following: Ask, Advise, Assess, Assist, and Arrange.47

Ask. Tobacco users are increasingly considered outcasts in our society and approaching them about their tobacco use should be done with care. If they indicate they use tobacco in their medical history, follow-up to obtain information about how long, what form and the number of cigarettes or cigars they smoke per day. Don’t be judgmental, and present yourself as someone who wants to help. Let them know that as a dental provider it is important for you to have knowledge of their tobacco use as it may predispose to periodontal disease, dental implant failure, oral cancer, and other oral lesions. Furthermore, inform the patient that your office considers treating tobacco use and dependence as an important part of the management of their oral disease. It is critical to their oral health as well as to their overall health.

Advise. In a clear, strong and personalized manner urge every tobacco user to quit. Note changes in the mouth such as stained teeth, gingival recession, periodontal pockets or mucous membrane lesions that are likely related to their tobacco use. Tell them that these diseases can be treated, and with tobacco cessation tissues will often return to normal.

Assess-readiness to Quit. Assess whether the tobacco user is willing to quit. It may help to gage the patient’s readiness to quit by using a scale of 1–10, 1 being no desire to quit and 10 being ready to quit today. If the patient scores a 5 or 6, ask what it would take for them move up the scale to an 8 or 9.

Assist-with Quitting. If a patient tells you they want to quit, help the patient develop a quit plan. The quit plan helps a patient prepare for quitting, and includes the following (STAR):

Set a quit date
Tell family and friends
Anticipate challenges, especially nicotine withdrawal, which may occur in heavy smokers
Remove tobacco products from environment. Make home and work ‘smoke-free.’ For some patients quitting may be very difficult including those who have tried and failed to quit many times, those who smoke more than 15 cigarettes a day, or those who have been smoking for a long time (5 or more years). For such patients an FDA approved medication may help them quit. These medications include: nicotine replacement therapy in various forms including nicotine gum, nicotine lozenges, nicotine inhalers, nicotine nasal sprays and nicotine patches. In addition there are 2 FDA approved oral medications for nicotine cessation, Buproban (Zyban) and Varenicline (Chantix). A combination of counseling and medications often gives the patients the best chance of becoming a successful quitter. The decision to use this combination should be made by the dentist, in conjunction with the hygienist and patient. However, there is insufficient evidence for use of any of these medications for pregnant women, adolescents, smokeless tobacco users and light smokers (less than 10 cigarettes per day).

Counseling. Involves helping the patient develop coping skills to avoid temptation, as well as to recognize trigger situations and to develop techniques to avoid smoking binges.

- Provide basic information about quitting such as the addictive nature of smoking, and what to expect from withdrawal symptoms.
- Encourage the patient, let them know that there well tested effective tobacco cessation programs exist, and that one-half of people who ever smoked have quit.
- Communicate and encourage the patient to talk. Ask about patients’ fears about quitting, difficulties encountered with quitting, and reasons the patient wants to quit.
- Provide practical tips. For example, have the patient strive for total abstinence; note that quitting is more difficult when there is another smoker in the house or when alcohol is consumed.
- Provide supplemental materials such as the National Quit Line Number 1-800-QUIT-NOW. Also provide brochures, pamphlets, videos, apps and other aids to quitting.
- Recognize adverse side effects of smoking cessation including withdrawal symptoms nightmares and stress. Also acknowledge they may gain weight after quitting.

Arrange

The last phase of the 5A’s program is arrange, i.e. to refer the patient for more advanced treatment as necessary.

For patients not ready to quit or who have failed to quit with your plan

- Reopen the discussion at each visit, in a non-judgmental, but helpful manner.
- Recommend a local tobacco cessation clinic or quit coach, especially if they are heavy smokers, or have failed to quit after many attempts. They may have to be treated for nicotine addiction by a physician under controlled conditions.

Details of tobacco cessation medications as well as other information is available.51 There are other approaches for
smoking cessation which have been shown to be successful. These include the Ask-Advise-Connect approach.52

**Nutritional Counseling in the Dental Office**

Poor nutrition is a risk factor for poor oral health as well as for diabetes, cardiovascular disease and osteoporosis. It is clear that dietary counseling is important in dental practice as poor nutrition affects caries, periodontal disease, and healing after oral surgery. Furthermore, patients who have reduced masticatory function due to tooth loss often have poor nutrition contributing to caries, obesity, diabetes and heart diseases. Specific dietary counseling for obesity also may reduce the risk for diabetes, cardiovascular disease, certain forms of cancer as well as periodontal disease and caries.

In dental practice there are two modes of dietary counseling; one **Orally Focused** directed to specific oral conditions such as caries and periodontal disease. The second is **Systemically Focused** dietary counseling in collaboration with other health care professionals such as a physician, dietician or nurse. Systemically Focused nutritional counseling is usually carried out for patients who suffer from or are at risk for diabetes, cardiovascular disease, stroke, osteoporosis, cancer, eating disorders, hypertension or other systemic conditions (Table 3).

**Orally Focused Nutritional Counseling**

**Restricting Refined Sugar Intake.** Historically numerous studies and systematic reviews clearly implicate refined dietary sugars as a key dietary causative agent in the development of dental caries.53 A systematic review of the effect of restricting dietary sugars on reducing caries was recently published by Moynihan and coworkers.54 From this review,54 it was concluded that caries are lower when the free sugar intake is less than 55 g/day for 7–10 year-olds, 50 g/day for 4–6 year-olds and 32 g/day for 1–3 year-olds. Furthermore, this review shows that even lower dietary consumption of free sugars resulted in even lower caries. This review also noted that in adults, similar clinically relevant reductions in caries occur with comparable reduction of free sugar intake. Furthermore, these anticiogenic effects of restriction of dietary sugar occur despite the protection offered by fluoride.55,56 These papers,54–56 document the association of refined sugar with dental caries, and support restriction of the intake of free sugars to less than 50 g/day for older children and adults, and 30 g/day for children 1–3 year-olds.54–56 It is also likely that even lower levels will result in lower caries rates, but further studies are needed before this can be a recommendation.

The recommendation to limit daily consumption of refined carbohydrates also should be coupled with recommendations to reduce overall canicogenicity of the diet by limiting the overall consumption of high retention carbohydrates and to limit the number of exposures to refined carbohydrates to fewer than 3 per day. For practical advice, consider that the refined sugar in a 12 ounce can of soda is about 33 g. Also a slice of pecan pie and a cup of chocolate ice cream each have about 33 g of sugar.

**Deleterious Effects of Refined Sugars on Systemic Health – “toxic sugar”**

The link between poor diet, including increased consumption of refined sugars, with obesity and diabetes has been well described.57–59 It is clear from several recent studies however that obesity does not fully explain the variation in trends in diabetes associated with sugar consumption.60–62 One hypothesis to explain more fully the effect of sugar on diabetes proposes that although refined sugar added to the diet does contribute to obesity, these sugars can also increase diabetes risk independent of the obesity effect. Laboratory and clinical studies have shown that deleterious liver changes and pancreatic cell death have been associated with sugar in the diet, leading to increased risk for diabetes independent of the increased risk associated with obesity.63

A recent epidemiologic study relating sugar availability and diabetes prevalence among 40 million people in 175 countries showed that the duration and degree of sugar exposure of a population directly and independently correlated with diabetes prevalence.60 Furthermore, this study showed that declines in sugar availability were associated with subsequent reduction in diabetes prevalence in these populations. Hence it appears that differences in sugar availability (and likely consumption) explain differences in diabetes prevalence not fully explained by obesity.60 They found that for every 12 ounce can of soft drink available, the diabetes prevalence goes up by 1%. Furthermore, there was no difference if the countries used high fructose corn syrup or cane sugar in the soft drink.60

The message is clear; it is not simply overeating that can lead to diabetes, it overeating sugar: It is not just obesity, but insulin resistance which leads to diabetes and sugar can led to insulin resistance and hence to diabetes (Figure 4). This study60 as well as laboratory and animal studies64,65,66 that suggest that sugar directly affects the liver and pancreas leading to insulin resistance gives us further reason to strongly recommend restriction of refined sugars in the diet.

Restricting dietary sugar will clearly result in less caries, and also less obesity. In addition, it is likely also to reduce the risk

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for diabetes and its complications including cardiovascular disease and periodontal disease (Figure 5).

**Nutrition and Obesity**
Nutritional counseling to assist patients to fight obesity is justified in dental practice based on its role in increasing the risk for periodontal disease. Suvan et al. have recently presented evidence that obesity is also linked to poor clinical outcomes after periodontal therapy. Obesity is an emerging epidemic that has doubled in prevalence since 1980, and hence dietary counseling to assist patients to reduce overweight or obesity is of great potential public health benefit. Obesity is a chronic disease associated with diabetes, heart disease, cancer and a number of other conditions described earlier in this paper. Nutritional counseling to assist dental patients to reduce obesity is important and perhaps best carried out in collaboration with other health care professionals, especially if the patient is at risk for or has diabetes or heart disease. Clearly, one recommendation that can be made in the dental office is to restrict sugar intake. Further nutritional counseling is appropriate for those who are overweight or obese. For these patients, weight reduction programs are often successful; however patients often regain the weight. Major lifestyle changes are often needed to bring about life-long healthy eating habits and sustained weight reduction. Hence it is important that the dental setting coordinates weight reduction programs with the patient’s physician.

**Which Diet to Recommend for Weight Loss**
There are many different diets that have been recommended for weight loss, some with exercise regimens. Studies show many of these can work in the short term, one year or so. For example, a recent meta-analysis shows that a very low carbohydrate diet is better at leading to greater weight loss than a low fat diet. Other reviews show no differences in weight loss comparing low carbohydrate diets to low fat diets.

There are dietary considerations for dental patients at different times in their lifecycle. Infants, children, young adults, pregnant women, post-menopausal women and the elderly all have different dietary requirements and challenges. However overweight is often a common problem and sugar restriction a common recommendation.

**General Counseling Tips for a Dental Patient**
- Restrict dietary intake of refined sugar to 50 g/day for adults and older children and 30 g/day for children from 1 to 3 years old.
- Limit eating event to 3 times per day with no more than 2 snacks per day.
- Snacks should be healthy food choices low in cariogenic potential, such as cheese, raw vegetables, and fresh fruit.
- Incorporate low fat, calcium rich foods in the diet.
- Whole grains and whole grain products that do not have added sugar or salt can be recommended as a source of carbohydrate.
- Reduce salt intake.
- Read the food labels and be aware of serving sizes.

For the patient education the following resources are helpful:

- [www.aafp.org](http://www.aafp.org) (American Academy of Family Physicians)
- [www.eatright.org](http://www.eatright.org) (American Dietetic Association)
- [www.osteo.org](http://www.osteo.org) (NIH resource center on osteoporosis)
- [www.vrg.org](http://www.vrg.org) (vegetarian resource group)

In summary, diet counseling in the dental office can be very specific with recommendations to restrict refined sugar to 50 g/day for adults and older children and 30 g/day for children 1–3 years old and to reduce frequency of consumption of cariogenic carbohydrates. In addition, dietary counseling for weight loss is best in collaboration with health care professionals to achieve a balanced non-cariogenic overall healthy diet is suggested.

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