

## Concise Review

## Impact of Smoking Cessation on Periodontal Tissues



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## ABSTRACT

There is cumulative evidence supporting the negative effects of smoking on periodontal tissues. Smoking cessation can be successfully accomplished through specific programs, including behaviour modification and medications, and has been suggested as a suitable way to reduce the risk of several diseases, including periodontitis. The aim of this review is to provide a concise overview of the current knowledge about the impact of smoking cessation on periodontal tissues and therapy, with data from studies published in the last 15 years. Literature was searched using Medline database from 2005 up to and including September 2020 using medical subject heading (MeSH) terms and other search terms, restricted to the English language. Studies were evaluated and summarised in a narrative review format. Results demonstrated that there is convincing evidence to support the benefits of tobacco cessation in reducing the risk of periodontitis and tooth loss. In addition, the harmful effects of smoking on periodontal tissues seem to be assuaged as the number of years since quitting increases. The existing current evidence, even limited, also shows that smoking cessation may result in additional benefits to the outcome of nonsurgical periodontal treatment. Periodontal care providers should not only check their patient's smoking habit for estimating risk of disease progression and predictability of periodontal therapy, but they should also help smokers improve their oral and systemic health by providing efficient and personalised tobacco-cessation counselling and treatment.

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## Introduction

Tobacco use, mainly as cigarette smoking, is the number 1 cause of preventable disease and death worldwide.<sup>1</sup> In addition to nicotine, the major addictive component of tobacco smoke, cigarette smoke has more than 4000 other chemical compounds exhibiting diverse biological activities, including oxidizing, inflammatory, or carcinogenic actions.<sup>2</sup> Consequently, it is well-recognized that smoking increases the risk of numerous systemic disorders such as chronic obstructive pulmonary and cardiovascular diseases, pregnancy complications, and cancers, particularly lung, liver, and colorectal.<sup>3</sup> In addition to the detrimental effects of smoking on systemic health, there is strong

evidence supporting the harmful effects of smoking on oral health by increasing the risk of candidiasis, cavities (caries), precancerous and cancerous lesions, implant failure, and periodontal diseases.<sup>4</sup> Consumption of tobacco is the most common contributing factor in the development of mucosal dysplasia and in the increase of odds for the occurrence of head and neck cancers, mainly oral squamous cell carcinoma.<sup>5,6</sup>

Periodontitis is an infectious, inflammatory oral disease affecting susceptible subjects, and it is recognized as 1 of the main causes of tooth loss in adults throughout the world. A recent systematic review on the global burden of oral diseases, with data from 195 countries and territories, demonstrated that in 2017, 796 million people had severe periodontitis worldwide.<sup>7</sup>

The detrimental effects of smoking on periodontal tissues were first reported in 1947, when necrotising ulcerative gingivitis was related to tobacco consumption.<sup>8</sup> Afterwards, several clinical studies, performed in different populations, supported

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the notion that smoking habit increases the risk of periodontitis development and progression and presents a negative impact on periodontal therapy outcomes.<sup>9</sup> A recent systematic review of prospective studies estimated that smoking increases the risk of periodontitis by 85%.<sup>10</sup> In addition, a smoking habit is a significant predictor for tooth loss in patients with periodontitis.<sup>11</sup> Noteworthy, the detrimental effect of smoking on periodontal tissues was categorically recognised in 2017 when the new periodontitis classification scheme included this risk factor as a “grade modifier” due to its aggravating effects on the risk of periodontitis progression.<sup>12</sup>

Because cigarette smoking involves an assortment of chemical compounds, it has been suggested as a puzzling and complex active player in the pathogenesis of periodontitis. Although the relation of smoking and periodontitis is well-supported by clinical studies, unfortunately, the precise biological mechanisms related to this association have not been defined yet.<sup>9</sup> Therefore, to date, there are no specific periodontal preventive and therapeutic approaches for smokers. Smoking cessation has been emphasised as the best practicable way to decrease the risk of periodontitis onset and progression and to improve treatment outcomes.

The present review will provide a concise summary of the current knowledge about the impact of smoking cessation on periodontal tissues and therapy with data from studies published in the last 15 years.

### Smoking cessation: basic concepts

Smoking cessation is a successful way of reducing the risk for chronic obstructive pulmonary disease, myocardial infarction, and various types of cancers and, consequently, the global morbidity, mortality, and health care expenditures.<sup>13,14</sup> Smokers since early adulthood who quit at 30, 40, or 50 years of age, advance approximately 10, 9, and 6 years of life expectancy, respectively, compared with individuals who continue smoking.<sup>15</sup> Therefore, quitting smoking is 1 of the most important and yet challenging methods to improve patients' health, and supporting patients with smoking cessation should be 1 of the main missions of health care professionals.<sup>3</sup>

Smoking cessation usually involves the intention to not smoke (‘attempt to quit’) followed by consciously resisting the physical and psychological smoking cravings, resulting in a period of abstinence. Generally, ‘lapse’ means a slip back to smoking following a previous period of abstinence. A lapse may be a remote episode followed by the reinstatement of abstinence, or it may progress to a relapse. ‘Relapse’ normally denotes a period of continuous smoking after a period of abstinence or an attempt at abstinence. Short-term abstinence is generally defined when smoking ceases for up to 4 weeks. In clinical trials, ‘long-term’ abstinence success is 6 or 12 months after the target quit time. Therefore, long-term abstinence can involve numerous cessation approaches, and effective cessation may rely on several ‘milestones,’ including the accomplishment of short-term abstinence, avoidance of a lapse, and if lapse happens, prevention of relapse.<sup>16-18</sup>

Numerous variables have been associated with increased initial cessation rates and reduced lapse/relapse risks such as the level of nicotine dependence, gender,

ethnicity, matrimonial status, schooling, presence of smoking in the workstation, and number of smokers in the social network.<sup>18</sup> In 2016, a study in the periodontology field assessed the predictors of smoking interruption in a 2-year follow up study of patients with periodontitis treated with nonsurgical periodontal therapy and smoking cessation treatment. The results demonstrated that the success of smoking cessation was associated with male gender, baseline carbon monoxide levels less than 10 ppm, not living or working with smokers, and the baseline cigarette dependence level.<sup>19</sup>

Currently, different strategies have been proposed to treat smoking dependency including nonpharmacological therapies (eg, counselling and behavioural interventions), pharmacological therapies, and combinations of both. **Table 1** summarises the main nonpharmacological and pharmacological approaches recommended for smoking cessation. The nonpharmacological therapies are considered validated methods to help the process of quitting. Therapies can be offered individually or in a group, in person or by telephone, or even through social media by different health care professionals including, but not limited to, physicians, dentists, nurses, and psychologists. Counselling interventions are considered moderately effective, while incentive-based interventions seem to significantly increase smoking cessation success.<sup>20,21</sup>

In general, the pharmacological treatments available for smoking cessation have proven to be both safe and effective and usually include the use of nicotine replacement therapies, varenicline, cytisine, or the atypical antidepressant bupropion (**Table 1**). In motivated persons, electronic cigarettes can also be helpful to increase quit rates.<sup>15,20,21</sup> The intensities of nicotine dependency and withdrawal are important considerations in deciding the category and intensity of tobacco-cessation approaches. Decreases in nicotine

**Table 1 – Main nonpharmacological and pharmacological approaches recommended for smoking cessation.<sup>20</sup>**

<b>Nonpharmacological strategies for smoking cessation</b>
Counselling
Cognitive behavioural therapy
Written or telephone or digital advices
<b>Pharmacological approaches for smoking cessation</b>
<b>First-choice agents</b>
NRT
Transdermal patch
Gum
Lozenge
Oral inhaler
Nasal spray
Combined NRT
Varenicline (combined or not with NRT)
Bupropion sustained-release (combined or not with NRT)
Varenicline + bupropion sustained-release
Cytisine
<b>Second-choice agents or adjuvants</b>
Anxiolytics (benzodiazepines)
<b>Other antidepressants</b>
Selective serotonin reuptake inhibitors (SSRIs)
Serotonin and norepinephrine reuptake inhibitors (SNRIs)
Atypical antidepressants

NRT = nicotine replacement therapy.

exposure cause symptoms of nicotine withdrawal, including craving, depression, anger, irritability, frustration, and difficulty concentrating. Overall, the appropriate choice of pharmacological therapy for smoking cessation should be personalised for each patient based on scientific evidence, taking into account the patient's previous nicotine consumption levels, preference for pharmacologic modality, current medication regimen and possible drug interactions, and medical status if medical conditions such as cardiovascular diseases, psychiatric, renal, and hepatic comorbidities are present.<sup>20,21</sup> The combination of counselling and pharmacotherapy have been shown to improve the chance of long-term abstinence and, therefore, should be offered to patients wanting to quit smoking.<sup>22</sup>

### **Multinational agreement on the benefits of smoking cessation on periodontitis and tooth loss**

In the last few decades, particular attention has been given to the influence of tobacco cessation on oral health. Smoking cessation has been suggested as an efficient strategy for reducing the risk of periodontitis. In this context, a number of preclinical and clinical studies have examined the impact of smoking cessation on periodontal parameters and tooth loss.

Two studies using a rodent model of cigarette smoking have reported that smoking cessation yielded greater bone density and lower bone loss around ligature-induced periodontitis and higher alveolar bone density around nonligated teeth.<sup>23,24</sup> These findings in animals are supported by several studies in humans that reported significant benefits of smoking cessation on periodontal parameters and risk of disease progression in populations from different nations.

A cross-sectional study evaluating older Thai adults observed that quitting smoking significantly reduced the odds of having periodontitis. Current smokers and former smokers were 4.8 times and 1.8 times, respectively, more likely to have advanced periodontitis than the nonsmokers.<sup>25</sup> A population-based prospective birth cohort in New Zealand evaluated the association between smoking and periodontitis in a representative population of young adults. Periodontal examinations were carried out when participants reached 26 and 32 years of age, with information about history of smoking was acquired at ages 15, 18, 21, 26, and 32. The results confirmed that present and long-term smoking in young adults is harmful to periodontal health. Most importantly, smoking interruption contributed to a somewhat more rapid improvement of periodontal health in those subjects.<sup>26,27</sup>

In 2010, Arora et al<sup>28</sup> reported on tooth loss and health-related characteristics, including smoking habits, in a large population from Australia. Current and ex-smokers demonstrated an odds of edentulism of 2.51 and 1.50, respectively, after adjustment for gender, age, social income, and schooling. Among former smokers, the risk of tooth loss was reduced with increased time since smoking interruption. However, it remained elevated even in subjects who quit smoking 30 or more years when compared with those who had never smoked. In the same year, a cohort study of Japanese men reported that the odds of having periodontitis or >8 missing teeth in subjects who had never smoked did not

differ to that of subjects who stated that they had quit smoking for 11 years or more.<sup>29</sup> Subsequently, Costa et al<sup>30</sup> reported periodontitis prevalence of 25.6%, 29.3%, and 45.1% for Brazilian nonsmokers, ex-smokers, and current smokers, respectively. After correcting for several confounding factors, the odds ratio for periodontitis was 3.09 for former smokers and 5.24 for current smokers. Furthermore, a significant reduction in the risk of periodontitis was observed as the years of smoking cessation increased.

Dietrich et al<sup>31</sup> evaluated the relationship among tobacco smoking, smoking cessation, and the frequency of tooth loss in a cohort study from Germany. Results demonstrated that smoking cessation was significantly related to a decrease in the risk of tooth loss, with the risk resembling that of never smokers after 10 to 20 years of cessation. A retrospective study exploring data from the Korea National Health and Nutrition Examination Survey demonstrated that the risk of periodontal diseases, expressed as community periodontal index scores of 3 or 4 points, declined after 10 years since smoking cessation when compared with current smokers and did not differ from never smokers.<sup>32</sup>

According to data from the US National Health and Nutrition Examination Survey from the 2009 to 2012, the prevalence of periodontitis was 34.5% among current smokers, 19.3% in former smokers, and 13.1% in nonsmokers. Furthermore, the longer time since stopping smoking, the lower the chance of having periodontal disease.<sup>33</sup> A cohort study evaluating Brazilian patients in supportive periodontal therapy for 6-year reported that frequency of recurrence of periodontitis (defined as probing depth  $\geq 4$  mm and clinical attachment loss  $\geq 3$  mm associated with bleeding on probing or suppuration) was 44.2%, 68.2%, and 80.0% for nonsmokers, former smokers, and current smokers, respectively. In addition, the odds ratio for recurrence of periodontitis at 6 years after active periodontal therapy was 2.80 for former smokers and 5.97 for current smokers, when compared to nonsmokers. A significant reduction in the risk of recurrence of periodontitis as the duration of smoking cessation increased was also observed.<sup>34</sup> Recently, a retrospective study assessed the long-term effects of smoking on tooth loss related to periodontitis in US patients under supportive periodontal therapy. Results demonstrated that light and heavy former smokers needed about 15 years to reach the tooth loss risk level of never smokers. The probability of tooth loss due to periodontitis was reduced by 6% per year of smoking cessation.<sup>35</sup>

### **Impact of smoking cessation interventions in combination with periodontal therapy**

Cigarette smoking can pose a higher risk of periodontal treatment failure and influence the risk of disease recurrence.<sup>9</sup> Although some clinical investigations have assessed the role of smoking cessation on periodontal therapy outcomes over the past 15 years, there are only a few publications that evaluate the effectiveness of incorporating smoking cessation approaches into periodontal therapy.

A 12-month prospective longitudinal study published in 2005 demonstrated a beneficial effect of smoking cessation on probing depth reduction following nonsurgical therapy for

smokers with periodontitis.<sup>36</sup> In 2011, Rosa et al<sup>37</sup> observed that subjects with periodontitis who stopped smoking and were treated with scaling and root planning had clinical attachment gain at 12-month follow-up, unlike those who did not stop smoking or oscillated. Subsequently, the same research group reported the 24-month outcomes of nonsurgical periodontal therapy associated with smoking cessation. Patients that quit smoking presented with significantly higher gain of mean clinical attachment, reduction of mean probing depth, and a reduced proportion of sites with clinical attachment loss  $\geq 3$  mm when compared to those that did not quit smoking.<sup>38</sup>

Therefore, the existing evidence on this topic, even though limited, shows that implementing proper tobacco-dependence treatment and achieving smoking cessation could increase the success of periodontitis treatment. More data from interventional studies on the influence of smoking cessation on periodontal treatment outcomes are necessary, controlling for the limitations inherent in such investigations such as blind assessments, patient compliance, attrition rates, and chemical confirmation of smoking status.

### Systematic reviews on the effects of smoking cessation on periodontitis and periodontal therapy

Systematic reviews and meta-analyses, taking into account the quality of the publications, are considered to be the strongest level of scientific evidence to assist in clinical decision-making and recommendations.<sup>39</sup> In the last decade, a limited number of systematic reviews have addressed the importance of smoking cessation on periodontal health. Even though a small number of studies were generally included in each review, overall results have indicated a helpful effect of stopping smoking on periodontal parameters, including probing depth, clinical attachment level and radiographical bone loss, risk of periodontitis, and tooth loss.<sup>40-42</sup>

To date, 2 systematic reviews with meta-analyses assessed the influence of tobacco smoking interruption on the clinical outcomes of nonsurgical periodontal treatment.<sup>41,43</sup> Both reported that smoking cessation yielded benefits in regard to probing depth and clinical attachment level in individuals who received nonsurgical periodontal treatment. However, even 6 years apart, only data from 2 interventional studies were included in both systematic reviews, reinforcing the need for more prospective studies on the impact of combined periodontal treatment with a tobacco cessation program.<sup>41,43</sup>

### Periodontal care providers playing a role in smoking cessation programs

Dental professionals are in an ideal position to support their periodontal patients be successful in smoking cessation.<sup>44</sup> Previous evidence shows that patients believe dentists are capable of offering cessation counselling, and they have positive beliefs about the dentist's role in smoking cessation.<sup>45</sup> The potential for dental care providers to contribute to smoking cessation efforts was assessed in a study evaluating the

effectiveness of a Tobacco Counselling Cessation Protocol (TCCP) employed in the dental curriculum at the University at Buffalo School of Dental Medicine.<sup>46</sup> Results demonstrated that 14% of patients who received the proposed TCCP decreased the number of cigarettes smoked per day and 22% quit completely. Furthermore, of the 51% of those who had the TCCP and promised to abandon smoking at the time of intervention, only 19% had returned to smoking while 32% were still smoke-free 6 months after counselling cessation.

The aforementioned benefits of smoking cessation on periodontal tissues indicate that appointments for periodontal care are a valuable opportunity to approach patients who smoke. Thus, periodontal care providers should play a significant role in implementing interventional and counselling therapies for smoking cessation to aid in the promotion of healthy behaviours. Periodontal diseases seem to be the main influential factors among the patients who are encouraged to quit smoking.<sup>47</sup>

Scientific evidence shows that a modest, but not unimportant, rate of smoking cessation can be accomplished by means of counselling by periodontal care providers.<sup>48,49</sup> Unfortunately, however, the performance of hygienists and periodontists in smoking cessation activities seems to be limited, as indicated by the rates of smoking cessation among patients with periodontitis. A previous study evaluated quit rates of smokers with periodontitis that received periodontal treatment and smoking cessation counsel by dental hygienists who were trained in smoking cessation counselling: 41%, 33%, 29%, and 25% of patients had quit smoking at 1, 3, 6, and 12 months, respectively, after treatment.<sup>48</sup> In 2011, Patel et al<sup>50</sup> administered a survey assessing the periodontists' knowledge and approaches about tobacco cessation and application of interventions in their regular practice. According to the results, periodontists believe that smoking cessation interventions are a responsibility of dental care providers. Nevertheless, due to some perceived difficulties, the described rates of complete smoking cessation interventions in periodontal practices are low. Remarkably, 99% of periodontists know to ask their patients about smoking habits. Unfortunately, even though half of the patients with periodontitis desired to have a cessation program along with periodontal therapy, only 35% of periodontists spend more than 5 minutes of counselling with these patients.<sup>51</sup>

Therefore, dentists should believe in their potential to contribute to smoking cessation and invest more time in smoking cessation interventions. Even with achieving slight to moderate smoking quit rates, it would be of great value to the patient's oral and systemic health and to public health in general.

### Conclusions

- Smoking cessation, in general and in patients with periodontitis, could be achieved through specific programs, using nonpharmacological and pharmacological approaches.
- There is strong evidence to support meaningful benefits of tobacco cessation in reducing the risk of periodontitis and tooth loss. Although the harmful consequences of smoking on periodontal tissues may endure for a long time,



such effects seem to be reduced as the number of years since quitting increases.

- There is still little evidence on the impact of smoking cessation on periodontal treatment. The existing evidence on this topic, even though limited, shows that smoking cessation could result in additional benefits to the outcome of the nonsurgical periodontal treatment.
- Periodontal care providers should not only check the patient's smoking habit for estimating risk of disease progression and predictability of periodontal therapy, but they should also help smokers improve their oral and systemic health by providing efficient and personalized tobacco cessation counselling and management.
- Dentists, in general, can also support smokers desire to quit by consistently identifying patients who smoke, counselling them to quit, and offering them information about cessation strategies.
- The management of smoking cessation in a dental practice should be performed in accordance with all applicable state and country laws, especially if pharmacological approaches are to be part of treatment.

### Conflict of interest

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