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Review

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Effects of smoking on oral cavity

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ABSTRACT

Smoking is a common practice and damages almost all organs and systems of the body. Oral cavity is often overlooked yet such an important region. Its rich flora contains many microorganisms that cause local and systemic diseases if microbiological flora is altered. Cigarette smoke renders oral mucosa epithelium to be susceptible for colonization of pathogens. These pathogens can cause or contribute formation of systemic diseases such as diabetes and obesity. Also smoking causes mutations that can lead to cancers. Many cancerous or precancerous lesions and bad breath attributed to smoking. This review focuses smoking related oral cavity conditions and their mechanisms.

Introduction

Smoking is one of the most important public health problems in the world. Tobacco usage (Cigarette, cigar, pipe, hookah etc) results in a very strong addiction syndrome. This syndrome reflects all basic features of addiction according to DSM V. Although smoking rate is decreasing in developed countries, sadly, smoking is a common practice in developing countries. The most important reasons for this situation are marketing strategies of international tobacco companies and lack of education in developing countries (Caliskan, 2015). It is a known fact that cigarette smoking causes adverse effects on the whole body (Ozturk et al., 2014). While struggling against smoking primary care physicians often neglect the effect of tobacco on oral health. This review aims to help primary care physicians to gain knowledge and improve their perspective about this topic.

Smoking and oral health

Oral cavity is the initial portion of the digestive tract and it is surrounded by the lips, cheeks, palate, tongue and the mouth floor. The section between teeth, gums, lips and cheeks is called “vestibulum oris”. “Cavitas oris propria” is the inner section surrounded by teeth and gums includes the tongue. Oral cavity is an important structure that hosts both soft and rigid surfaces washed by saliva and open to the external

environment. Smoking causes cancers, mucosal lesions and periodontal diseases in all regions of oral cavity. It increases coronal and root caries. Smokers are notorious for large carries and missing teeth as well as bad breath. (Heintze, 1984; Sayed and Stephen, 2000; Wanda et al., 2007; Aguilar-Zinser et al., 2008; Yıldırım et al., 2010). Oral lesions associated with smoking is shown in Table 1.

Table 1. Oral lesions and conditions associated with tobacco use

Oral precancerous lesions
Leukoplakia
Erythroplakia
Smokeless tobacco keratosis
Oral cancers
Squamous cell carcinomas of the
Tongue
Floor of the mouth
Lip
Gingiva
Verrucous carcinomas of the
Buccal mucosa
Gingiva
Alveolar ridge
Periodontal diseases
Increased plaque and calculus depositions
Ischaemia
Enfections
Periodontal pockets
Gingival recession
Alveolar bone loss
Root caries
Peri-implantitis
Halitosis
Taste derangement
Stained teeth and restorations
Black hairy tongue syndrome

(Tomar and Asma, 2000; Gurvits and Tan, 2014; Çetin Kargın and Marakoğlu, 2015)

The effect of smoke on oral health

Chemical carcinogens in cigarettes corrupts protein and lipid-A- derived 3-OH fatty acid profile in the salivary and causes mutations and chromosome breakages in the DNA (Jeng et al., 2001; IARC, 2004; Borojevic, 2012). Oral lesions associated with smoking in general, is caused by various toxins and carcinogens made from the burning tobacco. With the burning of tobacco, various carcinogens i.e., tar, carbon monoxide, benzopyrene, Cd complex-nitrogen oxide are released or formed besides nicotine. In fact around 4000 chemicals, most of them irritants if not carcinogen, are released from burning tobacco. Cotinine, the most important metabolite of nicotine, is detected in blood, urine and gingival fluid. Cotinine levels of regular smokers in the saliva are found to be more than 100 ng/ml (Özbek and Karabıyıkoğlu, 1996; Tangada et al., 1997; Mızrak and Acun Kaya, 2005).

Smoking and oral flora

Nicotine affects proliferation, binding and chemotaxis of periodontal ligament cells negatively. Pro-inflammatory cytokines produced by gingival fibroblasts have synergistic relationship with lipo-polysaccharides of *Escherichia coli* and *Porphyromonas gingivalis P. gingivalis* (Giannopoulou et al., 2001). The effects of smoking on oral cavity immunity is shown in Fig. 1. Smoking affects directly periodontopathogen colonies, sub-gingival ecology and increases colonization of the mouth by potential pathogen microorganisms (Blackwell et al., 1992; Grossi et al., 1996). Some of these frequently found pathogens are Actinobacillus actinomycetemcomitans (A.A.), *P. gingivalis*, *Prevotella intermedia* (*P. intermedi* A), Eikenella corrodens (*E. corrodens*) and Fusobacterium nucleatum (*F. nucleatum*) (Kinane and Radvar, 1997).

Smoking makes binding of some pathogen microorganisms to the epithelism easier. The ability of binding to the epithelium is important for colonization of bacteria in the oropharyngeal mucous membranes and stops the destruction of the bacteria. Yetkin at al. isolated pathogen bacteria in 43% of smokers and 20% of non-smokers ($p<0.05$) (Yetkin et al., 2010). Greenberg et al. (2006) showed that more of Haemophilus influenzae and Streptococcus pneumoniae carriage is found in individuals exposed to cigarette smoke.

Smoking and oral neoplastic effects

Smoking can lead to precancerous lesions and oral cancers related to p53 mutations (Chen et al., 2008; Gibbons et al., 2014; Yeh et al., 2016). Many molecular and immunohistochemical studies found that main p53 mutations occur in 220, 245-248 and 278-281 codons as G —> A, G —> T or G —> C transversions or deletions (Iggo et al., 1990; Somers et al., 1992; Fıeld et al., 1993; Brennan et al., 1995).

"Volatile sulphur compounds" (VSCs) in tobacco smoke are the dominant components that cause halitosis. Moreover smoking contributes to halitosis by causing hyposalivation and periodontal diseases (Al-Atrooshi and Al-Rawi, 2007; Scully and Greenman, 2012). In a study where oral hygiene and smoking evaluated, 82% of smokers and 52% of controls complained of halitosis (Soylu Özler and Akoğlu, 2014). Smoking is an important risk factor for the prevalence, the affected area size and severity of the periodontal diseases (Chambrone et al., 2010). In the United States smoking is responsible for almost half of the cases of periodontitis (Tomar and Asma, 2000). The risk of periodontitis in smokers is increased to 2-7 folds (Susin et al., 2004; César Neto et al., 2012). Pathogens related to periodontal diseases, are shown to be associated with

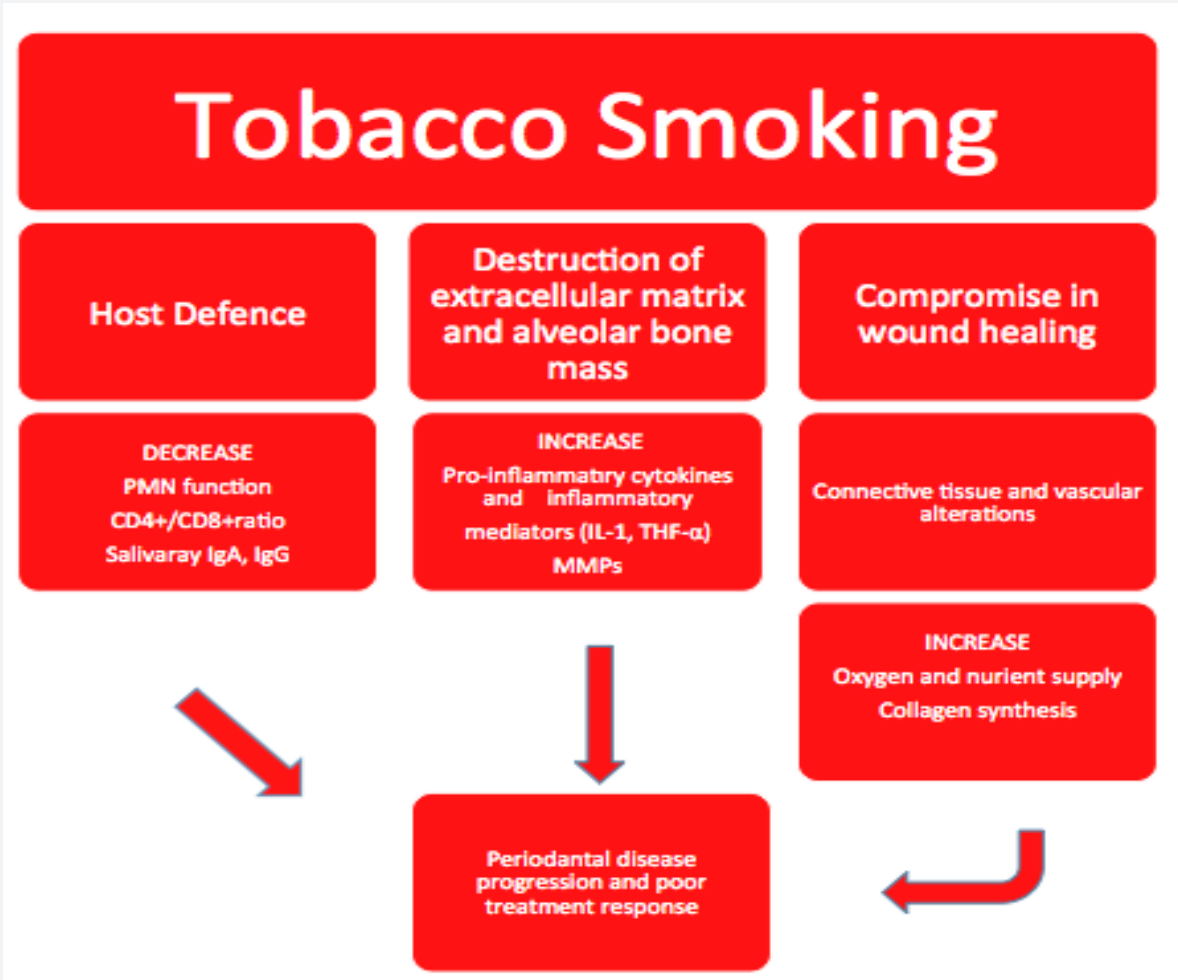

Fig. 1. The effect of tobacco smoking on periodontal tissues (Sham et al., 2003) PMN polymorphonuclear leukocytes
IgA: Immunoglobulin A; **IgG:** Immunoglobulin; **GIL-1:** Interleukin-1; **TNF-α:** Tumour necrosis factor-alpha; **MMPs:** Matrix metalloproteinase

systemic conditions of cardiovascular disease, stroke, premature or low-weight infants, upper respiratory tract infections, diabetes, obesity, rheumatoid arthritis and renal diseases (Külekçi and Gökbuget, 2009). Therefore tobacco related mouth diseases affects whole body directly or indirectly.

Second hand smoke is thought to be associated with periodontal diseases. Erdemir at al. (2010) studied 109 children and concluded that passive exposure to smoke is a risk in terms of periodontal diseases compared to those without any exposure (Tanner et al., 2005). Real time PCR is shown that smoking increases amount and depth of bacterial invasion (Gomes et al., 2006; Teixeira et al., 2009). Hairy tongue is an interesting finding in smokers. A study has revealed the frequency of hairy tongue in 32.3% of smokers and 16.5% of non-smokers ($p<0.05$) (Özeç et al., 2008).

The damages of Smoking on teeth and oral tissues are related to the amount and duration of usage. Some studies purport that after 10 years of smoking cessation, the risk of oral cancer is equalized to those of nonsmokers but some say despite the reduction, the risk is still higher than non-smokers (Macfarlane et al., 1995).

In conclusion, Oral cavity is an important region overshadowed by cardiovascular or respiratory studies. Smoking may affect oral cavity in different levels from a simple complaint to life threatening conditions. Cessation of smoking will prevent many oral cavity conditions and systemic diseases.

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