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E-Cigarette and Periodontal Health: A Brief Review

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ABSTRACT

Numerous studies have shown a strong association of cigarette smoking as a risk factor for periodontal disease is readily available so far. However, data regarding E-cigarettes as a new alternative to smoking is limited. Some studies have shown that e cigarette smoking or vaping have less effect on periodontium in comparison to tobacco cigarette smoking. As the popularity of E-cigarette increases the potential for damage exists, it is necessary to investigate and study the impact of e cigarettes on Oral health. Therefore, we aimed to review the literature regarding the impact of electronic cigarette smoking on periodontal health.

Keywords*: E-cigarette, Vaping, ENDS, Tobacco, smoking, oral health, periodontal health.*

Introduction

One of the main risk factor for periodontitis also known as chronic polymicrobial inflammatory disease is smoking, as it alters microorganisms of oral cavity and also alters the host immune response.1,2 Many previous studies have demonstrated the ill effects of tobacco- containing products on Oral tissues such as mucosal lesions, plaque formation, teeth staining, gingivitis, periodontitis, alveolar bone loss, Tooth loss, failure of prosthetic and surgical treatments an increased risk of oral cancer.3-5

Over the years, electronic cigarette smoking or vaping has increased, however conventional cigarette smoking has decreased. E cigarettes are battery operated devices, which helps the user to inhale the aerosol mixture which contains nicotine along with the propylene glycol or glycerine and other additional substances. It may sometimes be without nicotine also. However, the uses of E-cigarettes are regulated by FDA. Heavily marketed, E- nicotine delivery systems such as e-cigarette are also available in various flavours and high nicotine concentrations. E-cigarette has been proposed as a strategy of smoking cessation or a less harmful replacement of conventional cigarette smoking.6,7 The data supporting this is limited and inconclusive. This review presents a brief overview of the effect of E-cigarette smoking on periodontal health and periodontitis.

Electronic nicotine delivery system (ENDS) and inhaled nicotine

The nicotine is a main bioactive component of the tobacco-derived products, including the conventional cigarettes, e-cigarettes, cigars and water pipes ranging from 0 mg–100 mg/ml. Nicotine is well known for its addictive properties.8,9 Electronic nicotine-delivery system [ENDS] is the recently emerged nicotine delivery systems. ENDS are proposed to reduce the craving for conventional cigarettes. In recent times, a rapid growth has been taken place in both the marketing and consumption of these e-cigs. Each “puff,” results in heating element vaporization of a small amount of liquid. In this way, the ENDS user is not really inhaling the smoke but an aerosol/vapor of nicotine up to 24–100 mg as mist/vapor. Thereby, ENDS will deliver a significant amount of the nicotine compared to the tobacco cessation devices which are available commercially.9

E-cigarettes

The e-cigarettes are battery operated devices which contain a metal heating element in a stainless steel shell, an atomizer, a cartridge and a battery. The e-cigarette solution in the cartridge is referred to as e-liquid or e-juice and is generally composed of nicotine, flavor ingredients in propylene glycol, and vegetable glycine. In addition, some vaping devices contain cannabis, which further broadens the

composition and appeal of aerosols. The heating element vaporizes a solution that contains a mixture of the chemicals including nicotine and other additives or carbonyl/oxidative stress, DNA damage and stress induced cellular senescence leading to the oral health problems. It affects the periodontal health leading to periodontal disease i.e. periodontitis which is characterized by chronic inflammation of tooth supporting tissues. The possible oral health effects of e-cigarettes have been vigorously debated in the dental literature over recent years.

Mechanism of action

The E-cigarette aerosol includes, but is not limited to, tobacco-specific nitrosamines, aldehydes, metals, and volatile organic compounds10. These compounds could potentially alter the oral microbiome and have adverse effects on oral health. Disturbance of the oral microbiome, particularly commensal microorganisms, might lead to dysbiosis and increase pathobionts, which might lead to oral diseases, such as periodontal disease. Dysbiosis might, in turn, activate different inflammatory pathways and, subsequently, lead to systemic health conditions, such as respiratory11, immune12, and cardiovascular complications13. Furthermore, recent studies showed that e-cigarette aerosol exposure caused elevated concentrations of proinflammatory cytokines (IL)-6 and IL- 1b, thus potentially increasing susceptibility to periodontal disease14,15 (Table 1).

Some studies have also reported a range of effects, including cytotoxicity, reduced cell proliferation and migration, increased apoptosis and inflammatory mediator production, and detection of oxidative damage such as protein carbonylation and DNA strand breaks.16-18 The protein carbonylation results in the autoantibody production which in turn may lead to the destruction of matrix as well as bone loss during periodontitis. Thereby, it is possible that the carbonyls or aldehydes play an important role in the ecig aerosol-induced oral toxicity. The nicotine has also shown to have the anti-proliferative properties and affects the fibroblasts in vitro. This implies that the E-cig containing nicotine affects the oral myofibroblast differentiation in the users of e-cig; and thus it may affect their ability to heal the wounds by decreasing the wound contraction by the myofibroblasts. This can be due to release of matrix metalloproteases (MMP-9, MMP-12) and prostaglandins (PGE2) as well as their effects on the mesenchymal stem cells (MSCs).

The e-cigarette devices or ENDS deliver the nicotine at various concentrations. The nicotine has been associated with the impaired leukocyte activity as well as the healing by inhibiting the neovascularization and also the osteoblastic differentiation. Likewise, the tobacco smoking including the nicotine is associated with an increased risk of the impaired healing, implant failure, poor papilla regeneration as well as increased bone loss. Thereby, it is possible that the nicotine derived from the e-cig may impair the healing potential at the bone and implant interface. E-cigarette vapor has been shown to promote cell apoptosis, necrosis20 and persistent DNA damage in gingival epithelium.17 Menthol

flavoring in e-cigarette liquid has also been shown to reduce the proliferation rate of human periodontal ligament fibroblasts21. Nicotine found in many e-cigarette aerosols22 has been shown to inhibit the growth of gingival fibroblasts23, human periodontal ligament cells24 and alter the function of oral or peripheral neutrophils25. E-cigarettes have been perceived as less harmful than conventional cigarette smoking and reported by some as a safer alternative to cigarette smoking but e-cigarettes and other electronic nicotine products may still be deleterious to human health. Harmful or potentially harmful compounds such tobacco-specific nitrosamines, polycyclic aromatic hydrocarbons, metals and volatile organic compounds have been documented in some electronic nicotine product aerosols and the urine of e-cigarette users. The use of e-cigarettes is also found to be associated with changes in 284 genes, encoding a variety of metabolic pathways and other functions. Several proinflammatory cytokines were elevated in e-cigarette users including interleukin (IL)-2 and IL-6, granulocyte-macrophage colony-stimulating factor (GM-CSF), tumor necrosis factor α (TNF-α), and interferon-γ (IFN-γ), whereas the anti-inflammatory cytokine IL-10 was decreased.14,19

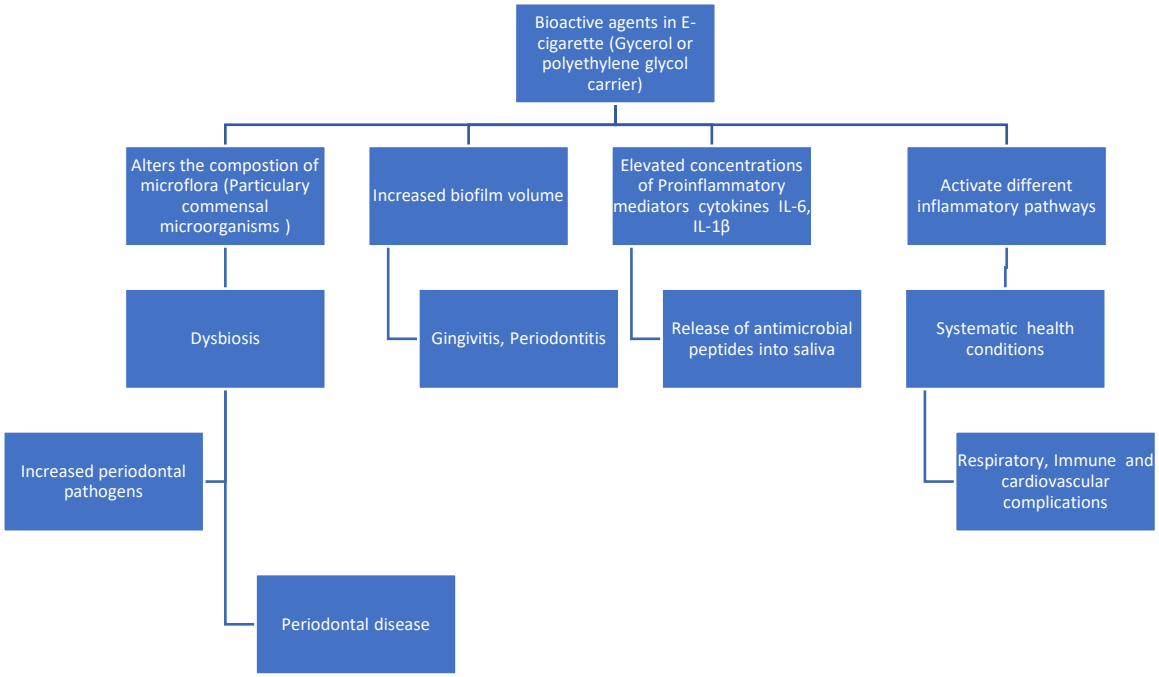

Table 1: Mechanism of action of E-cigarette.

Advantages of E-cigarette over conventional smoking:

• It reduces the number of cigarettes smoked.

• More effective than conventional nicotine replacement therapy.

• Considered to be less harmful than the conventional cigarette smoking.

• Available in range of flavors and designs, these features appeal to current smokers who otherwise resist cessation methods.

• Easily accessible.

Disadvantages

• Doesn't result in complete withdrawal.

• Used for long term in comparison to conventional nicotine replacement therapy, when used as an aid to quit smoking

• High probability risk of smoking-related diseases.

• Damage to oral tissues

• May Cause severe lung diseases which may led to death.

• Dual use of e-cigarettes and conventional cigarettes together is common and may cause harms similar to conventional smoking alone.

• Unknown long-term health impacts.

Tobacco consumption

Tobacco cessation is essential to reduce the mortality and morbidity related to tobacco use.

Global Scenario:

According to the World Health Organization (WHO), there are about 1100 million regular smokers in the world today. Tobacco is responsible for the death of 1 in 10 adults i.e. about 5 million deaths each year Globally with a slight trend of 2.41 million deaths in developing countries and 2.43 million deaths in developed countries.About 1/3rd population is affected because of second hand tobacco smoke affecting their health as well..

Indian Scenario:

India is the world's third largest tobacco producing country and ranks second for consumption of tobacco products in the world. India accounts for the highest tobacco-related mortality with about 7,00,000 annual deaths attributable to smoking in the last ten years, which is estimated to be rising up to 1million in the coming next ten years. More than one-third (35%) of adults in India use tobacco in some form, 21% of adults use smokeless tobacco, 9% only smoke tobacco and 5% smoke as well as use

smokeless tobacco. It is estimated that annual oral cancer incidence among Indian males is as high as 10 per 100,000.

Presently, India has about 18 Tobacco Cessation Clinics (TCCs) across the country. This clearly is an inadequate effort taking the existing 250 million tobacco consuming population into consideration. This includes:

1. Cognitive behavioral management (Cognitive Behavioral Therapy (CBT) includes methods such as self-help and brief interventions which can be provided by health professionals.

2. Intensive therapy at smoking cessation centers.

3. The pharmacological means include Nicotine Replacement Therapy (NRT) and antidepressants like bupropion.

Conclusion

The e-cigarettes are relatively new devices and hence no long-term evidence study regarding their effect on oral health is available. Although e-cigarettes may be less harmful than the traditional or conventional smoking, e-cigarettes can still contribute to the pathogenesis of periodontal diseases by cell injury, inflammation and impaired repair ability. The chemicals in the e cigarette vapor are known to cause DNA damage and also cellular senescence. Studying the oral health consequences of e-cigarette use is challenging given the changing nature of the products and difficulties of identifying potential e-cigarette effects in patients with a past or current history of combustible tobacco use. For those using e-cigarettes as a tobacco quit aid, the evidence of oral health impacts is uncertain and complicated by the substantial oral health changes that occur when users quit tobacco smoking. There is a clear need for further well-conducted studies in this field. Those areas that have the strongest potential to benefit patients are understanding the oral health consequences in nonsmokers who initiate e-cigarette use, establishing the effectiveness of e-cigarettes as a tobacco quit aid (especially within the dental setting), and understanding any impacts on periodontal health in smokers who switch to e-cigarettes.

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