



# African Journal of Biological Sciences



Research Paper  
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## Impact of E-Cigarettes on Periodontal Health. Systematic Review

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### Article Info

Volume 6, Issue 8, April 2024

Received: 12 Feb 2024

Accepted: 15 March 2024

Published: 06 April 2024

### Abstract

The electronic cigarette or vapor, is a nicotine delivery device that was developed by Honlik in 2003, it appears as an alternative to the traditional cigarette. The prevalence of use was determined to be approximately 1 million people. Thus, prolonged use of this electronic system can cause periodontitis, since nicotine levels in saliva decrease the immune response. Thus, the present study aims to discuss the correlation between the use of electronic cigarettes and the development of periodontitis, in addition to highlighting the role of the dentist in the diagnosis and treatment of the effects of this deleterious habit. Regarding the methodology used, it consists of a systematic literary review, through searches in the Google Scholar, Scopus, PubMed, MEDLINE and LILACS databases via the VHL in the period from 2019 to 2023. Through this, it was found that the causes that lead to the use of these devices are, above all, social and that the vapor from electronic cigarettes is an aggravating factor for the formation of periodontitis in young people due to the changes it causes at the cellular level. However, the population still does not have full knowledge of the clinical findings that prove this relationship, which makes it difficult to raise awareness and, therefore, minimize this habit. Therefore, the dentist has the role of preventing periodontitis from occurring in advanced stages, warning about the risks of continuing to use electronic cigarettes.

Keywords: Electronic cigarettes, Vapers, periodontal disease, Periodontitis

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### Introduction

The act of smoking has been established millions of years ago, from ancient to contemporary societies. With the passage of time and the development of medicine, smoking is now considered a public health problem and its consequences are alerted and known by a large part of the population<sup>1</sup>. According to data from the World Health Organization (WHO) in 2021, about 1.3 billion people in the world are smokers and use conventional cigarettes,

pipes, cigars and chewable tobacco products, however, this study did not take into consideration electronic cigarettes.<sup>2</sup>

The electronic cigarette, also known as a vaper, is a nicotine delivery device that was developed by Honlik in 2003 and was launched on the market in 2004 as an alternative to conventional cigarettes<sup>3</sup>. Its promise was to be a tool in the fight against smoking with an idea of being less harmful than conventional cigarettes<sup>4</sup>.

In the United States in 2019, it was estimated that approximately 4 million adolescents used e-cigarettes, mainly those in school<sup>3</sup>. In the same year in Brazil, the prevalence of use was determined to be approximately 1 million people, of whom 70% were between 15 and 24 years old, with 40 times more use than adults aged 40 years or older<sup>5</sup>.

A study carried out in Ecuador by the University of Specialties Espiritu Santo (UEES) analyzed the consumption of electronic cigarettes in 3,443 students from schools, colleges and universities in different parts of the country, where they determined that 52% acquired this device to smoke at least once, since the age of 12 and that 76% of young people smoke for more than an hour after waking up and during the day. They do this between 11 and 30 times<sup>6</sup>.

The search for electronic devices to smoke among adolescents can be due to factors such as exposure to risk, the search for new experiences, stimulation from the social circle, pressure from industries and misleading forms of advertising where tobacco is shown as synonymous with maturity and the beginning of adulthood<sup>7</sup>.

Additionally, it is believed that the use of these cigarettes is safe, due to the addition of flavors and less concentration of harmful products in combustion, which is incorrect because there are other toxic compounds added to the consumption of alcohol or other narcotic substances. It is also known that most of the users of these devices are smokers or ex-smokers of conventional cigarettes, some even make double use of electronic cigarettes associated with other types of tobacco. Wanting to quit conventional cigarettes is another reason for starting to use electronic cigarettes<sup>8</sup>. The acquisition of these devices is done in a very fast and practical way, despite the fact that their commercialization is prohibited in some countries<sup>9</sup>.

These vapers, or electronic cigarettes, work through a circuit that is capable of heating a liquid, transforming it into vapor to be swallowed. What makes this type of device attractive to young people is that in addition to nicotine, this liquid contains varied aromas and flavors of different types<sup>10</sup>.

They were launched on the market as less harmful compared to conventional cigarettes and as an alternative way to reduce their consumption. However, they have direct health implications and generate a highly addictive vice in consumers<sup>11</sup>. Research conducted in 2022 by Covitel showed that 1 in 5 young people between the ages of 18 and 24 in Brazil have already used an e-cigarette at least once in their lives. Therefore, this population became a global concern as a result of the health impacts, especially on oral health<sup>12</sup>.

In addition, they can cause an imbalance in the oral microbiota, since the oral cavity is the first to come into contact with the hot vapor resulting from the functioning mechanisms of electronic cigarettes. There are studies that show the relationship between the use of electronic cigarettes and the development and potentialization of diseases that affect the stomatological system, such as; xerostomia, nicotic stomatitis,<sup>1</sup> angular cheilitis, hyperplastic candidiasis, hairy tongue,<sup>13</sup> carious lesion, increased bacterial plaque, increased

periodontal pocket, marginal bone loss, loss of clinical attachment,<sup>14</sup> and periodontal disease.<sup>12</sup>

One of the imbalances produced by the consumption of electronic cigarettes is the emergence of periodontitis, which is a multifactorial inflammatory disease that leads to the destruction of the supporting tissues of the teeth, in which the host's inflammatory response to bacteria and their products is largely responsible for the destruction of periodontal tissue<sup>2</sup>. In addition, periodontal diseases are classified as the most common in the world and the relationships between the host and the oral microbiota vary throughout the development of the disease, which can lead to the progression of the pathology<sup>15</sup>.

Recent studies show that the use of electronic cigarettes has negative effects on the periodontium compared to patients who do not smoke, in addition to the carbonyl stress derived from the use of this device that increases the levels of prostaglandin E-2 and cyclooxygenase-2, substances induced when there are inflammatory lesion processes, in the gingival epithelium<sup>14</sup>.

Although there is a scarcity in the literature, it has already been proven that the constant use of this device is capable of altering the balance of the oral microbiota, with effects on the periodontal pocket and the subsequent immunological and inflammatory responses of the host, leading to the destruction of the oral epithelium and the need for intervention to prevent the loss of dental elements and systemic diseases as a consequence of microbial dysbiosis<sup>16</sup>.

Therefore, this work aims to analyze the impacts of the electronic cigarette and its components on periodontal health, as well as the progression of periodontal disease and the development of pathological lesions through a systematic review of the literature.

## **GENERAL OBJECTIVE**

To analyze the impacts of the electronic cigarette and its components on periodontal health.

## **Materials and Methods**

The present study is an integrative systematic review, based on the PRISMA<sup>17</sup> procedure, in which it is intended to report how the incidence of periodontal disease is related to the use of electronic cigarettes, allowing the consolidation, for the development of works, to avoid duplication and identify omissions, and forgotten literary productions.

Review articles can cover a variety of topics and may include research results. Because a very broad description is presented, generalization is not possible<sup>5</sup>. The systematic review also has the benefit of opening the possibility to guide the construction of a theoretical framework in order to give foundation to the research, especially with the essentials of the original publications through the selection of a certain bibliography for the development of the chosen topic.

This article, made up of literature reviews, addresses how e-cigarettes affect the periodontium of adolescents. The bibliographic survey was carried out through research and analysis of scientific articles in the following databases: Google Scholar, PubMed, MEDLINE and LILACS via VHL. In Portuguese, English, Spanish, Italian and Japanese in a search period between 2019 and 2023

The research was conducted since June 16, 2023. The research strategy (keywords and search sequence) for each database was:

- Scopus: (2 articles): search= (electronic cigarette (vape) AND periodontal disease)
- Google Scholar: (4 articles): search= (e-cigarette and periodontal disease)
- Pubmed: (11 articles): search= (electronic cigarette (vape) AND periodontal disease)
- Scielo: (3 items): search= (e-cigarette and periodontal disease)

#### Inclusion criteria:

Language type: Spanish and English, Portuguese, Japanese, Italian

Publication period: From 2019 to 2023

Original article of research, systematization or review.

Quality of the articles.

#### Exclusion Criteria

Articles that cannot be consulted in full text

Articles with few references

That are not published within the established period

Assessment of study quality

To assess the quality of the studies, we used the guidelines of the Consolidated Standards for Trial Communication (CONSORT-2010)<sup>18</sup>. This checklist is used worldwide to improve reported randomised controlled clinical trials by using a 25-item list to assess the title (including type of design), preparation of the abstract (structured and complete), background and explanation of reasons, definition of objectives and hypotheses, description of trial design (including major changes to methods after the start of the trial and reasons), the eligibility criteria of the participants, the setting and location where the data were collected, the description of the intervention (with sufficient detail to allow its of the intervention (sufficient detail to allow replication), fully defined outcome measures, calculation of the sample size (or power analysis), the method used to generate the sample data. the method used to generate the randomization sequence (including type of randomness), use of blinding methods, statistical procedures used for analyses, description of results (including comparison at baseline), discussion of results (including limitations and generalizability), and other information (registry, protocol, and funding).

#### Processing

The topic and objectives of the research were established. Inclusion and exclusion criteria were established. The evaluation of the research was carried out, based on the objectives set and the interpretation of the results was presented and the contribution was made from the review carried out.

## Results and Discussion

The results are presented according to the inclusion and exclusion criteria proposed in the methodology, according to the phases of the PRISMA procedure, which are summarized in Figure 1 and Table 1.

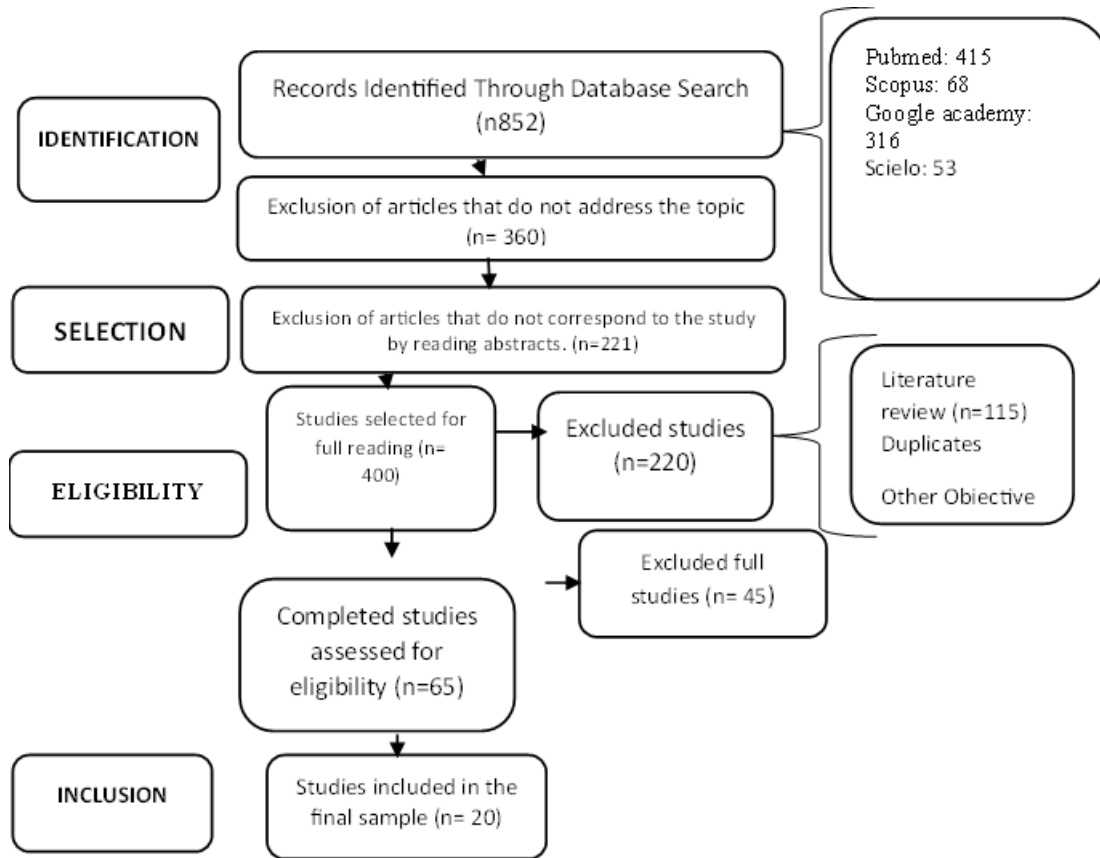


Figure 1. Article search flowchart.

Table 1. Selected Articles

N°	Base	Magazine	Author	Year	Title	Country	Type of study	Main findings
1	PubMed	Dentistry <i>Journal of Oral Rehabilitation</i>	Christi Grace Alejandra Cabezas-Cantos, / Xu et al <sup>29</sup>	2022	Mechanistic Effects of E-Liquids on Biofilm Formation and Growth of Oral Commensal Streptococcal Communities: Effect of Flavoring Agents	USA	Experimental clinical study	The results of these experiments contribute significantly to the understanding of the effects of E-liquids on oral health by demonstrating that flavored E-liquids ± are detrimental to the in vitro growth of oral commensal bacterial biofilms, following a bactericidal mechanism. The flavoring agents in E-liquids may pose a health risk to the oral microenvironment and therefore to systemic health.
2	PubMed	Clinical Oral Investigations	Paolo Pesce et al <sup>30</sup>	2022	Evaluation of periodontal indices among non-smokers, tobacco, and e-cigarette smokers: a systematic review and network meta-analysis	Italy	Systematic review and meta-analysis	The results of the present review suggest a reduced effect on periodontal tissue of smoking e-cigarettes compared to traditional cigarettes, despite the fact that recent studies have shown that smoking e-cigarettes increases oxidative stress, inflammatory responses, change in lung cell behavior, and stimulates DNA injury.
3	Scopus Science Direct	Saudi Dental Journal	Naglaa M. Kamal ,Noha S. Shams <sup>31</sup>	2022	The impact of tobacco smoking and electronic Cigarette vaping on salivary biomarkers. To comparative study	Egypt	Comparative study	The results of this study support the hypothesis that inflammatory cytokine levels are higher in CS and CD than in NS. It was shown that the type of smoker can influence some of the detectable inflammatory biomarkers, which may be beneficial for future regulatory and translational research. More research is required to determine the negative consequences of e-cigarette vaping on oral health.
4	PubMed	Frontiers in Oral Health	Xu F et al <sup>32</sup>	2021	Comparative Effects of E-Cigarette Aerosol on Periodontium of Periodontitis Patients	USA	Experimental clinical study	Carbon monoxide and salivary cotinine levels were highest among cigarette smokers. Catheterization bleeding and mean PDs increased similarly over time in all three groups, but CAL increased uniquely in e-cigarette smokers. Rates of severe periodontal disease were higher in cigarette smokers and e-cigarette users than in nonsmokers, but the interpretation is confounded by the older age of cigarette smokers. The design and protocol of this study will help in future larger studies on e-cigarettes and oral health.
5	PubMed	European Review for Medical and Pharmaceutical Sciences	A.S. Alqahtani et al <sup>33</sup>	2022	Comparative assessment of periodontal treatment needs among the electronic cigarette users and traditional smokers	Saudi Arabia	Experimental clinical study	Since smoking plays the most imperative role in periodontal health, regardless of the type of smoking method, e-cigarette smokers need a less complicated treatment protocol than conventional cigarette smokers. However, more studies need to be done in larger groups.

6	Scopus Science Direct	Journal of Dentistry	Lina AlQobaly et al <sup>34</sup>	2022	Does smoking explain the association between use of e-cigarettes and self-reported periodontal disease?	USE D	Cross-sectional study	This population-based cross-sectional study shows that e-cigarette use is associated with self-reported periodontal disease. Smoking seems to explain the association. Dental professionals should consider the effect of conventional smoking and understand the risks of e-cigarettes on oral health and their benefits when used as a smoking cessation aid.
7	PubMed	American Association for the Advancement of Science	Gan esa SM et al <sup>19</sup>	2020	Adverse effects of electronic cigarettes on the disease-naive oral microbiome	USE D	Experimental clinical study	The results of these experiments demonstrate that e-cigarettes exert a powerful detrimental effect on the subgingival ecosystem, altering host immunotolerance and the analysis of intermediate biomarkers strongly suggests that e-cigarettes have the potential to change the balance between the host and the microbiome, posing a significant risk for future disease. and that the pathogenic mechanisms might not be similar to what we have learned from studying the disease in smokers.
8	PubMed	BMC Oral Health	Reham AlJasser et al <sup>35</sup>	2021	The effect of conventional versus electronic cigarette use on treatment outcomes of peri-implant disease	Saudi Arabia	Experimental and comparative case study	E-cigarette smoking was found to be the most prevalent risk indicator for peri-implantitis. The compromised response of peri-implantitis treatment, both clinically and biologically, was found more among smokers of e-cigarettes compared to smokers and non-smokers of conventional cigarettes. All clinical parameters showed improvement after initiation of therapy compared to baseline. Salivary biomarkers (MMP-8, IL-1 $\beta$ and IL-6) have shown a decrease in all treated groups.
9	Google Scholar	UPC Academic Repository	Becerra Miguras, Maite <sup>36</sup>	2022	Association between the self-perception of periodontal health and the consumption of electronic cigarettes in young people in Metropolitan Lima during 2021	Peru	observational, analytical, and cross-cutting	It was shown that the electronic cigarette increases oxidative stress and the levels of pro-inflammatory cytokines in the periodontal ligament and gums, so the use of the electronic cigarette could generate periodontal damage. The electronic cigarette compared to the conventional cigarette could be less toxic to the periodontal tissues, showing improvements in periodontal parameters such as bleeding and bacterial plaque index, however, the perception of reddish or swollen gums should be evaluated the progression of the periodontal state with prolonged use of the electronic cigarette.
10	Google Scholar	RI-UNPHU Institutional Repository	Brent Maria, Elka Cabrera <sup>37</sup>	2021	Periodontal parameters in patients who smoked electronic cigarettes "vapes" who attended the Dr. Rene Puig Bentz	Dominican Republic	observational, cross-sectional comparative	The relationship between periodontal clinical parameters in the e-cigarette smoking groups and the non-smoking group was statistically significant differences specifically in the plaque index, gingival index and clinical attachment loss, with an increase in these values being found for the e-cigarette group. Although the results of the present study did not find significant values in periodontal parameters in relation to the time of use of the electronic cigarette, an increase in higher levels of inflammation could be



					dental clinic in the period May-August 2021			found in users who have more time of use of these devices. The electronic cigarette vape is related to the increase of periodontal parameters, plaque index, gingival index and loss of clinical attachment. The electronic cigarette is related to the increase of periodontal parameters depth to probing and bleeding to probing
11	Scielo	Universita s Dentistry	María José Suárez Suárez, Carlos Daniel Suárez Pérez and Santiag o José Sarmie nto León <sup>38</sup>	2023	The electronic cigarette and its relationship with periodontal health. A systematic review of the literature	Colo mbia	Systemati c review	It was evidenced that the components of the electronic cigarette, including nicotine, affect the periodontal level, the participants had significant changes in the gum and at the level of the alveolar bone. E-cigarette with nicotine was also shown to promote cell apoptosis, necrosis, and persistent DNA damage at the level of the gingival epithelium. It was found that nicotine inhibits the growth of gingival fibroblasts, human periodontal ligament cells and alters the function of oral or peripheral neutrophils.
12	Google Scholar	RI-UNPHU Institution al Repositor y	Audry Encarn ación López and Nicole Eugeni a Gutiérr ez Silva <sup>39</sup>	2021	Lesions in the oral mucosa and/or alterations in the non-pathological conditions of the oral cavity in patients who smoke electronic cigarettes (Vapes), who come to the Dr. René Puig Benz Dentistry Clinic in the period May - August 2021.	Dom inica n Repu blic	Analytical observatio nal study	Patients who smoked e-cigarettes and non-smokers were analyzed and then compared. Nicotine dependence was measured in smokers, and males showed statistically significant differences between sex and type of lesion in the oral mucosa, where melanosis and frictional hyperkeratosis prevailed. No statistically significant differences were found according to the type of injury and non-pathological conditions in relation to the groups, as well as dependence.
13	PubMed	Journal of Periodont ology	Chand ni Shah et.al <sup>40</sup>	2021	Retrospective exploratory study of smoking status and e-cigarette use with response to non-	Sout h Kore a	Retrospec tive study	The aim of this study was to compare the response to periodontal treatment in e-cigarette users, current smokers, former smokers, and non-smokers. After treatment, nonsmokers showed greater improvement in periodontal disease compared to the other groups. E-cigarette users and current smokers had the greatest need for post-treatment surgery. Overall, periodontal treatment was

					surgical periodontal therapy			successful in reducing disease in the population studied. The results suggest that non-smokers responded better to treatment, followed by former smokers, while e-cigarette users and current smokers had worse outcomes.
14	PubMed	American Society for Microbiology	Thomas Scott C. et.al <sup>16</sup>	2022	Electronic Cigarette Use Promotes a Unique Periodontal Microbiome	USE D	Retrospective study	This study compared the periodontal characteristics and microbiota of e-cigarette users (ES), current smokers (CS) and non-smokers (NS). Significant differences were found in periodontal disease severity and microbiome structure between cohorts. The CS showed higher levels of cotinine and carbon monoxide, as well as greater severity of the disease. Each cohort had a unique microbiome, but the CS shared more characteristics with the SE than with the NS. Differentially abundant bacterial genera were identified between cohorts. Adolescent boys are the ones who have the habit of smoking the most, but among women there is evidence of an increase in its consumption, the age of initiation of the habit is between 12 and 15 years. Smokers are three times more likely to develop gum disease than nonsmokers.
15	Scielo	Medicent Electron	Valdés S, Hernández D, et al <sup>41</sup>	2021	Smoking and its relationship with oral conditions in adolescents	Cuba	Observational study	Different oral conditions were identified: periodontal disease, dental caries, tooth staining, halitosis, and to a lesser extent, lesions in the oral mucosa and tooth loss.
16	Google Scholar	Dental Journal	Wijaksana E, Megasari N <sup>42</sup>	2022	E-cigarettes effect on periodontal health: a systematic review	Indonesia	Systematic review and meta-analysis	This review found that e-cigarettes are less harmful compared to tobacco cigarettes with comparable results among smokers on some clinical parameters of periodontal health such as probing depth, clinical attachment loss, plaque index and bleeding index. Bleeding on probing is one of the fundamental clinical health parameters for the periodontium, it is related to the sign of an early inflammation of the periodontium can be found in early gingivitis injury and can be visualized before redness and swelling. Nicotine from tobacco and liquid E-cigs decreases the response to gingival bleeding due to its vasoconstrictor effect on gingival blood vessels. This effect impairs the gingival crevicular fluid by decreasing its flow rate, impairing homeostasis between the host response and microbiome.
17	PubMed	Clinical and Experimental Dental Research	Figueredo C, et al <sup>14</sup>	2021	The impact of vaping on periodontitis: A systematic review	Canada	Systematic review	This was the first review conducted to assess the impact of vaping on periodontitis by investigating changes in periodontal parameters in vaping users compared to control groups. Vaping groups have a lower rate of bleeding on probing compared to controls. The differences in bleeding on probing can be attributed to the presence of nicotine in e-cigarettes, nicotine is known to be vasoconstrictive, which would reduce natural blood flow to the gums and could lead to tissue ischemia and alter properties.

A reduction in bleeding on probing is more of a negative effect than a positive one, since gingival bleeding is a warning symptom patients about the need for professional treatment. Without bleeding, the first clinical symptom that the patient may notice is tooth mobility.

18	PubMed	Frontiers in Public Health	Zhang Q, Wen C <sup>43</sup>	2023	The risk profile of electronic nicotine delivery systems, compared to traditional cigarettes, on oral disease a review	Malaysia	Systemic review	Conventional ENDS usually have pre-filled nicotine pods, the main ingredients in e-liquid formulations are nicotine, flavorings, and a matrix. The matrix consists mainly of glycerin, propanediol. Propanediol has certain hygroscopic properties and combines easily with saliva, causing dry mouth. Glycerin is also a colorless liquid that is 60% sweeter than sucrose, but is not metabolized by cavity-causing bacteria. Smokers have poor oral hygiene, and tobacco tar promotes pigmentation and the adhesion of bacteria to the tooth surface, resulting in plaque buildup and an increase in calculus, gingivitis, and periodontitis. Nicotine can cause vasoconstriction and decreased blood flow, resulting in reduced oxygen and blood supply to the gums and a reduction in the gums' ability to remain healthy.
19	Scielo	Rev Estomatol Herediana	Sandra Aparecida Marinho <sup>44</sup>	2021	Electronic Cigar: Mocinho ou Vilão?	Brazil	Retrospective study	It was found that e-cigarettes can even help in the cessation of conventional smoking, however, its users are not exempt from suffering systemic health complications. These contain toxic substances and should not be completely considered safe and harmless.
20	Pubmed	JapaneseDentalScienceReview	Takashihanioka <sup>24</sup>	2019	Smoking and periodontal microorganisms	Japan	Longitudinal study	Smoking cessation in patients with periodontitis is beneficial in promoting a health-compatible subgingival microbial community. To maximize the benefits of these interventions in dental settings, further studies on the periodontal microbiome are needed to elucidate the impact of tobacco intervention on preventing recurrence of periodontal destruction in susceptible subjects.

The use of e-cigarettes (EC) promotes a specific periodontal microbiota, which will have its composition influenced by the duration of EC use associated with nicotine aromas and concentrations, exerting selection pressures on the microbial community (Thomas<sup>16</sup>, et. al., 2022). According to Thomas<sup>16</sup> (2022), Ganesan<sup>19</sup> (2020) showed that one of the significant effects of smoking (CE) on the oral microbiota is the alteration of the biofilm architecture, which directly involves dental caries and periodontitis, i.e., it is evident that there is a relationship between the use of EC and the appearance of periodontal diseases.

According to Figueredo<sup>14</sup> (2021), diseases located in the periodontium are inflammatory processes resulting from an association between bacterial activity and the host's immune response, which can result in the loss of the periodontal ligament and apical migration of the junctional epithelium.

Risk factors may favor the prevalence and severity of the disease, such as smoking linked to the use of electronic cigarettes (EC). Like Figueredo<sup>14</sup> (2021), Ren<sup>15</sup> (2022) states that periodontitis is an inflammation caused by the presence of bacteria in the gum and periodontal tissues, being an infectious disease with characteristics of progressive loss of attachment plus loss of cementum.

For a long time, periodontal disease was believed to be a condition of adulthood, but the lack of motivation in the practice of oral hygiene in adolescence induces its appearance (Nápoles<sup>20</sup>, 2017). In this age group, the onset of periodontitis is multifactorial and is also associated with changes in hormone levels during puberty, stress, chronic disease conditions, socioeconomic factors, education, diet, hygiene habits, and lifestyle.

In a survey conducted by Nápoles<sup>20</sup> (2017), mild gingivitis predominated in 66.7% of adolescents, which was related to poor oral health in a scenario that addressed factors of a different nature, i.e., gingivitis is a common pathology among young people. Therefore, the use of electronic cigarettes becomes one more variable for the affectation of the periodontium of adolescents, who are being influenced by the socializing power of the device and by the erroneous information that they are less harmful compared to common cigarettes and, as a result, there is negligence in the search for information related to the harmful effects of this practice on oral and systemic health. With that, there is the worsening of periodontitis among adolescent ES users.

According to Arora<sup>21</sup> (2014), there is a correlation between nicotine levels in saliva and the severity of periodontal severity, in which the action of tobacco on the periodontium alters gingival blood flow, leads to a difference in the number of blood vessels in the marginal gum, reducing the immune response, also alerting to the toxic effects of nicotine that generate damage in the insertion of fibroblasts to the root surface. disturbing the healing process.

According to Arora<sup>21</sup>, Bizzarro<sup>22</sup> (et al, 2013) states that the healing process is impaired since smoking reduces serum levels of vitamin C, which aids in healing. It is essential to act in the prevention of periodontal disease in smoking patients, emphasizing that the best preventive method would be to stop smoking, since smoking influences periodontal disease, worsens its severity and incidence and makes its treatment difficult (Meulman<sup>23</sup> et al., 2013).

According to (Hanioka<sup>24</sup> T. et al 2019), periodontal pathogenic microorganisms exposed to nicotine and tobacco smoke extracts undergo functional changes, which corroborates the clinical findings associated with dysbiosis of the subgingival microbiota (altered microbial ecological status). Periodontal microbiota dysbiosis was present in smokers regardless of the stage of periodontal disease (healthy, gingivitis or periodontitis) and predominated only in smokers, even after regression of gingivitis and clinical symptoms of periodontitis decreased. Thus, it is concluded that smoking cessation in patients with periodontitis is clearly beneficial in promoting a healthy subgingival microbiome.

Accordingly, Ryder<sup>25</sup> et al (2018) consolidate that the role of smoking in promoting the growth of oral pathogens may lie in the ability to directly alter the environment in which microorganisms grow, or it may affect the host's protective responses, including the regulation of the inflammatory response. It should be noted that inflammation itself indirectly alters the biofilm environment and allows for further growth of pathogenic bacteria.

According to Buduneli<sup>26</sup> and Scott<sup>16</sup> (2018), tobacco use is an important risk factor for chronic periodontitis. Smoking leads to the suppression of gingival inflammation, which is manifested by reduced bleeding response to plaque. At the same time, it promotes the destruction of periodontal tissue compared to non-smokers.

The bleeding response recovered quickly after quitting smoking. The mechanisms underlying the elimination of vascularity in smokers have yet to be fully elucidated. While there may be a genetic component in susceptibility, tobacco use profoundly affects biological mediators that regulate angiogenic responses and hemorrhagic reactions to bacterial challenges, promotes oral bacterial dysbiosis, affects innate cellular function, and contributes to the protease-antiprotease imbalance of gingival tissues.

According to (Hanioka<sup>24</sup> T. et al 2019), it complements the notable difference in changes in the microbial profile of subgingival microorganisms between smokers and those associated with smoking cessation after non-periodontal treatment surgery as it is beneficial for the treatment of smoking, since not smoking can help prevent the onset of severe periodontal disease, that changes the ecosystem to a healthy microbial community. In addition, (Stavropoulos<sup>27</sup> A. et al 2021), states that periodontal treatment for smokers can be surgical or non-surgical surgery and that research in this area has shown that smoking negatively affects both surgical and non-surgical periodontal treatment.

The combination of azithromycin with scaling and root planing increases the effectiveness of non-surgical periodontal treatment. (Cardoso<sup>28</sup> 2020) pointed out that ultrasonic equipment is widely used in the treatment of periodontal disease, and has the advantages of speed and easy access to hard-to-reach areas, however, the root roughness it can produce is greater than that of manual cleaning. In this regard, more research is needed to confirm and prove its efficacy using an antimicrobial agent such as polyvinylpyrrolidone iodine (PVPI) and chlorhexidine.

Tobacco products are capable of altering multiple mechanisms and structures such as: bone, connective and epithelial tissue, microbiota, immune system, microcirculation and saliva, thus affecting the depth of periodontal pockets leading to attachment loss and can lead to tooth loss. Analysing the changes that smoking can cause, it is important to carry out dental interventions according to preventive measures and to guide patients about the risks that smoking poses to individuals.

Therefore, it is observed that smoking is considered a risk factor for oral health, in addition to reducing the regeneration of periodontal tissue and the effectiveness of implant placement. Along with genetic problems and suppression of the individual's immune system, tobacco is able to increase the prevalence and progression of periodontal disease. There is a need for specific smoker-friendly prevention and treatment approaches for better monitoring of chronic periodontitis and other destructive oral diseases caused by tobacco. It is important for the dentist to inform and guide his or her smoking patient about the risks and damage to periodontal tissue related to smoking (Camargo et al., 2016).

## **Conclusion**

It is observed that there is a significantly high biological plausibility in the relationship between the EC smoker and periodontal disease with the influence of the former on the latter. In addition, the use of smoking products favors, in people with periodontitis, worsening of

insertion loss, formation of periodontal pockets and loss of alveolar bone, with consequent loss of teeth.

For this reason, the role of the dentist is essential to raise awareness about the consequences of periodontitis, such as: diagnosis of periodontitis and emphasize the importance of quitting smoking to improve clinical case, because despite being a common pathology among smokers of common and electronic cigarettes, product of severe chronic gingivitis, The perpetuation of smoking leads to a delay in the effective treatment of the disease in question, which increases the level of injury.

Clinical findings demonstrate an increase in the incidence of periodontitis in young people, mainly in the age group of 15 to 24 years and, due to the constant use of e-cigarettes, many users still do not perceive discrete and continuous changes in the oral microbiota and only become aware of them after seeing a dental surgeon. Therefore, it is worth noting that late identification of periodontitis increases pocket formation.

Periodontal disease is a worrying factor due to the negative effects and consequences for the oral cavity, resulting in more severe cases in the loss of teeth and/or formation of oral cancer, with squamous cell carcinoma standing out as the most frequent. Therefore, it is necessary to implement public policies and develop strategies aimed at everyone in the community, such as policies to eliminate smoking and ensure the availability of appropriate basic dental care so that there is a reduction in the incidence of periodontal disease in cigarette users.

In this context, the dental professional assumes an important role in guiding and referring the patient to the treatment of ES addiction with an expert in the field and warning them of the dangers of permanence of the continued use of this device.

For future work, we suggest an in-depth investigation into other oral affectations caused by smoking in addition to periodontal disease, such as gingival recession, susceptibility to caries, bruxism, darkening of the gums and teeth, xerostomia and inflammation, making a systematic association between the incidence of these consequences with users of electronic cigarettes, conventional cigarettes and non-smokers.

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