

The Impact of E-Cigarettes on Oral and Dental Health: Narrative Review

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Abstract

E-cigarettes, also known as electronic cigarettes or vape pens, have become increasingly popular in recent years as an alternative to traditional tobacco products. However, there is growing concern about the potential impact of e-cigarettes on oral and dental health. This narrative review aims to provide an overview of the current evidence on the topic and to highlight the potential risks associated with e-cigarette use. One of the main concerns surrounding e-cigarettes is the potential for oral and dental health problems. E-cigarettes contain a liquid solution that is heated and inhaled as a vapor, and this vapor can contain a variety of chemicals and toxins. Some of these chemicals have been found to have adverse effects on oral health, including inflammation of the gums, dry mouth, and an increased risk of cavities. Additionally, the act of vaping itself can lead to oral health issues, as the repetitive motion of inhaling and exhaling can cause irritation to the mouth and throat. Furthermore, the nicotine content in e-cigarettes can also have negative effects on oral and dental health. Nicotine is a vasoconstrictor, meaning it restricts blood flow, which can lead to a decrease in the delivery of oxygen and nutrients to the gums and other oral tissues. This can result in a higher risk of gum disease and delayed healing after oral surgery or dental procedures. In addition, nicotine has been shown to contribute to the development of oral cancer, as well as other oral health issues such as tooth decay and tooth loss. More research is needed to fully understand the long-term effects of e-cigarettes on oral and dental health, but in the meantime, it is crucial for individuals to take steps to protect their oral health and to be aware of the potential risks associated with e-cigarette use.

Keywords: Vape, E-Cigarettes, Oral health, Dental Health, Nicotine.

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INTRODUCTION

Batteries-operated electronic cigarettes, or e-cigarettes, are used to heat and aerosolize liquids containing ingredients such as propylene glycol, glycerol (a humectant), various flavours, and, most often, nicotine [1]. The use of e-cigarettes has drastically expanded in some international markets, such as the US, Russia, and Germany, since they were made commercially available in the US and Europe in 2006 [2]. More than 15% of adult Americans, mostly those between the ages of 18 and 44, report having ever used an e-cigarette. Due in part to the marketing of e-cigarettes as safer alternatives to traditional cigarettes, users of conventional cigarettes are especially fond of these products [3]. In the US and UK, 15.9% and 21.9% of regular cigarette users, respectively, report using e-cigarettes [4].

E-cigarettes have the same negative effects on oral health as regular cigarettes. Essentially, the oral cavity is more susceptible to the immunologic, microbiological, carcinogenic, and clinical consequences of E-cigarettes and other tobacco products since it is the first area of the body to be exposed to their ingredients. One of the main causes of dental cavities, *Streptococcus mutans*, is encouraged to colonise e-liquids due to their viscosity [2]. The main components of the e-liquid, which include nicotine, acetaldehyde, acrolein, formaldehyde, and flavouring agents like cinnamaldehyde, have been shown to change host response, increase periodontal inflammation, and change the oral microbiome to include more oral pathobionts [1, 4].

The detrimental effects of E-cigarette usage on dental health may be mitigated by practicing good oral hygiene habits; naturally, the best method to guarantee improved oral health is to stop smoking. Using fluoride-containing toothpaste twice a day, in addition to additional mouth rinses, could help lower the incidence of dental cavities and periodontal disease. Reducing the amount of refined carbohydrates consumed on a daily basis will also lower the risk of caries, and routine dental checkups will help to ensure that oral lesions are promptly detected and that caries reversal methods are implemented [5].

Most clinical trials to date have been carried out in specialised settings with professional assistance on particular groups (e.g., dependent smokers, with high rates of social disadvantages, and motivated to quit). Future research must assess the likelihood that the efficacy of e-cigarettes as shown in these studies will not be repeated in "real-world" situations. While e-cigarettes are regulated differently in each country, the US FDA has not yet approved them as assistance for quitting [2]. Dental professionals should be aware of whether e-cigarettes are a useful tool for quitting smoking because doing so will have a significant influence on oral health. But it's equally critical to comprehend the potential risks that come with using e-cigarettes on its own [1, 5].

Negative Effects of E-Cigarettes:

The battery, PG, VG, flavours, and the availability of high nicotine concentrations are the main concerns with e-cigarettes. There are clinical reports of e-cigarette fires and explosions that harm users in the literature, but none from Canada [6]. These occurrences might be the consequence of mishandling equipment or batteries or the usage of uncontrolled "mechanical mod" devices, which might lead to a dead battery. Users of e-cigarettes may experience negative side effects from the nicotine carrier solvents in vaping solutions, which is another cause for concern. There have been reports of certain tastes used in e-cigarette fluid being hazardous. With an estimated daily consumption rate of 3 mL of e-cigarette liquid, Clapp and Jaspers hypothesised that e-cigarette users would be exposed to levels of diacetyl that were higher than the 5 parts per billion limit set by the Centres for Disease Control and Prevention (CDC) and the National Institute for Occupational Safety and Health [7].

Studies conducted *in vitro* have also confirmed the negative effects of diacetyl-rich e-cigarette juice. Cell toxicity in bronchial epithelial cells exposed to flavor-infused liquids was correlated with the liquid's diacetyl content. Benzaldehyde has also been demonstrated to have possible health risks, so it's not just the ingredient in e-cigarettes called diacetyl that is causing alarm [8].

Furthermore, the pharmacokinetics of nicotine and the behaviour of users may be affected by the flavour

of liquid high in nicotine. In fact, flavoured nicotine-rich e-cigarettes were shown to have a larger subjective reward value than unflavored ones in a study including young adult e-cigarette smokers. It was discovered that individuals exerted more effort to inhale flavor-infused e-cigarettes compared to those without taste. Moreover, the subjects inhaled twice as many flavor-infused e-cigarette puffs as unflavored ones. The scientists came to the conclusion that flavouring increased the typical nicotine reward, which could encourage young adults who smoke to overuse it [9, 10].

According to a systematic analysis on the health effects of e-cigarettes that was released by the World Health Organisation, using e-cigarettes is strongly linked to symptoms of respiratory distress, irritation of the mouth and throat, cough, headache, and nausea. The health hazards associated with e-cigarette usage are higher, particularly for those who have never smoked or are ex-smokers. Little is known, though, regarding the consequences of using e-cigarettes in addition to traditional cigarettes. Harmful health disorders such as infertility, nasopharyngeal cancer, lung cancer, bladder cancer, and gastroesophageal reflux illness have been connected to the use of e-cigarettes, water pipes, and tobacco products [8, 11].

E-cigarettes Effect on Oral Health:

Oral health is impacted by e-cigarette use in addition to overall health. The most frequent side effects of e-cigarettes on oral health are periodontal disease and irritation of the mouth and throat, according to the most recent systematic reviews. Those who started using e-cigarettes and are not smokers frequently experience mouth and throat irritation [12]. But switching to e-cigarettes is more likely to lessen irritation for regular cigarette smokers. Deeper probing depths and greater plaque formation are the most prevalent periodontal issues. Oral keratinocytes may become cytotoxic due to e-cigarette aerosols' oxidative stress response [13].

Effect on Teeth:

One of the main concerns regarding the effects of e-cigarettes on oral health is the potential for tooth decay and gum disease. E-cigarettes contain nicotine, which is known to constrict blood vessels and reduce blood flow to the gums. This can lead to a decrease in the production of saliva, which plays a crucial role in protecting the teeth and gums from bacteria and acid [5, 12]. Without an adequate amount of saliva, the risk of developing tooth decay and gum disease increases. In addition to the potential impact on saliva production, e-cigarettes also contain other harmful chemicals that can have negative effects on oral health. For example, the aerosol produced by e-cigarettes can contain harmful substances such as formaldehyde, acrolein, and acetaldehyde, which can damage the soft tissues in the mouth and contribute to oral diseases [14].

Furthermore, the act of vaping itself can also have detrimental effects on teeth and tooth-supporting tissue. The repetitive motion of inhaling and exhaling the aerosol can lead to dry mouth, which can further increase the risk of developing oral health issues. Additionally, the heat from the vapor can irritate the soft tissues in the mouth, leading to inflammation and potential damage to the gums [15].

A recent research found that many case reports show individuals who use e-cigarettes to have lesions on their tongue, oral mucosa, or ulcerative tissues. Case studies cannot be utilised to determine the population prevalence of such lesions or whether they are directly related to e-cigarette use. Nonetheless, a number of maxillofacial trauma instances, such as alveolar fractures and intraoral burns, are easily linked to explosive e-cigarette device malfunctions. Although these severe wounds are noteworthy for the dental field, these explosions are probably preventable with high production standards [16].

Several studies that were not specifically created to evaluate oral health have found that mouth or throat discomfort and dry mouth are typical complaints among e-cigarette users. A comprehensive evaluation of 11 trials evaluating e-cigarettes as potential smoking cessation aids found that the most often reported adverse event group, affecting up to 39% of participants, was cough or mouth/throat discomfort. The most common symptoms among adult e-cigarette ever-users were cough (40%) and dry or irritated mouth or throat (31%) out of six recorded symptoms [17]. This is consistent with a nationwide telephone survey conducted in the United States [18].

Effect on Periodontal Health:

Research has demonstrated links between periodontal disease and a number of illness conditions, such as respiratory, cardiovascular, and unfavourable pregnancy outcomes. The evidence was inconclusive even though periodontal effects studies were more meticulously constructed for periodontal outcomes [19]. Overall, the findings seem in line with research on the effects on the mouth and throat; that is, there is some indication that e-cigarette users have a higher chance of their periodontal and gingival health declining when compared to non-users or smokers, but a lower risk when compared to regular smokers [20].

On gingival tissue, nicotine has a vasoconstrictive impact. This would explain why the majority of research found that using e-cigarettes was linked to less gingival bleeding than not using them, or why switching from traditional smoking to e-cigarette use may result in more gingival bleeding than they did before. The review's descriptive results imply that using e-cigarettes could have negative dental effects [21]. Specifically, flavourings found in e-liquids may contribute to the deterioration of enamel and increase the

growth of cariogenic bacteria. In addition, the case reports that are part of this review detail severe oral damage that results from e-cigarette explosions. In the United States, emergency departments saw an estimated 2035 patients with burn injuries and e-cigarette explosions between 2015 and 2017 [22].

It makes sense that the effects of e-cigarettes on periodontitis and peri-implant disease have been among the most researched topics, given the wealth of data connecting tobacco smoke with an elevated risk for these disorders. All things considered, the data points to a higher risk of periodontal disease in e-cigarette users than in tobacco smokers, but a lower risk in non-smokers [23]. Even while there is a range of risk for periodontitis and peri-implantitis, from nonsmokers to smokers, it is not feasible to conclusively identify e-cigarette users within this range based on the available data. However, when participants stopped smoking and shifted to using e-cigarettes, both with and without periodontal therapy being given, a number of studies have reported clinical improvements in those with preexisting periodontal disease [24].

Reviews and public health materials frequently reference a pilot research that assessed gingival bleeding in e-cigarette users as proof of increased bleeding associated with e-cigarette use. The study saw a rise in bleeding on probing over the period of e-cigarette use in 18 smokers who were instructed to transition to an e-cigarette for two weeks. It is unclear, though, if this was a direct consequence of switching to an e-cigarette or if it was just the widely noted clinical observation of a brief rise in gingival bleeding upon quitting [25].

There have been correlations between using e-cigarettes and poorer oral health revealed in nationally representative cross-sectional research, even after confounding adjustment. E-cigarette use was linked to oral pain and chipped or broken teeth in children in South Korea. In comparison to tobacco nonusers, parents reporting "dental problems" for their children was more likely among children who used both conventional and e-cigarettes in the United States [26]. Adults in the US who regularly used e-cigarettes had a somewhat higher likelihood of ever having a tooth extracted due to gum disease or decay (56% vs. 51%) than those who never used them. Similarly, e-cigarette users were more likely than tobacco never-users to have ever had a gingival disease diagnosis or treatment. In South Korea, the odds of examiner-measured periodontal disease were approximately double for both e-cigarette users and conventional cigarette smokers versus nonusers [27].

All e-cigarette parts are now regulated by the U.S. Food and Drug Administration's (2017) Centre for Tobacco Products, including batteries, which are frequently to blame for explosive incidents. This organisation provides a website for reporting explosions, consumer safety advice, and suggestions for

manufacturers submitting new product applications to include battery amperage, voltage, and wattage data so the FDA can evaluate battery risks. [28, 29]

Carcinogenic effect:

Glycerol, propylene glycol, and nicotine are present in e-cigarette vapour along with flavouring particles, scent enhancers, traces of carcinogens, and heavy metals like nickel and aluminium. In e-cigarette vapour, humectants such as glycerol and propylene glycol undergo oxidation, forming aldehydes such as formaldehyde, acetaldehyde, and acrolein. It has been demonstrated that these free radical species, which are well-known to be genotoxic agents, cause inflammation that eventually damages tissue. When propylene glycol is heated and aerosolized, it produces propylene oxide, which is thought to cause cancer in people [30].

Known carcinogens linked to traditional smoking have also been found in e-cigarette users' saliva. Among them are thiocyanate and NNN. Similar to traditional smoking, the vapour from an e-cigarette is inhaled directly into the mouth of the user, making contact with the oral epithelium. The *in vitro* research included in this review showed decreased cell viability and proliferation, changed cell shape and activity, increased transcription of pro-inflammatory cytokines, DNA damage, and promotion of apoptosis and necrosis, indicating cytotoxic, genotoxic, and inflammatory effects. According to this research, the vapour from e-cigarettes may not be safe for cells [31].

To distinguish between the effects of particular components, such as flavour particles, and changes at the cellular level, more research is required. Restrictions and suggestions for additional study The fact that most of the studies were not created with the intention of assessing how using e-cigarettes will affect oral health is a significant drawback of this evaluation. In order to quantify the oral health outcome of interest, many of the mouth, throat, and dental effects were measured as auxiliary findings without clinical verification. These methods of measurement included self-report surveys or diaries [30, 31].

CONCLUSION

Because e-cigarette products are always changing and it might be difficult to identify potential e-cigarette effects in patients who have used combustible tobacco in the past or present, studying the impact of e-cigarette usage on oral health is a complex task. Because quitting tobacco smoking causes significant changes to one's oral health, the evidence of the effects of e-cigarette use on dental health is hazy and complex for individuals who use them as a tobacco quit assistance. More thorough research in this area is definitely needed. Understanding the effects of e-cigarette use on nonsmokers' oral health, proving the usefulness of e-cigarettes as a tobacco cessation aid (particularly in the dental setting), and comprehending any effects on

smokers' periodontal health upon switching to e-cigarettes are the areas with the greatest potential to benefit patients.

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