

Masthead Logo

Virginia Commonwealth University
VCU Scholars Compass

Dental Hygiene Student Scholarship

Dental Hygiene Program

2019

Electronic nicotine delivery systems: vaping away gum tissue

Christina Tulloch

Virginia Commonwealth University

Denise Thieleman

Virginia Commonwealth University

Follow this and additional works at: https://scholarscompass.vcu.edu/denh_student

Part of the [Dental Hygiene Commons](#)

Downloaded from

https://scholarscompass.vcu.edu/denh_student/5

This Poster is brought to you for free and open access by the Dental Hygiene Program at VCU Scholars Compass. It has been accepted for inclusion in Dental Hygiene Student Scholarship by an authorized administrator of VCU Scholars Compass. For more information, please contact libcompass@vcu.edu.

Electronic nicotine delivery systems: vaping away gum tissue

Thieleman, Denise, BS¹; Tulloch, Christina, BS¹

¹Dental Hygiene Program, Department of General Practice, Virginia Commonwealth University

Abstract

Objective: Conventional cigarettes have shown severe toxicity on immune cells and wound healing in the periodontium, but little is known about the comparative effects of electronic nicotine delivery systems (ENDS). If current conventional cigarette users are to transition to a less detrimental alternative, the evidence must demonstrate if electronic nicotine delivery systems can be deemed safer to the periodontium than conventional options.

Methods: The PubMed, and Cochrane databases were utilized to find current scientific evidence on the effects of ENDS use on the periodontium. Relevant articles were summarized to write a review of literature. In this study, 25 articles published from 2015 to present were reviewed.

Results: ENDS have been shown to contribute to several pathophysiological effects including oxidative and carbonyl stress, inflammatory dysfunction, presence of apoptotic necrotic epithelial cells, and impaired fibroblastic activity. Evidence-based research has shown the use of electronic nicotine devices lead to changes in cellular activity which manifests as a strong risk factor for periodontal disease and fibrosis of the oral submucosa.

Conclusion: ENDS studies are ongoing, and studies are difficult to complete due to participants partaking in multiple forms of smoking. Although individuals transitioning from conventional to newer electronic nicotine delivery devices perceive making a healthy switch, scientific evidence indicates the risk of periodontal damage and disease are significant.

Introduction

Electronic nicotine delivery systems (ENDS) are devices capable of converting a liquid mixture containing flavoring and concentrated nicotine to a vapor which is inhaled. ENDS vapor is comprised of several chemicals (propylene glycol, vegetable glycerin, aldehydes) and heavy metals (nickel, chromium, silver, copper).^[1] The vapors pose a risk to periodontal tissue health and induce oxidative stress leading to the release of destructive inflammatory cytokines.^[1] The release of the cytokines and induction of oxidative stress increases the user's risk for periodontal disease and permanent destruction to periodontium.

According to the CDC, in 2018, more than 3.8 million middle and high school students admitted to using ENDS in the past 30 days.^[2] The increased use of ENDS in younger populations poses a risk to systemic and oral health diseases at an earlier age, increasing the risk of irreversible systemic and periodontium damage. The increasing prevalence of ENDS use is a public health concern and is a trending area of focus for researchers. The contribution of conventional cigarettes to periodontal disease progression is well known, but there are currently few studies outlining scientific findings regarding the use of ENDS and the effects on the periodontium.

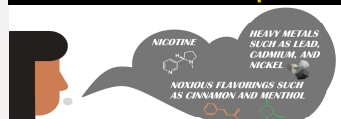
Discussion

Inflammation and Alveolar Bone Loss: Aldehydes, found in flavored ENDS vapor, induce carbonyl/oxidative stress,^[3] resulting in an increase in the severity of chronic inflammation. These molecules elicit periodontal fibroblasts to release detrimental levels of inflammatory cytokines TNF- α and IL-1 β .^[4] A dysregulated tissue concentration of these cytokines contributes to alveolar bone resorption and tissue degradation. Levels of PGE2 and COX-2 were found to be increased after using flavored vapor, and these molecules can further contribute to cytokine imbalance.^[4] Inhalation of nicotine has shown to be higher with ENDS use versus conventional cigarettes.^[5] Nicotine inhibits the potential of human periodontal ligament cells, thereby reducing normal osteogenesis.^[6]

Heavy Metal Exposure: Heavy metal exposure from ENDS have proven to be higher than exposure from conventional cigarettes.^[7] The metal alloys in ENDS units can be exposed to high levels of heat and voltage, causing traces of lead and cadmium to be released into the vapor.^[7] Cadmium has shown to trigger alveolar bone loss via affected osteoclast function.^[8] Researchers have established a statistically significant correlation between serum lead levels and periodontitis.^[9]

Fibroblastic Sensitivity and Apoptotic Cells: ENDS flavorings have been shown to have destructive effects on periodontal ligament fibroblasts with regards to cell migration and growth inhibition.^[10] ENDS were found to cause gingival epithelial cells to adopt an atypical morphology, and increasing exposure to vapor was correlated with increasing amounts of apoptotic gingival epithelial cells.^[11]

What Is In ENDS Vapor?



Due to the variety of formulations and lack of regulatory oversight, it can be difficult for users to know which compounds are in ENDS devices and liquids. Many ENDS components and ingredients have been placed on an FDA list of "harmful and potentially harmful constituents (HPHCs)."

Conclusion

- ENDS vapor, especially with flavoring chemicals, has been shown to contribute to the pathogenesis of periodontal diseases.
- Nicotine intake can be greater with ENDS than conventional cigarettes and can negatively affect the user's gingival epithelial cells, periodontal fibroblasts, and osteoclasts.
- Exposure to heavy metals can be greater in ENDS than conventional cigarettes and has negative consequences for the periodontium.

Future Research

- The studies featured in this review were not performed over long periods of time and the authors recommend future longitudinal studies be performed to strengthen the body of evidence focusing on ENDS use and the effects on the periodontium.
- There are limited studies focusing on the association between exposure to heavy metals and periodontitis, and more studies are warranted.
- The studies performed in the future should aid in assisting public health officials and healthcare providers to deliver the appropriate message about ENDS safety and will serve as a guide for future regulatory measures.

References

- [1] Malmqvist SA, Ahangir MR, Michalopoulos GJ, Acharya A, Rossini GE, Javed F. Chemical and histologic periodontal disease and alveolar bone loss: IL-1 β and IL-6 levels in cigarette and e-cigarette smokers and E-cig users. *Environmental Toxicology and Pharmacology*. 2018; 61:38-44.
- [2] Centers for Disease Control and Prevention. (2018). CDC WISQARS 2017 [online]. Available at <https://www.cdc.gov/wisqars/> [Accessed 17 Feb. 2019].
- [3] Sankar M, Javed F, Rossini GE, Rahman I. E-cigarettes and flavorings induce inflammatory and pro-inflammation responses in oral epithelial cells and periodontal fibroblasts. *Chirurgia*. 2018; 121(5):747-751.
- [4] Al-Ahadi KA, Al-Ahadi M, Al-Ahadi AS, Al-Khatib T, Al-Sayid F, Al-Sayid Z. Peri-implant parameters, tumor necrosis factor- α , and interleukin-1 beta levels in vaping individuals. *Clinical Implant Dentistry and Related Research*. 2018; 20(2):103-114.
- [5] Hendry CP, Hill MR, Spindle TR, Lopez AA, Kung'u-Thiong N, Sato T, et al. Electronic cigarette nicotine delivery can exceed that of conventional cigarettes: a preliminary report. *Toxicology Clinical Research*. 2015; 2(4):191-194.
- [6] Yu W, Hu B, Shi X, Cao Z, Ren H, He Z, et al. Nicotine inhibits osteogenic differentiation of human periodontal ligament cells under cyclic tensile stress through canonical Wnt pathway and α 7 nicotinic acetylcholine receptors. *Journal of Periodontal Research*. 2015; 50(4):559-64.
- [7] Choi D. *Regulation of Health Effects of Heavy Metals in Electronic Cigarette Aerosols—A Systematic Review*. *Biological Trace Element Research*. 2018; 188(2):259-313.
- [8] Kim H, Kim JH, Kim TS, Bae SH. Association of serum cadmium and lead with periodontal disease: a study of the Fourth Korean National Health and Nutrition Examination Survey. *J Clin Periodontol*. 2013; 40:1104-104.
- [9] Serrano MCC, Nicholson SD, Brown T, Wang J, Eiland SA, Bart BA. Lead exposure and periodontitis in US adults. *Journal of Periodontal Research*. 2007; 42(1):45-50.
- [10] Willemansen T, Van't Hofe G, Smit AM, Ouwens D, van't Hofe G, van't Hofe G, et al. Influence of E-smoking liquids on human periodontal ligament fibroblasts. *Front & Back Medicine*. 2018; 3(1):1-7.
- [11] Ruzhishvili M, Park HJ, Sami A, Zakiwanji A, Christakos M, Chae J. E-Cigarette Vapor Induces an Apoptotic Response in Human Gingival Epithelial Cells Through the Caspase-3 Pathway. *Journal of Cellular Biochemistry*. 2016; 122(6):1938-47.