

E-Cigarettes and Oral Health

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- Electronic Cigarette (e-cigarette) is a battery-operated device that vaporizes a mixture of propylene glycol, nicotine and flavoring agent to simulate tobacco smoking.
- E-cigarette was introduced as a product that aids with smoking cessation.
- Smoking is one of the most important risk factors for oral cancer, periodontal diseases and implant failure.
- E-cigarette companies claim that e-cigarettes can improve oral health by providing alternatives to smoking.
- Whether e-cigarettes play a role in smoking cessation is still unclear. A randomized controlled trial found little efficacy of e-cigarettes for smoking cessation (Tomar *et al.*, 2015).
- E-cigarettes are tobacco-free and do not generate toxic combustion products.
- However, e-cigarette vapor aerosols contain variable levels of aldehyde and carbonyls which can cause carbonyl/oxidative stress, DNA adducts/damage, and stress-induced cellular senescence (irreversible growth arrest that induces chronic inflammation) (Sundar *et al.*, 2016).
- The effect of e-cigarette on oral health is not fully understood and is still debated among many scientists and clinicians.

- Multiple periodontal parameters were compared between smokers, e-cigarette users (who never smoked conventional cigarette before), and no smokers. It was found that plaque index, periodontal probing, and clinical attachment loss were significantly higher in smokers compared to other groups. There was no difference between e-cigarette users and no smokers (Javed *et al.*, 2017).
- There was no significant difference in self-perceived gingival pain and swelling between e-cigarette users and no smokers (Javed *et al.*, 2017).
- It is argued that e-cigarette use is not as hazardous to periodontal health compared to cigarette smoking (Javed *et al.*, 2017).
- However, bleeding in probing (a classical marker for periodontal disease severity) was masked in both smokers and e-cigarette users compared to no smokers – this is likely due to the vasoconstriction effect of nicotine on gingival blood vessels (Javed *et al.*, 2017).

- Micronucleus assay test is a cytologic method which samples cells from oral cavity to screen for drug toxicity on cells. The presence of micronuclei within a cell is accepted as a predictive factor for risk of cancer.
- A study that conducted micronucleus assay test on three groups (Smokers vs. e-cigarette users vs. No smokers) found that the number of micronuclei was significantly

higher in smoker group compared to e-cigarette group, but the number of micronuclei was similar between e-cigarette and no smoker control groups. The authors concluded that e-cigarettes cause no harm in the oral cavity and is a reliable smoking cessation method (Franco *et al.*, 2016). However, the study only followed patients for 6 months which may not be long enough to see the true effect of e-cigarette on oral cancer risk.

- Although carcinogens appear to be reduced in e-cigarettes, there are several health concerns regarding nicotine.
- Nicotine has antiproliferative property *in vitro*. Thus, nicotine exposure through e-cigarette may potentially impair wound healing.
- Nicotine is associated with impaired leukocyte activity and healing by inhibiting neurovascularization and osteoblastic differentiation (Levin and Schwartz-Arad, 2005). Thus, it is hypothesized that e-cigarette may impair healing of the bone/implant interface.
- Berley *et al.* reported that bone-to-implant contact significantly decreased in rats' femur that received subcutaneous nicotine.
- Bone matrix-related genes around implants also downregulated in rats that received nicotine (Yamano *et al.*, 2010).
- An *in vitro* study showed that the amount of reactive oxygen species (ROS) reactivity is similar between conventional smoking and e-cigarette smoking (Sundar *et al.*, 2016).
- Since Periodontal and gingival cells are the first targets by e-cigarette aerosols, there is a concern that e-cigarette may have adverse effect on periodontal/gingival oral health.
- An *in vitro* study showed that e-cigarette aerosol exposure in human periodontal ligament fibroblasts and human gingival epithelium progenitor cells increase protein carbonylation, pro-inflammatory cytokine (IL-8) releases, and DNA damage markers (Sundar *et al.*, 2016).
- Since the introduction of e-cigarettes, there have been reports of explosions and fires caused by e-cigarettes.
- E-cigarette explosions inside the user's mouth results in abdominal burns, oral lacerations, teeth fractures and avulsions.
- Explosion may be due to several factors such as e-cigarette device design, battery quality, and compatibility between the device and the charger
- During history taking, dentists should identify all forms of tobacco and nicotine use (including cigars, cigarettes, e-cigarettes, chewing tobacco, snus and other forms).

- Dentists should advise patients about the unknown danger of e-cigarette use.
- Use evidence-based tobacco-cessation strategies. There is insufficient evidence for clinicians to promote e-cigarettes as a tobacco cessation method.

Conclusion

- E-cigarettes are relatively new devices; hence no long-term evidence regarding their effect on oral health is available.
- E-cigarettes may be less harmful than traditional smoking, however e-cigarettes can still contribute to the pathogenesis of periodontal diseases by inflammation, cell injury, and impaired repair ability.
- Chemicals in e-cigarette vapor is known to cause DNA damage and cellular senescence.
- There is insufficient evidence for clinicians to promote e-cigarettes as a smoking cessation aid.
- Further research is needed to establish the risk of using e-cigarette.

References

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