

# EFFECT OF SMOKING ON GINGIVAL HEALTH - A REVIEW

Reishy V<sup>1</sup>, Gifrina Jayaraj<sup>2</sup>, Gayatri Devi R<sup>3</sup>

<sup>1</sup>Saveetha Dental College and Hospitals, Saveetha institute of Medical and Technical Sciences, Chennai, India

<sup>2</sup>Reader, Department of Oral Pathology, Saveetha Dental College and Hospitals, Saveetha institute of Medical and Technical Sciences, Chennai, India

<sup>3</sup>Assistant Professor, Department of Physiology, Saveetha Dental College and Hospitals, Saveetha institute of Medical and Technical Sciences, Chennai, India

<sup>1</sup>[151901073.sdc@saveetha.com](mailto:151901073.sdc@saveetha.com)

<sup>2</sup>[gifrina@saveetha.com](mailto:gifrina@saveetha.com)

<sup>3</sup>[gayatri Devi@saveetha.com](mailto:gayatri Devi@saveetha.com)

## ABSTRACT

Smoking is recognised as a risk factor for human health. It is related to many problems like respiratory problems, cardiovascular disease, cancer, etc. Smoking is associated with incidence of gingivitis, periodontitis, epithelial malignancy in the oral cavity. It increases the number and depth of periodontal patients. Loss of tissue strength caused due to harmful compounds like tobacco, increase gingival recession and changes to the oral cavity. Prevalence of moderate and severe diseases are higher in smokers than non-smokers. Smoking affects both gingival epithelium and connective tissue. Density of blood vessels is decreased in smokers. Effect of smoking on vascular status is caused by nicotine compounds. This review was done based on the articles obtained from various platforms like PubMed, PubMed central and Google Scholar. They were collected with a restriction in time basis from 2000-2020. The inclusion criteria were original research papers. In vitro, studied among various conditions and articles that contain pros and cons. Exclusion criteria came into account for review articles, retracted articles and articles of other languages. All the articles are selected based on the effect of smoking on gingival health. Thus, smoking results in various oral health problems like incidence of gingivitis, periodontitis, epithelial malignancy in the oral cavity. It affects gingival recession and changes to the oral mucosa. This review article gives knowledge about the correlation between smoking and health of gingival treatment with various dental problems.

**KEYWORDS:** Gingiva, Health, Oral problem, Periodontitis, Smoking.

## INTRODUCTION

Smoking is recognised as a risk factor for human health. It is related to many problems like respiratory problems, cardiovascular disease, cancer, etc. Smoking is associated with incidence of gingivitis, periodontitis, epithelial malignancy in the oral cavity. It increases the number and depth of periodontal patients. Loss of tissue strength caused due to harmful compounds like tobacco, increased gingival recession and changes to the oral mucosa. Prevalence of moderate and severe diseases are higher in smokers than non-smokers. Smoking affects both gingival epithelium and connective tissue. Smokers have a blood vessel of about  $<0.5\mu$  diameter less than non-smokers said by Hassan Semyari (Jalayer Naderi et al., 2015). Sreedevi et al. (2012) showed that the density of blood vessels are decreased in smokers. The researchers believe that the effect of smoking on vascular status is caused by nicotine compounds. Nicotine stimulates the production of adrenaline and noradrenaline that causes vasoconstriction and this leads to the decrease of bleeding. Decrease in the capillary diameter and the density of blood vessels in gingival tissues of smokers explains the reduction of gingival index. Inflammatory responses are changed

in smokers and causes the reduction of redness and bleeding. These signs are clearly mild in smokers. Cessation of bleeding causes the increase in gingival bleeding in smokers as non-smokers. Many different research topics have been discussed. There has been a study for checking the condition or the health of the periodontal ligament (Haber et al., 1993; Pindborg, 1947). There is a difference in tissue changes of the gingiva and connective tissue that are different in smokers and non-smokers (Kasper et al., 2015). There are a lot of effects on gingiva related to smoking such as the ability to heal (Prasanna and Gheena, 2016), decrease in the proinflammatory cytokines and chemokines (Lung et al., 2005), blood vessel density, lumen area (Harrita and Santhanam, 2019). Harmful compounds like nicotine, tobacco, are all leads to the causation of the periodontitis disease (Rai and Rai, 2012).

This review is to summarise the effect of smoking on the health of gingiva. Various factors that are present in and around the gingiva are responsible for the health of the gingiva like plaque index, periodontal health, periodontal risk factor, and gingival crevicular fluid (Hema Shree et al., 2019). Gingival crevicular fluid volume and vessel present in gingiva and the blood flow rate is responsible for the health of the gingiva. Systematically review articles from pubmed and appraise.

## **METHODOLOGY**

This review was done based on the articles obtained from Various platforms like PubMed, PubMed central and Google scholar. They were collected with a restriction in time basis from 1970-2020. The inclusion were original research papers, *in vitro* studied among various conditions and articles that contain pros and cons. Exclusion criteria came into account for review articles, retracted articles and articles of other languages. All the articles were selected based on the effect of smoking on gingival health. They are determined by article title, abstract and complete article. When article holder websites were analyzed on the topic of effect of smoking on gingival health, more than 2000 articles and based articles were found, when it was shortlisted based on the inclusion and exclusion criteria, the number of articles were lowered to 130 articles. When timeline and other factors were quoted only 29 articles came into play. This article is reviewed from the 29 articles collected. Quality of articles used was assessed using a quality assessment tool and graded as strong, moderate and weak. The level of evidence of the reviewed articles were categorized as per the criteria of the centre for evidence - based medicine, Oxford, United Kingdom (CEBM, 2011).

### **Effect of smoking on gingiva**

Histopathological changes in gingival epithelium and connective tissue are different in smokers and non-smoker (Kasper et al., 2015). Periodontal disease is the most chronic disease in adults. Smoking is an environmental risk factor that results in periodontitis. Impaired immune response compromises periodontal tissue for the ability to heal (Prasanna and Gheena, 2016). Smoking affects neutrophils function, prevention, elimination, periodontal pathogens in heavy smokers, is very reactive to oxygen species release and oxidative stress mediated tissue damage. Studies have shown that smokers exhibited decreased several proinflammatory cytokines and chemokines and the regulators of helper-T-cells and natural killer cells (Kasper et al., 2015; Palmer et al., 2005) (Johnson et al., 2010). It reflects the immunosuppressant effects in smoking. Smoking causes a strong suppressive effect in gingival bleeding (Dietrich et al., 2004). Smoking exerts a strong chronic dose dependant suppressive effect of gingival bleeding on probing. Cigarette smoking is a significant risk factor for pathogenesis of periodontal disease that influence both sub gingival microbiota in the host's response. Influence of smoking is related to the amount of gingival in crevicular fluid during the experiment of gingivitis (Cappuyns and Mombelli, 2003). Results indicate that smoking interferes with cytokine production. Smokers have decreased inflammatory response, plaque formation and reduced gingival bleeding (Uma et al., 2020). Gingival bleeding response in plaque is

significantly suppressed in cigarette smokers. Gingival vessels are less compared to inflamed gingival tissues in smokers than with healthy gingival tissues in non-smokers. Blood vessel density and blood vessel lumen area are higher in non-smokers compared to smokers (Kumar and Faizuddin, 2011). Mirbood(Kumar and Faizuddin, 2011) studied vessel density and vestibular gingiva in smokers and non-smokers using immunohistochemistry and found a decreased vessel density in smokers. Smoking produces an increase in gingival crevicular fluid flow rate that reflects changes in blood flow that has been known to produce nicotine (Palati et al., 2020). Smoking influences the thickness of marginal gingival epithelium is shown by Cunha (Cunha et al., 2000).

### **Periodontitis**

Prevalence of periodontitis is 2 to 20 times higher in smokers. Hyperplasia and mild dysplasia could occur (Abitha and Santhanam, 2019). Loss of tissue due to harmful compounds like tobacco, causes gingival recession changes in oral mucosa (Rai and Rai, 2012). The pathogenic mechanism in tissue degradation of periodontitis in smokers is different from non-smokers (Hannah et al., 2018). Potential biological mechanisms of smoking can cause widespread systematic effects and increased susceptibility to periodontitis (Palati et al., 2019). Smoking causes the severity of periodontitis in older adults who have a strong association with smoking and periodontitis (Gunasekaran and Abilasha, 2016). In a study, assessing the periodontal status of loss of teeth in smokers and non-smokers in Belgium city concluded that smoking is associated with higher plaque and calculus deposits (Sarbeen et al., 2016).

### **Histopathological features of gingiva in smokers**

Smoking affects epithelium and the connective tissue of gingiva(Takei and Carranza, 2012). Smoking increases epithelial changes at the early phases of dysplasia, decreasing the inflammatory action (Sheriff et al., 2018). Gingival blood flow is lost in smokers compared to non-smokers. Smoking affects periodontal tissues, vascular and immunological response of the body (Novak et al., 2012). Smoking has an effect on gingival blood vessels (Harrita and Santhanam, 2019). The reduction in clinical inflammation signs confirmed by a decrease in gingival bleeding on probing, tissue redness, oedema and the amount of blood vessels in the marginal gingival tissues causes vascular changes in the endothelium damaged by smoking (Biddle et al., 2001). The age of the subjects in the study matched as gingival vasculature and age associated (Giannopoulou et al., 2003).

### **Levels of chemokine and cytokines**

Chemokine and cytokine are at elevated levels in smokers. Smokers exhibited decreased pro inflammatory cytokines and chemokines, regulators of helper T cells and natural killer cells, (Lung et al., 2005). It reflects immunosuppressive effects and susceptibility of periodontitis (Ahad and Gheena, 2016). Exhibit decrease in several pro inflammatory cytokines and chemokines profiles (Sukumaran and Padavala, 2018). Immunosuppressive effects enhanced susceptibility periodontitis (Manohar and Abilasha, 2019; Sukumaran and Padavala, 2018).

### **Tobacco as a reason for the health of gingiva**

Tobacco smoking is a risk factor for major periodontal problems and smoking demonstrates that it reduces inflammatory signs of vasoconstriction and increased gingival epithelium thickness (Soder et al., 2002). Reduction in clinical inflammation in smokers as a metabolism of nicotine, a byproduct in peripheral constrictive gingival vessels. Cigarette and tobacco usage is considered a numerous disease outbreaks, many had developed in developing countries (Nociti et al., 2015). Reduction in bleeding on probing evokes inflammatory response and plaque accumulation among smokers (Rivera-Hidalgo, 2003). Several studies say tobacco smoking is an important risk factor for the development of severity and inflammatory

periodontal disease (Dalle-Donne *et al.*, 2020). Oral health is related to quality of life to assess the perceived oral health by means of one question. Self-assessments of oral health were associated with clinical characteristics. (Cunha *et al.*, 2000).

### **Gingival epithelium**

Nicotine increases the rate of proliferation of gingival epithelium and increasing epithelial thickness in smokers. Smokers possess more gingival inflammation. (Kumar *et al.*, 2015). Epithelial cells acting as a mechanical barrier can reduce but not completely eliminate the deleterious effect of nicotine on gingival fibroblast (Imamura *et al.*, 2016).

### **DISCUSSION**

Histopathological changes in the epithelium of the gingiva and connective tissue are different in smokers. Smoking affects both the epithelium of the gingiva and connective tissue. Smokers have blood vessel of < 0.5 $\mu$  diameter less inflammatory cells than non-smokers. Smoking increases the changes in the epithelium at early stages of Dysplasia (Kasper *et al.*, 2015; Takei and Carranza, 2012). Inflammatory cells are less in smokers. Blood vessel density is reduced in smokers (Papapanou, 1996). It affects functions of neutrophils, prevention, elimination of periodontal pathogens in smokers, release of reactive oxygen species and oxidative stress mediated tissue damage (Biddle *et al.*, 2001). Several studies indicate that tobacco smoking is a dangerous risk factor for the development and severity of periodontal disease (Dalle-Donne *et al.*, 2020).

The limitations of this study is that it includes a different study population and a wide range of studies. The future scope focuses on how to treat patients with smoking habits, nicotine and tobacco users well and information on how to manage these kinds of patients with dental issues would be supported in the treatment plan.

### **CONCLUSION**

This review article gives knowledge about the correlation between smoking and health of gingival treatment with various dental problems. Smoking thus results in various oral health problems such as gingivitis, periodontitis and epithelial malignancy. It affects recession in gingiva and causes changes to the oral mucosa.

### **CONFLICT OF INTEREST**

The authors have none to declare

#### **Author Contribution**

Rieshy V: Literature search, data collection, Analysis, manuscript drafting.

Gifrina Jayaraj: Data verification, manuscript drafting.

Gayatri Devi: Data verification, manuscript drafting.

### **REFERENCES**

- [1] Abitha T and Santhanam A (2019) Correlation between bizygomatic and maxillary central incisor width for gender identification. Brazilian Dental Science. DOI: 10.14295/bds.2019.v22i4.1775.
- [2] Ahad M and Gheena S (2016) Awareness, attitude and knowledge about evidence based dentistry among the dental practitioner in Chennai city. Research Journal of Pharmacy and Technology. DOI: 10.5958/0974-360x.2016.00380.2.

- [3] Biddle AJ, Palmer RM, Wilson RF, et al. (2001) Comparison of the validity of periodontal probing measurements in smokers and non-smokers. *Journal of clinical periodontology* 28(8). Wiley Online Library: 806–812.
- [4] Cappuyns I and Mombelli A (2003) Effect of smoking on gingival crevicular fluid cytokine profile during experimental gingivitis. *Journal of clinical*. Wiley Online Library. Available at: <https://onlinelibrary.wiley.com/doi/abs/10.1034/j.1600-051X.2003.00416.x>.
- [5] CEBM (2011) Explanation of the 2011 OCEBM Levels of Evidence - CEBM. Available at: <https://www.cebm.net/2011/06/explanation-2011-ocebm-levels-evidence/> (accessed 20 June 2020).
- [6] Cunha RL, Maialle KG and Menegalli FC (2000) Evaluation of the drying process in spouted bed and spout fluidized bed of xanthan gum: focus on product quality. *Powder Technology*. DOI: 10.1016/s0032-5910(99)00197-7.
- [7] Dalle-Donne I, Garavaglia ML, Colombo G, et al. (2020) Cigarette smoke and glutathione: Focus on in vitro cell models. *Toxicology in vitro: an international journal published in association with BIBRA* 65. Elsevier: 104818.
- [8] Dietrich T, Bernimoulin J-P and Glynn RJ (2004) The effect of cigarette smoking on gingival bleeding. *Journal of periodontology* 75(1): 16–22.
- [9] Giannopoulou C, Kamma JJ and Mombelli A (2003) Effect of inflammation, smoking and stress on gingival crevicular fluid cytokine level. *Journal of clinical periodontology* 30(2). Wiley Online Library: 145–153.
- [10] Gunasekaran G and Abilasha R (2016) TOOTH SENSITIVITY AMONG RESIDENTIAL UNIVERSITY STUDENTS IN CHENNAI. *Asian Journal of Pharmaceutical and Clinical Research*. DOI: 10.22159/ajpcr.2016.v9s2.13228.
- [11] Haber J, Wattles J, Crowley M, et al. (1993) Evidence for Cigarette Smoking as a Major Risk Factor for Periodontitis. *Journal of Periodontology*. DOI: 10.1902/jop.1993.64.1.16.
- [12] Hannah R, Ramani P, Herald. J. Sherlin, et al. (2018) Awareness about the use, Ethics and Scope of Dental Photography among Undergraduate Dental Students Dentist Behind the lens. *Research Journal of Pharmacy and Technology*. DOI: 10.5958/0974-360x.2018.00189.0.
- [13] Harrita S and Santhanam A (2019) Determination of Physical Height Using Clinical Crown Height of Deciduous Teeth. *Indian Journal of Forensic Medicine & Toxicology*. DOI: 10.5958/0973-9130.2019.00255.x.
- [14] Hema Shree K, Ramani P, Sherlin H, et al. (2019) Saliva as a Diagnostic Tool in Oral Squamous Cell Carcinoma - a Systematic Review with Meta Analysis. *Pathology oncology research: POR* 25(2): 447–453.
- [15] Imamura K, Kokubu E, Kita D, et al. (2016) Role of mitogen-activated protein kinase pathways in migration of gingival epithelial cells in response to stimulation by cigarette smoke condensate and infection by *Porphyromonas gingivalis*. *Journal of Periodontal Research*. DOI: 10.1111/jre.12341.
- [16] Jalayer Naderi N, Semyari H and Elahinia Z (2015) The Impact of Smoking on Gingiva: a Histopathological Study. *Iranian journal of pathology* 10(3): 214–220.
- [17] Johnson GK, Guthmiller JM, Joly S, et al. (2010) Interleukin-1 and interleukin-8 in nicotine- and lipopolysaccharide-exposed gingival keratinocyte cultures. *Journal of periodontal research* 45(4): 583–588.
- [18] Kasper DL, Fauci AS, Hauser SL, et al. (2015) *Harrison's Principles of Internal Medicine* 19/E (Vol.1 & Vol.2) (ebook). McGraw Hill Professional.
- [19] Kumar J, Pai G, Natarajan S, et al. (2015) Histomorphometric analysis of gingival tissue in smokers and nonsmokers. *SRM Journal of Research in Dental Sciences*. DOI: 10.4103/0976-433x.156214.
- [20] Kumar V and Faizuddin M (2011) Effect of smoking on gingival microvasculature: A histological study. *Journal of Indian Society of Periodontology* 15(4). [ncbi.nlm.nih.gov](http://ncbi.nlm.nih.gov): 344–348.

- [21] Lung ZHS, Kelleher MGD, Porter RWJ, et al. (2005) Poor patient awareness of the relationship between smoking and periodontal diseases. *British Dental Journal*. DOI: 10.1038/sj.bdj.4812971.
- [22] Manohar J and Abilasha R (2019) A Study on the Knowledge of Causes and Prevalance of Pigmentation of Gingiva among Dental Students. *Indian Journal of Public Health Research & Development*. DOI: 10.5958/0976-5506.2019.01859.x.
- [23] Nociti FH Jr, Casati MZ and Duarte PM (2015) Current perspective of the impact of smoking on the progression and treatment of periodontitis. *Periodontology 2000* 67(1): 187–210.
- [24] Novak MJ, John Novak M, Novak KF, et al. (2012) Smoking and Periodontal Disease. *Carranza's Clinical Periodontology*. DOI: 10.1016/b978-1-4377-0416-7.00026-3.
- [25] Palati S, Ramani P, Herald. J. Sherlin, et al. (2019) Age Estimation of an Individual Using Olze's Method in Indian Population-A Cross-Sectional Study. *Indian Journal of Forensic Medicine & Toxicology*. DOI: 10.5958/0973-9130.2019.00179.8.
- [26] Palati S, Ramani P, Shrelin HJ, et al. (2020) Knowledge, Attitude and practice survey on the perspective of oral lesions and dental health in geriatric patients residing in old age homes. *Indian journal of dental research: official publication of Indian Society for Dental Research* 31(1): 22–25.
- [27] Palmer RM, Wilson RF, Hasan AS, et al. (2005) Mechanisms of action of environmental factors - tobacco smoking. *Journal of Clinical Periodontology*. DOI: 10.1111/j.1600-051x.2005.00786.x.
- [28] Papapanou PN (1996) Periodontal Diseases: Epidemiology. *Annals of Periodontology*. DOI: 10.1902/annals.1996.1.1.1.
- [29] Pindborg JJ (1947) Tobacco and Gingivitis. *Journal of Dental Research*. DOI: 10.1177/00220345470260030901.
- [30] Prasanna GE and Gheena S (2016) A study of empathy across students from 4 health disciplines among 1st years and Final years. *Research Journal of Pharmacy and Technology*. DOI: 10.5958/0974-360x.2016.00286.9.
- [31] Rai DJJ and Rai JJ (2012) Knowledge and Awareness among interns and residents about medical law and negligence in a medical college in Vadodara - A Questionnaire Study. *IOSR Journal of Dental and Medical Sciences*. DOI: 10.9790/0853-0343238.
- [32] Rivera-Hidalgo F (2003) Smoking and periodontal disease. *Periodontology 2000*. DOI: 10.1046/j.0906-6713.2003.03205.x.
- [33] Sarbeen JI, Insira Sarbeen J and Gheena S (2016) Microbial variation in climatic change and its effect on human health. *Research Journal of Pharmacy and Technology*. DOI: 10.5958/0974-360x.2016.00359.0.
- [34] Sheriff KAH, Ahmed Hilal Sheriff K and Santhanam A (2018) Knowledge and Awareness towards Oral Biopsy among Students of Saveetha Dental College. *Research Journal of Pharmacy and Technology*. DOI: 10.5958/0974-360x.2018.00101.4.
- [35] Soder B, Jin LJ and Wickholm S (2002) Granulocyte elastase, matrix metalloproteinase-8 and prostaglandin E2 in gingival crevicular fluid in matched clinical sites in smokers and non-smokers with persistent periodontitis. *Journal of Clinical Periodontology*. DOI: 10.1034/j.1600-051x.2002.290502.x.
- [36] Sreedevi M, Ramesh A and Dwarakanath C (2012) Periodontal status in smokers and nonsmokers: a clinical, microbiological, and histopathological study. *International journal of dentistry* 2012: 571590.
- [37] Sukumaran G and Padavala S (2018) Molar incisor hypomineralization and its prevalence. *Contemporary Clinical Dentistry*. DOI: 10.4103/ccd.ccd\_161\_18.

[38] Takei HH and Carranza FA (2012) Clinical Diagnosis. Carranza's Clinical Periodontology. DOI: 10.1016/b978-1-4377-0416-7.00030-5.

[39] Uma PK, Ramani P, Sherlin HJ, et al. (2020) Knowledge about Legal Aspects of Medical Negligence in India among Dentists--A Questionnaire Survey. Medico Legal Update 20(1). ijop.net: 111–115.

**Table 1 : Description of included studies:**

S.No	Name of the Author	Year	Type of study	Points taken	Level of evidence
1	Dr. Johnson Prakash ( <u>Johnson et al., 2010</u> )	2017	Research	Histological evaluation	Level 3
2	Srikant Natarajan ( <u>Srikant Natarajan, et al</u> )	2015	Case Study	Histomorphometric analysis	Level 2
3	Hassan Semyari ( <u>Jalayer Naderi et al., 2015</u> )	2015	Research	Impact of smoking on gingiva	Level 2
4	Priyanka Prakash ( <u>Dietrich et al., 2004</u> )	2014	Case Study	Histomorphometric and immunohistochemical study	Level 3
5	Maddipati Sreedevi ( <u>Sreedevi et al., 2012</u> )	2012	Case Study	Histopathological study	Level 1
6	D. K. Gautam ( <u>Novak et al., 2012</u> )	2011	Research	Effect of cigarette smoking	Level 2
7	Vijaya kumar ( <u>Kumar and Faizuddin, 2011</u> )	2011	Research	Histological study	Level 3
8	Cunha ( <u>Cunha et al., 2000</u> )	2007	Case Study	Quality of gingiva	Level 3
9	Gloria Calsina ( <u>Dalle-Donne et al., 2020</u> )	2002	Research	Effect of smoking	Level 2
10	Andrea Mombelli ( <u>Cappuyns and Mombelli, 2003</u> )	2002	Case Study	Effect of nicotine in the production fibroblast.	Level 1