

REVIEW ARTICLE

Tobacco Use – A Risk Factor for Dental Implant

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ABSTRACT

The use of endosseous implants has increased over the past decade in certain edentulous situations. Dental implant has become a routine procedure done by dental surgeon and has been widely accepted by the patients as their treatment plan. Due to the remarkable success of implant, there are various researches going on to seek out factors liable for the failure of dental implants. With the growing use of tobacco among patients, its ill effects on bone quality and quantity have been well documented in several studies. The purpose of this article is to describe the relationship between usage of tobacco product and implant-related surgical procedures including the incidence of complications related to these procedures, and long-term survival and success rates of dental implants among smokers.

Keywords: Dental Implant, Implant failure, Tobacco product.

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INTRODUCTION

Tooth loss can cause the appearance of an incomplete smile or functional disability, which affects the quality of life of the patients.^[1] One of the most imperative developments in modern dentistry is the ability to replace missing teeth using titanium implants placed directly into the jaw.^[2] The use of osseointegrated implants as a foundation for the prosthetic replacement of missing teeth has become widespread within the past decade. Implants

are artificial tooth that anchored within the gums or jaw bone to replace a missing tooth. They are made of bio-compatible materials, just an equivalent as hip implants or similar orthopedic devices, and function as anchors or support for traditional sorts of dentistry, such as crowns, bridges, or dentures.^[3] The major breakthrough in implant success which ultimately led to the very successful materials and techniques now being used was made in 1952 by a Swedish orthopedic surgeon named Per-Ingvar Branemark while investigating microscopic healing of bony defects in rabbit using specially designed microscope heads made up of titanium.^[2] Although dental implants have demonstrated success and survival rates of up to 100%, there are many complications which are associated with dental implant such as peri-implant diseases (peri-implant mucositis and peri-implantitis). Besides poor plaque control, a history of periodontitis, an immunocompromised state (such as found among patients with AIDS and poorly controlled diabetes mellitus), and occlusal overloading, a significant risk factor for peri-implant diseases is habitual use of tobacco products.^[4,5] It has been reported that tobacco smoke contains over 4000 potential toxins, of which nicotine is taken into account together of the foremost hazardous and addictive.^[6] Bain and Moy also found differences between moderate and heavy smokers, with increased tobacco use correlated to an increased implant failure rate. The authors have found that the prevalence of Type IV bone was twice as high among heavy smokers as compared to non-smokers or even light smokers.^[7] Other studies have also identified tobacco use as one of the statistically significant ($P = 0.004$) factors associated with an increased risk of implant failure, with a hazard ratio of 4.3, that is, the risk of implant failure in smokers is 4.3 times that in non-smokers.^[8] Dental implant-supported fixed or removable prostheses are one of the most widely used treatment options, though the success of implant restorations is adversely affected by smoking and the resulting biological complications cause the loss of the supporting bone. The aim of this review is to shed light on the usage of tobacco products as a risk factor for dental implant.

NICOTINE AND ITS EFFECTS ON OSSEOINTEGRATION

Nicotine is a parasympathomimetic alkaloid and a psychostimulant drug, which is found in the leaves of tobacco plant, *Nicotiana tabacum*. It has a half-life of

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2 h, in contrast to cotinine (a principal metabolite of nicotine) which has a half-life of 15–20 h.^[9] The oral cavities of smokeless tobacco (ST) users and smokers are exposed to high concentration of nicotine. It is found in the plasma and saliva of smokers in a concentration of 4–73 mg/mL and 96–1.6 mg/mL, respectively.^[10–13] Nicotine has been associated with deleterious effect on bone healing. The osseointegration process requires the recruitment of osteoblasts, their anchorage, adhesion, spreading, proliferation, and differentiation into osteoblasts that secrete extracellular matrix calcification on the implant surface. All these cellular events are sensitive to the local and systemic effects of nicotine and other associated components.^[13,14] Nicotine reduces osteoblastic activity affecting the amount of collagen available to form the extracellular matrix. It may also induce microvascular obstruction which results in ischemia and decreases the blood cells proliferation with direct reduction of blood flow and nutrients in the healing area after implant insertion. Nicotine also decreases the proliferation of macrophages that participate in both specific and non-specific immune response during the acute phase of cellular injury and acts against antigens, cytokines and initiates the immune process. Therefore, when the macrophages function is decreased, the immune response is directly affected and causes increased susceptibility to infections in the surgical area of implant insertion.^[15]

TOBACCO PRODUCT USAGE AND SURVIVAL OF IMPLANTS

Cigarette Smoking

The risk factor for peri-implant diseases and implant failure is cigarette smoking. It has been found that the oral cavity of smokers has higher incidence of gingivitis and periodontitis, increased plaque accumulation, higher rate of tooth loss, and increased resorption of the alveolar ridge. Cigarette smoking may adversely affect wound healing and, thus, jeopardize the success of bone grafting and dental implant placement.^[16] Levin *et al.* reported that peri-implant marginal bone loss is statistically significantly higher in cigarette smokers than in ex-smokers and non-smokers.^[17] However, controversial results have also been reported. In a study by Romanos *et al.*, platform-switched implants were placed in smokers (individuals who had smoked at least 20 cigarettes daily for over 10 years) and non-smokers using the same treatment protocol. All implants were immediately loaded and the mean follow-up periods in smokers and non-smokers were approximately 5 and 9 years, respectively. At follow-up, implant survival rates were 97% among smokers and 99% among non-smokers. The study concluded that long-term clinical outcomes for

immediately loaded platform-shifted implants placed in smokers and non-smokers are comparable provided that the abutments are placed on the day of surgery and never removed.^[18]

Waterpipe Smoking (WS)

It also known as hookah, hubble bubble, narghile, and sheesha. It is a type of tobacco smoking in which charcoal heated air passes through a perforated aluminum foil and across powdered tobacco to become smoke, which bubbles through water before being inhaled. WS is a cultural norm in many countries such as Bahrain, Egypt, Israel, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.^[19] It has been found that the likelihood of peri-implant disease development has been associated with WS because the nicotine and chemicals in WS induce a state of oxidative stress in peri-implant tissues (gingiva and alveolar bone), which if left uncontrolled will lead to implant failure/loss. It is, therefore, hypothesized that WS is a significant risk factor for peri-implant diseases; and peri-implant bleeding on probing, probing depth, and marginal bone loss are higher among cigar/pipe smokers than in non-smokers. However, to date, there are no studies in indexed literature that have assessed this hypothesis.^[20] Many individuals start WS in an attempt to quit cigarette smoking as they consider that WS is less harmful than traditional cigarette smoking as the tobacco smoke in waterpipes get filtered through water, which absorbs nicotine.

Pipe and Cigar Smoking

Pipe and cigar smoking habits are common in many parts of the world, including the United States, and the habit is particularly common among individuals belonging to privileged socioeconomic groups. The toxic constituents in cigar and pipe smoke are similar to those in cigarette smoke.^[21] Due to the curing and fermentation process for cigar tobacco, cigar smoke has been shown to have higher levels of tobacco-specific nitrosamines than cigarette smoke. In the study by Feldman *et al.*, calculus deposition, probing depth, and alveolar bone loss were significantly higher in cigarette smokers than pipe/cigar smokers.^[22]

Electronic Cigarette Vaping

An electronic cigarette (E-cigarette) is a battery operated device that consists of (a) a metal heating element in a stainless steel casing; (b) a container; (c) an atomizer; and (d) a battery. The container is filled with liquid, which usually contains nicotine, propylene glycol, glycerine, and artificial flavorings.^[23,24] Results from a recent *in vitro* study showed that

E-cigarettes with flavorings enhance oxidative stress and increase the release of destructive inflammatory cytokines (interleukin 8 and prostaglandin E2) in human periodontal ligament fibroblasts, human gingival epithelium progenitors pooled, and epigingival 3D epithelium.^[25] A proposed immune-inflammatory mechanism associated with peri-implant inflammation and bone loss in vaping individuals is shown in Figure 1.^[20] To the best of our knowledge, no clinical studies have been done to assess the effect of electronic cigarette smoking on periodontal and peri-implant bone and soft tissues.

USAGE OF ST AND ITS ASSOCIATION TO THE SUCCESS AND SURVIVAL OF IMPLANTS

Various forms of ST products are available commercially despite the imposition of a ban on the manufacturing and sale of such products. Its use is common globally. They are consumed orally or nasally without burning tobacco. Snuff is the most commonly use ST. It can be either use as moist or dry. Studies that compared the periodontal inflammatory effects of different types of ST product have shown that all types of ST are equally hazardous to periodontal health and none of the ST products can be considered as less hazardous than any other.^[26,27] No studies have been found in the indexed literatures that have assessed the use of ST products in relation to their effect on dental implants. It is hypothesized that (a) peri-implant inflammatory parameters (peri-implant bleeding on probing, probing depth, and marginal bone loss) are worse in ST product users than in controls and that (b) peri-implant inflammatory parameters are worse around implants located in the buccal vestibule in which ST product is placed compared with implants on the contralateral side. Additional studies are needed to test these hypotheses.^[20]

SUMMARY OF THE REVIEW

- Smoking has negative effects on the outcome of almost all therapeutic procedures performed in the oral cavity, including implant placement.
- Significant numbers of implants fail after second-stage surgery and it is more in maxilla as compared to mandible in smokers.
- The failure rate of implants is more in smokers as compared to nonsmokers and it is directly proportional to tobacco use.
- Marginal bone loss and incidence of peri-implantitis are more after implant placement in smokers.
- It is advised to stop the habit 1 week before and up to 2 months after implant placement to increase implant survival in smokers.

RECOMMENDATIONS

- Proper detailed history of smoking which includes the duration of smoking, the intensity (past and present), and the present status of smoking should first be obtained.
- Patient with long-term smoking or heavy smokers should be strictly advised to stop or reduce number of cigarettes.
- The ill effect on dental implant and chances of failure should be informed before procedure if the patient does not agree to stop smoking.
- In the presence of long history of smoking, location of implant should be decided properly as implants in maxilla are in greater risk than mandible.
- Surgeon should keep on counseling the smokers to cease or reduce smoking.
- It is important to identify former heavy smokers who have recently stopped and the attitude of patient toward treatment.

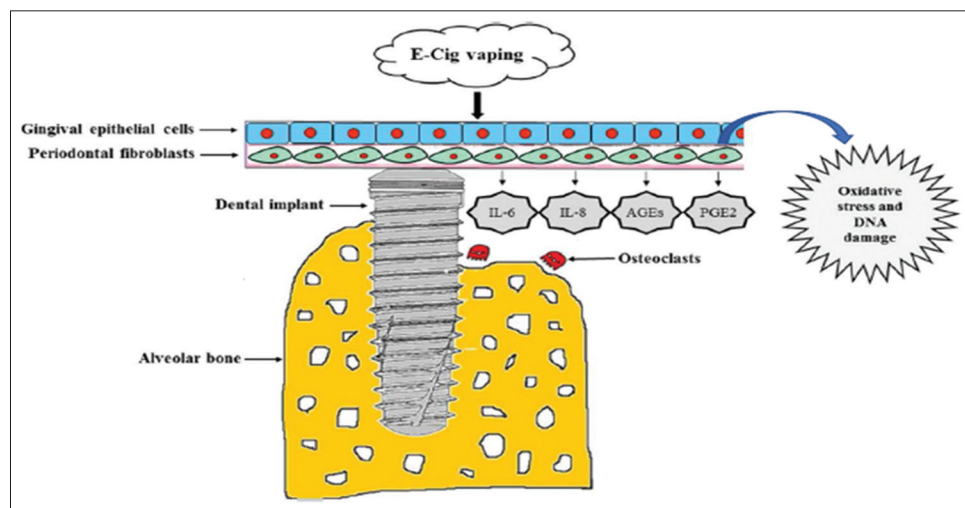


Figure 1: A proposed immunoinflammatory mechanism associated with peri-implant inflammation and bone loss in vaping individuals. (AGEs: Advanced glycation end products, IL: Interleukin, PGE2: Prostaglandin E2)

CONCLUSION

Smoking has its influence on general as well as oral health of an individual. Even though smoking is a risk factor for implant failure, it is not considered an absolute contraindication. The effect of smoking on the dental implant can be reversed if patient with heavy smokers follows proper smoking cessation protocols. From the level of experimental evidence currently available, it seems that usage of tobacco product in any form may negatively influence the outcome of dental implant, therapy by enhancing oxidative stress in periodontal and peri-implant tissues and augmenting alveolar bone loss. Hence, well-designed clinical studies are needed in this regard.

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