

Smoking and dental implants

V. Kasat, R. Ladda¹

Departments of Oral Medicine and Radiology, ¹Prosthodontics, Rural Dental College, Loni, Maharashtra, India

Corresponding author (email:<drvikrantkasat@rediffmail.com>)

Dr. Vikrant Kasat, Department of Oral Medicine and Radiology, Rural Dental College, Loni, Maharashtra, India.

Abstract

Smoking is a prevalent behaviour in the population. The aim of this review is to bring to light the effects of smoking on dental implants. These facts will assist dental professionals when implants are planned in tobacco users. A search of “PubMed” was made with the key words “dental implant,” “nicotine,” “smoking,” “tobacco,” and “osseointegration.” Also, publications on tobacco control by the Government of India were considered. For review, only those articles published from 1988 onward in English language were selected. Smoking has its influence on general as well as oral health of an individual. Tobacco negatively affects the outcome of almost all therapeutic procedures performed in the oral cavity. The failure rate of implant osseointegration is considerably higher among smokers, and maintenance of oral hygiene around the implants and the risk of peri-implantitis are adversely affected by smoking. To increase implant survival in smokers, various protocols have been recommended. Although osseointegrated dental implants have become the state of the art for tooth replacement, they are not without limitations or complications. In this litigious era, it is extremely important that the practitioner clearly understands and is able and willing to convey the spectrum of possible complications and their frequency to the patients..

Key words: Bone, dental implants, nicotine, osseointegration, smoking, titanium, tobacco

INTRODUCTION

One of the most imperative developments in modern dentistry is the ability to replace missing teeth using titanium implants placed directly into the jaw. From one tooth to a whole arch or simply to stabilise a moving denture, implant dentistry can offer a successful alternative to many restorative problems. 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. These were placed firmly in holes drilled into the thigh bone. At the end of the experiment while attempting to retrieve

the microscope heads, he found that they could not be removed and had actually integrated into the bone. He called this innovation as “osseointegration.” Further studies convinced him that the titanium was biocompatible and could be used in humans.

Smoking is a prevalent behaviour in the population all over the world. The aim of this review is to shed light on the effects of smoking with special emphasis on dental implants. For this, a search of “PubMed” was made with the key words “dental implant,” “nicotine,” “smoking,” “tobacco,” and “osseointegration.” Also, publications on tobacco control by the Government of India were considered.

SMOKING AND HEALTH

4.83 million people worldwide died in 2000 as a result of their addiction to nicotine.^[1] This number is sufficient to explain the harm being caused by tobacco. Tobacco appears to be as old as human civilization and was introduced into India by Portuguese traders during AD 1600. It spread like fire to such a great extent that today India is the second largest producer and consumer of tobacco in the world.^[2] Nicotine increases

Access this article online	
Quick Response Code: 	Website: www.jispcd.org
	DOI: 10.4103/2231-0762.109358

the heart rate, blood pressure, and respiratory rate, and makes the user feel more alert. Unfortunately, these effects wear off after 20 min or so and the tobacco user is left craving for another pick-me-up.^[3]

Smoking has its influence on general as well as oral health of an individual. A primary relationship between smoking and coronary heart disease, stroke, subclinical atherosclerosis, chronic obstructive pulmonary disease, pneumonia, low birth weight, and various cancers has been established without doubt. Pregnant women who smoke tobacco have increased risk of stillbirth.^[4]

As far as oral health is concerned, it increases the risk of periodontal disease, oral precancerous and cancerous lesions, root caries, and peri-implantitis. It also causes taste derangement, staining of teeth and restorations, as well as delayed wound healing after extractions, periodontal procedures, and orthognathic surgeries. Smoking upregulates the expression of pro-inflammatory cytokines such as interleukin-1, which contributes to increased tissue damage and alveolar bone resorption.^[5] Nicotine may have an effect on cellular protein synthesis and impairs the gingival fibroblast's ability to adhere, thus interfering with wound healing and/or exacerbating periodontal disease.^[6]

The exact mechanism by which smoking compromises wound healing is unknown. Various mechanisms hypothesized include cytotoxicity of nicotine, carbon monoxide, and hydrogen cyanide to the cells involved in wound healing, vasoconstriction and decreased tissue perfusion due to catecholamine release, increased platelet adhesiveness and blood viscosity leading to the augmented risk of microvascular occlusion, increased levels of fibrinogen, carboxyhaemoglobin, and compromised polymorphonuclear leukocyte function.^[7,8]

Tobacco negatively affects the outcome of almost all routine therapeutic procedures performed in the oral cavity, starting from simple nonsurgical periodontal therapy to orthognathic surgeries. Smokers respond less favourably than non-smokers to surgical periodontal therapy.^[9] Fibrinolytic activity caused by smoking reduces alveolar blood supply after dental extractions and dry socket is common among smokers.^[10] Bone formation following distraction osteogenesis may be compromised by high doses of nicotine exposure.^[11]

SMOKING AND IMPLANTS

For an implant to succeed, there has to be an amalgamation of numerous factors, right from a good surgery to a good prosthesis and its proper maintenance. Clinical trials document a consistently high success rate for endosseous dental implants in partially and completely edentulous patients. Failures occur at a low rate, but tend to cluster in those with risk factors. Risk factor is anything that increases chances or possibility of failure.

Reported predictors for implant success and failure are generally divided into patient-related factors (e.g. general patient health status, smoking habits, quantity and quality of bone, oral hygiene maintenance), implant characteristics (e.g. dimensions, coating, and loading), implant location, and clinician experience.^[12] In general, factors related to the patient appear to be more critical than those related to the implant in determining the likelihood of implant failure.^[13]

Clinical trials of endosseous implants consistently rate smoking as a primary patient-centered risk factor for implant loss. Various studies report a failure rate of implants in smokers compared to nonsmokers, ranging from 6.5% to 20%.^[14-19] The negative impact of tobacco smoking in implant outcome may be related to multiple factors and their mechanism may be mediated through both local and systemic biologic routes.^[20]

Effects of smoking on implant survival and success are more pronounced in areas of poor quality trabecular bone.^[21] In smokers, maxillary implants have more failure rate as compared to mandibular implants.^[15,17,22] Probably, maxillary bone is of lower quality and consequently more susceptible to the damaging effects of smoking.^[23] Vasoconstriction caused by the local absorption of nicotine into the bloodstream is shown to be a significant factor for implant failure by some studies. This can explain lower failure rates in the posterior mandible among smokers, since this area is covered by the tongue and hence protected against local influence of tobacco smoke.^[5]

Some studies have revealed that increased tobacco use is associated with increased implant failures.^[17] Fartash^[24] published a prospective study on mandibular implant overdenture, citing higher implant failure in heavy smokers (30–40 cigarettes per day) with type IV bone. In addition, Lindquist^[25] reported significantly greater marginal bone loss around implants in heavy smokers (>14 cigarettes per day) than in those with low cigarette consumption (<14 cigarettes per day).

Smoking does not affect the process of osseointegration; rather, its negative effects seem to arise after the second-stage surgery. Gorman *et al.*,^[16] in a study on patients who had received over 2000 implants, found significantly more failures in smokers after second-stage surgery. In a study, Lambert *et al.*^[23] noticed a trend of greater failures in smokers between the time after uncovering and before insertion of the prosthesis. The author theorized that the effect of tobacco on healing after implant placement was different from that after tooth extraction, because implant wounds were closed and the intimate adaptation of the implant to the bone tissue did not allow the same magnitude of interference in healing by the vasoconstrictive action of nicotine. But once the implants were uncovered, the soft tissues around them were adversely affected by tobacco in a manner similar to that by which periodontal tissues were harmfully affected. These results suggested that increased implant failure in smokers is not the result of poor healing or osseointegration, but because of exposure of peri-implant tissues to tobacco smoke.

Queiroz *et al.*^[26] collected salivary samples of 41 subjects and determined the levels of salivary arginase activity by the measurement of L-ornithine and expressed as mIU/mg of protein. They found increased salivary arginase activity in smokers with dental implants in contrast to non-smokers with dental implants. They suggested that an increased arginase activity may lead to less nitric oxide production which consequently increases the susceptibility to bacterial infection and implant failure in smokers.

Smoking also has a strong influence on the complication rates of implants. It causes significantly more marginal bone loss after implant placement, increases the incidence of peri-implantitis^[22,27] (deep mucosal pockets around dental implants, inflammation of the peri-implant mucosa, and increased resorption of peri-implant bone), and affects the success rates of bone grafts. The failure rate of implants placed in grafted maxillary sinuses of smokers is again two times more compared to that in nonsmokers. Kan *et al.*^[28] in their study found that cigarette smoking was detrimental to the success of osseointegrated implants in grafted maxillary sinuses, regardless of the amount of cigarette consumption.

Marginal bone loss around implant in the smokers is more pronounced in the maxilla.^[29] In a study by Levin *et al.*,^[30] present smokers demonstrated higher marginal bone loss during all time intervals than ex-smokers and both demonstrated higher marginal bone loss than nonsmokers. Lindquist *et al.*^[31] found greater marginal bone loss in smokers, but it did not lead to any implant loss over the

10-year period. Patients with the combination of smoking and poor oral hygiene had about three times greater bone loss after 10 years than nonsmokers. The higher marginal bone loss could be partially explained by the findings of Oates *et al.*^[32] They demonstrated elevated pyridinoline levels in the crevicular fluid associated with endosseous dental implants of smokers and suggested that smoking may affect implant success to a certain extent through alterations in the levels of bone resorption.

To increase implant survival in smokers, various protocols have been recommended. Bain and Moy^[33] suggested that the patient should cease smoking at least 1 week prior to surgery to allow reversal of the increased levels of platelet adhesion and blood viscosity, as well as the short-term effects associated with nicotine. The patient should continue to avoid tobacco for at least 2 months after implant placement, by which time bone healing would have progressed to the osteoblastic phase and early osseointegration would have been established. Lambert *et al.*^[23] suggested that detrimental effects may be reduced by cessation of smoking, using pre-operative antibiotics and hydroxyapatite-coated implants.

The key findings of this review can be summarized as follows:

- Smoking has adverse effects on general as well as oral health of an individual and it negatively affects the outcome of almost all therapeutic procedures performed in the oral cavity, including implant placement.
- Failure rate of implants is more in smokers compared to nonsmokers and is directly proportional to tobacco use.
- In smokers, implant failure is more in maxilla as compared to mandible and significant numbers of implants fail after second-stage surgery.
- In smokers, marginal bone loss and incidence of peri-implantitis is more after implant placement.
- Implants placed in grafted maxillary sinuses of smokers fail two times more compared to that in nonsmokers.
- To increase implant survival in smokers, it is advised to stop the habit 1 week prior to and up to 2 months after implant placement.

CONCLUSION

Though smoking is a risk factor for implant failure, it is not considered an absolute contraindication. When implant treatment is planned, smoking history should first be obtained and should include the duration, the intensity (past and present), and the present status of smoking. Smokers undergoing both implant-related surgical

procedures and dental implantation should be encouraged by their dentists to cease smoking, emphasizing that smoking can increase complications and reduce the success rate of these procedures. Clinician has to decide whether or not to commence implant treatment in high-risk situations, but once it is decided to go ahead, the patient's informed consent is essential before starting treatment.

REFERENCES

- Ezzati M, Lopez AD. Estimates of global mortality attributable to smoking in 2000. *Lancet* 2003;13:847-52.
- Reddy KS, Gupta PC, editors. Report on Tobacco Control in India. Vol 9. New Delhi: Shree Om Enterprises Pvt. Ltd; 2004. p. 26.
- Benegal V, Isaac M, Murthy P, Rekha D, Joseph J, Sahoo S, *et al*, editors. Manual for Tobacco Cessation. New Delhi: Ministry of Health and Family Welfare, Government of India; 2005. p. 7.
- Gupta PC, Subramoney S. Smokeless tobacco use and risk of stillbirth: A cohort study in Mumbai, India. *Epidemiology* 2006;17:47-51.
- Travis J, Pike R, Imamura T, Potempa J. The role of proteolytic enzymes in the development of pulmonary emphysema and periodontal disease. *Am J Respir Crit Care Med* 1994;150: S143-6.
- Synder HB, Caughman G, Lewis J, Billman MA, Schuster G. Nicotine modulation of in vitro human gingival fibroblast beta1 integrin expression. *J Periodontol* 2002;73:505-10.
- Baig MR, Rajan M. Effects of smoking on the outcome of implant treatment: A literature review. *Indian J Dent Res* 2007;18:190-5.
- Al-Belasy FA. The relationship of "shisha" (water pipe) smoking to postextraction dry socket. *J Oral Maxillofac Surg* 2004; 62:10-4.
- Bostrom L, Linder LE, Bergstrom J. Influence of smoking on the outcome of periodontal surgery. A 5-year follow-up. *J Clin Periodontol* 1998;25:194-201.
- Meechan JG, Macgregor ID, Rogers SN, Hobson RS, Bate JP, Dennison M. The effect of smoking on immediate post-extraction socket filling with blood and on the incidence of painful socket. *Br J Oral Maxillofac Surg* 1988;26:402-9.
- Ma L, Zheng LW, Cheung LK. Inhibitory effect of nicotine on bone regeneration in mandibular distraction osteogenesis. *Front Biosci* 2007;12:3256-62.
- Porter JA, von Fraunhofer JA. Success or failure of dental implants? A literature review with treatment considerations. *Gen Dent* 2005;53:423-32.
- Chuang SK, Cai T, Douglass CW, Wei LJ, Dodson TB. Frailty approach for the analysis of clustered failure time observations in dental research. *J Dent Res* 2005;84:54-8.
- Sanchez-Perez A, Moya-Villaescusa MJ, Caffesse RG. Tobacco as a risk factor for survival of dental implants. *J Periodontol* 2007;78:351-9.
- De Bruyn H, Collaert B. The effect of smoking on early implant failure. *Clin Oral Implants Res* 1994;5:260-4.
- Gorman LM, Lambert PM, Morris HF, Ochi S, Winkler S. The effect of smoking on implant failure at second- stage surgery. DICRG Interim Report No 5. Dental Implant Clinical Research Group. *Implant Dent* 1994;3:165-8.
- Bain CA, Moy PK. The association between the failure of dental implants and cigarette smoking. *Int J Oral Maxillofac Implants* 1993;8:609-15.
- Wallace RH. The relationship between cigarette smoking and dental implant failure. *Eur J Prosthodont Restor Dent* 2000;8:103-6.
- Moy PK, Medina D, Shetty V, Aghaloo TL. Dental implant failure rates and associated risk factors. *Int J Oral Maxillofac Implants* 2005;20:569-70.
- Levin L, Schwartz-Arad D. The effect of cigarette smoking on dental implants and related surgery. *Implant Dent* 2005;14: 357-61.
- Klokkevold PR, Han TJ. How do smoking, diabetes, and periodontitis affect outcomes of implant treatment? *Int J Oral Maxillofac Implants* 2007;22(Suppl):173-202.
- Haas R, Haimbock W, Mailath G, Watzek G. The relationship of smoking on peri-implant tissue: A retrospective study. *J Prosthet Dent* 1996;76:592-6.
- Lambert PM, Morris HF, Ochi S. The influence of smoking on 3-year clinical success of osseointegrated dental implants. *Ann Periodontol* 2000;5:79-89.
- Fartash B, Tangerud T, Silness J, Arvidson K. Rehabilitation of mandibular edentulism by single crystal sapphire implants and overdentures. 3-12 year results in 86 patients. A dual center international study. *Clin Oral Implants Res* 1996;7:220-9.
- Lindquist LW, Carlsson GE, Jemt T. A prospective 15-year follow-up study of mandibular fixed prostheses supported by osseointegrated implants. *Clin Oral Implants Res* 1996;7:329-36.
- Queiroz DA, Cortelli JR, Holzhausen M, Rodrigues E, Aquino DR, Saad WA. Smoking increases salivary arginase activity in patients with dental implants. *Clin Oral Investig* 2009;13:263-7.
- Schwartz-Arad D, Samet N, Samet N, Mamlider A. Smoking and complications of endosseous dental implants. *J Periodontol* 2002;73:153-7.
- Kan JY, Rungcharassaeng K, Lozada JL, Goodacre CJ. Effects of smoking on implant success in grafted maxillary sinuses. *J Prosthet Dent* 1999;82:307-11.
- Nitzan D, Mamlider A, Levin L, Schwartz-Arad D. Impact of smoking on marginal bone loss. *Int J Oral Maxillofac Implants* 2005;20:605-9.
- Levin L, Hertzberg R, Har-Nes S, Schwartz-Arad D. Long-term marginal bone loss around single dental implants affected by current and past smoking habits. *Implant Dent* 2008;17:422-9.
- Lindquist LW, Carlsson GE, Jemt T. Association between marginal bone loss around osseointegrated mandibular implants and smoking habits: A 10-year follow-up study. *J Dent Res* 1997;76:1667-74.
- Oates TW, Caraway D, Jones J. Relation between smoking and biomarkers of bone resorption associated with dental endosseous implants. *Implant Dent* 2004;13:352-7.
- Bain CA. Smoking and implant failure- Benefits of a smoking cessation protocol. *Int J Oral Maxillofac Implants* 1996;11: 756-9.

How to cite this article: Kasat V, Ladda R. Smoking and dental implants. *J Int Soc Prevent Communit Dent* 2012;2:38-41.

Source of Support: Nil, **Conflict of Interest:** None declared.