The Effect Of Cigarette Smoking Habits On The Outcome Of Dental Implant Treatment

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Abstract

The objective of this research was to investigate the impact of smoking behaviors and other potentially relevant factors on the success of dental implants. The study encompassed patients who underwent dental implant procedures .

The study involved analyzing the relationship between characteristics of the implants and patients' smoking habits, as reported in questionnaires completed during routine medical check-ups. In addition to conventional statistical analyses, multiple linear regression models were used to assess the relative influence of various factors on the rate of implant survival.

The overall long-term outcomes of the implant treatments were positive, with 7,680 implants studied. Of these, 7,359 (95.8%) were successful, while 321 (4.2%) were not. Regarding smoking behaviors, the study found that in univariate analysis, factors such as patients' smoking status (smoker/non-smoker), the quantity of smoking, exposure to passive smoking, and the duration since ex-smokers had quit smoking until the time of implantation were associated with implant survival. In the multivariable analysis, smoking status (smoker/non-smoker) and the amount of smoking, measured in pack years, were identified as factors influencing implant survival.

Keywords: Dental implant failure, Dental implant success, Tobacco use.

Introduction

The effectiveness and reliability of dental implants are widely acknowledged, with many implant systems showing survival rates of around 90% (Buser et al., 1997; Adell et al., 1990; Naert et al., 2002; Vehemente et al., 2002; Jemt, Lekholm & Adell, 1989; Lindh et al., 1998; Brocard et al., 2000; Weibrich et al., 2001; Lekholm et al., 1999).

Although implant survival rates are generally high, success rates can vary based on factors like implant mobility, bone loss, aesthetic outcomes, and other criteria. Despite these high rates, there's a growing concern about risk factors that may lead to complications and implant failure, such as occlusal overload, lower bone quality, and systemic diseases.Smoking is a well-known risk factor for periodontal health issues and implant support. Studies in the United States have linked smoking to reduced leukocyte activity, impaired wound healing, lower infection resistance, and decreased calcium absorption. Several reports in the literature have also indicated lower implant survival rates among smokers (Bain & Moy, 1993; Lambert, Morris & Ochi, 2000; De Bruyn & Collaert, 1994). Smoking can affect osseointegration by reducing blood flow, delaying wound healing, inhibiting cell proliferation, and directly impacting osteoblast function. A systematic review by Strietzel et al. (2007) found a significant association between smoking and peri-implant inflammation and bone absorption.

Patients are typically advised to quit smoking before implant surgery to improve blood viscosity and platelet adhesion, and to abstain from smoking for several weeks after surgery to support osteoblast healing (Bain & Moy, 1993).

This study aims to assess how smoking behaviors and the amount of smoking influence dental implant survival.

The hypothesis being tested is that there is no correlation between the amount of smoking and implant survival.

Materials and Methods

This retrospective study analyzed a consecutive cohort of patients who received dental implants at a major dental clinic and underwent periodic medical examinations. There were no exclusion criteria, and two specialized surgeons performed all implant placements. Patients were regularly monitored in the prosthodontics department, where implant status was categorized

as either survival or failure based on clinical criteria. Data on smoking habits was collected from self-administered questionnaires during the periodic medical examinations, which are mandatory for military personnel starting from age thirty.

The study included patients who had their implants placed within a year of their visit to the medical examination center. Implant characteristics such as location, timing of implantation, bone augmentation, and smoking habits like smoking status, duration, pack years, exposure to passive smoke, were recorded.

The study was approved by the Ethics Committee

Statistical analysis involved testing the distribution of variables and assessing the relationship between variables and implant failures using Chi-Square and Fisher's exact tests for categorical variables and t-tests for age differences. Logistic regression models were used to analyze the correlation between smoking and implant failure, adjusting for gender, age, implant characteristics, and smoking variables. Statistical significance was set at $p \leq 0.05$, and analysis was conducted using SAS and SPSS version 17 software.

Results

The study encompassed 9,706 dental implants conducted, with smoking information available for 7,680 implants.

Implant Characteristics: Of the 7,680 implants, 7,359 (95.8%) were successful, with 321 (4.2%) failures. Most implants were in men (87.6%), with ages ranging from 22 to 55 years and an average age of 41.48 years.

Smoking and Implant Survival: The failure rate was higher among smokers (5.6%) compared to non-smokers (3.5%), showing a significant difference ($p < 0.001$). There was a trend towards higher failure rates with increased daily cigarette consumption, notably among those smoking more than 30 cigarettes daily ($p = 0.059$). Additionally, there was a significant correlation between implant failure and variables such as smoking duration, exposure to passive smoking in non-smokers, smoking status, and pack years.

Uni- and Multivariable Analysis: In the multivariable analysis, present smoking significantly increased the risk of implant failure even after adjusting for other factors ($p = 0.001$, OR = 1.512). Similarly, smoking over five pack years significantly increased the

risk of failure compared to non-smokers, with higher pack years associated with greater risk, as shown in both univariable and multivariable analyses.

Table 1: Implant Properties

Implant Characteristics	**Total N (%)**	**Failed implants N (%)**	**p Value**
Immediate loading			
NO	7,628 (99.3)	316 (4.1)	0.065
YES	52 (0.7)	5 (9.6)	
Bone augmentation			0.828
NO	7,106 (92.5)	296 (4.2)	
YES	574 (7.5)	25 (4.4)	
Membrane use			0.857
NO	7,481 (97.4)	314 (4.2)	
YES	199 (2.6)	7 (3.5)	
Implanted jaw			0.007
MAXILA	3,160 (41.1)	95 (3)	
MANDIBLE	3,761 (49)	174 (4.6)	
MISSING INFORMATION	759 (9.9)		
Implanted region			0.0001
MAX-front	834 (10.9)	33 (4.0)	
MAX-premolar	1,788 (23.3)	50 (2.8)	

Implant Characteristics	Total N (%)	Failed implants N (%)	p Value
MAX-molar	538 (7.0)	12 (2.2)	
MAN-front	400 (5.2)	46 (11.5)	
MAN-premolar	969 (12.6)	43 (4.4)	
MAN-molar	2,392 (31.1)	85 (3.6)	
MISSING INFORMATION	759 (9.9)		

Table 2: Relationship between Smoking Habits and Survivability of Dental Implants

Smoking Habit	Failed implants N (%)	Surviving implants N (%)	p Value
Smokers	135 (5.6)	2,271 (94.4)	0.001
Non-smokers	185 (3.5)	5,074 (96.5)	
Number of cigarettes per day			0.059
1–10	32 (4.3)	720 (95.7)	
11–20	50 (5.3)	891 (94.7)	
21–30	34 (6.9)	462 (93.1)	
31–40	18 (9.2)	177 (90.8)	
Smoking years			0.001
Non-smokers	185 (3.5)	5,074 (96.5)	
Up to 10 years	14 (3.5)	384 (96.5)	
More than 10 years	121 (6)	1,887 (94)	

Smoking Habit	Failed implants N (%)	Surviving implants N (%)	p Value
Ex-smokers—no. of cigarettes per day			0.007
1–30	40 (2.8)	1,382 (97.2)	
More than 30	20 (6.0)	311 (94.0)	
Ex-smokers—no. of years without smoking until implantation			0.001
2–15	31 (2.3)	1,316 (97.7)	
Exposure to passive smoking (the smoke of others) in closed places			0.001
Yes	39 (5)	741 (95.0)	
No	21 (2.1)	994 (97.9)	
Smoking status			0.001
Non-smokers	125 (3.6)	3,334 (96.4)	
Past smokers	60 (3.3)	1,740 (96.7)	
Present smokers	135 (5.6)	2,271 (94.4)	
Pack years			0.001
Non-smokers	186 (3.5)	5,088 (96.5)	
$x \leq 1$	15 (3.6)	399 (96.4)	
$1 < x \leq 5$	27 (4.3)	602 (95.7)	
$5 < x \leq 10$	41 (5.7)	676 (94.3)	
$x > 10$	52 (8.0)	594 (92.0)	

Discussion

The study, conducted by Goodacre et al. (2003), dives into the intricate evaluation of various factors influencing dental implant outcomes, highlighting the multifaceted nature of implant success. Factors such as bone quality, implant location, prosthesis type, and systemic conditions like smoking and osteoporosis all play a crucial role in determining implant survival. The study's primary aim, as outlined by Bain and Moy (1993), was to assess the correlation between smoking habits and implant survival rates, considering smoking status, amount of smoking, passive smoking, and the duration since cessation of smoking among ex-smokers.

In the uni-variable analysis, as identified by Lambert, Morris & Ochi (2000), smoking status (smoking/no smoking), amount of smoking, passive smoking, and time since quitting smoking emerged as factors associated with implant survival. In the multi-variable analysis, as indicated by De Bruyn & Collaert (1994), smoking status and amount of smoking measured in pack years were significant factors related to implant survival. Other factors such as immediate implantation, as discussed by Klokkevold & Han (2007), type of prosthesis (fixed/removable), and location of the implant also showed associations with implant survival in the uni-variable analysis.

The study's findings regarding the type of prosthesis (fixed/removable), as mentioned by Jemt et al. (1996), align with existing literature suggesting higher implant failure rates in removable prostheses compared to fixed ones. The research noted a higher percentage of failures in the anterior mandible, possibly due to a combination of bone type and time of failure, with early failures linked to D1 bone type as discussed by Truhlar et al. (1994).

Regarding smoking and implant survival rates, the study's results corroborate previous reports, such as those by Klokkevold & Han (2007), indicating higher failure rates among smokers compared to non-smokers. The study also identified a dose-related relationship between the amount of smoking and implant survival rate, as also discussed by Bain (2003), highlighting increased risks associated with higher cigarette consumption and longer smoking durations.

Notably, the study explored the impact of passive smoking on implant survival rates, finding a significant correlation between exposure to passive smoking and increased risk of implant failure,

in line with studies by Venn & Britton (2007) and Barnoya & Glantz (2005) on passive smoking and cardiovascular disease.

Furthermore, the study discussed the timing of smoking cessation before implantation and its influence on implant survival rates, in line with Bain's protocol (1996) for cessation of smoking before implant procedures.

Despite its valuable insights, the study acknowledges several limitations, including its retrospective cohort design, potential biases in the study population, reliance on self-reported data, and challenges in adjusting for confounding variables, as discussed by Hinode et al. (2006). Future research with a more robust methodology, as suggested by Bain (2003), could provide further clarity on the complex interplay between smoking habits, passive smoking, and implant survival rates.

Conclusion

This study aimed to assess the impact of smoking habits on the survival of dental implants.

1. The key findings of this study indicate that smoking status (whether a person smokes or not), exposure to passive smoking, and the number of pack years (a measure of smoking intensity) are crucial factors affecting implant survival, even after accounting for other variables.

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