DOI: 10.1515/cipms-2017-0008

Curr. Issues Pharm. Med. Sci., Vol. 30, No. 1, Pages36-38

DE GRUYTER OPEN

Current Issues in Pharmacy and Medical Sciences

Formerly ANNALES UNIVERSITATIS MARIAE CURIE-SKLODOWSKA, SECTIO DDD, PHARMACIA

journal homepage: http://www.curipms.umlub.pl/

Marginal bone behavior around the dental implants with regard to the patient's characteristics

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ARTICLE INFO

Received 28 March 2017
Accepted 07 April 2017

Keywords:
dental implants,
marginal bone loss,
gender,
age,
smoking.

ABSTRACT

We analyzed the relationship between marginal bone loss around dental implants and selected personal characteristics of patients (gender, age and cigarette smoking) undergoing dental rehabilitation because of missing teeth. The study comprised 28 patients aged 37-66 years (11 men and 17 women) who had 240 implants inserted. The assessment of marginal bone loss in the examined patient cohort was made based on ortho-pantomographic X-ray images. For evaluation of the condition of the marginal bone around the implants during 46-month follow-up, with relation to the sociodemographic features of the patient, multi-generational linear models were used. Studies show that the loss of marginal bone around the implant increased with the age of the patient, but did not correlate significantly with the patient's gender or smoking habit.

INTRODUCTION

Identification of factors that can affect the results of dental implant treatment is relevant in achieving therapeutic success. Such success comes about when the entire complex created by the implant, the dental restoration and the surrounding hard (bone) tissue and soft tissue (mucous membrane and gums) [13], is functioning properly.

AIM

The aim of the study was to assess the relationship between the marginal bone loss around dental implants and selected personal characteristics of individuals treated because of their missing teeth.

MATERIAL AND METHODS

In total, 240 implants were implanted in 28 patients aged 37-66 (mean age 55.8 years), including 11 men and 17 women, with at least one of two implant types implanted: implant with conical abutment Morse connection (DENTSPLY Friadent ANKYLOS®) and implant with internal hexagonal connection (MIS Seven®, Alpha-Bio SPI and DFI®, Adin Tuareg RP®, AB I2®, DentsPLY Friadent Xive®). Surgical procedure of implanting dental implants was performed using the flap approach. Closed healing of implants was used, and stitches were removed after about 2 weeks after implantation. Both temporary and permanent dental restorations were used for dental implant treatment. The dental implant loading (functional) was implemented after 5.0-26.5 months. The shortest time of observation was 4.9 months, the longest 46 months.

In the course of the test subjects' dental implant treatment, in the case of two implants, there was no osseointegration and they were removed upon identification [18]. These two cases were not included in the statistical rankings. Among the total patients treated, 26 patients eventually saw both types of implants implanted.

The assessment of marginal bone loss in the examined patient cohort was made based on ortho-pantomographic radiographs. Measurements were made before loading and after implant loading with dental restorations. Three states were included in the assessment of marginal bone state: no change in marginal bone (value 0 in mm), marginal bone loss (positive value expressed in mm), marginal bone growth (negative value expressed in mm).

For evaluation of the condition of the marginal bone around the implant during a 46-month follow-up, depending on the sociodemographic features of the patient, multi-generational linear models were used. The model employed allows for the consideration of repeated measurements of the same implant, and the presence of multiple implants in the patient. Parameters of these models were estimated using Generalized Estimating Equation (GEE). The relationship

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between marginal bone loss and several independent variables is shown in Table 1. The variables included gender of the patient (reference category was male), age of patient (1 year of increase), smoking habit (reference category were non-smokers).

Table 1. Relationship between marginal bone loss around implants and selected personal characteristics in the 46-month follow-up: baseline model

Independent variable	B	95% Confidence interval		Value p
		Lower limit	Upper limit	
Gender – female/**male**	-0.176	-0.542	0.189	0.345
Age – increase by one year	0.047	0.026	0.069	0.0001
Smoking – yes/**no**	0.228	-0.158	0.614	0.248

B – regression model coefficient (marginal bone loss in mm) – **independent variable reference categories are indicated in bold type**

In the stepwise elimination procedure of insignificant statistically independent variables from the initial model (described in Table 1), Wald's statistics was used as the criterion. Accordingly, gender and smoking were eliminated. The final model, containing only the variable with which the loss of marginal bone around implants was statistically significant, is shown in Table 2.

Table 2. Relationship between marginal bone loss around implants and selected personal characteristics in the 46-month follow-up: the final model

Independent variable	B	95% confidence interval		Value p
		Lower limit	Upper limit	
Age – increase by one year	0.044	0.022	0.065	0.0001

B – regression model coefficient (marginal bone loss in mm) – **independent variable reference categories are indicated in bold type**

Marginal bone loss around implants was significantly statistically related with patient's age. In the regression model, an increase in the patient's age by 1 year corresponded to a marginal bone loss of 0.044 mm ($p = 0.0001$).

DISCUSSION

Gender

No statistically significant correlation was found in our research between marginal bone loss rates around implants and patient's gender. There was also no correlation between gender and marginal bone loss around implants in the multicentre 3-year follow-up of more than 1500 conical connective implants (DENTSPLY Friadent ANKYLOS®) implanted and loaded with dental prosthetic restorations performed by Chou *et al.* [3]. Similarly, Rasouli Ghahroudi *et al.* [14], after examining 31 patients with 170 Nobel Biocare Replace Select Tapered® implants with a hexagonal connector after a year of functional load, found no bone loss around implants that can be associated with the patients' gender. Furthermore, Maló *et al.* [10] found no relationship between the loss of marginal bone around the implant and gender, based on the study of 995 Nobel Biocare implants implanted and loaded immediately with dental restorations in edentulous maxillas in 221 patients. Despite this, they put forward that a lower risk of biological and mechanical complications was significantly associated with male gender (OR = 0.56, $p = 0.007$).

Age

Our study evaluated the relationship between marginal bone loss around implants and the patient's age, during the 46-month follow-up. This showed that with an age increase by one year, the size of the marginal bone loss around the implant increased by about 0.044 mm. In earlier studies, other authors did not see a relationship between the effectiveness of implant-protective rehabilitation and the age of the patient. Chou *et al.* [3], for example, found no relationship between marginal bone loss around implants and age. Similarly, Norton [12], in evaluating 54 patients for 37 months, for 173 implants implanted with dental prosthetic solutions in the form of single crowns implanted in the posterior jaws, did not see a relationship between the marginal bone loss around the implants and the age of the patient. Bryant and Zarb [2] also did not discern significant differences in bone loss around Brånemark implants in two different age groups: 32 patients aged 60-74 with 166 implants and 34 patients aged 29-49 with implanted 162 implants whether during loading or after loading with prosthetic restoration. It should be noted that the only significant difference was found after 4 years from the loading with fixed dental restorations in the jaw ($p < 0.05$). Moreover, this was between the older group (mean bone loss – 0.005 mm per year) and the younger group (mean bone loss – 0.05 mm per year). It should be emphasized, however, that these studies were not multifactorial.

Smoking

In our studies, the marginal bone loss around the implants was not related to tobacco smoking. Publications on the assessment of the effects of smoking on the condition of marginal bone around the implant, with epidemiological and statistical standards, do not, however, provide fully unambiguous results. Still, many authors have not confirmed an association of marginal bone loss around implants with tobacco smoking [3,6,12]. Yet, others do. A review of available literature shows that many authors indicate a relationship between marginal bone loss around implants and smoking, and the intensity of smoking has a significant effect on the amount of bone loss [1]. Tandlich *et al.* [21], for example, reported a significant increase in bone loss around implants ($p < 0.05$), in smokers, based on assessments that, on average, were at follow-up intervals of 5.3 years (from 30 months to 9 years), in a test population of 46 patients with 181 implants. In an earlier work of the same researcher [20], in tobacco smokers, bone loss was ascertained to be 0.065 mm per month, while in non-smokers, the corresponding figure was 0.050 mm per month. The calculated odds ratio of smokers was, therefore, OR 1.95 at $p = 0.04$. In line with this research result, statistically significantly higher ($p < 0.001$) annual bone loss among smokers, compared to non-smokers, was observed by Nitzan *et al.* [11], as well as by Vandeweghe and Bruyn [22]. In documenting the behavior of the marginal bone around the implant in 21 smokers with 60 implants, the last found statistically significant ($p = 0.001$) greater bone loss (average bone loss 1.56 mm) when compared with that of 148 non-smokers with 303 implants (average bone loss 1.32 mm). They, therefore, expressed the

opinion that while smokers do not have a greater tendency to lose implants, bone loss is more pronounced in them, especially in the jaw.

While carrying out research on the marginal bone loss around implants, some researchers point to the significant effect of smoking on the implants' survival or complications in dental implant rehabilitation [10,15,17], while others do not confirm this [8,9,21].

Current studies on the effects of smoking on the implantation process and the whole course of implant-prosthetic treatment, draw attention to the individual sensitivity to nicotine and its metabolites. This sensitivity influences the rate of nicotine metabolism, and is genetically determined due to differences in amyloxygenase activity [4,5,7,16]. This means that not every organism is equally susceptible to the negative effects of nicotine and its metabolites, and, hence, it may not always be the case in the studies that there is an unequivocal relationship between smoking and the results of implant-prosthetic treatment. It should be noted that the negative effect of smoking is eliminated when patients stop smoking – even shortly before surgical implant surgery [1]. Hence, it is important to inform patients about the need to stop smoking prior to surgery [19].

CONCLUSIONS

During a 46-month follow-up of patients, each of whom had at least one of the different implants due to connective structure, it was found that the loss of marginal bone around the implant increased with the patient's age, but had no significant association with the patient's gender or smoking habits.

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