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Research Article

Factors Influencing Marginal Bone Loss Around the Dental Implant: A Focus on GBR, Patient Related Factors and Implant Related Factors

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Abstract

Purpose of this study was to investigate the marginal bone loss around the implant conducted by the periodontal department of Kyungpook National University Dental Hospital, and to analyze the effect of the patient related factors, implant related factors and practice of Guided bone regeneration. To determine the amount of marginal bone loss around the dental implant, panoramic radiograph at the three stages were compared: Immediately after secondary implant surgery, 1year and 2year after the application of prosthesis. Among the patient-related factors, male suffered greater marginal bone loss around the implant than female after 2 years of follow up period. GBR performed showed greater marginal resorption after 2 years of follow up. Also external type of implant showed less marginal resorption than internal type of implant.

Keywords: Dental Implants; GBR; Marginal Bone Resorption; Patient Factor

Introduction

Dental Implant is currently one of the treatment options to restore the missing tooth. Prior to the introduction of dental implants procedure, fixed dental restoration or dentures were the only treatment options. However, these treatments require deleting healthy adjacent teeth, which increases the risk of periodontal and pulpal disease [1]. Moreover, bone resorption, which progresses in the edentulous area, cannot be prevented with conventional prosthetic techniques; also, oral hygiene management is difficult in the pontic area. Another conventional treatment option, oral rehabilitation using dentures, significantly decreases masticatory efficiency compared to the natural dentition, and consequently, patient's satisfaction declines significantly due to psychological dissatisfaction [2]. Since the concept of osseointegration introduced by Brännmark in 1969, technology related to implant, including surface characteristic and optimum shape of implant, has been refined over the past 50 years. Currently, the success rate of implants has been improved significantly and is one of the first treatment option to be considered to restore the edentulous area. Compared to the treatment with fixed prosthetics or the denture, the advantages of treatment using implants are distinctive; however unresolved complications still exist [3].

Marginal bone resorption around the dental implant is one of the key factors to consider during the dental implant placement procedure. According to P. Astrand (1996), 1 mm of physiological bone loss can be observed in the first year after the function of the dental implant, and an annual 0.1 mm of bone loss is considered as stable implant [4]. Accelerated marginal bone resorption may depict the failing osseointegration, and can be the sign of poor prognosis of the treatment. There are three main causes of marginal bone loss around the dental implant: genetic programming, hormonal activity, and applied load [5] However, according to H.E. Lura, mechanical force within the limits of tolerance actually stimulate the bone apposition by constantly reshaping by its role [6].

Furthermore, adequate amount of alveolar bone support is essential prior to dental implant procedure. According to Bränemark, a sufficient amount of alveolar bone is one of the key factors that determine the long-term prognosis of the implant [3]. For the success of the implant, at least 1 mm or more alveolar bone is required from the implant surface. However, insufficient alveolar bone height is the clinical obstacle that clinician often encounter, and the alveolar bone defect may occur due to the various reasons: trauma, periodontal destruction, and endodontic lesion [7]. If the alveolar bone is insufficient vertically or horizontally, the implant fixture cannot be completely embedded in the alveolar bone and can be served as the source of infection around the dental implant.

To place the dental implant on the defective alveolar bone, proper regenerative procedure is essential. Among the numerous bone augmentation techniques, guided bone regeneration (GBR) is a widely used method and it usually used to overcome the horizontal bone defects. Nyman introduced the concept of guided tissue regeneration which allow osseous regeneration by isolating soft tissue migration [8]. These regenerative concepts developed from bone graft to GBR that uses an absorbable or non-absorbable membrane, which protects the graft material from contamination, and excludes the proliferation of soft tissue cells, and serves as a scaffold for bone apposition in the defective part [9].

Dental implant surface related factors, patient-related factors, and clinician-related factors work in combination as factors that affect implant prognosis. Implant-related elements include the length, diameter, placement position, and surface treatment method of the implant [10]. Patient-related factors include gender [11], smoking status [12], systemic disease, history of periodontal disease, and oral hygiene status. Clinician-related factors include surgical methods and experience of clinician. In order to determine the long-term success and prognosis of the implant, it is necessary to analyze the marginal bone loss around the implant. Therefore, the measurement of the marginal bone height has an important meaning as a method of evaluating the success of the implant [13,14].

The purpose of this study was to investigate the marginal bone loss around the implant conducted by the periodontal department of Kyungpook National University Dental Hospital, and to analyze the effect of the patient's gender, patient's cooperation, type of implant, surface modification of implant, and practice of Guided bone regeneration.

Materials and Methods

From 2008 to 2013, a retrospective analysis study was conducted using medical records for patients who visited the periodontal department of Kyungpook National University Dental Hospital and underwent implant procedures. A total of 25 patients and 28 implants were reviewed, and all of the patients were able to perform follow-up for more than 2 years from the date of implantation.

Using the patient's medical records, 1) patient's gender and age distribution 2) patient's cooperation and number of visits 3) the type of implant established and the surface treatment method 4) whether guided bone regeneration was performed.

25 patients were included in this study; 19 were male and 6 were female, ranging from 32 to 79 years old, and the average age was 52. Total of 28 dental implants surgery were included, and the patient group who underwent guided bone regeneration during the first surgery was the experimental group (n = 10), and the patient group who underwent only dental implant implantation without bone augmentation was the control group (n = 14). If the dental implant was determined that osseointegration is failed, such as uncontrolled inflammation around the implant and was removed due to the severe bone loss, the case was not included. The method of bone augmentation and the type of implant embedded were investigated, and the dental implant surgery with autologous bone transplantation and maxillary sinus graft were not included.

To determine the amount of marginal bone loss around the dental implant, panoramic radiograph at the three stages were compared; initial panoramic radiograph were taken at the second stage of dental implant surgery, panoramic radiograph was taken at the 1 year after applying prostheses, and third radiograph was taken at 2 years after prostheses. The distance was measured by setting the point of dental implant and crown contact as the reference point. The amount of bone resorption was measured at the mesial and distal aspect of implant medium, and the average value was used.

The patient's gender, patient cooperation depicted by the number of visit, characteristics of the implant surface, location, and practice of bone regeneration surgery were set as independent variables, and the amount of marginal bone absorption measured after 1 and 2 years of implant function was set as dependent variables.

The marginal bone absorption around dental implant according to each factor was statistically tested using the Mann-Whitney test, and the ANOVA test was used for the assessment of the patient's cooperation. All statistical processing used the IBM SPSS Statistics 23 for Windows (SPSS Inc., Illinois, USA) program and found that there was a significant difference below 5% significance level.

The research protocol of this study was reviewed and approved by the Research Ethics Committee of Kyungpook National University.

Results

Implant marginal bone resorption according to patient-related factors

Implant marginal bone loss according to gender occurred more significantly when observed for more than 2 years in males, and there was a statistically significant difference between the two groups. (P=0.01) There was no statistically significant difference in implant marginal bone loss according to age between patients under 60 years of age and those over 60 years of age (Table 1).

		Implant Installed	Bone Loss (1yr) (Mm)	P-Value	Bone Loss (2yr) (Mm)	P-Value
Sex	Male	19	0.321	0.85	1.199	**0.01 ***
	Female	6	0.194		0.309	
Age	< 60	18	0.237	0.08	0.991	0.17
	≥ 60	7	0.389		0.891	

Table 1: Implalnt marginal bone loss according to patient-related factors.

* Statistically significant (P<0.05).

Implant marginal bone loss according to GBR-related factor

After the observation 1 year after guided bone regeneration, the marginal bone loss was greater in the GBR group, but it was not statistically significant. When f/u was performed for more than 2 years, marginal bone loss occurred relatively large in the GBR-treated group, and the difference between the two groups was statistically significant (Table 2).

	Implant Installed	Bone Loss (1yr) (Mm)	P-Value	Bone Loss (2yr) (Mm)	P-Value
GBR	10	0.230	0.71	1.489	**0.04 ***
Without GBR	14	0.281		0.486	

Table 2: Implant marginal bone loss according to GBR-related factor.

* Statistically significant (P<0.05).

Implant marginal bone loss due to implant-related factors

Implant surfaces can be largely classified into RBM and Ti-Unite, and when after 1 year of follow up period, marginal bone loss occurred more significantly in RBM surface implants; but the difference was not statistically significant, and similar results were shown in the 2 years of observation period. External and Internal types of dental implant, dental implant marginal bone resorption occurred more significantly in the 1 year and 2 years internal type group; however, the statistically significant difference were only shown at the 2 years group (Table 3 and 4).

Implant Surface	Implant Installed	Bone Loss (1yr) (Mm)	P-Value	Bone Loss (2yr) (Mm)	P-Value
RBM	19	0.260	0.88	0.640	0.54
Ti-unite	8	0.085		0.620	
Implant type	Implant installed	bone loss (1yr) (mm)	p-value	Bone loss (2yr) (mm)	p-value
Internal type	21	0.380	0.12	0.940	**0.01 ***
External type	6	0.090		0.125	

Table 3: Implant marginal bone loss according to Implant characteristic.

* Statistically significant (P<0.05).

Frequency Of Visit (Number/ Year)	Implant Installed	Bone Loss (1yr) (Mm)	P-Value	Bone Loss (2yr) (Mm)	P-Value
Less than 3	3	0.490	0.75	1.780	**0.01 ***
3 5	15	0.304		1.002	
more than 5	7	0.286		0.993	

Table 4: Implant marginal bone loss according to accommodation of patient.

* Statistically significant (P<0.05).

Implant marginal bone loss according to patient cooperation

It was classified into three groups according to the number of visits per year of patients. Overall, as the number of patient visits increased, decreased amount of marginal bone resorption was shown, but the difference was not statistically significant.

Discussion

This study was conducted retrospectively and was a long-term follow-up of patients who visited the periodontal department of Kyungpook National University Dental Hospital from 2008 to 2013. During the observation period, the implant failed in two patients, and the case was excluded from our study.

In this study, among the factors affecting implant prognosis, practice of GBR, patient-related factors, implant-related factors, and patient cooperation were evaluated for marginal bone loss of dental implant. There were factors that showed a statistically significant relationship between the evaluation factor and the survival rate.

First of all, among the patient-related factors, male suffered greater marginal bone loss around the implant than female and there was a statistically significant difference when follow-up period exceeded two years. Greater marginal bone loss in the male group can be related with the strong occlusal force [16]. In addition, there were no smokers in the female group in present study, but about half (9 male) were found as smokers. Smokers have a lower long-term survival rate of implants than non-smokers, and the prognosis is also poor, which is considered to have affected in this study [17].

Two materials (MBCP and Bio-oss) were used in bone augmentation techniques. However, in this study, we compared the marginal bone resorption according to the presence or absence of Guided bone regeneration. There was no significant difference in the degree of bone resorption after 1 year of implant placement. However, when follow up period exceeded the 2 years, the mean marginal bone resorption showed the statistically significant difference (1.489 mm and 0.486 mm). Benic (2009) [16] reported that there was no significant difference in marginal bone loss between dental implant with or without GBR [18]. Meanwhile, Bazrafshan and Darby [19] reported that bone loss was significantly lower in the bone graft group as a result of observing bone grafts for 2 to 7 years at the same time during implant placement, contrary to the this study.

Among the implant related factors, the connection type of implant (external or internal type) showed the statistically different outcome; and external type of dental implant was shown as more reliable type than internal type of implant. The data was consistent with the systematic review of Palacios-Garzón [20] that the external implant type gave more promising result than the internal type; while difference between the two type of implant was not significant. Author also implied larger samples and longer follow-up period is needed as our experiment.

Conclusion

Based on our results, gender, type of implant and GBR procedure may affect the marginal bone resorption around the dental implant. Thus, patient-related factors should be thoroughly analyzed before implant placement, and the clinician should aware that GBR procedure possibly lead to marginal bone loss after the function of dental implant. However, other factors such as the bone quality of the implant site, the type of prosthesis above the implant and the cause of tooth loss can affect the marginal bone resorption of the implant. This study was conducted retrospectively, and the variables affecting the cumulative survival rate are diverse. On the further study, the broad experiment group would be necessary for data that are more consistent.

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