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Evaluation of proximal bone loss around 2 commercial brands of SLA-surfaced implants and investigating possible effective factors

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ABSTRACT

Introduction: The long term clinical success of dental implants depends on the stability of crestal bone level. Different dental implantation systems focus on micro-and macro-design to reduce late bone resorption. The purpose of this study was to evaluate bone loss at the proximal (mesial and distal) surfaces of SLA implants from 2 different companies.

Materials and Methods: This retrospective cross-sectional study was done on 48 patients receiving 161 SLA-surfaced (Straumann and Dentium) dental implants. The marginal bone loss was measured at mesial & distal sides of the implants on peri-apical X-ray images. The effective factors considered in this study were patients age, implant brand, time passed from fixture placement, preprosthetic surgery and type of prosthetic treatment that were obtained from patient records & interviews.

Results: Average mesial and distal bone loss was 1.50±1.359 and 1.517±1.3465 respectively. Pearson correlation coefficient indicates that 1) time passed from fixture placement, 2) commercial brand, 3) history of pre-prosthetic surgery and 4) age affected the amount of bone loss.

Conclusion: SLA-surfaced dental implants showed an acceptable amount of bone resorption and no statistically significant difference was observed between commercial brands.

Keywords: Bone loss; Dental implants; Osseointegration.

Introduction

Over the last few decades, dental implants are the first choice to restore missing teeth because they have solved many problems associated with conventional prosthodontic treatments. Therefore, it is crucial to know about their success rate in short and long term and find possible factors affecting it. It was reported that the success rate of implants over a period of 10 years is 90-95% [1]. The long-term clinical success of implant treatments depends on the level of bone, adjacent soft tissue, and the proximity contact between the epithelium and the implant surface [2]. It has been suggested that pre-implant bone stress/strain should remain at physiological level to reduce the chance of bone resorption and increase implant success [3]. Based on some literature, during the first year being in function, titanium submerged implants have 0.9 to 1.6mm bone loss from their first thread [4]; after this period, the amount of bone loss reduce to 0.05-0.13mm [5-7]. Adell et al reported an average 1.2mm marginal bone loss during the healing period and first year of loading. After that, the average bone loss was only 0.1mm annually [8].

Zarb proposed that after the first year of being in function, bone loss around implants is quite small (0.2 mm annually) [9]. Daubert et al found that after 11 years, the survival rate of implants was 91.6% [10]. On the other hand, different implant systems have been introduced in recent years and many scientific papers have been published to compare them with factors such as crestal bone loss. One of these systems is SLA implants (implants that have acid-blasted etched surfaces). According to the literature, these implants have a better survival rate than others such as machined surface or coated plasma spray implants [5,11]. In a prospective cohort study of patients with complete and partial edentulous, vanvelzen and colleagues concluded that after 10 years of loading, the mean bone loss around the straumann SLA implants was 0.52mm and the advanced bone loss occurred in less than 10% of patients [12]. It was reported that cumulative survival rate was 99.7% [12]. According to a study by Rocuzzo et al. [13] for a 10-year follow-up of 98 SLA implants, depending on the periodontal disease, marginal bone loss can range between 0.34 or 0.56mm. In general, marginal bone loss in the first year, with implant designs such as SLA is limited to generally 0.2-0.3mm. As SLA implants showed good results regard bone loss and survival rate in most studies and due to the importance of clinical and radiographic assessments of implants and accessing to a system with minimal bone loss, this study is aimed to analyze the level of bone loss in patients that had been treated by SLA-surfaced implants in Department of Oral Surgery at Tehran University of Medical Sciences.

Methods and Materials

This retrospective study was performed on patients received SLA surface implants in the Dentistry Department of Tehran University of Medical Sciences from September 2015 to September 2018 (Study Date: September 2018). Forty-eight patients with complete or partial edentulous participated in this study. Prior to performing the task, informed consent was obtained from each patient. The missing teeth were replaced with SLA-surface implants and fixed or removable prostheses. All patients completed the treatment process at least one year before the study and all were healthy for systemic disease except one patient undergoing dialysis treatment and two young patients with Papillon Lefort syndrome. A pre-and post-treatment panoramic x-ray had been taken from each patient and a new periapical x-ray was taken from each implant by prallel method. Peri-apical images were also available for some patients to find more details any time necessary during the treatment or follow-up visits, Bone loss was then measured with a straight dental gauge (Faratab, Iran) by a trained person in The Department of Oral Radiology, calculating the distance between the highest point of the implant and the deepest point of bone adjacent to that.

In cases of mild bone loss-less than 1mm–once another periapical x-ray was obtained at another time. Bone loss was measured on both the mesial and distal sides. The proximal bone loss and the factors that can affect it are listed in the table. 1,2 and 3.

Ethical considerations

All patients gave a written informed consent to contribute in this study.

Results

Forty-eight patients (F=27, m=21) received 161 implants in Department of Implantology at Tehran University of Medical Sciences. Each patient received 3.375 implants on average. Patients' average age was 49.19±13.037 (22-75) years old. 90 implants were placed in the mandible (55.55%): 38 implants in the anterior and 52 implants in the posterior sites. 72 implants (44.45%) were also placed in the maxilla: 26 implants in the anterior and 46 implants in the posterior sites.

Table 1 shows the relationship between the minimum, maximum, and average rates of mesial and distal bone loss and the age of patients over time. Table 2 lists other factors that may affect bone loss. According to statistical analysis, the rate of bone loss also increases over time. Average mesial and distal bone loss was 1.50±1.359 and 1.517±1.3465 respectively.

Four factors had a significant effect on proximal bone loss:

The time passed since implant surgery, commercial brand of implant Straumann (AG, Waldenburg, Switzerland) vs Implantium (Dentium, Suwon, Korea), history of pre-prosthetic surgery and age (Table 3).

Mesial Bone Loss:

4 factors (time passed from surgical placement of implant, commercial brand, history of pre-prosthetic surgery and age) had a significant effect on mesial bone loss (Table 3):

1. Time passed from surgery: each month was associated with average 0.046mm mesial bone loss.

2. Implant commercial brand: IMPLANTIUM showed 2.111mm mesial bone loss on average while Straumann implants had mean bone loss of 0.835mm.

3. Pre-prosthetic surgery: history of bone grafting increased mesial bone loss about 0.89mm on average.

4 Age: as the age increased, average bone loss increased by 0.015mm annually.

All data were statistically significant. Patients' systemic condition and type of prosthodontics treatment did not affect mesial bone loss significantly (P>0.05).

Distal Bone Loss

According to table 3, these factors could affect distal bone loss significantly (P<0.05):

1. Time passed from implant insertion (each month associated with average 0.046mm increase in distal bone loss).

2. Implant commercial brand: IMPLANTIUM showed mean bone loss of 2.335, while distal bone loss for Straumann was 0.835mm.

3. History of pre-prosthetic surgery: history of bone grafting increased distal bone loss about 0.665mm.

4. Age: aging can increase bone loss (0.013mm annually).

Type of prosthetic treatment and patients' systemic condition did not affect distal bone loss significantly (P>0.05).

Mesial and distal bone loss correlation:

Pearson correlation co-efficient showed that mesial and distal bone loss have a correlation of %90 which is considerable. This means that 1mm bone loss in mesial side is accompanied by 0.9mm bone loss in distal side.

	Minimum	*Maximum*	*Average±S.D.*
Time (months)	*21*	*52*	*40.80±7.457*
Mesial Bone Loss (mm)	*0*	*8*	*1.50±1.359*
Distal Bone Loss (mm)	*0*	*8*	*1.517±1.3465*
Age (years)	*19*	*72*	*49.1925±13.03721*

Table 1. Characteristics of patients enrolled in study; (Time, Mesial and Distal Bone loss, Age).

		Number (cases)	*Percentage*
Commercial Brand	*IMPLANTIUM*	*86*	*53.4*
	ITI	*75*	*46.5*
Type of Prosthetic Restoration	*Fixed*	*130*	*80.7*
	Overdenture	*31*	*19.2*
Prosthetic consideration	*No Prosthetic consideration*	*123*	*76.5*
	Cantilever	*3*	*1.8*
	Bridge Abutment	*31*	*19.2*
	Splinted Crown	*4*	*2.4*
Pre-Prosthethic Surgery	*No pre-prosthetic surgery*	*157*	*97.5*
	History of successful graft	*2*	*1.2*
	history of unsuccessful graft	*2*	*1.2*

Table 2. Other factors which can affect bone loss: commercial brand, type of prosthetic restoration, prosthetic considerations and pre-prosthethic surgery.

	Variables	Non Standardized Coefficients		Standardized Coefficients	t	Significance level
		Beta coefficient	Standard error	Beta coefficient		
Mesial Bone Loss	Implants' Commercial Brands	1.276	0.222	0.470	5.741	0
	Pre-prosthetic Surgery	0.890	0.395	0.162	2.225	0.026
	Time	0.046	0.015	0.225	3.129	0.002
	Age	0.015	0.007	0.145	2.026	0.044
Distal Bone Loss	Implants' Commercial Brands	1.180	0.226	0.438	5.227	0
	Pre-prosthetic Surgery	0.665	0.401	0.122	1.660	0.099
	Time	0.040	0.015	0.222	2.666	0.008
	Age	0.013	0.008	0.121	1.661	0.099

Table 3. Dependent variables associated with mesial and distal bone loss ($p<0.05$).

Discussion

In this study, we evaluated the amount of bone loss in proximal areas of SLA-surface implants in patients treated at the Dental School of Tehran University of Medical Sciences.

The average mesial and distal bone loss:

The average mesial and distal bone loss was 1.5 and 1.517mm respectively. Time passed from implant surgery, implant commercial brand, age and history of pre-prosthetic surgery can affect severity of bone loss in both sides. Despite the fact that bone loss occurred in most patients, almost all implants were stable in the time of study and no mobility or infection was observed. Also, the average bone loss was acceptable based on previous studies [5,9,17-21].

Adell et al. (1981) reported bone loss of 1.5 millimeter after one year [10]. In the study of Rismanchian and Birang, bone loss was 1.08 at loading time and 1.43mm one year after implant placement [17]. Alberkson reported 0.9-1.6mm bone loss first year after insertion of implants [18].

Implant commercial brand:

Commercial brand could affect bone loss in this study. Few studies compared bone loss of different commercial brands. Geckili et al [22] used panoramic X-ray and Corel Draw software to analyze marginal bone loss around 157 narrow diameter implants of four different brands; Straumann (ITI), Astra tech, Biolok and Xive in a 5 year period. No difference was observed, except significant rise in bone loss around Biolok compared to Astra Tech ($p<0.05$). Mean marginal bone loss around implants was reported 1.0 and 0.98mm in mesial and distal site, respectively. Digital panoramic image is not a good choice to assess marginal bone loss around an implant, because of possible distortions and artifacts that may occur.

However, using a software instead of a trained person and a prolonged time period of follow up (5 years) to assess bone loss is satisfying. Laurell et al. [23] in 2011 performed a meta-analysis on marginal bone loss around three different implant brands (Astra tech, Straumann ITI, Branemark Noble Biocare) after 5years of function via radiographic examination. Different implant systems showed significant differences in marginal bone loss. Astra Tech showed minimum bone loss (mean of 0.24mm) followed by Straumann ITI (mean of 0.48mm) and Branemark Noble Biocare (mean of 0.75mm). In this study, Straumann ITI implants showed less bone loss than IMPLANTIUM. By the way, due to sample size and limited follow up period longer follow-up period is recommended before establish a definite conclusion.

Based on another systematic review [24] scrutinized 71 articles reporting on bone loss after at least 5 years of follow-up, reported that SLA surface implants had less marginal bone loss than turned surface or Ti-Unite surface implants. However, all implant systems show no further progressive bone loss from the end of year 1 to year 5.

Bone grafting surgery:

In this study, bone grafting was considered as a factor which can affect bone loss. Data shows increased bone loss around implants in both mesial and distal side ($p<0.05$) after bone grafting. However, more studies are necessary due to limited sample size. Different grafting techniques and biomaterials may also lead to different amounts of bone loss. Literature showed controversy about the effect of bone grafting on bone loss. One study reported no differences in implant success and survival rate following bone grafting in comparison to the control group [25]. Graziani (2004) found that implant survival rate was higher in patients who underwent bone grafting than those who did not and urvival rate for all implants (regardless of whether the surgery performed or not) was %75-100 [26].

Age:

Based on statistical analysis, one year increase in age leads to increase bone loss about 0.015mm in mesial and 0.013 in distal side ($p<0.05$); however, the result should interpret with caution because of the sample size. In a number of studies [7,27-30], there was no clear relationship between age and bone loss. One study reported more bone loss in patients younger than 60 years old [31]. However, another study concluded that there is no significant difference in bone loss between patients younger or older than 60 years old [32].

Time passed from surgery:

Time of implant presence (21-52 month) in the bone was another factor affecting bone loss in this study. According to Tabrizi et al, duration of implant presence in bone was the most effective factor on bone loss [33]. After implant surgery, bone loss increased 0.046 and 0.040mm at mesial and distal side, respectively which was statistically significant. According to Norton study there is no difference between mesial and distal bone loss during the first year of function [34]. Maybe more distal bone loss can be correlated to more plaque accumulation in distal side because of the difficulty in cleaning that area.

Prostheses treatment:

Based on the results of this study, type of prosthesis is not an important factor on marginal bone loss. This result was supported by another study which about narrow diameter implants of four different systems [22].

Medical history:

Systemic diseases was one of the most important factors leading to implant failure in porter's study [35]. In that study, it was specifically emphasized on chronic oral disease such as Lichen Planus and autoimmune disease as an important factor contributing in implant failure. But another study on 722 implants showed systemic disease had no significant effect on bone loss [36]. There was no correlation between marginal bone loss and hemodialysis or Papillon-Lefevre syndrome in this study; but results should interpret with caution again due to sample size.

Conclusion

Mean bone loss around SLA implants was 1.5mm on average which is acceptable based on previous studies. Nevertheless, studies with different and longer follow-up intervals by focusing other clinical indices such as plaque index, bleeding index, and gingival index are required for definite conclusion.

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