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Original Article

Average annual crestal bone loss of ITI implants following the first year of loading

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Abstract

BACKGROUND: Long term success of dental implants directly depends on marginal bone resorption. The aim of this study was to determine the annual average bone loss on the mesial and distal aspects of implants following the first year of implantation.

METHODS: This was a descriptive analytical study of patients treated with ITI (International Team of Implantology) implants at the Dental School of Isfahan University of Medical Sciences from 1998-2002 (1377-81). A total of 15 patients with 41 implants were selected by convenience sampling method. The height of the alveolar bone was measured using panoramic radiography before and after loading with calipers to determine the average bone loss. Other information such as pocket depth, bleeding index, plaque index, gingival recession, was obtained by clinical examinations. The mean bone loss on the mesial & distal sides was analyzed by ANOVA at 0.05 level of significance.

RESULTS: The average bone loss on the proximal sides of ITI implants obtained annually after the first year of loading was 0.084 ± 0.035 mm with slight difference on the mesial (0.092 ± 0.035) and distal (0.072 ± 0.033) sides. There was negligible difference between male and female patients. The average survival rate for thirty three months was 95.1%.

CONCLUSION: The average bone loss on the mesial and distal sides of ITI implants compared with other studies was satisfactory. Survival and success rates were acceptable.

KEYWORDS: Dental implants, bone resorption, survival rate, dental plaque index.

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Replacement of lost teeth with proper prostheses, acceptable aesthetics and function is the final goal of every dentist. The failure of routine treatment methods used in distal extension or edentulous patients with ridge loss has motivated research into finding more acceptable ways.

The discovery of osseointegration in 1960 led to the utilization of tissue integrated implants, and further biological and biomechanical research led to improvement in the function of titanium implants [1]. Natural teeth, prostheses and implants are dependent on alveolar bone [1, 2]. In implantology, bone stability is the key factor to success [3]. Crum and Rooney's research found that patients using dentures had 5.2 mm of bone loss within 5 years. However, this loss was only 0.6 mm with overdenture implants [4]. With the increasing usage of implants, it is therefore appropriate to study their success and failure rates in conjunction with alveolar bone loss. Alveolar crestal bone loss is one of the most important indices for evaluating implant health, and its loss after implantation is of great significance. If more than half of the bone around the implant is lost, that implant is considered to have failed [2]. One of the methods for evaluating the success of an

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implant is radiography. Using this method, the alveolar bone height around an implant can be measured [5].

The purpose of this research was to study the alveolar bone loss around the ITI implants and to compare the annual average bone loss on the mesial and distal aspects of implants following the first year of implantation.

Methods

This study was a cross-sectional analytical descriptive research. Fifteen patients with good general health were referred to the Implantology Department of the Dental Faculty of Isfahan University of Medical Sciences between 1998 and 2002 (1377 and 1381). Their residual ridge morphology was considered adequate to accommodate the dimensions of the implants. During this study a total of 41 maxillary and mandibular ITI implants (supplied by Straumann AG, Waldenberg, Switzerland) were inserted. These included 14 overdenture abutments and 27 fixed partial denture abutments. All of the Implants were loaded between 3 to 6 months after implantation. The implants were analyzed over an average period of 33 months after the first year of implantation. The following criteria were evaluated in this study:

1. Bone height on the mesial and distal aspects of each implant: panoramic radiography was used before loading and annually after the first year of loading to measure the bone level on the mesial and distal aspects of each implant. Measurements were taken with digital calipers from the shoulder of the implant to the observed point of contacting the bone (with a 0.01 mm level of accuracy).

The exact distance between the pitch of the implant threads was used to adjust the magnification of the radiographs to allow direct use of the scale in measuring the distance from the implant shoulder to the bone level.

2. Pocket depth was measured using a periodontal probe at a controlled force (one-fifth of the probing force of a natural tooth pocket) [3]. The probe was gently directed parallel the long axis of the implant between the mucosa and the implant body surface until resistance was felt. The probing depth was measured from the gingival margin to the epical advancement of the probe's tip on the four aspects around each implant (to the nearest 0.5 mm) (mesial, distal, buccal and lingual).

3. Gingival recession was recorded as the distance from the implant shoulder to the gingival margin on the buccal surface.

4. Bleeding Index: bleeding on probing was evaluated on four sites around each implant (mesial, distal, buccal and lingual) according to the Mombelli Index [3]; 0: no bleeding; 1: spot bleeding; 2: linear bleeding; 3: spontaneous bleeding.

5. Plaque Index: plaque adherent to the fixture and abutment was quantified using the Muhlmann Index [3] at four sites around the implants (mesial, distal, buccal and lingual). The presence of plaque was tested by running the side of the probe around the implant surface at the peri-implant sulcus; 0: no plaque in the gingival area; 1: the presence of a film of plaque recognized by running a probe; 2: moderate soft debris within the peri-implant sulcus as seen by the naked eye; 3: the presence of abundant plaque.

Statistical Analysis

One sample t-test was used to determine whether mean bone level changes were significantly different from zero (no change) or not. ANOVA was used to analyze the effect of gender and the difference between bone loss on the mesial and distal sides. A significance level of 0.05 was chosen.

Results

The mean value and standard deviation of marginal bone loss of ITI implants are provided in table I.

The average bone loss on the proximal side of ITI implants obtained annually after the first year of loading was 0.084 ± 0.035 mm. The average bone loss was 0.07 (± 0.032) on the mesial side and 0.09 (± 0.037) on the distal side of the ITI implants. There was no significant difference between mesial and distal bone loss. There was also no significant difference be-

tween female and male patients. Mean annual bone loss in all patients was less than 0.1 mm with the exception of one male patient in mesial and distal aspect of 0.12 mm bone loss. However, none of the means was significantly different from zero. The average survival rate of ITI implants over a 33-month period was 95.1%.

The relative frequencies of plaque index, tissue recession, bleeding on probing and pocket depth are presented in table 2.

Table 1. Mean of mesial and distal crestal bone resorption of ITI implants after the first year of loading.

Sex	Number of Patients	Location	Mean ± Standard Deviation
Male	20	Mesial	0.12 ± 0.024
Female	19	Mesial	0.05 ± 0.039
Male	20	Distal	0.12 ± 0.027
Female	19	Distal	0.09 ± 0.047
Total	39	Mesial	0.07 ± 0.032
Total	39	Distal	0.09 ± 0.037

Table 2. Relative frequency of the tested criteria in ITI implants in percent.

	Plaque Index*				Tissue Recession (mm)				Bleeding Index **				Pocket Depth (mm)				
Grade	0	1	2	3	0-1	1-2	2-3	3-4	0	1	2	3	0-1	1-2	2-3	3-4	>4
Relative frequency (in percent)	20.5	51.3	23.1	5.1	71.8	18	10.2	0	67.6	15.3	23.1	0	0	38.5	30.8	17.9	12.8

*According to Muhlmann Index [3]; 0: No plaque, 1: Plaque is obvious in probing, 2: Visible plaque, 3: Abundant plaque with great adherence.
**According to Mombelli Index [3]; 0: No bleeding, 1: Spot bleeding, 2: Linear bleeding, 3:Spontaneous bleeding.

Table 3. Mean marginal bone resorption reported by authors (in mm).

Authors	Mean Bone Loss at the End of First Year	Annual Bone Loss after the First Year
Leimola [12]	–	0.25
Hammerle [11]	1.02	-
Behneke [10]	0.8	0.1
Tang [13]	0.63	-
Weber [14]	0.6	0.05
Van Steenberghe [15]	-	0.14
Leonhardlt [16]	-	0.17
Heydenrijk [17]	0.6	-
Behneke [9]	0.5	0.1
Heydenrijk [19] (within the first two years)	0.8 to 1.4	-
Chou [18]	-	0.2
Ricci [20]	-	0.43

Discussion

Studies reporting bone level changes revealed that considerable variation exists among individuals, and also in year to year resorption per patient [3]. Time dependent marginal bone loss was observed. This appears to be unavoidable around implants, although the rate tends to reduce after 1 to 2 years of function [6].

Crestal bone loss is an early manifestation of wound healing occurs one month after implant placement, and the stability of the implant and implant abutment interface play an important early role in crestal bone levels [7]. However, late marginal bone resorption has been attributed to biomechanical factors [6].

In this study the average annual crestal bone loss after the first year of loading on the mesial and distal sides of ITI implants was 0.07 (± 0.032) and 0.09 (± 0.037) mm respectively which is acceptable when compared with other studies. There was no significant difference between bone loss on the mesial and distal sides, which is contrary to Bragger's report; he stated that there is more bone resorption on the distal side of implants [8]. This difference may be attributed to the longer period of Bragger's study and the increased incidence of noticeable plaque deposition after 5 years of function. This could be due to the difficulty of maintaining a high level of oral hygiene over a long period of time [9].

Table 3 shows the results of some other studies concerned with marginal bone resorption [9-20].

The gender of patients had no significant effect on marginal bone loss and this supports the findings of other studies [3,15].

In this study, only 28% of individuals were positive for plaque around the implants (plaque index grades 2 and 3) and bleeding on probing was present in only 23% of cases (bleeding on probing grades 2 and 3) [3]. However, in Leonhardt's [16] study 50% were positive for plaque and 61% had bleeding on probing.

As noted previously this could be attributable to a longer period of study too. Salvi showed that the marginal bone level, pocket depth and probing attachment level of implants were significantly associated with smoking, general health, implant location and full mouth probing depth. As a result, the clinician must consider the patient's general health, smoking habit and oral hygiene for successful treatment [21]. More than 70% of patients had less than 3 mm pocket depth and 90% of them had less than 2 mm tissue recession after loading the implants. These results are comparable with other studies [3,17].

Conclusion

1. The average annual bone loss on the proximal aspects of ITI implants was O.O84 to O.035 over a period of 33 months.
2. There was no significant difference in bone loss on the mesial and distal aspects.
3. Gender appeared to play no role in bone loss around the implants.
4. The average survival rates of ITI implants was 95.1% over a 33-month period.

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