

Crestal Bone Resorption: An Assessment Cross-Section

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Abstract

The aim of this study was to conduct a cross-sectional analysis of panoramic radiographs of patients implanted with internal hexagon implants after 90 to 180 days of the implant insertion. Fifty-eight panoramic radiographs were selected, totaling 208 internal hexagon implants, with different diameters and placed by different surgeons with conventional surgical techniques. The selected patients presented no alterations or bone graft in the region and showed satisfactory oral health condition. Within the limitations of this study, it can be concluded that:

- 1- There were no differences regarding bone resorption considering gender, race, maxillary and mandible;
- 2- A significant difference only for women with larger implants with resorption;
- 3- It can be seen that there implants with bone resorption without exposure to the oral environment;
- 4- According to the data obtained verified that bone resorption cannot be only associated with the presence of microorganisms;
- 5- The load may have about dental implants association but in the present study showed implants with and without the presence of resorption load.

Key Words: Diagnosis, Bone loss, Radiology, Imaging, Implant Dentistry/Implantology, Oral implants/Implantology

Introduction

In implantology, bone resorption occurs as a response of the body in order to restore the minimum distance between the bone crest and implant-abutment interface, which would correspond to the biological distance of a natural tooth [1].

Although bone loss around implants is described as a complication when it becomes uncontrolled, resorption does not always lead to implant loss, but it may be the result of biomechanics and adaptation to the stress generated on the implant when it is loaded [2] and this resorption occurs within the first 18 months [3,4].

In clinical trials, bone remodeling occurs in the first 6 months after implantation [5] therefore, it is not significant after a long period. When implants are inserted immediately after removal of a tooth, remodeling occurs in a standard way with no esthetic interference [6].

The average amount of bone loss measured is 1.2 mm in the first year of prosthetic loading and it might range from 0 to 3 mm. Small changes in crestal bone height after placement of the load on the implant have not negatively affected the long-term success of implants [7]. Greater intensity of resorption of the bone crest in the first year of placement in comparison with the following years may not be clearly explained solely by occlusal overload because bone loss should be progressive due to resorption and does not decrease over the years. There are hypotheses that explain why this resorption phenomenon is greater in the first year of implant function. The first hypothesis would be functional adaptation of oral muscles, the second one

would be the wear of the prosthetic material and the third the increase in bone density [4].

With regard to overload and hygiene, these may be the cause of implant loss [8] as well as pressure during implant insertion which leads to the lack of osseointegration [9]. A study has shown that mechanical trauma did not influence peri-implant bone loss [10]. As for the height of the crown placed on the implant, the higher the height of the crowns, the higher bone resorption [11] and the longer the cantilever, the greater resorption will be [12].

Comparing the use of progressive loading and immediate loading, some authors found fewer changes in the bone with immediate loading of implants than in progressive loading of implants [13,14]. If considering the surgical protocol or the type of technique used [15], the results of studies on placement techniques of submerged (two-stage surgery) or non-submerged (one-stage surgery) implants showed tissue healing after implant placement.

Then, the aim of this study was to conduct a cross-sectional analysis of radiographs of patients implanted with the same type of internal hexagon implants that were inserted within 90 to 180 days without exposure to the oral environment, with no healing caps, submerged and no loading.

Materials and Methods

Fifty-eight panoramic radiographs were selected, totaling 208 internal hexagon implants, Implacil De BortoliAce brand (Dental Implant System - Swede Implant), surface treated

by sandblasting and acid etching, with different diameters and placed by different surgeons with conventional surgical techniques. The patients represented by the panoramic radiographs had no alterations or bone graft in the region and showed satisfactory oral health condition. The same protocol was performed before surgery that is, prophylaxis with pumice stone and mouthwash with water associated with 0.2% chlorhexidine.

After examinations of patients for placement of reopening and healing abutments were asked radiographs to patients, which was verified on radiographs presence of resorption in implants and some others did not present the same resorption but the implants were the same conditions, submerged and unloaded where the analysis of radiographs were made and made to measure by a software Software Image tools 3.00 (University of Texas Health Science Center in San Antonio)

The radiographs of the patients were randomly selected verifying the time of implant placement that was established from 90 to 180 days after implant insertion, irrespective of the location, gender or number of implants placed. Only the type of implant with an internal hexagon was chosen, following the period of absence of premature loads with the two-stage surgical procedure, favoring initial stability. After obtaining the radiographs, the researcher separated them in accordance with gender, age, race and location of the implants. After tabulating data in the program Excel® 2007, the number of implants per patient was taken note. The information obtained from the patients was recorded on a medical chart with the knowledge and approval of the patients by means of an informed consent term. The radiographs were analyzed by a calibrated examiner with the aid of a loupe with 4X magnification (BioArt - Equipamentos Odontológicos SA, São Carlos SP, Brazil) verifying the presence or absence of resorption around the implants and confirmed by a periapical X-Ray.

After separating the radiographs, the patients were examined clinically to verify the general conditions and checking whether the implants were completely submerged. Panoramic radiographs were taken by the same operator using an X-ray Panorâmico Dabi HF100 appliance and X-Ray Spectro 70X Eletronic (Dabi Atlante- Ribeirão Preto, SP, Brazil), and then the regions of the implants were separated for analysis.

With the radiographs separated, a calibrated examiner read the radiographs, analyzing only the presence or absence of bone resorption and noting on a spreadsheet which was then divided into age, gender, race, maxilla and mandible and the dental region in which they were present. Afterwards, the Chi-square and Odds Ratio tests were applied; α significance level was 5% ($p \leq 0.05$). The study follows the cross-sectional model.

Results

Table 1 shows the characteristics of the sample and the percentage of bone resorption between the genders evaluated. Fifty-eight patients were analyzed, 22.4% were men and 77.6% women. For men, 46.2% showed no bone resorption

and 53.8% showed bone resorption. For women, 44.4% showed no bone resorption and 55.6% showed bone resorption. The proportional percentage is very similar between men and women. The number of implants for men without bone resorption was 82.5% and 17.5% with bone resorption. For women, the number of implants without bone resorption was 64.3% and 35.7% with bone resorption. A larger proportional percentage of bone resorption was observed in women.

The mean age was 46 years with an average of 45 years. In the distribution by classes, a higher frequency was found for the interval from 42.3 to 50.7 years. The percentages of bone resorption according to race are reported on *Table 2*. It was not observed significant differences between Caucasian (29.7%) and Afro-Brazilian (28.6%) individuals for bone resorption.

Table 3 presents the percentage of bone resorption according to the local of occurrence (mandible or maxilla). Considering the number of implants with bone resorption, a percentage of 29.6% was observed in the maxilla and 33% in the mandible.

Tests of association among the variables were performed and the results are showed on *Table 4*.

There were no significance differences regarding bone resorption considering gender, race, maxillary and mandible. A significant difference only for women with larger implants with resorption was found.

Discussion

In the present study, prevalence of peri-implant bone resorption was found but it was not possible to determine a cause-and-effect relationship. The observations of cause and effect are best evidenced in a prospective cohort study and a cross-sectional study, which can only determine proportion and odds ratio.

Small changes in crestal bone height after the load on the implants have not negatively affected the success of the implants [7], which is in agreement with previous studies [16]. According to these studies, remodeling of the bone crest is a criterion for successful dental implants. However, the occurrence of bone loss is around 1.2 mm within the first year [17] when the prosthetic load is applied, whereas this bone loss is due to functional adaptation of the oral muscles, wear of the prosthetic material and increase in bone density [4].

Biomechanics and adaptation to the stress generated by the load are also causes of resorption of the bone crest [2], which is in disagreement with studies in the literature [1] that claim that it is a response of the organism to restore the biological distance. Other causes may be related to occlusal trauma, reflection of the periosteum, osteotomy of the implant, host autoimmune response and the biological space [18], which is not in agreement with the statement that mechanical trauma does not influence resorption [10]. However, excessive micromovement, immediately after insertion of the implant, would suddenly interrupt the sequence of events of bone repair, which would result in the formation of a fibrous tissue capsule instead of direct apposition of mineralized tissue [19-24]. However, the surgical protocol also shows no influence

Table 1. Characteristics of the sample and the percentage of bone resorption between genders.

Gender and resorption	n	%
Male	13	22.4
Female	45	77.6
Male without resorption	6	46.2
Male with resorption	7	53.8
Female without resorption	20	44.4
Female with resorption	25	55.6
Implants Male without resorption	33	82.5
Implants Male with resorption	7	17.5
Implants Female without resorption	108	64.3
Implants Female with resorption	60	35.7

Table 2. Percentages of bone resorption according to race.

Race and resorption	n	%
Melanodermous	15	25.9
Caucasian	43	74.1
Implants in melanodermous	63	30.3
Implants in caucasian	145	69.7
Implants in melanodermous with resorption	18	28.6
Implants in melanodermous without resorption	45	71.4
Implants in Caucasian with resorption	43	29.7
Implants in Caucasian without resorption	102	70.3

Table 3. Percentage of bone resorption according to the local of occurrence.

Local of occurrence and resorption	n	%
Maxilla	108	51.9
Mandible	100	48.1
Maxilla with resorption	32	29.6
Maxilla without resorption	76	70.4
Mandible with resorption	33	33.0
Mandible without resorption	67	67.0

Table 4. Comparisons, hypothesis testing and p-value among the variables.

Comparisons	Test χ^2	"odds" value
Male x Female with/without bone resorption	0.8357	0.9333
Male x Female Number of implants with/without bone resorption	0.0267*	0.3818
Melanodermous X Caucasian Number of implants with/without bone resorption	0.9936	0.9488
Maxilla x mandible with/without bone resorption	0.2354	0.6951
Number of implants Maxilla x Mandible	0.7082	0.8549

on the morphology of peri-implant bone regeneration [25], which is in agreement with the results obtained in the present study because implants were not exposed to the oral environment and the presence of load.

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Some authors [13, 14] have concluded that immediate loading of implants shows significant lower remodeling of the level of the bone crest than implants with delayed loading and the type of metal alloy for the abutment in screw-retained or cemented prosthesis does not influence the final result of bone healing [26,27].

According to the results obtained, it was found that the presence of resorption in men and women showed no direct relationship, even with a higher proportion of implants being analyzed in men. Therefore, for the comparison between men and women, with and without bone resorption, no significant differences among the observed and expected frequencies were found. The value obtained from the Odds Ratio test was 0.933 and equal chances of manifestation of bone resorption or not are observed between men and women (Table 4). However, a higher proportional percentage of bone resorption was found in women.

Considering the age, the presence of resorption with normal distribution was found and the distribution of classes showed higher frequency of resorption for the interval from 42.3 to 50.7 years. Therefore, as older as the patient, greater is the presence of implants, but according to the literature, this does not influence the resorption [28].

In the comparison between the number of implants with bone resorption between Afro-Brazilian and Caucasian individuals, no significant differences were observed, $p=0.994$. The Odds Ratio = 0.949 provided a similar value of chance between Afro-Brazilians and Caucasians.

For the association between maxilla and mandible with the presence or absence of bone resorption, the value of $p = 0.708$ shows no significant association and the value of Odds Ratio = 0.855 shows similar chances of bone resorption occurring in the mandible or maxilla.

More studies and surveys associated with bone resorption should be conducted to obtain a satisfactory result, in which situations of failure did not occur and which could be predicted after planning of oral rehabilitation in patients with bone resorption involving different types of implants.

Conclusion

Within the limitations of this study, it can be concluded that:

- 1- There were no differences regarding bone resorption considering gender, race, maxillary and mandible;
- 2- A significant difference only for women with larger implants with resorption.
- 3- It can be seen that there implants with bone resorption without exposure to the oral environment.
- 4- According to the data obtained verified that bone resorption cannot be only associated with the presence of microorganisms.
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