**Research Article**

# Prevalence of Peri-implant Diseases – Part 1

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## Abstract

**Aim:** Determine the prevalence of peri-implant diseases; mucositis and periodontitis, of patients from the Center of Studies of Continuing Education in Implant Dentistry of the Federal University of Santa Catarina. In addition to the extension of the disease, the proportion of affected implants was studied.

**Materials and Methods:** A cross-sectional study was carried out in 200 patients presenting 760 external-hexed cylindrical dental implant supported prosthesis with at least 1 year of loading time (range: 1–9 years). Probing depth, bleeding on probing and suppuration data were collected. Radiographs were required to evaluate supporting bone levels around implants.

**Results:** One hundred and thirty-nine (69%) patients presented all healthy implants, 46 (23%) patients presented peri-implant mucositis and 15 (8%) presented peri-implantitis. The overall outcome was 547 (72%) healthy implants, 161(21%) with peri-implant mucostitis and 62 (7%) with peri-implantitis.

**Conclusion:** According to the results, it is concluded that the prevalence of peri-implant mucositis was 23% and peri-implantitis to 8%.

**Keywords:** Diagnostics; Infectious diseases; Peri-implant diseases; Peri-implantitis; Peri-implant mucositis; Prevalence

## Clinical Relevance

### Scientific rationale for study

The prevalence of peri-implant diseases has not yet been presented with absolute values due to insufficient studies [1].

### Principal findings

The peri-implant mucositis prevalence in this study was significantly lower than the results presented in the literature. However, peri-implantitis prevalence concurs and other time diverges with the literature.

### Practical implications

Excessive force applied in the BOP exam could have resulted in false positive findings for the peri-implant diseases. Care is necessary to adequately diagnose the disease.

## Introduction

Peri-implant mucositis is clinically described as the inflammation of the peri-implant mucosa without bone loss; being the most important clinical diagnosis the presence of Bleeding on Probing (BOP) [2]. Peri-implantitis is associated with clinical characteristics of mucositis in combination with radiographic presence of bone loss [3,4].

The prevalence of peri-implant diseases has not yet been presented with absolute values due to insufficient number of studies [1]. The absence of this information may be attributed to the lack of standardization of the scientific methodology; as well as, to the different definitions for peri-implant diseases [5-7]. It has been reported that peri-implant diseases are present in 28% to 56% [1] of individuals that present dental implants. Retrospective studies [8-15], with dental implant loaded for 5 or more years, revealed that peri-

implant diseases were a frequent finding; however, they showed very variable results. In 2008, the Council of the 6th European Workshop on Periodontology expressed the need for more studies to provide sufficient information in regards to the prevalence of peri-implant diseases [4].

This study aims to determine the prevalence of peri-implant diseases; such as, peri-implant mucositis and peri-implantitis, of patients from the Center of Continuing Education in Implant Dentistry (CEPID) of the Federal University of Santa Catarina (UFSC). In addition, the extension (the proportion of affected implants) of the disease was studied.

## Materials and Methods

The present study was approved by the Human Ethics Committee of the Federal University of Santa Catarina and an informed consent was obtained from each participant.

### Sample selection

This was a retrospective study of which 357 subjects from the CEPID-UFSC database were explained of the study by phone and at a consultation visit. These subjects showed to have received external-hexed cylindrical implants supporting prosthesis (es) which were placed for more than 1 year between the years of 2001 to 2010. These subjects were contacted by phone to participate on this study. If the patient agreed upon his or her participation in the study, the patient was scheduled for the evaluations and a consent form was signed. Of the 357 subjects contacted, 41 declined its ability to participate in the study for various reasons. Of the remaining subjects, only 200 (n=760 implants) completed all the follow-up visits and therefore had their data compiled for this study. Of the 760 implants placed, 33% were maxillary teeth and 67% were mandibular. More than 80% of

the implant were placed to substitute molars and pre-molars. Details of the sampling are shown in Table 1. The suprastructures evaluated in this study were crowns (65%), 3 (28%) unit bridges and full-arch prostheses (9%).

## Surgical protocol

A consensus report from the 3rd European Workshop on Periodontology used the bone level at implant loading as the baseline [16]. All the implants placed were machined surface Master Screw® (Conexão, São Paulo) SP, Brazil). They were placed with the platform at the level of the alveolar crest. The crest or the edentulous ridge was reduced when the implant was planned to be placed at a lower level from the existing bony ridge. The platform-crest level surgical protocol used by the institution allowed an expected saucerization of < 2 mm for reaching the biological width [17]. Therefore, a bone loss of ≥ 2mm was considered peri-implantitis [14,18] when associated with presence of Probing Depth (PD) > 4 mm and/or bleeding/suppuration upon probing [19,20].

## Data collection

After each prosthesis was removed, the following data was collected:

**BOP index:** Presence or absence was registered after the introduction of 1 mm of the periodontal probe (PCV12PT Hu-Friedy Inc., Chicago, IL, USA) into the gingival sulcus with a gingival "sweep" movement [2]. Data was analyzed after removal of the periodontal probe and time elapsed for 30 seconds.

**PD:** PD measurements were collected on the mesial, mid-buccal, distal and the deepest site on the palatal/lingual, after calibration of the examiner for a probing pressure of 0.25 N [4].

**Suppuration:** Visible presence or absence of suppuration was registered after probing the peri-implant sulcus.

## Radiographic analysis

Bone level was measured around the dental implants using the parallel cone technique in order to obtain radiographic images (Kodak Insight film, Carestream, INC., New York, EUA) for analyses.

**Table 1**: Description of the samples regarding sex, age and scholarity.

| Variables | Sample | Implants placed |
|---|---|---|
| | n (%) | n (%) |
| **Sex (n=200)** | | |
| Male | 71 (34,7) | 304 (40,0) |
| Female | 129 (64,3) | 456 (60,0) |
| **Age** (years) (**n=200**) | | |
| 19-39 | 32 (16,0) | 88 (11,6) |
| 40-49 | 66 (33,3) | 196 (25,9) |
| 50-59 | 61 (30,5) | 298 (39,3) |
| 60 or more | 41 (20,2) | 177 (23,2) |
| **Scholarity (n=200)** | | |
| Up to 8th grade | 36 (17,1) | 125 (16,2) |
| Up to 12th grade | 85 (43,0) | 348 (46,0) |
| College | 79 (39,9) | 287 (37,8) |
| **TOTAL** | 200 (100,0) | 760 (100,0) |

The radiographs were digitalized by and image analysis program (Digimizer* version 3.7.0, Medical Software Brolkstraat, Belgium). The values were obtained by measuring the distance from the implant platform to the first radiographic bone contact on the Mesial (MBL); and, on the Distal (DBL). The measurements were made at baseline (T0) by only one calibrated examiner, different from the clinical examiner; and, repeated after 7 days (T7). The mean bone loss value obtained from both measurements (T0 and T7) was used as the final measurement of each site. For the final measurement for each implant, a mean bone loss value was established by adding the mesial mean with the distal mean values and dividing the sum by 2.

## Group analysis and division

The following criteria were used as the definition for the clinical and radiographic analyses. Peri-implant mucositis was considered when the probing depth was of ≤ 4mm with presence of BOP around an implant presenting < 2 mm of bone loss. Data was compiled according to each implant and 4 sites (mesial, distal, mid-buccal and palatal/lingual). Peri-implantitis was defined when showing PD of > 4mm, associated with BOP and/or suppuration, and bone loss ≥ 2mm [6]. Bone loss was evaluated from the data compiled in 2 sites (mesial and distal) only, due to the inability to evaluate the mid-buccal and lingual/palatal implant sites in an x-ray.

In the prevalence analyses, patients were divided into 3 groups: 1) Healthy; 2) presenting mucositis (at least 1 implant with mucositis); and, 3) presenting peri-implantitis (at least 1 implant with peri-implantitis). While analyzing the results when all the implants were taken into consideration, they were divided into 4 groups; implants without bleeding and with less than 2 mm of bone loss; implants without bleeding and with ≥ 2mm of bone loss; implants with mucositis; and, implants with peri-implantitis. The division of the healthy implants (without bleeding) into 2 groups aimed to optimize the evaluation of the subjects presenting peri-implant bone loss of ≥ 2mm, even in the absence of bleeding, which may suggest a history of peri-implantitis [7].

## Statistical analyses

All data were compiled and compared between groups. The extra-examiner reproducibility of the MBL and DBL measurements was tested with the Intra-class Correction Coefficient (ICC).

Binary logistic regression analysis was applied for the comparison amongst the groups of the presence of mucositis and peri-implantitis. The assumed confidence interval was of 95%. The Microsoft Excel (Microsoft Office XP) and Statistical Package for Social Science (SPSS) programs for Windows (version 13.0) were used for value data tab and data analyses. Statistical significance was considered significant when P was less than 0.05.

## Results

The sample size was composed of 200 patients that summed a total amount of 760 dental implants. Regarding the time the implant supported prostheses were in function, 162 patients (611 implants) had the prostheses for up to 5 years, and 38 patients (149 implants) for more than 5 years. The mean time interval with the prostheses in function was of 4.02 years (standard deviation of 1.67 years). The patient age ranged from 21 to 86 years, with an average of 50.6 years

(standard deviation of 11.22). Gender was distributed as 64% females. Sample details are presented in Table 1.

From a total of 139 (69%) patients presenting all implants healthy, 46 (23%) patients presented at least 1 implant with peri-implant mucositis and 15 (8%) patients with at least 1 implant with peri-implantitis. Table 2 shows the distribution of patients according to sex and the prevalence category of the peri-implant diseases.

Table 3 shows the detailed results of the 760 implants distributed in the 4 groups according to the prevalence of the peri-implant diseases.

## Discussion

Studies show a considerable variation in the prevalence of peri-implant diseases. However, [21] has presented similar results to the present study. They conducted a systematic review which indicated an incidence of 8.6% for peri-implantitis for dental implants in function for more than 5 years. Another similar analysis was shown by [22-24], when the prevalence of peri-implantitis was of 6.4%, 8,9% and 11,2%, respectively. In the present study, the patient population was of moderate susceptibility to periodontal disease, considering that the implant clinic was a branch from the Department of Periodontology and that the same patients were first referred to the Periodontology clinic prior to the treatment plan involving the need for dental implant rehabilitations.

The prevalence of peri-implantitis in the present study differ from the ones presented by the systematic review conducted by [1], where 80% of the subjects showed peri-implant mucositis and 28% - 56% presented peri-implantitis. Our results also differ from those presented by Koldsland OC et al and Mir-Mari et al. [6,7]. It can be assumed that this higher percentage could be attributed to the time that the implants were in function, which in this review was a minimum of 5 years. Therefore, even after separating the data of the 38 patients with dental implants in function for more than 5 years,

the results still show great discrepancy. Karoussis et al. and Rinke et al. [24,25] showed that studies evaluating dental implants in function for less than 5 to 10 years may not reproduce the differences in the susceptibility to bone loss due to the fact that peri-implant diseases can take years to develop [26].

Variations in the factors and methods of analyses may contribute to the discrepant results shown in the literature. As already described [1], the diverse methods of analysis (participants/dental implants) was a determinant factor for the exclusion of the majority of the 683 studies reviewed. Other exclusion factors of this review are the clinical and radiographic criteria used for the identification of peri-implant diseases, which make it impractical to compare results from different studies. In regards to this criteria, 2 problems are evident; the absence of fundamental criterions, and the lack of standardization. An example of this lack of criterion was that in one study there was absence of clinical data, as: BOP, which is fundamental for diagnosis of the presence of a peri-implant disease.

Dental implant loss may be due to multiple episodes of peri-implant infections [27] and; therefore, in some instances absence of clinical signs may mask the previous disease. Based in this premise, it may be suggested to add the data from the group presenting implants with bone loss of ≥ 2 mm and without BOP of the present study, to the date from the group presenting peri-implantitis. This would indicate a result similar to the one presented by Ellegaard et al. and Karoussis et al. [25,28].

The greatest discrepancies of the results were found in the prevalence of peri-implant mucositis. The prevalence of the disease in the present study was significantly lower than the literature reviewed. A possible factor for this discrepancy could be the force used to perform the BOP exam. The standardization of the probing pressure was a determinant factor for the correct diagnosis of the peri-implant diseases and this factor should be considered while validating the comparison amongst results. Some studies show that the peri-implant mucosa could be more sensitive to probing, which would account for a higher percentage of BOP in these tissues when compared to teeth [29,30]. In the present study, the selection and calibration of the examiners demonstrates the importance of applying only the necessary force for measuring the clinical inflammation accurately. From a total of 14 possible trained examiners, only 2 presented a tolerant limit of applied force variation. Twelve examiners demonstrated force limitations of 50 N, even after calibration; therefore, they were not used in this study. Radiological studies show that the tip of the periodontal probe was in close proximity to the peri-implant marginal bone when the probing forces were of 0.5N or more [31]. Ericsson & Lindhe [32] also showed, in an experimental study, that in the healthy peri-implant mucosa, a probing force of 0.5 N resulted in the tip of the probe passing through the connective tissue and being in close proximity to the marginal bone. It is possible that the discrepancy of the results, regarding specifically peri-implant mucositis, could be due to this factor. Some reviewed studies did not mention the probing force applied or the calibration phase as part of the methodology. The authors of the present study suggest the use of electronic periodontal probes to standardize clinical measurements.

The total number of existing cases in a determined population indicates the prevalence of a disease. Therefore, the prevalence of a

**Table 2:** Distribution of patients according to sex and prevalence category for peri-implant diseases.

| Groups* | Total |
|---------|-------|
| 1 | 139 |
| 2 | 46 |
| 3 | 15 |
| Total | 200 |

* 1) Healthy patients; 2) Patients with peri-implant mucositis; 3) Patients with peri-implantitis.

**Table 3:** Distribution of implants according to the prevalence category of the peri-implant diseases.

| Groups* | Number of implants | Percentage |
|---------|--------------------|------------|
| 1 | 418 | 55% |
| 2 | 129 | 17% |
| 3 | 161 | 21% |
| 4 | 52 | 7% |
| Total | 760 | 100% |

* 1) Healthy implants without bone loss; 2) Healthy implants with bone loss and without BOP; 3) Implants with peri-implant mucositis; 4) Implants with peri-implantitis.

disease should be determined by the number of individuals and not the number of individual dental implants [1]. Finally, there is a need for describing the extension of the diseases; that is, in regards to the amount and the severity (quantity of bone loss) of dental implants affected in each individual. The ability of obtaining data in a more organized manner will allow for the prevalence and severity of peri-implant diseases to be consequently conclusive, as already suggested by Heitz-Mayfield [26]. Special attention should be given to the standardization of the different criteria applied, as: follow-up time intervals and the criteria used to differentiate health from diseased sites.

According to the results obtained from the present study, it was concluded that the prevalence of peri-implant mucositis was 23% and for peri-implantitis was 8% of the studied group for implants placed for more than 1 year in function.

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