Prevalence of peri-implant diseases. A cross-sectional study based on a private practice environment


Abstract
Aim: To determine the prevalence of peri-implant diseases in private practice patients enrolled in a periodontal maintenance programme.

Material and Methods: A cross-sectional study was carried out in patients with dental implants attending the dental clinic to comply with a periodontal maintenance programme between January and June 2010. Implants with at least 1 year of loading time (range: 1–18 years) were included. A patient-based prevalence analysis of peri-implant diseases was carried out. Additionally, implants were classified into the following categories: healthy, clinically stable, mucositis and peri-implantitis.

Results: A total of 245 patients (964 dental implants) were analysed. Implant and patient-based peri-implantitis prevalences were 9.1% [95% confidence interval (95%CI): 7.5–11.1%] and 16.3% [95%CI: 12.2–21.5%] respectively. Mucositis affected 21.6% [95%CI: 19.1–24.5%] of the studied implants and 38.8% [95%CI: 33.3–45.4%] of the patients.

Conclusions: The prevalence of peri-implantitis in private practice patients enrolled in a periodontal maintenance programme was estimated to be between 12% and 22%. Almost 40% of the patients had mucositis. These prevalences are similar to those published in University environment samples.

Key words: complications; dental implants; mucositis; peri-implantitis; periodontal maintenance

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Mucositis and peri-implantitis are the most frequent long-term complications related with dental implants (Berglundh et al. 2002). However, the lack of widely accepted diagnostic criteria for such pathologies makes interpretation of the published prevalences very difficult. The literature reports that peri-implantitis affects 7.8–43.3% of all studied implants (Berglundh et al. 2002, Ferreira et al. 2006, Roos-Jansäker et al. 2006, Zitzmann & Berglundh 2008, Koldsland et al. 2010). Most authors agree that further research is needed to characterize the risk factors, progression and treatment of this disorder. Accordingly, the 6th Workshop in Periodontology (Zitzmann & Berglundh 2008) emphasized the need to realign future studies, recommending a new approach to this condition based on epidemiological studies with a
cross-sectional design, samples of between 100 and 500 patients, and clinical and radiological examinations. Focusing on private practice would also be desirable to improve generalization of the published data. Furthermore, this report encouraged researchers to provide additional information on prevalence using the patient as the analytical unit, and also to classify implants into different groups of peri-implant health and disease.

Accordingly, the present study was designed with the main objective of determining the prevalence of peri-implant diseases in private practice patients enrolled in a periodontal maintenance programme.

Additionally, the study aims to determine whether patients with peri-implant disease affecting at least one implant are more prone to have disorders in other implants.

Material and Methods

A cross-sectional study was conducted in patients enrolled in a periodontal maintenance programme (with follow-up visits every 3–6 months) in a private dental clinic in Menorca (Spain). The study was approved by the Ethics Committee of the Balearic Islands (Spain), and complied with the Declaration of Helsinki. The recommendations for peri-implantitis prevalence studies established by the 6th Workshop in Periodontology (Zittmann & Berglundh 2008) and the Strobe Statement guidelines (Vandenbroucke et al. 2007, von Elm et al. 2007) for cross-sectional studies were also taken into consideration in designing the current research.

All patients with dental implants and more than 1 year of follow-up after loading consecutively attending a periodontal maintenance appointment between January and June of 2010 were enrolled, and they agreed to participate in the study. Implants with machined (Bränemark System, Goteborg, Sweden), TiUnite™ (Nobel Biocare, Zurich, Switzerland) and Osseotite™ (3i, Florida, FL, USA) surfaces were placed by the same surgeon (PMO). Implant geometry was similar for both systems with thread pitches of 0.6 mm for regular platform implants. A total of 245 patients (964 dental implants) with a mean age of 60.1 years [range 20–87 years, standard deviation (SD) = 10.7 years] were analysed.

Two calibrated professionals (JMM and PMO) performed standardized periodontal maintenance check-ups. These included a complete periodontal examination, with probing pocket depth (PPD) (deepest value for each implant was registered), modified plaque and gingival index according to Mombelli et al. (1987) (mPI and mGI), bleeding on probing (BOP) and suppuration. Periapical digital radiographies using the long-cone parallel technique were obtained for the measurement of bone level (BL), counting the number of threads without bone support (Digora v.2.5; Tuusula, Finland). A single researcher assessed the mesial and distal aspects of each implant, and registered the highest value (Pikner & Gröndahl 2009, Koldsland et al. 2010). Twenty randomly selected radiographs were examined twice, 1 week apart, to analyse intra-examiner reproducibility. The intra-class correlation coefficient (ICC) was 0.881 (95%CI: 0.725–0.951; p < 0.001), indicating good intra-examiner agreement.

On performing implant-based analyses, the following diagnostic criteria were applied to evaluate the data:

-Health: BL < 2 threads without BOP.

-Clinical stability: BL ≥ 2 threads without BOP.

-Inflammation:
  - Peri-implant mucositis: BL < 2 threads with BOP.
  - Peri-implantitis: BL ≥ 2 threads with BOP or suppuration.

For a patient to be considered healthy or clinically stable, all implants should be classified as healthy or clinically stable. On the other hand, if any of the implants was classified in the inflammation, mucositis or peri-implantitis groups, the patient was considered not healthy. Patients were classified in the group of their worst implant.

Sample size was calculated to estimate the population prevalence of peri-implantitis with 5% precision and 95% confidence. To this effect, peri-implantitis prevalence was estimated a priori to affect 20% of the patients. Thus, a sample size of 245 patients was required.

A more detailed analysis was made in patients diagnosed with peri-implantitis (n = 40). To determine whether these patients were more prone to reveal diseased implant sites, a subgroup of 29 patients (199 implants) was created after excluding patients with less than four implants.

A descriptive patient- and implant-based analysis, using the Statistical Package for the Social Sciences (SPSS v.16.0; SPSS, Chicago, IL, USA) was carried out. Ninety-five per cent confidence intervals (95%CI) were estimated from data for all prevalences. Patients with incomplete data (demographic variables, periodontal and radiological examinations) were excluded from the analysis.

Results

The duration of implant follow-up ranged from 1 to 18 years (mean = 6.3 years; SD = 4.3 years). The sample comprised 524 (54.5%) implants placed in the maxilla and 440 (45.6%) in the mandible.

According to the previously mentioned diagnostic criteria, 208 implants presented mucositis, representing a prevalence of 21.6% (95% CI: 19.1–24.5%) and affecting a total of 96 patients [38.8% (95%CI: 33.3–45.4%)]. On the other hand, 88 implants [9.1% (95%CI: 7.5–11.1%)] in 40 patients [16.3% (95%CI: 12.2–21.5%)] were diagnosed for peri-implantitis. The correlations between the different diagnoses, the periodontal examination variables and the follow-up periods are shown in Tables 1 and 2. On the other hand, Table 3 shows the outcomes according to implant surface.

In the subgroup of patients with at least 4 implants and a diagnosis of peri-implantitis, 74 implants [37.2% (95%CI: 30.1–44.1%)] matched the definition of peri-implantitis. Figure 1 shows the results of this subgroup.

Discussion

The main objective of this study was to analyse the prevalence of different categories of peri-implant health and
disease in the private practice setting. The patient peri-implantitis prevalence ranged between 12% and 22%, with mucositis being a common finding (39%).

One of the main limitations of the present study is related to the research design used. Cross-sectional studies are suitable for determining the prevalence of a disease, but they cannot accurately identify its risk factors.

Most of the studies on peri-implantitis base their outcomes on samples of patients treated in Universities. This offers an important number of advantages, including homogenous samples, highly experienced and calibrated examiners, and compliant patients (follow-up visits might be financially rewarded). On the other hand, studies based on private practice are more complex and imply less controlled conditions and more heterogeneous samples. In spite of this, a study performed in a private practice should add additional information about peri-implantitis, and probably can increase the external validity of the results, as the great majority of patients are treated in private dental offices.

One of the main factors defining peri-implant disease as a highly controversial subject is that many studies base their results on implants rather than on patients. The results of the present report support this statement, as the proportion of patients with peri-implantitis (16%) was considerably higher than the percentage of affected implants (9%).

The 6th Workshop in Periodontology (Zitzmann & Berglundh 2008) recommended an epidemiological approach to peri-implantitis, using cross-sectional studies. To our knowledge, only four cross-sectional studies aiming to analyse the preva-

### Table 1. Descriptive results for the main study variables among different peri-implant health and disease groups

<table>
<thead>
<tr>
<th>Health and disease prevalence [95%CI]</th>
<th>Follow-up (years)</th>
<th>Probing depth (mm)</th>
<th>mPI (0–3)</th>
<th>mGI (0–3)</th>
<th>Bone level (threads)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>51.3% [47.8–54.2]</td>
<td>6.5 ± 4.5</td>
<td>2.2 ± 1.0</td>
<td>0.5 ± 0.7</td>
<td>0 ± 0</td>
</tr>
<tr>
<td>Clinical stability</td>
<td>18.2% [15.8–20.7]</td>
<td>6.3 ± 4.1</td>
<td>2.4 ± 1.1</td>
<td>0.5 ± 0.7</td>
<td>0 ± 0</td>
</tr>
<tr>
<td>Inflammation</td>
<td>30.7% [27.8–33.7]</td>
<td>5.8 ± 4.1</td>
<td>3.0 ± 1.2</td>
<td>1.0 ± 0.7</td>
<td>1.1 ± 0.4</td>
</tr>
<tr>
<td>Mucositis</td>
<td>21.6% [19.1–24.5]</td>
<td>5.8 ± 4.2</td>
<td>2.8 ± 1.0</td>
<td>0.9 ± 0.7</td>
<td>1.1 ± 0.4</td>
</tr>
<tr>
<td>Peri-implantitis</td>
<td>9.1% [7.5–11.1]</td>
<td>6.0 ± 3.9</td>
<td>3.5 ± 1.6</td>
<td>1.2 ± 0.7</td>
<td>1.1 ± 0.4</td>
</tr>
</tbody>
</table>

### Table 2. Health and disease prevalence in relation to the follow-up periods

<table>
<thead>
<tr>
<th>Implant-based prevalence [95%CI] and follow-up (years)</th>
<th>≥ 1 year–&lt;5 years</th>
<th>≥ 5 years–&lt;10 years</th>
<th>≥ 10 years–&lt;15 years</th>
<th>≥ 15 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>50.2% [46.0–54.7]</td>
<td>46.8% [41.7–52.5]</td>
<td>62.1% [52.4–71.1]</td>
<td>58.9% [47.9–69.9]</td>
</tr>
<tr>
<td>Inflammation</td>
<td>26.8% [21.9–32.2]</td>
<td>35.9% [31.7–40.2]</td>
<td>21.4% [15.2–28.9]</td>
<td>32.6% [29.1–36.2]</td>
</tr>
</tbody>
</table>

### Table 3. Health and disease prevalence for the different implant surfaces

<table>
<thead>
<tr>
<th>Implant-based prevalence [95%CI] and implant surface</th>
<th>Machined</th>
<th>TiUnite</th>
<th>Osseotite</th>
<th>Medium Rough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>51.3% [46.0–57.0]</td>
<td>48.0% [43.4–52.1]</td>
<td>61.1% [52.3–69.1]</td>
<td>51.0% [47.2–54.8]</td>
</tr>
<tr>
<td>Inflammation</td>
<td>26.8% [21.9–32.2]</td>
<td>35.9% [31.7–40.2]</td>
<td>21.4% [15.2–28.9]</td>
<td>32.6% [29.1–36.2]</td>
</tr>
<tr>
<td>Peri-implantitis</td>
<td>9.3% [6.3–12.9]</td>
<td>10.1% [7.6–12.9]</td>
<td>6.0% [2.7–10.1]</td>
<td>9.1% [6.8–11.3]</td>
</tr>
<tr>
<td>Follow-up (years ± SD)</td>
<td>11.25 ± 3.87</td>
<td>3.45 ± 1.94</td>
<td>5.87 ± 1.19</td>
<td>4.00 ± 2.06</td>
</tr>
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</table>

Fig. 1. Results of the implant-based analysis in a subgroup of patients (n = 29) with at least 4 implants and a diagnosis of peri-implantitis.
lence of mucositis and peri-implantitis have been published to date. Roos-Jansáker et al. (2006), in a study of 218 patients and involving a follow-up of 9–14 years, found that 16% of the patients had peri-implantitis. However, Zitzmann & Berglundh (2008) reinterpreted these results using different diagnostic criteria for peri-implantitis and stated that the prevalence in this material would be of 55.6%. Koldsland et al. (2010) likewise reported the importance of diagnostic criteria in relation to peri-implantitis outcomes. Depending on the threshold used, the prevalence of peri-implantitis ranged between 11% and 47%. Another paper by Ferreira et al. (2006), involving 221 patients and a mean follow-up of 42 months, reported a prevalence of peri-implantitis at patient level of 8.9%. This prevalence was significantly lower than that reported in the present study, probably because this study only included non-smoking patients, and the mean follow-up time was considerably shorter with 3.5 years. Rinke et al. (2011) based their investigation on patients treated in a dental private clinic and found prevalences of 11.2% and 44.9% for peri-implantitis and mucositis respectively.

All patients included in our sample followed a periodontal maintenance programme. This fact might explain the low values of the Mombelli Index, especially in the disease groups (peri-implantitis: mPl: 1.2 ± 0.7 and mGI: 1.1 ± 0.4). A higher prevalence of peri-implant diseases might be expected among non-compliant patients.

According to Mombelli & Décailliet (2011), peri-implant disease (mucositis or peri-implantitis) definitions include inflammation with or without bone loss as a requirement for diagnosis. These definitions may be excluding an important group composed of implants with clinically healthy tissues but that have lost bone support as a result of a remodeling process or after successful treatment of peri-implantitis. These fixtures can probably be maintained on a long-term basis if patients are committed to a strict periodontal maintenance programme, and if risk factors have been controlled. It can be observed that while bone level is very similar (clinical stability $2.8 \pm 1.1$ versus peri-implantitis $3.0 \pm 1.4$ threads without bone support), periodontal parameters (probing, mPl and mGI) are considerably lower in the stability group. The differences regarding bone support may increase over time, as disease progression is expected in the peri-implantitis group. Further research is needed to analyse the progression of both groups, and to determine whether changes from peri-implantitis diagnosis to a situation of clinical stability increase the long-term survival of these implants.

The present study also contributes information on the condition of implants placed in peri-implantitis diagnosed patients (i.e. patients who have at least one implant with peri-implantitis) (Fig. 1). As most risk factors [e.g. smoking and antecedents of periodontitis (Heitz-Mayfield 2008, Schwarz & Becker 2010, Serino & Ström 2009, Rinke et al. 2011)] affect all fixtures in the same manner, an evaluation was made of whether peri-implant diseases in most cases represent a generalized condition. Our findings seem to support this hypothesis, as only 11.1% of the implants placed in patients diagnosed with peri-implantitis were considered healthy.

The prevalence of peri-implantitis in private practice based patients enrolled in a periodontal maintenance programme ranges from 12% to 22%. Patients with mucositis were a common finding (39%). These prevalences are similar to those published in University environment samples. Lastly, peri-implantitis seems to be a generalized disorder, since usually most of the implants in patients diagnosed with such conditions are affected by the disease.

References


<table>
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<tr>
<th>Clinical Relevance</th>
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<tr>
<td><strong>Scientific rationale for the study:</strong> In recent years, the prevalence of peri-implant diseases has increased dramatically, becoming a genuine problem for clinicians. Very little information on the prevalence of these diseases in private practice is available.</td>
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<tr>
<td><strong>Principal findings:</strong> The prevalences of peri-implantitis and mucositis in a private practice environment are comparable to those published in University environments. Implants placed in patients who already have other implants with peri-implantitis are at a great risk of developing peri-implant disease.</td>
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<td><strong>Practical implications:</strong> Clinicians should be aware that peri-implantitis is probably the most common complication in implant dentistry. Before implant placement, patients should be informed about peri-implant diseases, and about the most important risk factors.</td>
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