

# Peri-Implantitis, A Systematic Review

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**Abstract:** *The peri-implant diseases, namely peri-implant mucositis and peri-implantitis, have been extensively studied. However, little is known about the true magnitude of the problem, owing mainly to the lack of consistent and definite diagnostic criteria used to describe the condition. The objective of the present review is to systematically estimate the overall frequency of peri-implant diseases in general and high-risk patients. Five to ten years after implantation, approximately 10% of the implants and 20% of the patients were affected by peri-implantitis. Peri-implant diseases are not uncommon following implant therapy. Long-term maintenance care for high-risk groups is essential to reduce the risk of peri-implantitis.*

**Keywords:** dental implants, peri-implantitis, peri-mucositis, prevention

## 1. Introduction

The use of oral implants to support fixed and removable prostheses is a widely accepted treatment modality of high success and predictability (1,2). Despite the high success and survival rates of oral implants, failures do occur, and implant supported prostheses may require substantial periodontal and prosthodontic maintenance over time (3). Implant failures have been traditionally described as early or late. Early failures occur before implant loading and could be caused by surgery-, implant-, or host-related factors. Late failures, on the other hand, occur after prosthodontic rehabilitation as a result of periimplant disease or biomechanical overload (4). Peri-implant disease is thought to result in bone loss around the implants and subsequent loss of osseointegration (5). An accurate estimate of the true prevalence of peri-implant disease, however, remains controversial. The inconsistencies in defining and reporting its two common forms, peri-implant mucositis and peri-implantitis, are very apparent (6). The term peri-implantitis first appeared in the literature in a study by Mombelli et al. (7). It was described as an infectious disease with many features common to periodontitis. Since then, a growing interest in defining peri-implant disease as a clinical entity and proposing a treatment approach for it has been observed. The multifaceted etiology and varied characteristics of the disease, however, resulted in lack of consensus in defining peri-implant disease from a clinical perspective. For example, two consensus reports (8) define peri-implant mucositis as an inflammatory response limited to the soft tissues surrounding a functioning oral implant, whereas peri-implantitis elicits an inflammatory response that involves loss of marginal bone around a functioning oral implant. These reports, however, failed to set rigid clinical parameters that could be used to diagnose the two conditions. Furthermore, the 3rd International Team for Implantology Consensus Conference (9) presented similar definitions, and additional diagnostic parameters were also suggested. Accordingly, the presence of plaque and suppuration, bleeding on probing (BOP), and probing depth (PD) >5 mm were required to define peri-implantitis. Analysis of peri-implant sulcular fluid was also included as a diagnostic aid for periimplantitis, albeit without indicating a specific marker for it. Other variations of the above diagnostic criteria for peri-implant diseases also exist in the

literature. For example, peri-implant mucositis was diagnosed based on the presence of BOP/suppuration and PD >4 mm, whereas peri-implantitis required PD >5 mm and radiographic bone loss of >0.2 mm annually or progressive bone loss of >3 threads combined with signs of peri-implant mucositis (10). The prevalence of peri-implant diseases has been reported in the literature (11). However, considerable variations among these studies are noted. In a systematic review (12) the biologic and technical complications in oral implant therapy were summarized by reviewing a large number of longitudinal prospective studies. Peri-implantitis, was reported in 6.47% of the implants included in their review (13). In contrast, other authors (14) showed that the frequency of peri-implantitis varied between 28% and 56% of the participants and 12% and 43% of individual implants. The causes for the discrepancy in the results reported in these systematic reviews could be the lack of standardized criteria for diagnosing peri-implant mucositis and peri-implantitis, the different implant systems used, or the differences in the observation periods. The aim of this article was to systematically review the current literature to estimate the prevalence and incidence of peri-implant disease and determine the risk factors associated with its development in patients receiving oral implant treatment.

## 2. Material and Methods

Studies were selected if they prospective, retrospective, cross-sectional, and observational cohort study reporting the number of cases of peri-implant mucositis and/or peri-implantitis using specific clinical parameters; The relevant articles were retrieved from the following electronic databases: 1) MEDLINE; 2) Embase; 3) Cochrane.

## 3. Results

Peri-implantitis is such a recent phenomenon that there is still virtually no dependable data on the prevalence of the infection. Estimates put its incidence at around 1% per year. The question of how frequently periimplant disease crops up is not easy to answer. To begin with, there is a lack of specially designed epidemiological studies on the topic. As a result we can only infer the number from retrospective

cohort studies. Next, studies define peri-implantitis differently, so results cannot always be compared between studies. Third, the frequency of peri-implantitis in a patient group is subject to diverse factors; therefore, the frequency differs by patient group.

The definition of peri-implantitis, of course, plays a crucial role in calculating the prevalence and incidence (15). Peri-implantitis is such a recent medical condition that it was rarely treated as a biological complication in studies published prior to 2000. Soft tissue lesions were specified in a small number of cases, but not defined, or peri-implantitis was defined according to a few arbitrary radiological bone heights, which were made public after a conference in 1986 (16). Therefore, data originating from earlier studies frequently cannot be used to ascertain the prevalence of peri-implant disease. In addition to bone loss, there is now also probing pocket depth (PPD) as a relevant clinical parameter, especially when the goal is to diagnose peri-implantitis at an early stage. An increasing probing pocket depth is very likely the first indication of the onset of peri-implantitis and suggests the need for a radiographic examination of the state of the bone. Different studies have defined different probing pocket depth thresholds for diagnosing peri-implantitis. As a rule, a probing pocket depth of  $\geq 5$  mm has been taken as a basis for an early indication or Stage 1 peri-implantitis, and a probing pocket depth of  $\geq 6$  mm for more advanced peri-implantitis. (Stage 2). Different thresholds for the probing pocket depth inevitably change the recorded prevalence of the disease. For example, in a contemporary study (17) involving a group of 70 patients with treated periodontitis and with implants averaging eight years, it was observed that 22.2% of the implants were affected by Stage 1 peri-implantitis (PPD  $\geq 5$  mm) in a high percentage of the patients (36.8%). If the peri-implantitis threshold had been set at a probing pocket depth of  $\geq 6$  mm (Stage 2), the peri-implantitis prevalence would have decreased to 8.8% in 17.1% of the patients. In corollary, this means that peri-implantitis affecting one in twelve implants was diagnosed in one in six patients after an eight year "incubation period".

Prevalence subject to patient group: Researchers have listed the risk factors for peri-implantitis in their articles. The presence of these risk factors e.g., smoking, previous periodontitis, hard-to-clean reconstructions and cement residue from implant-supported crowns – also affects the prevalence of peri-implantitis in a patient group. As an example, residual cement from implantsupported crowns initiated periimplantitis in 85% of patients prone to periodontitis, whereas prevalence was only 1.08% in control patients with screw-retained crowns. On the other hand, after removal of residual cement, fiber-optic magnification revealed no further peri-implantitis in 74% of patients. Peri-implant disease correlates strongly with patient susceptibility to periodontal disease (18). Prevalence in susceptible patients can be influenced by residual periodontal pockets following active periodontal treatment or untreated periodontal pockets.

As the studies included in the analysis were heterogeneous, no meta-analysis could be performed, and no unequivocal, exact and relevant proportion of implants could be calculated following a specific peri-implant disease

"incubation period." The analysis therefore concentrated on describing all the relevant studies, and it was estimated that "five to ten years after implantation, approximately 10% of the implants and 20% of the patients were affected by peri-implantitis." It needs to be taken into account, however, that this cumulative prevalence of about 1% per year of "incubation" is a very rough estimate subject to the above-mentioned "patient specific" risk factors (19).

Estimation of the incidence: To calculate the assumed incidence of peri-implantitis would necessitate accurately defining an additional peri-implantitis symptom – most likely the loss of bone of  $\geq 2$ mm within a specific time period. From the prevalence we can only speculate that the incidence of new cases of peri-implantitis is around 1% per year.

#### 4. Conclusion

Considering that millions of oral implants are placed annually peri-implant disease can affect more than half a million implants each year. Therefore, clinicians and patients must be prepared to accept long-term, regular maintenance care to identify early signs of the disease and develop treatment strategies, particularly for those at high risk. Although the relationship between peri-implant mucositis and peri-implantitis is still not fully understood, regular follow-up care may also allow early intervention that may halt the potential progression of peri-implant mucositis into peri-implantitis. Researchers and clinicians should be strongly encouraged to adhere to standardized guidelines for reporting observational and clinical data and use precise and clear diagnostic criteria that may allow a better understanding of the overall effect of periimplant diseases. Long-term maintenance care for high-risk groups is essential to reduce the risk of peri-implantitis. Informed consent for patients receiving implant treatment must include the need for such maintenance therapy. However a meticulous attention to the hygienic conditions and the adoption of a systematic follow-up schedule are necessary. Further long-term studies are needed in order to achieve a better understanding of risk factors for peri-implant mucositis and peri-implantitis and validate effective preventive and therapeutic protocols.

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