

General genetic and acquired risk factors, and prevalence of peri-implant diseases – Consensus report of working group 1

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Abstract: For decades, oral implants have been used successfully for the replacement of missing teeth. Nevertheless, peri-implant diseases have become an increasingly important issue in daily practice. In this working group, the prevalence of peri-implant mucositis and peri-implantitis, as well as different general risk factors and their impact on the onset and progression of peri-implant diseases, were discussed based on reviews reflecting the current state of evidence. The influence of smoking on the peri-implant bone-healing process and its association with peri-implantitis has been explored in the current literature, demonstrating that smoking is an important risk indicator for the development of peri-implantitis and implant loss. Compared with non-smokers, smokers have a higher potential for pathological peri-implant bone loss, which is also influenced by poor oral hygiene. Despite the fact that a growing number of genetic polymorphisms have been identified and related to periodontal diseases, there are still no genetic patterns that could act as adjuncts to clinical diagnostics in order to identify patients at higher risk of peri-implant diseases. Long-term medications, such as bisphosphonate therapy (> 3 years), may have an impact on implant loss. A higher incidence of implant failure was reported in patients using selective serotonin reuptake inhibitors in anti-depression therapy. Alcoholism (defined as more than 5 units a day) has been associated with implant loss in retrospective and case-control studies, as well as in animal studies.

Key words: Peri-implantitis, peri-implant mucositis, risk factors, genetic risks, acquired risk factors, smoking

INTRODUCTION

Implants are valuable tools in dental therapy for the replacement of missing teeth. Peri-implant diseases are caused by an oral bacterial biofilm, which elicits a local inflammatory response leading to the destruction of the peri-implant soft and hard tissues^{1,2}. During recent years, peri-implant diseases have become an increasingly important issue in daily practice and often present challenging problems for dentists. This working group addressed the prevalence of peri-implant mucositis and peri-implantitis, as well as different general risk factors and their impact on the onset and progression of peri-implant diseases, based on reviews reflecting the current state of evidence.

The aim of the review written by G. Salvi *et al.* was to summarise the evidence on the prevalence of peri-

implant diseases. The manuscript was based on a literature search performed in MEDLINE via the PubMed database where all articles published before March 2018 were included, using Medical Subject Heading (MESH) search terms complemented by additional terms and their combinations. A wide range of prevalence of peri-implant diseases is reported in the literature. Differences in case definitions affect the reported extent and severity of peri-implant diseases and make comparisons among studies difficult. Convenience samples rather than randomly selected population samples were often analysed to estimate the prevalence of peri-implant diseases³.

The contribution of host response and genetic traits to the development of peri-implantitis, and possible associations between polymorphisms in various genes and predisposal to peri-implant lesions were addressed

by I. Fourmouis and M. Vlachos. The identification of genetic biomarkers associated with peri-implantitis risk could be valuable in daily clinical practice. However, no robust conclusions could be drawn from the current literature. The differences in study designs necessitate further trials using larger population samples from different ethnic groups⁴.

For the evaluation of smoking as a risk factor for peri-implant diseases, P. Casado *et al.* performed a comprehensive search in MEDLINE via the PubMed database of the United States' National Library of Medicine, for articles published before March 2018. All searches were performed using medical subject headings or free text words. After screening, data extraction and duplicate removal from 972 articles, 19 were included. Based on the evaluation, smoking is a risk factor for peri-implant disease development, and increases susceptibility to peri-implant disease⁵.

The goal of P. Kumar's review was to examine the impact of extrinsic factors that might increase risk at both subject- and site-level. Retained cement was associated with soft tissue inflammation and bone loss in implants. Methacrylates in particular were more commonly retained and caused suppuration and bleeding. This was amplified in the presence of periodontitis. Biopsies revealed the presence of cement particles embedded in peri-implant soft tissues, surrounded by a dense inflammatory infiltrate. Moreover, removal of the cement resulted in resolution of the inflammation. Certain systemic diseases, medications such as selective serotonin reuptake inhibitors (SSRIs), radiotherapy, alcoholism, and poor oral hygiene and compliance with periodontal maintenance therapy increase the risk for peri-implantitis. As stated by Kumar, all the reviews concluded that periodontitis increased the risk of peri-implantitis by 4.7- to 9-fold [95% confidence interval (CI): 3.9–20.6]. Also the relationship of the restoration to the fixture appears to significantly increase the risk of peri-implantitis⁶.

SUMMARY STATEMENTS IN THE AREAS OF PERI-IMPLANT DISEASE PREVALENCE, GENETIC AND ACQUIRED RISK FACTORS, AS DEVELOPED BY WORKING GROUP 1 DURING THE FDI CONSENSUS MEETING

Prevalence of peri-implant mucositis and peri-implantitis

What is the current prevalence of peri-implant mucositis?

A subject-based weighted mean prevalence of peri-implant mucositis of 43% (CI: 32%–54%) has been reported⁷. The meta-analysis included

longitudinal studies with 100–662 subjects, and a mean function time ranging from 3.4 to 11.0 years⁷.

What is the current prevalence of peri-implantitis?

A subject-based weighted mean prevalence of peri-implantitis of 22% (CI: 1%–47%) has been reported. An implant-based weighted mean prevalence was not reported. The mean implant-based prevalence of all implants included was 12.8%, ranging from 0.4%–36.6%. The meta-analysis included longitudinal studies with 100–662 subjects, and a mean function time ranging from 3.4 to 11.0 years⁷.

Renvert *et al.*⁸ reported peri-implantitis prevalence in 22.1% of subjects at 21–26 years after insertion (mean: 23.3 years).

What is the influence of time after insertion on the development of peri-implantitis?

A significant positive relationship between the prevalence of peri-implantitis and mean function time (coefficient: 0.044, *P*-value < 0.001) was reported⁷. Renvert *et al.* (2018) detected that the absence of peri-implant mucositis after 9–14 years of function is a strong predictor of further peri-implant health (after 20–26 years, *pv* = 0.89)⁸.

What is the current prevalence of peri-implantitis and implant loss in patients with/without a history of periodontitis?

A statistically significantly higher risk for peri-implantitis [risk ratio (RR): 2.17, 95% CI: 1.51–3.12] has been reported in patients with a history of treated periodontitis compared with patients without periodontitis⁹.

Patients with a history of treated periodontitis show a statistically significantly higher risk for implant loss (RR: 1.69, 95% CI: 1.31–2.17) compared with patients without periodontitis⁹.

Susceptibility to peri-implantitis

Are age, gender and race/ethnicity risk determinants for peri-implantitis?

There is currently no evidence to support the association between these risk determinants and peri-implantitis.

Are there genetic risk indicators or groups of genetic risk indicators for peri-implantitis?

Although a remarkable number of genes (and their polymorphisms) have been investigated for their association with peri-implantitis, no decisive results have been shown.

Is there a rationale for genetic testing of patients who are candidates for implant therapy?

Not presently. There is a compelling need for further well-designed studies using larger population samples in different ethnic groups.

The impact of tobacco smoking on peri-implantitis

What is the risk posed by tobacco smoking in terms of peri-implantitis?

Tobacco smokers tend to develop peri-implantitis earlier than never-smokers, and present a fourfold higher risk of peri-implantitis after 5 years. Therefore, smoking cessation counselling is highly recommended.

What is the difference in peri-implantitis prevalence between current smokers, former smokers and never-smokers?

The prevalence of peri-implantitis in current-smokers is reported to be at least four times higher than never- and former smokers.

What is the difference in implant loss between smokers and non-smokers?

Smokers have a 2.25 times higher risk of losing a functionally loaded implant compared with non-smokers following implant placement in native bone. This risk increases to 3.61 when implants are placed in augmented bone. Smokers with poor oral hygiene display a higher risk for progressive bone loss when compared with non-smokers with similar oral hygiene levels.

What is the synergy between smoking and other factors?

Roughened implant surfaces, maxillary location of implants, therapy with SSRIs, diabetes, periodontitis, osteoporosis and radiotherapy can be considered as confounding factors¹⁰.

Does smoking change the outcome of implant therapy in conjunction with bone augmentation procedures?

Bone augmentation procedures in smokers are less successful, because of the formation of poor-quality bone and increased rate of bone loss.

Systemic and behavioral risk indicators of peri-implantitis

What are the systemic and behavioral risk indicators of peri-implantitis?

The strongest risk indicators are poor oral hygiene and lack of compliance with maintenance therapy, as well as a history of periodontitis and untreated periodontitis.

Risk for peri-implantitis is increased by long-term use of non-steroidal anti-inflammatory drugs (3.2 ×), bisphosphonates (2.69 ×) and SSRIs (6.28 ×), as well as alcohol use (> 5 units per day; 2.3 ×).

Uncontrolled or poorly controlled diabetes Type 2 increases the risk by 2.75 times.

Smoking (see above).

Head and neck irradiation therapy significantly lowers implant survival rates by 2.63-fold, especially if the implant is placed within 12 months of radiation. The survival is independent of the radiation dose.

CONCLUSIONS

- There is sufficient evidence to conclude that a number of general risk factors have an impact on the short- and long-term success of implant therapy.
- Among them, smoking, periodontal disease and medications are modifiable factors, which if detected well in advance before implant insertion may considerably improve long-term stability.
- Thus, meticulous evaluation of the individual anamnesis is one of the important factors to realise before implant therapy.
- In addition, a periodontal examination is required in order to document the local periodontal condition of the dentition. Patients with a history of periodontal disease should be informed about their increased risk for the development of peri-implant diseases.
- In the presence of periodontitis, successful local treatment is of great importance in order to eliminate local niches and achieve periodontal health before implant insertion.
- If treatment success cannot be accomplished, the therapeutic concept comprising implant insertion should be changed and no implant should be placed.
- Smokers should receive smoking cessation counselling, and in a similar way alcoholism should be treated to reduce risk and improve the long-term success of implant therapy. This should be accompanied by frequent maintenance care visits to detect early changes in periodontal and peri-implant health.

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Conflict of interest

The authors have no conflicts of interest to declare.

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