

Primary prevention of peri-implantitis: Managing peri-implant mucositis

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Abstract

Aims: Over the past decades, the placement of dental implants has become a routine procedure in the oral rehabilitation of fully and partially edentulous patients. However, the number of patients/implants affected by peri-implant diseases is increasing. As there are – in contrast to periodontitis – at present no established and predictable concepts for the treatment of peri-implantitis, primary prevention is of key importance. The management of peri-implant mucositis is considered as a preventive measure for the onset of peri-implantitis. Therefore, the remit of this working group was to assess the prevalence of peri-implant diseases, as well as risks for peri-implant mucositis and to evaluate measures for the management of peri-implant mucositis.

Methods: Discussions were informed by four systematic reviews on the current epidemiology of peri-implant diseases, on potential risks contributing to the development of peri-implant mucositis, and on the effect of patient and of professionally administered measures to manage peri-implant mucositis. This consensus report is based on the outcomes of these systematic reviews and on the expert opinion of the participants.

Results: Key findings included: (i) meta-analysis estimated a weighted mean prevalence for peri-implant mucositis of 43% (CI: 32–54%) and for peri-implantitis of 22% (CI: 14–30%); (ii) bleeding on probing is considered as key clinical measure to distinguish between peri-implant health and disease; (iii) lack of regular supportive therapy in patients with peri-implant mucositis was associated with increased risk for onset of peri-implantitis; (iv) whereas plaque accumulation has been established as aetiological factor, smoking was identified as modifiable patient-related and excess cement as local risk indicator for the development of peri-implant mucositis; (v) patient-administered mechanical plaque control (with manual or powered toothbrushes) has been shown to be an effective preventive measure; (vi) professional intervention comprising oral hygiene instructions and mechanical debridement revealed a reduction in clinical signs of inflammation; (vii) adjunctive measures (antiseptics, local and systemic antibiotics, air-abrasive

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Conflict of interest and source of funding

Funds for this workshop were provided by the European Federation of Periodontology in part through unrestricted educational grants from Johnson & Johnson and Procter & Gamble. Workshop participants filed detailed disclosure of potential conflict of interest relevant to the workshop topics and these are kept on file. Declared potential dual commitments included having received research funding, consultant fees and speakers fee from: Colgate-Palmolive, Procter & Gamble, Johnson & Johnson, Sunstar, Unilever, Philips, Dentaïd, Ivoclar-Vivadent, Heraeus-Kulzer, Straumann.

devices) were not found to improve the efficacy of professionally administered plaque removal in reducing clinical signs of inflammation.

Conclusions: Consensus was reached on recommendations for patients with dental implants and oral health care professionals with regard to the efficacy of measures to manage peri-implant mucositis. It was particularly emphasized that implant placement and prosthetic reconstructions need to allow proper personal cleaning, diagnosis by probing and professional plaque removal.



Dental implants supporting dental restorations are part of the oral environment of a significant proportion of the population and thus, prevention of peri-implant diseases should be part of overall oral health care. There is great variation regarding the age of patients treated with dental implants and the type and extent of implant-supported restorative procedures.

Definitions of peri-implant diseases were agreed upon at previous European Workshops on Periodontology (Lindhe & Meyle 2008, Lang & Berglundh 2011). The key parameter for diagnosis for peri-implant mucositis is bleeding on gentle probing (<0.25 N). It is assumed that

peri-implant mucositis is the precursor to peri-implantitis, as is gingivitis for periodontitis, and that a continuum exists from healthy peri-implant mucosa to peri-implant mucositis and to peri-implantitis. Therefore, prevention of peri-implant diseases involves the prevention of peri-implant mucositis and the prevention of the conversion from peri-implant mucositis into peri-implantitis by treatment of existing peri-implant mucositis (Salvi & Zitzmann 2014).

The remit of this working group was to assess the current epidemiology of peri-implant diseases, potential risks contributing to the development of peri-implant mucosi-

tis, and the effect of patient and professionally administered measures to manage peri-implant mucositis. This consensus report is based on four systematic reviews and on the expert opinion of the participants.

Peri-implant Health and Disease – Current Epidemiology

In a systematic review, the prevalence, extent and severity of peri-implant diseases were assessed (Derks & Tomasi 2015).

As case definitions varied, the prevalence (based on subject-level) of peri-implant mucositis and peri-implantitis ranged from 19 to 65%

and from 1 to 47% respectively. Meta-analysis estimated a weighted mean prevalence of peri-implant mucositis of 43% (CI: 32–54%) in 1196 patients and 4209 implants. The weighted mean prevalence of peri-implantitis was 22% (CI: 14–30%), estimated in 2131 patients and 8893 implants. Studies were performed in eight different countries in Europe, South and North America.

The proportion of patients and implants with healthy peri-implant mucosa was not reported and could not be estimated from the presented data. Data on extent and severity of disease were rarely presented. Analysis in the review also revealed a positive relationship between prevalence of peri-implantitis and function time and a negative relationship between prevalence of peri-implantitis and threshold for bone loss (i.e. smaller prevalence data resulted when greater bone loss was set as threshold).

The systematic review identified a number of shortcomings in the included studies. Case definitions varied significantly. All studies were based upon convenience samples of limited sample size and a variation of follow-up. Estimates of prevalence and incidence should ideally be made on randomly selected patient samples of sufficient size and follow-up time to ensure accuracy.

What is the best clinical measure to distinguish between peri-implant health and disease?

Although bleeding on probing was a consistently used parameter in the studies included in the systematic review, case definitions frequently applied other parameters (e.g. probing depth) resulting in inconsistent distinction between health and disease. As bleeding on probing is an indicator for inflammation in the peri-implant mucosa, standardized sulcular or pocket probing assessment should be considered as the current clinical measure to distinguish between peri-implant health and disease.

Is there a need for defining severity and extent of peri-implant disease?

The present review identified few reports that presented information on frequencies of different degrees

of bone loss in peri-implantitis. Considerations should be given to the value of such severity indices. Extent of disease must include proportions of affected implants per patient in the presence of multiple implants.

What is the risk for conversion from peri-implant mucositis to peri-implantitis?

There is emerging evidence on the patient level from a retrospective study that the lack of annual supportive therapy in patients diagnosed with peri-implant mucositis was associated with increased risk for conversion of mucositis to peri-implantitis (Costa et al. 2012). After 5 years, 18% of the patients complying with supportive therapy presented with peri-implantitis, while the corresponding proportion in patients who did not adhere to supportive therapy was 43.9%.

Risk Indicators for Peri-implant Mucositis

A risk factor is defined as “an environmental, behavioural or biological factor that if present directly increases the probability of a disease occurring and, if absent or removed reduces that probability” (Genco 1996). In the absence of studies fulfilling the demands in the assessment of risk factors, a systematic review evaluated risk indicators for peri-implant mucositis based on cross-sectional and pre-clinical *in vivo* studies (Renvert & Polyzois 2015). Addressing aetiology, seven experimental and two cross-sectional studies demonstrated that plaque accumulation on implants resulted in peri-implant mucositis. The review assessed systemic/patient-related and local risk indicators for peri-implant mucositis.

What are the systemic/patient-related risk indicators for the development of peri-implant mucositis?

Smoking was identified as an independent risk indicator for peri-implant mucositis. A single study of limited size indicated that exposure to radiation therapy was associated with mucositis. One study identified diabetes as well as gender to be risk indicators for mucositis, while two cross-sectional studies described

function time of implants as a risk indicator for peri-implant mucositis.

What are the local risk indicators for the development of peri-implant mucositis?

Results from pre-clinical *in vivo* studies failed to demonstrate an effect of design and surface characteristics of the trans-mucosal portion of implants on the development of peri-implant soft tissue inflammation. The effect of the dimensions of keratinized tissues (distance between peri-implant mucosal margin and the muco-gingival junction) on the development of peri-implant mucositis is inconclusive.

Some evidence exists indicating that excess cement is a risk indicator for peri-implant mucositis.

Efficacy of Measures to Manage Peri-implant Mucositis

It is understood that patient-administered measures are usually performed in conjunction with professionally administered plaque removal procedures. For the purpose of this workshop, two systematic reviews were performed to evaluate the two procedures separately. One study evaluated the efficacy of patient-administered (Salvi & Ramseier 2015), and another one the efficacy of professionally administered measures (Schwarz et al. 2015) for plaque control in patients with peri-implant mucositis.

What are effective ways to prevent peri-implant mucositis – “primary prevention”?

At present, there are no studies available for the primary prevention of peri-implant mucositis. This is in contrast to the primary prevention of gingivitis, in which documentation exists for frequency of complete plaque removal required to maintain gingival health (Lang et al. 1973).

What are effective ways of patient-performed plaque control in the management of peri-implant mucositis?

In the systematic review on the efficacy of patient-administered measures, eleven RCTs with a follow-up from 3 to 24 months were included (Salvi & Ramseier 2015). Three major groups of treatment were identified, i.e. mechanical plaque removal

by means of manual or powered toothbrushes, chemical plaque control by means of adjunctive delivery of antimicrobials and triclosan-containing toothpastes. According to the consensus report of the VIII European Workshop (Sanz & Chapple 2012), the endpoint of therapy and *primary outcome* should be the resolution of peri-implant mucosal inflammation (frequency distribution of resolved lesions) as determined by the absence of BoP. Although complete resolution following patient-administered measures was not always reported, a reduction of clinical signs of inflammation as *secondary outcome* was evident in all studies. One study reported the percentage of implants with complete resolution of peri-implant mucositis. Manual brushing with or without adjunctive chlorhexidine gel was investigated over 3 months and 38% of the patients/implants were found with complete resolution of peri-implant mucositis (Heitz-Mayfield et al. 2011).

There were a variety of control treatments that had been used for comparison indicating that there is a lack of an accepted standard of care. All studies were designed as parallel arm RCTs and six of 11 had an observation time of 6 months, which is in line with the recommendations given in a previous consensus (Sanz & Chapple 2012). Study quality was analysed according to the Cochrane collaboration tool for assessing the risk of bias, and only four of the 11 studies achieved at least 80% of positive answers. Thus the results should be interpreted with caution.

What are effective ways of professional plaque control in the management of peri-implant mucositis?

In the systematic review on the efficacy of professionally administered plaque removal, seven RCTs were included (48.6% revealing high risk of bias) mainly employing a parallel group design, and BoP reduction was defined as the *primary outcome*. The definition of peri-implant mucositis was heterogeneous among studies but commonly included positive BoP at the respective sites. Case definitions were not reported in two of the studies evaluated.

Professional intervention mainly comprised oral hygiene instructions, mechanical debridement applying a variety of different hand or powered instruments and/or polishing tools and revealed a reduction in clinical signs of inflammation, while resolution of BoP on the subject level was not achieved.

Adjunctive measures (antiseptics, local and systemic antibiotics, air-abrasive devices) were not found to improve the efficacy of professionally administered plaque removal in reducing clinical signs of inflammation.

Is Resolution of Peri-implant Mucositis Achievable?

Both systematic reviews demonstrated that resolution of peri-implant mucositis is possible. However, current data also indicate that resolution of inflammation was not achieved in all patients. Experimental peri-implant mucositis was significantly reversed by professionally administered plaque removal and reinstitution of oral hygiene practices conducted over 3 weeks (Salvi et al. 2012).

What is the current standard of care for patient- and professionally administered plaque control for the management of peri-implant mucositis?

Patient-administered mechanical plaque control is an effective preventive measure. Chemical plaque control either by oral rinses or a dentifrice tested to date had limited adjunctive effect. Patient-administered mechanical plaque control alone (with manual or powered toothbrush) should be considered the current standard of care.

Professionally administered plaque control procedures should include regular (based on the individual needs) oral hygiene instructions and mechanical debridement employing different hand or powered instruments with or without polishing tools.

Limitations of Available Research

Meta-analysis was applied in two of the reviews presented in this working group (Derks & Tomasi 2015, Schwarz et al. 2015). The group highlighted that meta-analytic methods per se do not always strengthen the

level of the available scientific evidence, but rather facilitate its understanding. Recommendations (e.g. PRISMA, MOOSE) for systematic reviews including meta-analysis should be carefully considered.

The reviews identified some limitations of the included studies. For epidemiological studies as well as studies on intervention, the main issues were (i) the variation in case definition, (ii) the variation in sampling and sample size and (iii) the limited follow-up time. In addition, studies included in the two reviews on management of peri-implant mucositis showed varying risks of bias (according to the Cochrane checklist). A lack of standard control treatment for mucositis was apparent. Included studies assessed efficacy of interventions in highly controlled clinical settings. Such studies may not allow the evaluation of effectiveness in general populations. Comparisons of dichotomous and ordinal outcome variables were often based on group averages rather than analysis of frequency distributions.

Recommendations for Research

In a previous consensus report focusing on quality of reporting (Sanz & Chapple 2012) recommendations for future research on epidemiology and prevention of peri-implant diseases were given. The present working group strongly supports these previous recommendations. For epidemiological studies, establishment of national/regional implant databases was advocated. Studies should be adequately powered, randomly sampled and consider sufficient follow-up. Risk assessments should include a multiple-step process and aim at establishing causality by addressing criteria such as those proposed by Hill (1965).

The working group identified the need for defining and reporting peri-implant health (e.g. absence of bleeding on probing) and incidence of disease from prospective cohort studies.

For intervention trials, appropriate endpoints, i.e. resolution of inflammation at the given site, as well as the lack of standard control treatment were identified as critical issues. Therapeutic measures demonstrating efficacy in properly designed RCT studies should be evaluated in field studies. The com-

parison of clinical parameters should be based on changes rather than absolute values. Data management should consider multiple and multi-level logistic regression models to correctly address binary and ordinal data.

Areas of interest for future research are as follows:

- Primary prevention of peri-implant mucositis
- Risk assessment
- Importance of attached/keratinized tissue
- Efficacy of interproximal cleaning
- Further evaluation of adjunctive measures
- Individualized supportive therapy

Recommendations for Dental Professionals

According to the present data, peri-implant diseases are very common. Therefore, it is imperative for the clinician to examine and evaluate patients who have been provided with implant-supported restorations on a regular basis. The following aspects are recommended for the clinical routine:

- When implant treatment is considered, patients should be informed on the risks for biological complications (peri-implant diseases) and the need for preventive care.
- An individual risk assessment including systemic and local risk indicators should be performed and modifiable risk factors, such as residual increased probing pocket depth in the remaining dentition or smoking, should be eliminated. Hence, treatment of periodontal disease aiming for elimination of residual pockets with bleeding on probing and smoking cessation should precede implant placement
- The correct fit of implant components and the suprastructure has to be ensured to avoid additional niches for biofilm adherence. If cemented implant restorations have been selected, the restoration margins should be located at the

mucosal margin to allow meticulous removal of excess cement.

- Clinicians have to be aware that implant placement at a submucosal level (to hide crown margins) may carry a higher risk for peri-implant diseases.
- To facilitate personal oral hygiene, clinicians should consider having keratinized attached and unmovable tissue surrounding the transmucosal implant portion already during implant placement (for one-stage implant placement) or during abutment connection (for two-stage implant placement).
- Since infection control is essential in the prevention of peri-implant diseases, patients have to be instructed on their personal oral hygiene with regular monitoring and reinforcement.
- Implant position should be selected and suprastructures should be designed in a way facilitating sufficient access for regular diagnosis by probing as well as for personal and professional oral hygiene measures.
- Professional supportive care should be established according to the individual needs of the patient (e.g. 3-, 6- or 12-month recall intervals) and their compliance has to be confirmed.
- Particularly in patients with a history of treated aggressive periodontitis indicating an increased susceptibility for periodontal and peri-implant diseases, shorter recall intervals should be considered.
- During recall peri-implant tissues must be regularly examined including probing assessments with special emphasis on bleeding on probing.

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Clinical relevance

Background: In the absence of established and predictable treatment concepts for peri-implantitis, prevention is of uppermost importance.

Principal findings: Peri-implant diseases are highly prevalent. Bleeding on probing can distinguish between peri-implant health and disease.

Plaque accumulation is an aetiological factor and smoking and excess cement are modifiable risk indicators for the development of peri-implant mucositis. Both patient- and professionally administered mechanical measures for plaque removal are effective for the reduction of inflammation in the peri-implant mucosa.

Conclusions: Successful management of peri-implant mucositis should comprise proper diagnosis by regular probing as well as effective self-performed and supportive professional plaque removal.