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The Open Dentistry Journal, **2015**, *9*, 393-395

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A Classification Proposal for Peri-Implant Mucositis and Peri-Implantitis: A Critical Update

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Abstract: Definitions of peri-implant mucositis and peri-implantitis vary in the literature, and no clear criteria have been established for the diagnosis and treatment of such disorders. This study proposes a classification for peri-implant mucositis and peri-implantitis based on the severity of the disease, using a combination of peri-implant clinical and radiological parameters to classify severity into several stages (Stage 0A and 0B = peri-implant mucositis, and Stage I to IV = peri-implantitis). Following a review of the literature on the subject and justification of the proposed peri-implant disease classification, the latter aims to facilitate professional communication and data collection for research and community health studies.

Keywords: Classification, dental implant, disease, peri-implant mucositis, peri-implantitis, peri-implant.

INTRODUCTION

In 1986, Albrektson *et al.* [1] introduced the widely accepted criteria for implant success, accepting 0.2 mm of bone loss annually after the first year and 85% and 80% success rates after 5 and 10 years, respectively. Various degrees of marginal bone loss are normally seen around dental implants, probably reflecting remodeling / adaptation following surgery and during loading. In general, up to 1.5 mm of bone is lost during the first year of function, followed by a period of minimal annual bone loss [2]. A number of authors [3-5] have estimated that peri-implant bone loss occurs progressively over the first three years. Vandeweghe *et al.* [6], in a prospective study of bone loss in 15 implants, showed bone remodeling to continue for 6 months, after which no further changes were observed, with stabilization of bone loss at 1 mm.

The Sixth European Workshop on Periodontics 2008 [7], held in Göteborg (Sweden), defined peri-implant mucositis as the presence of inflammation of the peri-implant mucosa without signs of supporting bone loss, while peri-implantitis was defined as the presence of supporting bone loss in addition to inflammation of the mucosa [7]. In turn, the Seventh European Workshop on Periodontics 2011, held in Segovia (Spain), specified that the key feature of peri-implant mucositis is the presence of bleeding upon probing, while the key feature of peri-implantitis comprises changes in bone crest level associated to bleeding upon probing [8]. According to the latest definition of the American Academy of Periodontology [9], peri-implant mucositis is a disease in which the presence of inflammation is confined to the soft tissues surrounding a dental implant, with no signs of loss of supporting bone following initial bone remodeling during healing, while peri-implantitis is characterized as an inflammatory process around an implant, including both soft tissue inflammation and progressive loss of supporting bone beyond biological bone remodeling [10].

Peri-implant probing is essential for establishing a diagnosis of peri-implant disease. Conventional peri-implant probing under appropriate conditions of pressure, such as 0.25 N, does not cause tissue damage [11]. In addition, parallelized intraoral X-rays should be used in all dental implants to determine possible marginal bone loss, and confirmed bone loss moreover should be quantified. These periapical X-rays must be obtained at implant placement and prosthesis installation in order to allow comparisons with the periapical X-rays obtained on occasion of the periodic patient controls.

Definitions of peri-implantitis and peri-implant mucositis vary in the literature, and no clear criteria have been established for the diagnosis and treatment of these disorders [12]. The use of different thresholds referred to probing depth and radiographic bone loss for defining peri-implant diseases gives rise to considerable variability in the reported prevalence of peri-implant diseases. The reported prevalence of peri-implant mucositis varies between 36.3% [13] and 64.6% [14], while the prevalence of peri-implantitis ranges from 8.9% [14] to 47.1% [15]. According to Hallström *et al.* [16], the infectious etiology of peri-implant mucositis is well documented [17-19]. Peri-implant mucositis has been defined as the presence of bleeding in response to probing [13-15, 20-23], while other authors [14, 20, 21, 24] add the presence of purulent secretion to the definition. The specified probe depth varies between ≥ 4 mm and ≥ 5 mm [14, 20-22]. Other studies [15, 23, 25] have added the condition of no bone loss to the definition of mucositis, while other investigators propose higher defining thresholds such as radio-

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1874-2106/15

Table 1. Proposed classification of peri-implant mucositis.

Staging	Definition
Stage 0A	PPD ≤ 4 mm and BoP and/or SUP, with no signs of loss of supporting bone following initial bone remodeling during healing
Stage 0B	PPD > 4 mm and BoP and/or SUP, with no signs of loss of supporting bone following initial bone remodeling during healing

PPD = probing pocket depth; BoP = bleeding on probing; SUP = suppuration

Table 2. Proposed classification of peri-implantitis.

Staging	Definition
Stage I	BoP and/or SUP and bone loss ≤ 3 mm beyond biological bone remodeling
Stage II	BoP and/or SUP and bone loss > 3 mm and < 5 mm beyond biological bone remodeling
Stage III	BoP and/or SUP and bone loss ≥ 5 mm beyond biological bone remodeling
Stage IV	BoP and/or SUP and bone loss ≥ 50% of the implant length* beyond biological bone remodeling

BoP = bleeding on probing; SUP = suppuration
* Depending on implant length, if peri-implantitis can be classified as simultaneously corresponding to more than one stage, the most advanced stage should be chosen.

graphic bone loss of up to three threads after the first year of loading [13, 20, 21].

Different probing depths have been described in the diagnosis of peri-implant tissues with peri-implant mucositis: 2.07 (range 1-3.16 mm) [26]; 2.67±0.76 mm [27]; 2.9±0.7 mm [28]; 3.42±1.18 mm [29]; 3.55±0.40 mm [25]; 5.2±1.3 mm [30]; and 5.4±1.4 mm [31]. For this reason, our classification distinguishes between peri-implant mucositis with a probing depth of less than 4 mm and peri-implant mucositis with a greater probing depth.

Peri-implantitis is defined as the presence of bleeding upon probing and / or pus with concomitant radiographic bone loss [13-15, 20, 21, 23, 24, 32-36]. The bone loss criteria differ, however: > 0.4 mm after implant loading [15, 23]; detectable bone loss from the one-year examination and bone level ≥ 1.8 mm [32, 33]; ≥ 2 mm after implant loading [23]; ≥ 1.8 mm from the one-year examination [13, 20, 21, 34]; > 2 mm after the last radiological control [35]; ≥ 3 mm of radiological bone loss after abutment placement [37]; ≥ 3 mm after implant loading [36]; or > 5 mm of bone loss [24]. Ferreira *et al.* [14] in turn define peri-implantitis as the presence of a probing pocket depth of ≥ 5 mm, without mentioning bone loss. A number of studies [38, 39] have offered no clear definition of peri-implantitis, while another publication [37] defined it as radiological bone loss > 3 mm, without taking the clinical parameters into account. As commented by Tomasi *et al.* [40], the multitude of different disease criteria, the diagnostic and methodological inconsistencies, as well as the variable quality of the reports have so far hampered attempts to draw firm conclusions in the field of peri-implant diseases.

Although there is a classification contemplating three peri-implantitis stages [41] based on the Seventh European Workshop on Periodontics 2011 [8], we consider it necessary to unify the concepts of peri-implant mucositis and peri-implantitis within one same classification, since both form part of what we know as peri-implant diseases. A more exhaustive and precise classification of peri-implant diseases is needed with the aim of facilitating communication among investigators and comparison of the different clinical studies.

A recent consensus conference defined peri-implantitis as "infection with suppuration associated to clinically significant progressing crestal bone loss" [42]. Based on this definition, recent 10-year clinical reports on modern implant surfaces have shown low incidences of peri-implantitis. With this definition, the disease incidence according to recent longitudinal studies on modern implant surfaces is < 5% after 10 years of function [43]. We do not consider suppuration to be a necessary condition for diagnosing peri-implantitis, since in the same way that some cases of moderate and advanced periodontitis can develop without suppuration, certain cases of peri-implantitis may also show no suppuration.

Since there is no clear consensus on peri-implant diseases, we offer the following unified approach to the classification of peri-implant mucositis (Table **1**) and peri-implantitis (Table **2**).

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

ACKNOWLEDGEMENTS

Declared none.

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Received: December 25, 2014 Revised: August 17, 2015 Accepted: October 12, 2015