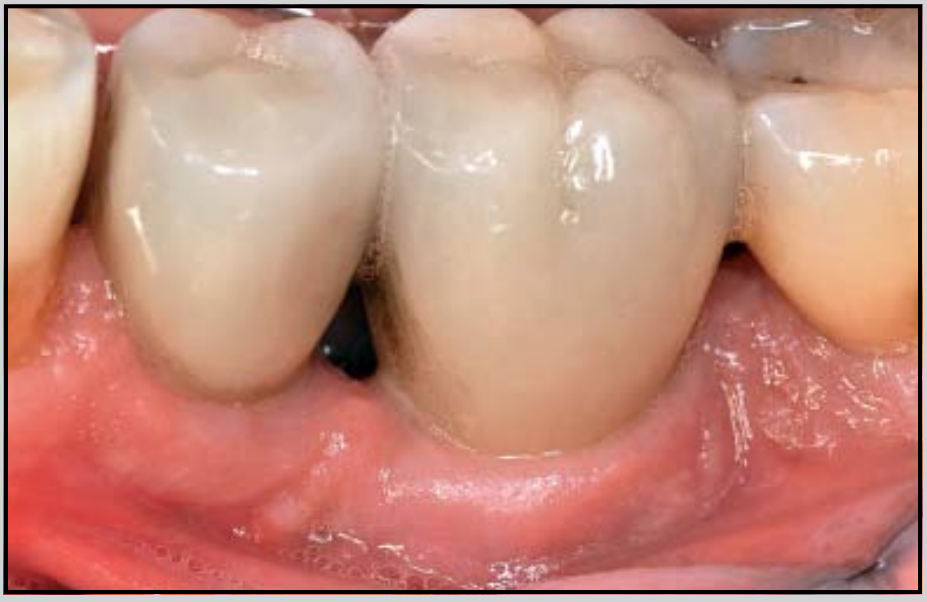
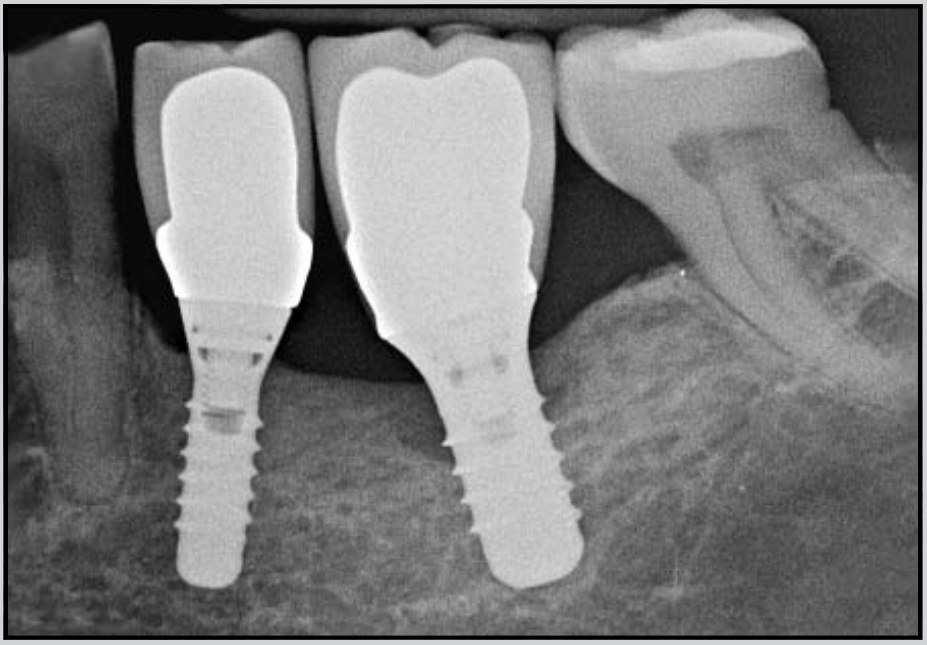
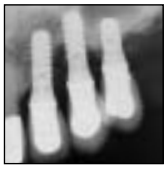




A Proposed Classification for Peri-Implantitis



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*Paul S. Rosen, DMD, MS***

The lack of a standardized classification to differentiate the various degrees of peri-implantitis has resulted in confusion when interpreting the results of studies evaluating the prevalence, treatment, and outcomes of therapy. The purpose of this paper is to propose a classification for peri-implantitis based on the severity of the disease. A combination of bleeding on probing and/or suppuration, probing depth, and extent of radiographic bone loss around the implant is used to classify the severity of peri-implantitis into early, moderate, and advanced categories. The rationale and method of measurement for the classification are presented and discussed. This classification should help in communication between researchers and clinicians and thus provide a better understanding of peri-implantitis. (Int J Periodontics Restorative Dent 2012;32:533–540.)

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Peri-implantitis was first introduced as a term in the 1980s and then modified in the 1990s to describe an inflammatory disease that results in loss of supporting bone around an implant.[1,2] This entity has clearly been differentiated from mucositis, in which the inflammation in the mucosa around an implant is not accompanied by bone loss and is reversible.[2] The general term *peri-implantitis* has been often applied to any implant with varying degrees of bone loss if accompanied by probing depths (PDs) ≥ 4 mm and bleeding and/or purulent exudate on probing.[3,4] However, as noted in a literature review by Zitzmann and Berglundh,[5] the clinical definition of peri-implantitis has differed in many studies. For example, Berglundh et al[6] defined peri-implantitis as having a PD > 6 mm or attachment loss or bone loss of ≥ 2.5 mm.[6] Although the pathogenesis of peri-implantitis has been described as the early lesion, established lesion, and advanced lesion, this peri-implantitis staging pertained to a histologic, not clinical, differentiation.[7] To date, there have been no standardized

Table 1	Classification of peri-implantitis
Early	PD ≥ 4 mm (bleeding and/or suppuration on probing*) Bone loss < 25% of the implant length†
Moderate	PD ≥ 6 mm (bleeding and/or suppuration on probing*) Bone loss 25% to 50% of the implant length†
Advanced	PD ≥ 8 mm (bleeding and/or suppuration on probing*) Bone loss > 50% of the implant length†

*Noted on two or more aspects of the implant.
†Measured on radiographs from time of definitive prosthesis loading to current radiograph. If not available, the earliest available radiograph following loading should be used.

parameters to clinically differentiate the various stages and severities of peri-implantitis. In contrast, differences in disease severity have been used when referring to chronic periodontal disease.[8–12] Initially, these were based on probing pocket depths and were classically divided into early (> 3 mm), moderate (4 to 6 mm), and advanced (≥ 7 mm) periodontitis. Radiographic thresholds for bone loss, when referring to periodontitis, varied from ≥ 1 mm to ≥ 3 mm.[13]

Even though criteria for classification of the stages of periodontitis may have varied in some reports, these recognized differences in disease severity allowed communication between clinicians and researchers and have been used in an effort to establish diagnosis, prognosis, and treatment procedures. For the most part, this classification has been descriptive of the extent of the disease, but never has it been validated regarding treatment efforts. Moreover, its ability to designate prognoses for teeth is quite equivocal.[14] However, lack of a similar classification for peri-implantitis often times has led to confusion in diagnosis, determination of disease prevalence, effectiveness of treatment, and evaluation of outcomes of treatment. For example, Koldsland et al[15] noted that depending on the definition of peri-implantitis, prevalence in one study ranged from 11.3% to 47.1% of subjects evaluated. In a literature review on the effect of implant surface characteristics and peri-implant disease, the authors noted that the effects of using different definitions of peri-implantitis produced an incidence ranging from 16% to 58%. They went on to underscore the importance of formulating "a definition of peri-implantitis that would be universally accepted and used in order to make meaningful comparisons based in numerous studies."[16]

The purposes of the present paper are to propose a classification for early, moderate, and advanced degrees of peri-implantitis and thereby help to clarify and determine the prevalence, treatment options, and endpoints and compare treatment modalities.

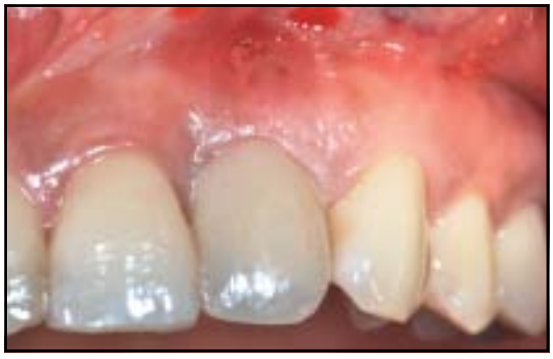
Explanation and rationale for classification

The proposed classification is based on three distinct clinical stages of peri-implantitis: early, moderate, and advanced (Table 1 and Figs 1 to 4).

Since peri-implantitis is an inflammatory disease affecting the soft and hard tissues around an osseointegrated implant, the presence of inflammation and progressive bone loss must be prerequisites for any diagnostic classification.[17] In the proposed classification, bleeding on probing (BoP) and/or suppuration were chosen as the best clinical indicators to determine if inflammation is present. BoP is most easily assessed by a dichotomous system, indicating presence or absence after probing with a UNC probe 15 mm in length (Hu-Friedy) or a PCP 11 probe with a 0.4-mm-diameter tip (Hu-Friedy) around six aspects of the implant(s). The presence or absence of BoP is determined by waiting 15 seconds following light probing and reporting a positive result if bleeding occurs.[18]

Fig 1a (left) *Clinical photograph of early peri-implantitis at an implant at the maxillary left lateral incisor position. Note the inflamed tissue and exudate.*

Fig 1b (right) *Radiograph of maxillary lateral incisor with bone loss < 25% of the implant length, depicting early peri-implantitis*



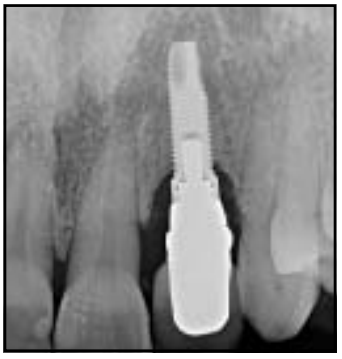
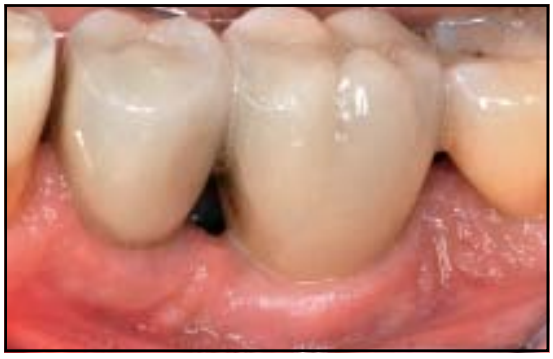


Fig 2a (left) *Clinical view of an implant in the mandibular left first molar site. Note the exudate.*

Fig 2b (right) *Radiograph depicting moderate peri-implantitis, with bone loss of 25% to 50% of the implant length on the mesial and distal aspects of the implant* (arrow).



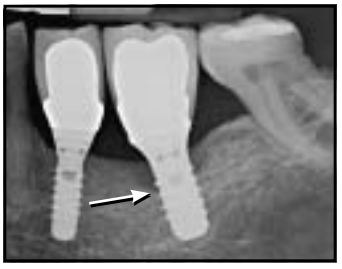
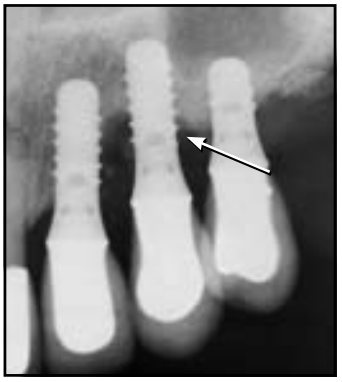


Fig 3a *Clinical probing distal to the implant at the maxillary left canine site measured 8 mm.*

Fig 3b (left) *Bleeding on probing was noted 15 seconds following removal of the probe* (arrow).

Fig 3c (right) *Radiograph depicting moderate peri-implantitis with bone loss < 50% of the implant length* (arrow).



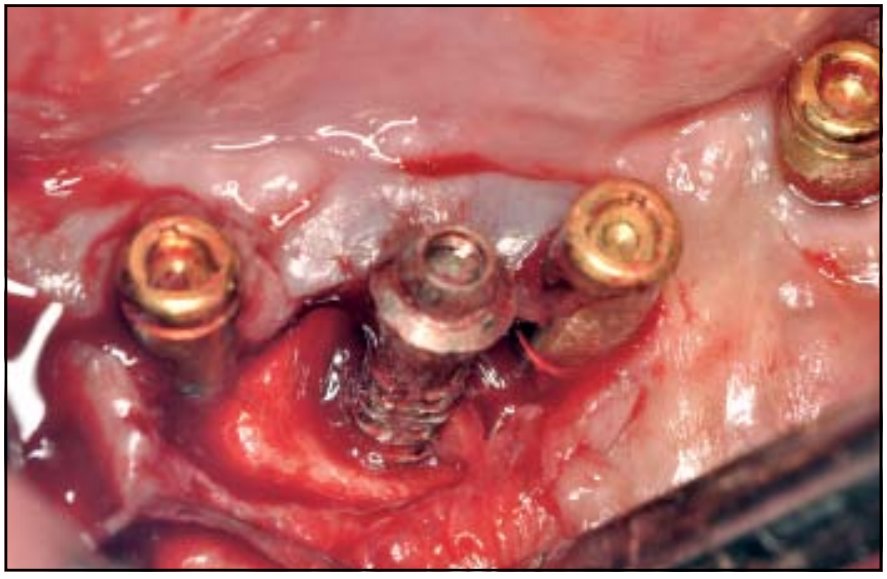


Fig 4a *Clinical photograph of an implant with advanced peri-implantitis.*

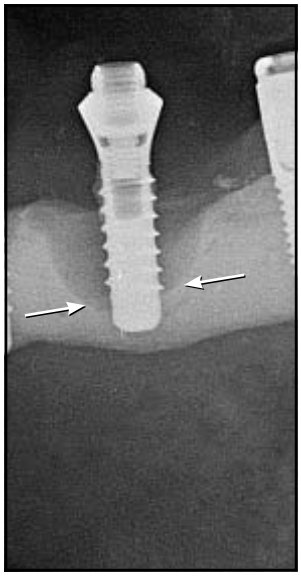


Fig 4b *Radiograph depicting advanced peri-implantitis, with bone loss > 50% of the length of the implant* (arrows).

PD may vary based on the condition of the overlying mucosa, amount or absence of keratinized tissue, the restoration obviating probing access because of its design, and probing pressure.[19] The latter was discussed in detail in an earlier publication, where it was stated that in the presence of inflamed tissues, periodontal probes penetrate close to the bone.[20] Moreover, since peri-implant probe measurements are more sensitive to force variation than periodontal pocket probing, it was recommended that a probing force of 0.25 N be used.[21] In lieu of a probe fitted with a pressure-sensitive device, light clinical probing is recommended around the implant. The probing method recommended to determine PD for the present classification was documented to be reproducible at ± 1 mm in greater than 95% of cases.[22] Excessive probing pressure, even with a healthy soft tissue complex, may cause a rupture of the fibers and result in falsely increased probing readings. However, light probing of ≥ 4 mm represents an appropriate clinical baseline for assessing the status of peri-implant mucosal health or disease.[19] This again can be determined using PDs in combination with BoP and/or suppuration at a minimum of two aspects of the implant. Furthermore, if access for accurate probing measurements is prevented by prosthesis design, then consideration should be made for its removal, particularly if a removable prosthesis is present. However, if the implant is missing a buccal plate because of poor positioning and the buccal mucosa does not show BoP, bone loss may be the result of physiologic resorption and a compromised blood supply to the buccal plate. Peri-implantitis may not be present in these cases even in the presence of PD and bone loss. However, most defects caused by peri-implantitis will affect more than one surface. Therefore, determination of severity in the proposed classification requires a minimum PD ≥ 4 mm as well as BoP and bone loss on two or more aspects of the implant.

One requirement that must be adhered to is that the implant should be placed in a position relative to the buccal plate that would not iatrogenically predispose it to bone loss. If the implant is placed or malposed too far buccally, there may be bone and soft tissue loss that is not bacterially induced. This is the rationale of requiring at least two aspects of the implant to be measured. If an implant displays BoP and PD ≥ 4 to 8 mm with bone loss > 25% of the length of the implant on two aspects of a buccally positioned implant, the disease should be classified in the appropriate severity category. The classification category is determined by the most severe involvement of the disease on any aspect of the implant.

Implants differ in shape and morphology. Many studies use ≥ 1.8 mm of bone loss corresponding to the third implant thread to diagnose peri-implantitis. However, this is arbitrary. Standardized radiographs can help determine the exact level of bone loss relative to a fixed reference point (ie, crown/abutment-implant junction) but this may be difficult to measure and compare in millimeters. The present classification is based on a comparison of bone loss determined by changes in the percent of bone loss related to the length of the implant. The percent of bone loss in the three categories is easily differentiated as < 25%, 25% to 50%, or > 50% of the implant length.

Although vertical bone loss of less than 0.2 mm annually following the implant's first year of loading (restoration) has been accepted as a criterion for determining success,[23] the accurate assessment of this amount is difficult to measure clinically and prone to inaccuracies. Therefore, studies that define peri-implantitis as present with progressive bone loss of ≥ 1.8 mm compared to 1-year data are difficult for the clinician to duplicate.[3] This is why the proposed classification measures bone loss as a percent of the implant length, making it easy to determine a distinct change in severity from early to moderate to severe peri-implantitis. This, combined with BoP and/or suppuration, allows diagnosis of the earliest clinically detectable stages of the disease and also avoids the problem of overexposing the patient to unnecessary radiation. Moreover, the fact that the pattern of peri-implantitis–associated bone loss was shown to occur in a nonlinear pattern with the rate of bone loss increasing over time stresses the need for diagnosis and treatment of the disease in its earliest stages.[24]

A key factor in the diagnosis of and differentiation between the three groups in the current classification involves the amount of bone loss around the implant. To accurately assess this, the authors believe in the necessity of obtaining a periapical radiograph immediately following placement of the definitive prosthesis. A panoramic radiograph cannot replace the periapical radiograph because its level of distortion prevents accurate comparisons. This baseline radiograph will help to establish an initial

relationship between the implant abutment–crown junction and the first bone-to-implant contact and enable comparison(s) with future radiographs to determine the extent of bone loss on the mesial and distal aspects of the implant (bone loss should be evident on at least two aspects of each implant evaluated).

Since the prosthesis may prevent accurate radiographic assessment of the bone level, its removal may be necessary at each radiographic evaluation. Bone sounding by anesthetizing the tissue around the implant and probing through the tissue to the most coronal level of buccal (facial) and lingual bone can help determine bone levels at these sites that cannot be ascertained on a standard periapical radiograph. This clinical measurement need only to be accurate in terms of implant length for proper classification in the currently proposed system. This obviates the need for millimeter bone measurements that may be noncomparable or inaccurate because of x-ray angulation. Moreover, this eliminates having to express bone loss in terms of exposed threads, which may differ between implant systems.

In terms of the importance of having universally recognized and easily diagnosed stages of peri-implantitis, nowhere is this more evident than in determining treatment and assessing outcomes. For example, in evaluating the results of outcomes of surgical treatment in a 2-year prospective clinical study in humans, Serino and Turri[25] noted that 42% of 86 subjects with an initial diagnosis of peri-implantitis presented with "peri-implant disease" despite treatment. However, the proportion of implants that became healthy following treatment was higher for those with a lesser degree of initial bone loss (2 to 4 mm) compared with implants where bone loss was ≥ 5 mm (74% vs 40%). Certainly, in light of these findings, the proposed classification might help determine the appropriate treatment option(s) to achieve improved outcomes.[25] Moreover, three studies evaluating regenerative treatment for peri-implantitis used different inclusion criteria to define the lesions treated.[22,26,27] The definition of peri-implantitis in these studies varied from "more than 50% of the implant length" to "PD > 6 mm and intrabony component > 3 mm" to a "minimum of 4-mm vertical bone loss."[22,26,27] Thus, outcomes could have been affected by the different degrees of initial involvement, which was not made clear in any of these studies. The proposed implant classification would allow an easy comparison of the initial disease and relate it to treatment outcomes in different studies with similar aims, thus allowing a comparison of modalities.

A standardized classification such as the one currently proposed can serve as the basis upon which both researchers and clinicians may further their knowledge. By proposing this classification scheme for peri-implantitis, it is the hope of the authors that it will facilitate early detection and intervention,

Table 2 **Prevalence using different parameters to define peri-implantitis**

Study	Type of study	No. of subjects/ implants	Parameters used to define peri-implantitis	Mean time (y)	Prevalence
Fransson et al[28]	Cross-section to determine prevalence of peri-implantitis	662/3,413	Progressive bone loss to > 3 threads of the implant	Group A: 9.1 Group B: 8.4	27.8% of subjects, 12.4% of implants
Roos-Jansåker et al[4]	Cross-section	218/1,057	BoP, probing bone level 3 to 4 threads (3.1–3.7 mm)	10.8 (range, 9–14)	16% of subjects, 6.6% of implants
Koldsland et al[15]	Evaluation of prevalence of peri-implant disease from subjects treated at University of Oslo 1990–2005	49/104	PD ≥ 4 mm, bone loss, radiographic bone loss > 2.0 mm, BoP	10.2	47.1% of subjects, 36.6% of implants
		12/106	Overt peri-implantitis: bone loss, radiographic bone loss ≥ 3.0 mm, BoP, suppuration at PD ≥ 6 mm	9.5	11.3% of subjects

BoP = bleeding on probing; PD = probing depth.

which has been proposed to be the most predictable means to effectively treat the disease.[24] It can also help to more accurately determine the exact prevalence of the disease (Table 2). Moreover, with a standardized means to communicate the level of disease severity, researchers and clinicians alike may better share information and results of efforts made to manage peri-implantitis. Modification of this classification may be required in the future as new information becomes available. The determination of the prognosis for implants with peri-implantitis for each of the three disease levels along with the relative effectiveness of treatment algorithms will require future research, thus further testing the validity of this proposed classification.

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