Periodontal diagnosis in the context of the 2017 classification system of periodontal diseases and conditions – implementation in clinical practice

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Key points

- Describes BSP recommendations for the implementation of the 2017 classification of periodontal diseases and conditions in UK dental practice.
- Illustrates a diagnostic pathway for patients with dental biofilm-induced periodontitis, building on the BPE.
- Describes grading and staging of periodontitis and assessment of current periodontal status to reach a diagnostic statement.

The 2017 World Workshop Classification system for periodontal and peri-implant diseases and conditions was developed in order to accommodate advances in knowledge derived from both biological and clinical research, that have emerged since the 1999 International Classification of Periodontal Diseases. Importantly, it defines clinical health for the first time, and distinguishes an intact and a reduced periodontium throughout. The term 'aggressive periodontitis' was removed, creating a staging and grading system for periodontitis that is based primarily upon attachment and bone loss and classifies the disease into four stages based on severity (I, II, III or IV) and three grades based on disease susceptibility (A, B or C). The British Society of Periodontology (BSP) convened an implementation group to develop guidance on how the new classification system should be implemented in clinical practice. A particular focus was to describe how the new classification system integrates with established diagnostic parameters and pathways, such as the basic periodontal examination (BPE). This implementation plan focuses on clinical practice; for research, readers are advised to follow the international classification system. In this paper we describe a diagnostic pathway for plaque-induced periodontal diseases that is consistent with established guidance and accommodates the novel 2017 classification system, as recommended by the BSP implementation group. Subsequent case reports will provide examples of the application of this guidance in clinical practice.

Background and context

The 2017 World Workshop Classification system for periodontal and peri-implant diseases and conditions was developed in order to accommodate advances in knowledge derived from both biological and clinical research that have emerged since the 1999 International Classification of Periodontal Diseases. The aim, as determined by the joint European Federation of Periodontology (EFP) and American Academy of Periodontology (AAP) management committee, was to adopt a reductionist model in order to create a system that could be implemented in general dental practice, the environment where over 95% of periodontal disease is diagnosed and managed. A further aim was to create a system that captured and distinguished the severity and extent of periodontitis (a reflection of the amount of periodontal tissue loss) on one hand, as well as a patient's susceptibility for periodontitis (as reflected by the historical rate of periodontitis progression). In addition, the system needed to accommodate the current periodontal status of a patient (probing pocket depth [PPD], and percentage of bleeding on probing [BoP]). The classification is a live system to be regularly updated by a task force to accommodate future advances in knowledge, either clinical or biological (for example, biomarkers), as it emerges.

In order for a clinician or student to understand periodontal assessment and diagnosis in the context of the 2017 classification system, it is critical to understand that the first step is to determine the type of periodontal disease (Table 1).

For the first time, the 2017 classification system gives clear definitions of periodontal health and gingivitis for:

- Patients with an intact periodontium
- Patients with a reduced periodontium due to causes other than periodontitis
- Patients with a reduced periodontium due to periodontitis.

For a detailed discussion of the evidence and rationale behind these definitions, the reader is referred to the consensus paper of workgroup one of the 2017 World Workshop.[1]

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In the 2017 classification system, the distinction between chronic and aggressive periodontitis has been removed on the basis that there was little evidence from biological studies that chronic and aggressive periodontitis were separate entities, rather than variations along a spectrum of the same disease process. The exception was classical localised juvenile (aggressive) periodontitis, where a clearly defined clinical phenotype exists, however, there was unease about including this as a distinct and separate entity within the classification system. The only other distinct types of periodontitis that the 2017 classification system recognises are necrotising periodontitis and periodontitis as a manifestation of systemic disease.[2]

Once a patient has been diagnosed with periodontitis, staging and grading should be performed (Table 2). However, as the periodontitis stage and grade are a reflection of historical disease experience, it does not directly map to established screening tools (for example, basic periodontal examination [BPE]) and it lacks a direct link to periodontal parameters that indicate current disease status (that is, PPD, BoP). Therefore, determining a patient's current disease status is an important second step, particularly in patients who have received periodontal therapy in the past. Importantly, a successfully treated periodontitis patient remains a periodontitis patient for life because the disease may progress at any time if periodontal maintenance is sub-optimal and risk factors are not controlled. However, at any given time following therapy a periodontitis patient may represent a case of health in a successfully treated patient (stable), or a case with recurrent gingival inflammation (BoP ≥10%) at sites with PPD ≤3 mm and no PPD >4 mm (disease remission), or a case of recurrent periodontitis, where there are bleeding sites ≥4 mm or any PPD ≥5 mm (unstable) (Fig. 1, Table 3). The 4 mm threshold is critical as it determines periodontal disease stability at non-bleeding sites following successful periodontal therapy.[1,3] However, it is important to note that a higher probing depth of 5 mm or 6 mm in the absence of bleeding may not necessarily represent active disease, in particular soon after periodontal treatment. Therefore, clinicians need to exercise careful clinical judgement when considering the need or lack of need for additional treatment such as re-instrumentation or surgery for such sites.

The purpose of this paper is to describe the practical implementation of the new classification system in clinical practice, and how it integrates with established diagnostic parameters and pathways, for plaque-induced periodontal diseases only. The full classification also includes non-plaque-induced gingival and periodontal conditions and lesions, as well as the classification of peri-implant diseases and conditions.[1,2,4,5]

Implementation

Principles

Comprehensive oral health assessment of any patient includes a periodontal assessment. This will typically commence by screening

Table 1 – Basic classification of periodontal diseases and conditions

Periodontal health, gingival diseases and conditions:
Periodontal health
intact periodontium
reduced periodontium*
Gingivitis: dental biofilm-induced
intact periodontium
reduced periodontium*
Gingival diseases and conditions: non-dental biofilm-induced
Periodontitis
Necrotising periodontal diseases
Periodontitis**
Periodontitis as a manifestation of systemic disease
Other conditions affecting the periodontium
Systemic diseases or conditions affecting the periodontal supporting tissues
Periodontal abscesses and endodontic-periodontal lesions
Mucogingival deformities and conditions
Traumatic occlusal forces
Tooth and prosthesis related factors

*Reduced periodontium due to causes other than periodontitis, eg, crown lengthening surgery. **All patients with evidence of historical or current periodontitis should be staged/graded at initial consultation

Table 2 Staging and grading of periodontitis

Staging of periodontitis				
	Stage I (early/mild)	Stage II (moderate)	Stage III (severe)	Stage IV (very severe)
Interproximal bone loss*	<15% or <2 mm**	Coronal third of root	Mid third of root	Apical third of root
Extent	Describe as: Localised (up to 30% of teeth), Generalised (more than 30% of teeth) Molar/incisor pattern			
Grading of periodontitis				
	Grade A (slow)	Grade B (moderate)	Grade C (rapid)	
% bone loss / age	<0.5	0.5–1.0	>1.0	

*Maximum bone loss in percentage of root length. **Measurement in mm from CEJ if only bitewing radiograph available (bone loss) or no radiographs clinically justified (CAL).

Notes:
If a patient has interproximal attachment loss but BPE codes of only 0, 1 & 2, (for example, a previously treated, stable periodontitis patient), and radiographs are not available/justifiable, staging & grading should be performed on the basis of measuring attachment loss in mm from the CEJ and estimation of concomitant bone loss.
If a patient is known to have lost teeth due to bone loss likely to have been within the apical third of the root, stage IV may be assigned

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for periodontal diseases using a system like the BPE and, if applicable, a full diagnostic workup/periodontal assessment. The principle change from current practice is that a complete diagnosis of a patient with periodontitis will include staging and grading of the disease.[2]

It is important to understand that the new classification system of periodontal diseases and conditions is not a diagnostic system or diagnostic algorithm, the diagnosis must accommodate both the classification (type of periodontal disease and, if applicable, staging and grading based on bone loss or clinical attachment loss [CAL]), and also current disease status (based on PPD and BoP). Secondary to the diagnosis, but equally important, is the third stage of determining a patient's risk factor profile.

The diagnostic work-up of periodontal patients will always include a detailed medical and dental history, oral examination and further investigations (including, where appropriate special tests, radiographs and a radiological report) which will allow the differentiation between the different types of periodontal disease (for example, gingivitis, necrotising periodontal disease, periodontitis associated with systemic disease, non-plaque-induced gingivitis, etc) and importantly, the recognition of alveolar bone loss or attachment loss due to causes other than periodontitis (for example, surgical crown lengthening, orthodontic treatment, endodontic-periodontal lesions, impacted third molars, restoration margins, etc), referred to in the new 2017 classification as a 'reduced periodontium in a non-periodontitis patient'.

Fig. 1 Possible transitions between different plaque-induced periodontal diseases. Modified from Chapple et al. 2018.[1] Classification is an important component of diagnosis, but diagnosis also includes current health/disease status, because diagnosis informs prognosis and therapeutic strategy

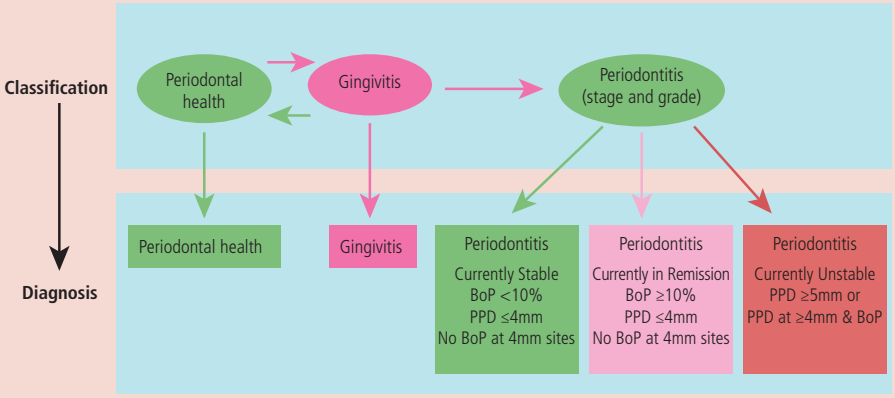

Table 3 Diagnostic 'look up table' for gingival health or dental plaque-induced gingivitis in clinical practice. Modified after Chapple et al. 2018[1]

Intact periodontium	**Health**	**Gingivitis**
Probing attachment loss	No	No
Probing pocket depths (assuming no pseudo pockets)	≤3 mm	≤3 mm
Bleeding on probing	<10%	≥10%
Radiological bone loss	No	No
Reduced periodontium Non periodontitis patient	**Health**	**Gingivitis**
Probing attachment loss	Yes	Yes
Probing pocket depths (all sites & assuming no pseudo pockets)	≤3 mm	≤3 mm
Bleeding on probing	<10%	≥10%
Radiological bone loss	Possible	Possible
Successfully treated periodontitis patient	**Health (stable)**	**Gingival inflammation in a patient with a history of periodontitis (remission)**
Probing attachment loss	Yes	Yes
Probing pocket depths (all sites & assuming no pseudo pockets)	≤4 mm (no 4 mm site with BoP)*	≤4 mm (no 4 mm site with BoP)*
Bleeding on probing	<10%	≥10%
Radiological bone loss	Yes	Yes

*A successfully treated periodontitis patient in whom sites of gingival bleeding appear, remains at high risk of disease recurrence at those sites and of progressive attachment loss. Therefore, gingival inflammation is defined as bleeding at a shallow site of ≤3 mm rather than ≤4 mm, as is the case in gingival health. Where the probing depth is 4 mm with bleeding, or higher, this is no longer a 'closed pocket' and is assumed to be unstable periodontitis

It is important to note that a higher probing depth of 5 mm or 6 mm in the absence of bleeding may not necessarily represent active disease, in particular soon after periodontal treatment

The BPE in the context of the new classification system

The BPE is a clinical application of the epidemiological community periodontal index of treatment needs (CPITN) (or community periodontal index [CPI]) tool, developed by the British Society of Periodontology[6] in order to rapidly screen for periodontal disease in patients with no overt signs of periodontal disease based on visual inspection alone. Hence, the BPE is a screening tool employed to rapidly guide clinicians to arrive at a provisional diagnosis of periodontal health, gingivitis or periodontitis, irrespective of historical attachment loss and bone loss (that is, irrespective of staging and grading). As such, the BPE guides the need for further diagnostic measures before establishing a definitive periodontal diagnosis and appropriate treatment planning.

Performing a BPE entails 'walking' the probe around each tooth, and recording only the worst score (code 0–4) in each sextant for efficiency.[7] The markings of the BPE/WHO probe at 3.5 mm and 5.5 mm are designed to allow the clinician to easily establish the presence or

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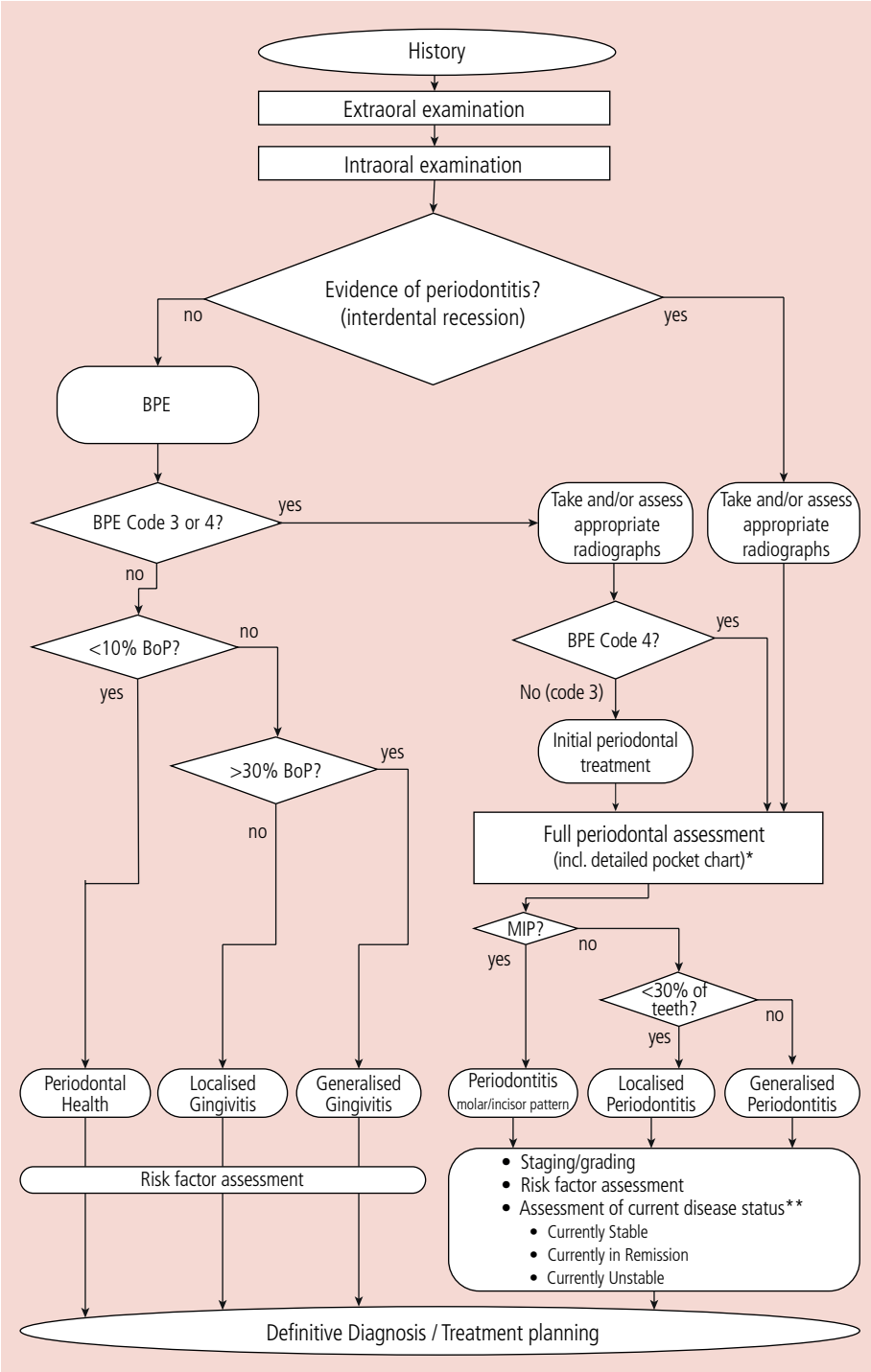
absence of PPD of at least 4 mm and 6 mm, respectively. Specifically, as soon as the black band of the probe is partially obscured, the PPD is at least 4 mm (BPE code 3), and as soon as the black band of the probe is completely obscured, the PPD is at least 6 mm (BPE code 4).

The BPE and its equivalent systems have been well established in the clinical community across Europe due to its relative simplicity and efficiency. The pathway described here is entirely consistent with current BSP guidance[7] on the use of the BPE, that is, its prosecution and interpretation has not changed. However, it is important to recognise that the BPE is of limited value in patients who have already been diagnosed with periodontitis. This is particularly relevant in the context of the new 2017 classification system, as staging of periodontitis is based on radiographic bone loss and/or CAL, which is not captured by the BPE. For example, the BPE is unable to identify patients with historical periodontitis, as it is based upon BoP and PPD, rather than recording attachment and bone loss. Therefore, clear and obvious evidence at initial presentation of historical periodontitis ascertained through history, examination (interproximal recession/attachment loss) or radiographs should trigger a full periodontal assessment immediately, as the BPE is effectively redundant in such patients (Fig. 2). For example, using the BPE on a patient with a history of periodontitis and no BPE scores over 2 would wrongly result in a provisional classification of periodontal health (<10% sites with BoP), localised gingivitis (10–30% sites with BoP) or generalised gingivitis (>30% sites with BoP), rather than capture the fact that the patient is a periodontitis patient with a current status of health or gingival inflammation (Fig. 1, Table 3).

Fig. 2 Algorithm for clinical periodontal assessment of plaque-induced periodontal disease. BPE – basic periodontal examination, BoP – bleeding on probing, MIP – molar incisor pattern. *A diagnosis of periodontitis requires CAL/radiographic bone loss at two non-adjacent teeth that cannot be attributed to causes other than periodontitis. **Assessment of current disease status as: currently stable: BoP<10%, PPD≤ 4 mm, no BoP at 4 mm sites; currently in remission: BoP≥10%, PPD≤ 4 mm, no BoP at 4 mm sites; currently unstable: PPD ≥5 mm or BoP at 4 mm sites



As per current BSP guidance[7] a maximum BPE code of 3 would trigger a panoramic radiograph and/or selective periapical radiographs, which will allow determination of percentage bone loss relative to the root length. A maximum BPE code of 4 would trigger periapical radiographs (or a panoramic radiograph) and a detailed pocket chart (Fig. 2). Following a radiological analysis and report and, where appropriate, additional diagnostic tests, a final diagnosis of the type of periodontal disease is made (Table 1).

Staging and grading of periodontitis

This BSP implementation group felt that the staging and grading system needed to be sufficiently simple and pragmatic to be adopted by clinicians, and therefore that it should be based upon parameters that are readily available in the surgery and which could be measured with reasonable reproducibility as part of appropriate routine clinical care for the majority of patients.

An important underlying principle of the staging process, which is to be performed at the initial assessment, is that patients cannot regress to a lower stage of periodontitis due to

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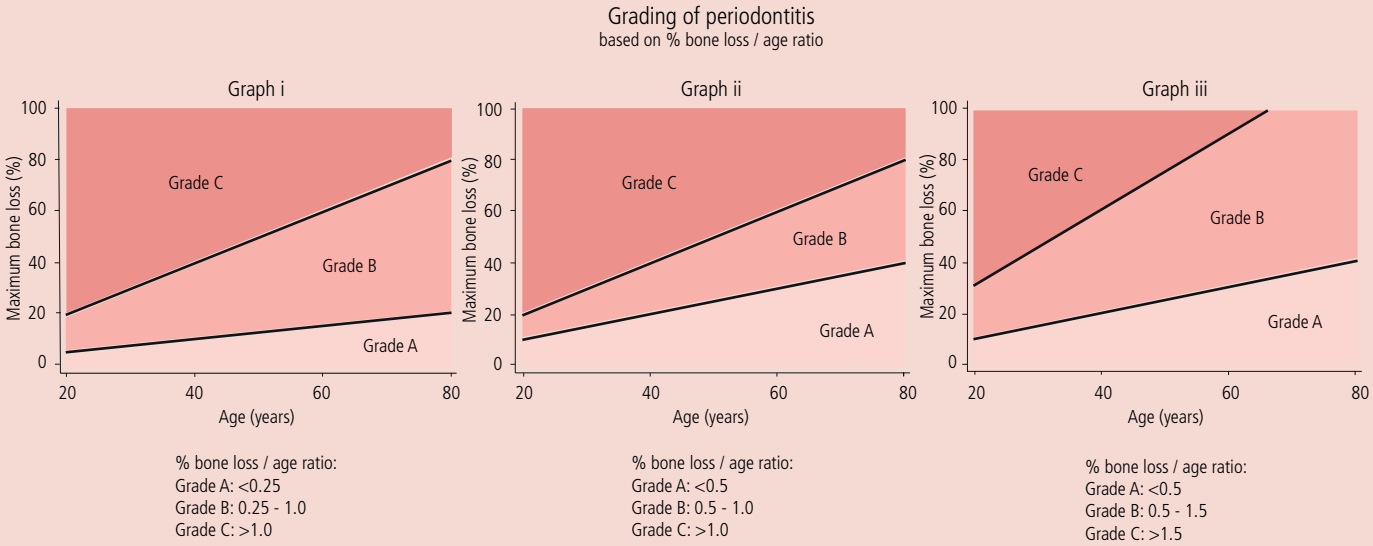
Fig. 3 Effect of different thresholds for definition of grade A, B and C periodontitis as a function of percentage of bone loss and age. Model ii is the model recommended by the BSP implementation group



treatment, therefore, periodontal parameters that are significantly affected by treatment (for example, BoP and PPD) cannot be employed to determine disease stage.

Staging

The staging of periodontitis (Table 2) reflects the severity of disease at presentation, which is also associated with the complexity of overall patient management.

The BSP implementation group recognised several challenges with the proposed periodontitis staging grid[8] for implementation in general dental practice, specifically:

- The lack of an unambiguous decision rule that describes how the various parameters in the staging grid should be combined to determine a patient's disease stage
- The fact that clinical attachment loss is not routinely measured in clinical practice
- The inclusion of complexity measures such as tooth loss due to periodontitis and alveolar ridge defects, which may be difficult to ascertain and/or may not be well defined.

For a patient diagnosed with periodontitis, we propose a simplified staging grid based on radiographic bone loss alone (Table 2). For reasons of simplicity, this is based on percentage bone loss in relation to the root length, which is an intuitive measure already used by many practitioners. We recognise that for some patients, in particular for those with early stage periodontitis, the availability of radiographs may be limited to bitewings in the posterior regions and no radiographs may be available for the anterior sextants. In such cases, and when periapical or panoramic radiographs are not indicated for clinical reasons, the clinician should use bitewings or CAL measured from the CEJ to estimate percentage of bone loss. The bone loss is taken as the worst value at any site in the mouth, where it is clear that the bone loss has arisen due to periodontitis and not for an incidental reason such as a root fracture or a previous surgical intervention (for example, wisdom tooth removal).

In rare situations where a patient is clearly known to have lost teeth due to advanced periodontal bone loss, likely to have been within the apical third of the root, then clinicians may, on a case by case basis, immediately assign a stage IV classification.

Grading

Grading (Table 2) is designed to reflect the patient's susceptibility to periodontitis because historical disease experience at a given age essentially accommodates all risk determinants that have conspired to cause periodontal bone loss over that patient's life course. Moreover, the periodontal disease experience of a patient at presentation has been widely demonstrated as being the best predictor of future disease experience in the absence of treatment.[9] Several potential measures of disease susceptibility were discussed at the 2017 World Workshop.[8] Our implementation group felt that the ratio of percentage of bone loss/age was the most pragmatic and thus suitable for use in clinical practice because:

- It maps directly to percentage of bone loss determined as part of the staging process
- It reflects the average rate of disease progression over time
- It is an intuitive measure that is already employed to gauge disease susceptibility by many clinicians, albeit not in an explicitly formal way.

The use of progression rate determined by the evaluation of successive radiographs is impractical in many clinical situations as such radiographs are rarely available and they convey little additional information compared to the percentage of bone loss/age ratio.

As periodontitis is a complex multifactorial disease, a plethora of causal factors determine the host response to the microbial challenge, including genetic, epigenetic, environmental and behavioural factors. The percentage of bone loss/age ratio captures the historical disease susceptibility due to the life-long exposure to all causal factors of a specific patient at that moment in time, including established, modifiable risk factors such as smoking and sub-optimally controlled/undiagnosed diabetes. As such, it is also the best possible estimate of future disease susceptibility, although disease susceptibility may change as the result of changes in a patient's risk factor profile and following periodontal treatment. For example, a patient may quit smoking or develop uncontrolled diabetes. However, the

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mere presence or absence of an established, modifiable risk factor (for example, smoking, diabetes), should not override or modify the disease grade assigned based on the percentage of bone loss/age ratio, which comprehensively reflects a patient's past susceptibility. For example, it would not be meaningful to assign a grade C (highest susceptibility/rate of progression) to a 70-year-old patient with Stage I periodontitis (maximum bone loss <15%), just because he/she smokes 20 cigarettes per day, as this patient clearly exhibits limited susceptibility and a low rate of progression, despite the exposure to smoking. However, this does not negate the importance of a comprehensive risk factor assessment, as the risk factor profile should form the third part of a complete periodontal assessment documented alongside the diagnosis and, if applicable, the elimination or reduction of risk factors is an essential component of periodontal management.

The thresholds of the percentage of bone loss/age ratio used to define the different disease grades are necessarily arbitrary. However, they should be easy to calculate mentally for a clinician, and the resulting grade categories should have reasonable coverage of the spectrum of periodontitis susceptibilities encountered in the general population. In addition to the thresholds proposed by Tonetti *et al.*[8] (grade A: <0.25, grade B: 0.25–1.0, grade C: >1.0), we also considered higher thresholds of 0.5 (grade A vs. B) and 1.5 (grade B vs. C). Figure 3 demonstrates three models (graphs i, ii, iii). Graph i is based on Tonetti *et al.*,[8] graph iii is an alternative model at the other extreme, and graph ii is the model the implementation group felt was the most appropriate for use in clinical practice. In graph i, if grade A is defined as a ratio of <0.25, few patients would be classified as grade A. For example, a 60-year-old patient with no more than 20% bone loss on all affected teeth would be classified as grade B (moderate rate of progression). Even an 80-year-old patient would have to have less than 20% bone loss on all affected teeth to be classified as grade A (slow rate of progression). However, in graph iii, defining grade C as a ratio of greater than 1.5 would result in few patients with high disease progression being classified as grade C (rapid rate of progression). For example, a 60-year-old patient would have to have more than 90% bone loss to be classified as grade C. Hence, the group felt that thresholds in graph ii of 0.5 and 1.0 are most appropriate for use in clinical practice (grade A: <0.5, grade B: 0.5–1.0, grade C: >1.0). These thresholds are also simple to apply and do not require the use of a calculator:

- Grade A is assigned if the maximum amount of radiographic bone loss in percentage terms is less than half the patient's age in years (for example, less than 30% in a 60-year-old or less than 40% in an 80-year-old)
- Grade C is assigned if the maximum amount of bone loss in percentage terms exceeds the patient's age in years (for example, more than 30% in a 28-year-old or more than 50% in a 49-year-old)
- Grade B is assigned otherwise.

Establishing a periodontal diagnosis as part of a comprehensive periodontal examination

Figure 2 provides a clinical decision-making algorithm to guide the practitioner to the definitive diagnosis, which includes several components, that is, type and extent of disease, periodontitis stage and grade, current periodontal status and risk factor profile. A periodontal assessment should begin with a comprehensive history. If the patient has no evidence of a history of periodontitis, then a BPE screening should be performed. No radiographs would be indicated for codes 0, 1 and 2 and a diagnosis of health or gingivitis can be made. If codes 3 and 4 are apparent then radiographs are required, which will allow determination of bone loss to facilitate staging and grading. This should be followed by a detailed full mouth pocket depth chart for code 4 patients, and for code 3 patients a detailed pocket chart is performed in affected sextants following initial periodontal therapy as an outcome assessment as per current BSP guidelines.[7] If a patient has clear and obvious evidence for a history of periodontitis, either from the history or because of blatant interproximal attachment loss, a full periodontal assessment is carried out, where some assessment of bone loss is necessary, and, if radiographs are not available or justifiable, the staging and grading is performed on the basis of measuring attachment loss in mm from the CEJ.

Disease extent (localised, generalised or, for periodontitis only, molar/incisor pattern) is assessed next. In patients with periodontitis, current disease status is then determined. Finally, a risk factor assessment is essential for treatment planning and patient management.

It may be helpful for a clinician to recognise that, in order to facilitate interpretation, the various components of the classification system (that is, stage/grade/extent) provide categorisations of phenomena that occur along a continuum. It is therefore inevitable that the categorisation may be difficult in borderline cases. Furthermore, causes other than periodontitis have to be considered for any attachment loss and/or alveolar bone loss, in particular if localised to one or two sites. It should therefore be self-evident that clinical judgement will remain the cornerstone of formulating an appropriate diagnosis and treatment plan.

Some case examples will be provided in a series of accompanying case reports that will be published over the next several months and illustrate the practical and pragmatic application of this implementation plan; with minimal practice it should be possible to stage and grade a patient in under 30 seconds.

Summary and conclusions

The 2017 World Workshop Classification of Periodontal Diseases and Conditions provides a contemporary and future-proof system for classifying the periodontal status of undiagnosed patients. The major novelty is the introduction of staging and grading for periodontitis patients and the loss of the term 'aggressive periodontitis'. The staging/grading system is designed primarily to capture and distinguish; (i) a patient's history of periodontal tissue destruction, as defined by bone and clinical attachment loss; and (ii) a patient's historical rate of disease progression as a measure of the patient's disease susceptibility and, therefore, a predictor of future disease progression in the absence of intervention for risk factor control and treatment. Moreover, once a patient has had periodontitis it cannot be reversed and the attachment loss needs to be reflected in their current diagnosis, even if they have been successfully treated and are currently a case of health (Fig. 1), because stability requires careful maintenance and continued risk factor control. However, the staging and grading module within the classification system does not account for current health/disease status, and this implementation plan incorporates current status into the diagnosis by accounting for presence of true pockets and bleeding on probing (inflammatory status), because these two elements drive treatment planning.

A diagnosis is made in order to support prognostication and treatment strategy and this implementation plan sets out the BSP's views and recommendations, which aim to integrate established diagnostic tools with the

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new 2017 classification system for rapid use in dental practice. It aims to provide a simplified staging and grading system as well as a diagnostic decision-making algorithm (Fig. 2), with BPE screening as a starting point in most patients, to guide the clinical management process. The diagnostic pathway includes the following stages:

- Determination of the type and extent of periodontal disease and, in the case of periodontitis, its staging and grading
- Identification of current health/disease status (via PPD and BoP).

The final diagnosis would embed all of these components in a 'diagnostic statement', for example:

Diagnosis = generalised periodontitis; stage IV, grade B; currently unstable.

Finally, relevant risk factors should be documented immediately below the diagnostic statement, eg:

Diagnosis = generalised periodontitis; stage IV, grade B; currently unstable.

Risk factors:

1. Current smoker >10 cigarettes per day
2. Sub-optimally controlled diabetes.

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