

Oral diagnosis and treatment planning: part 3. Periodontal disease and assessment of risk

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VERIFIABLE CPD PAPER

IN BRIEF

- The periodontal diagnosis aims to capture in a few words an impression of what affects a patient's periodontal tissues.
- Highlights that aspects of case history have particular relevance to establishing a periodontal diagnosis.
- Informs that the initial periodontal examination is a visual examination of the marginal periodontal tissues and the teeth in relation to these.

PRACTICE

Periodontal diseases are diagnosed on the basis of clinical signs, with radiographs assisting in treatment planning decisions and in the delivery of periodontal care. In the first instance, use of a screening system, to screen out patients with minimal or no disease, and to screen in those with disease requiring full diagnosis and treatment planning for periodontitis, is a very helpful approach. The full diagnostic approach relies on periodontal probing and the response to probing. Periodontal probing depth measurements and periodontal attachment level registrations are recordings of clinical findings, which depend upon the state of health of the periodontal tissues to a large extent.

PERIODONTAL DIAGNOSIS

A periodontal diagnosis is basically a 'label(s)' applied to a patient's periodontal condition(s) given on the basis of the findings from the case history and the clinical examination (as described in chapter 4 of the *BDJ* clinical guide associated with this *BDJ* series), perhaps supplemented by information gathered from the dental

radiographic assessment (chapter 5 of *BDJ* clinical guide). The periodontal diagnosis aims to capture in a few words an impression of what affects a patient's periodontal tissues, so that through the use of these few words the impression of the patient's periodontal condition can be communicated to the patient, the dentist, and other dental practitioners.



Fig. 1 Marginal gingivitis associated with dental plaque deposits in a patient with chronological enamel hypoplasia

ORAL DIAGNOSIS AND TREATMENT PLANNING*

- Part 1. Introduction to oral diagnosis and treatment planning
- Part 2. Dental caries and assessment of risk
- Part 3. Periodontal disease and assessment of risk**
- Part 4. Non-carious tooth surface loss and assessment of risk
- Part 5. Preventive and treatment planning for dental caries
- Part 6. Preventive and treatment planning for periodontal disease
- Part 7. Treatment planning for missing teeth
- Part 8. Reviews and maintenance of restorations

*This series represents chapters 1, 7, 8, 9, 14, 15, 16 and 19 from the *BDJ* book *A Clinical Guide to Oral Diagnosis and Treatment Planning*, edited by Roger Smales and Kevin Yip. All other chapters are published in the complete clinical guide available from the *BDJ* Books online shop.

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Accepted 7 June 2012
DOI: 10.1038/sj.bdj.2012.666
©British Dental Journal 2012; 213: 111-121

CURRENT CLASSIFICATION OF PERIODONTAL DISEASES AND CONDITIONS

The periodontal diagnosis arrived at should be compatible with whatever system for classification of periodontal diseases is currently in operation. However, a periodontal diagnosis generally goes beyond what is detailed in any classification criteria. The diagnosis will, in addition to labelling a patient with a periodontal disease state or condition, also attempt to convey the severity of the disease or condition and whether it is either localised, affecting only up to one-third of teeth in a reasonably complete dentition (and, perhaps if localised, localised to which particular teeth or mouth areas), or generalised, affecting more than one-third of the remaining teeth.

In terms of severity, there are no hard and fast rules for assigning a descriptor. If considering periodontal attachment loss, the current classification system suggests that 'mild' might indicate attachment loss

up to 2 mm, 'moderate' might indicate attachment loss of 3-5 mm, and 'severe' might indicate attachment loss in excess of 5 mm. Periodontal attachment loss is measured from the cemento-enamel junction to the base of the gingival sulcus or periodontal pocket using a graduated or banded periodontal probe. However, the terms 'mild', 'moderate' and 'severe' (or their equivalents) are also applied to the inflammatory changes in the periodontal tissues and to gingival enlargements/overgrowths, yet there is no guidance on what severities of redness and gingival swelling or enlargements/overgrowths these descriptors actually describe from histologic appearances.

Plaque-induced inflammatory periodontal diseases have been traditionally divided into gingivitis and periodontitis. Gingivitis refers to inflammatory reactions largely confined to marginal gingival tissues

(Fig. 1). Gingivitis can occur on teeth with reduced periodontal support, manifested as recession resulting from overvigorous oral hygiene practices or previous – and perhaps previously treated – periodontitis. Periodontitis refers to those inflammatory conditions that result in apical migration of the epithelial attachment from the region of the cemento-enamel junction onto the root surface, accompanied by destruction of periodontal fibre insertion into the root surface and resorption of crestal alveolar bone (Fig. 2).

The current classification¹ recognises basically the following categories of destructive periodontal diseases:

- Chronic periodontitis (Table 1)
- Aggressive periodontitis (Table 2)
- Periodontitis as a manifestation of systemic diseases (Table 3)
- Necrotising ulcerative gingivitis/periodontitis
- Abscesses of the periodontium (gingival, periodontal, pericoronal)
- Combined periodontic-endodontic lesions
- Developmental or acquired deformities and conditions.

Additionally, the current classification recognises that gingival lesions may result from specific infectious agents (bacteria, viruses, and fungi), mucocutaneous conditions, allergic reactions and trauma. Also, the current classification specifically accounts for some tooth-related factors that may modify or predispose to inflammatory periodontitis. These factors include some anatomic features (grooves, overhanging restorative margins, plaque retentive dental appliances, root fractures, cemental tears), and deformities or conditions affecting the marginal gingiva (gingival recession, gingival excess, gingival hyperpigmentation) (Figs 3-6).

Whatever periodontal diagnosis is arrived at, it should be compatible with the current disease classification.

The periodontal diagnosis should indicate the severity (mild/moderate/severe) and extent (localised/generalised). The periodontal diagnosis might additionally include, but this is subject to convention only, some secondary descriptors that outline the manifestations of the disease/condition. Table 4 lists some manifestations



Fig. 2 Gingival condition following scaling and root surface debridement, and improved oral hygiene measures in a patient with chronic periodontitis

Table 1 Chronic periodontitis

- Most prevalent periodontal disease in adults, but may commence in childhood or adolescence
- Local factors – plaque, calculus, overhangs – identifiable
- Subgingival calculus – a response to long-standing inflammation – usually detected at sites of periodontal pockets
- Usually slow to moderate disease progression, but may show rapid progression, in relation to increased risk
- Modified by risk exposures, such as tobacco smoking, diabetes mellitus

Adaption 2008 with permission from American Academy of Periodontology of Fig. 1 in Armitage G C. Development of a classification system for periodontal diseases and conditions. *Ann Periodontol* 1999; 4: 1-6.

Table 2 Aggressive periodontitis

- Save for periodontitis, patients are otherwise healthy
- Rapid periodontal attachment loss and alveolar bone destruction
- Familial aggregation often discovered
- Periodontal destruction may not be commensurate with local deposits of plaque, calculus
- May have a specific microbial association
- May be associated with effects in host response to microbial challenge
- May undergo spontaneous remission ('burn-out')

Localised:

- Circumpubertal onset
- First molar and incisor attachment loss on at least two teeth, and not on more than two teeth other than first molars and incisors

Generalised:

- Usually patients under 30 years of age on presentation, but may be older
- Attachment loss on three or more teeth other than incisors and first molars

Adaption 2008 with permission from American Academy of Periodontology of Fig. 1 in Armitage G C. Development of a classification system for periodontal diseases and conditions. *Ann Periodontol* 1999; 4: 1-6.

of chronic periodontitis, though these may equally apply to any other form of periodontitis.

THE CASE HISTORY IN PERIODONTAL DIAGNOSIS

Aspects of the case history have particular relevance to establishing a periodontal

Table 3 Periodontitis as a manifestation of systemic disease

Associated with haematological disorders, such as:

- Leukaemias
- Acquired neutropenia (drug induced)

Associated with genetic disorders, such as:

- Down syndrome
- Familial and cyclic neutropenia
- Papillon-Lefèvre syndrome

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Fig. 3 Chronic irritation due to plaque retention from a poorly fitting artificial crown placed on the maxillary central incisor has resulted in a fibrous epulis



Fig. 4 A misdirected pin has perforated into the gingival tissues to cause angular bone loss

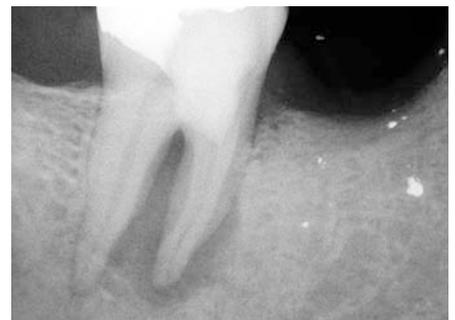


Fig. 5 A vertical tooth fracture has caused extensive bone loss associated with the distal root of the mandibular molar

diagnosis. The chief complaint and the history of this complaint can obviously indicate whether a condition is related to periodontal tissues and whether it is acute or has been longstanding. For some complaints such as tooth drifting/pathological migration (and perhaps gingival recession or gingival enlargement/overgrowth)

previous photographs showing the patient smiling can be of assistance.

In eliciting the previous dental history it is very important to ask questions about previous periodontal therapy and the outcomes. Reasons for tooth loss should be carefully ascertained through extensive questioning about tooth conditions, symptoms, etc, prior to tooth extraction/loss. Tooth loss due to periodontal destruction is a good indicator of previous susceptibility to periodontitis. Also, the reasons for some forms of aesthetic dentistry on anterior teeth should be ascertained, as these treatments may have been undertaken to mask tooth drifting/pathological migration. Similarly, the reasons for any splinting should be enquired about.

In establishing the previous medical history, careful note should be taken of pertinent aspects, such as all diseases and medications that are associated with modifying gingivitis/periodontitis, or indeed are capable of manifesting as gingival lesions or periodontitis. As an example, if a patient volunteers information that he or she suffers from diabetes mellitus, which obviously is related to periodontal disease experience, detailed questioning should establish: the duration since the diagnosis of the diabetes mellitus, the methods of diabetic control, the levels of diabetic control achieved, and the diabetic complications encountered. For medications, which may be interrelated with intra-oral conditions, the duration of administration and dosages should be established.

In questioning about the family and social history it is important to probe for any family history of periodontal disease, tooth loss due to periodontal disease, and early tooth loss in parents and siblings. Of course, not all family relationships are clear-cut, and not all such histories are accurate, but efforts should be made to establish any family experience of periodontal disease. Also, information gleaned about stress levels experienced at work, financial stress, domestic stress, etc, is of relevance to periodontal diseases and conditions.

In detailing a patient's habits, oral hygiene habits are important. Oral hygiene practices, the oral hygiene aids (Fig. 7), toothpastes and mouthrinses used, and their frequency of use, and the time taken for completion of tooth cleaning, etc, should all be recorded. It is most

often deficiencies, inadequacies, or over-vigorous use that may well relate to the periodontal disease/condition with which the patient presents, so a detailed history is required.

If tobacco smoking is suspected or confirmed, a detailed set of questions about duration of use, daily consumption, willingness to quit, previous attempts to quit, and reasons for failure to quit should be asked. The five 'A's for tobacco cessation support should be initiated:

1. Ask, at each appointment, about smoking
2. Assess a smoking patient's desire and/or readiness to quit
3. Advise on the dangers of failing to quit
4. Assist in efforts to quit
5. Arrange follow-up and support.

For smoking patients who do not show readiness to quit, there is a five 'R's approach to trying to instil a favourable view of quitting:

1. Relevance. Try to have the patient understand why quitting is relevant to him/her
2. Risk. For smoking patients with periodontal destruction, the risk to undesirable outcomes from smoking is already apparent. Show the patient the harm evident in the patient's mouth
3. Rewards. Get the patient to understand the personal and family health, and personal and family financial rewards from quitting
4. Road-blocks. Discuss the recognition and management of barriers to quitting
5. Repetition. At each subsequent appointment reinforce the positive 5 'R's motivational approach.

In determining the present dietary habits of a patient, attention should be paid to the diet's adequacy and balance, particularly in terms of an appropriate daily intake of fresh vegetables and fruit. With respect to alcohol consumption, it should be ascertained whether alcohol is consumed moderately, which may be beneficial to periodontal health, or excessively (over 21 units per week on a regular weekly basis), which can be detrimental to periodontal health.



Fig. 6 Chronic palatal irritation during pregnancy has resulted in a pyogenic granuloma (pregnancy epulis)

Table 4 Chronic periodontitis – manifestations

- Periodontal attachment loss
 - periodontal pockets (up to x mm)
 - gingival recession (up to y mm)
 - furcation involvements (Classes 1-4, or partial/complete)
- Tooth loss
- Tooth drifting/pathological migration
- Tooth hypermobility (Grades I-III)



Fig. 7 Plaque disclosing gel for use as an oral hygiene aid

THE INITIAL PERIODONTAL EXAMINATION

The initial periodontal examination is a visual examination of the marginal periodontal tissues and the teeth in relation to these. Because many periodontal examination protocols are based on periodontal probing, often the visual inspection is overlooked or inadequately performed. For the visual inspection to be adequately performed, the teeth and marginal periodontal tissues must be adequately illuminated, the teeth and marginal periodontal tissues be dried through the use of suction, which

is more appropriate than blowing compressed air, and the surface of any dental mirror to be used must be clean and free from contamination.

A visual inspection can determine if the marginal gingiva looks healthy. Healthy looking gingiva will be of a colour consistent with the patient's intraoral pigmentation and skin complexion, and healthy looking gingiva will not be swollen or have a glazed superficial appearance, and healthy gingiva will not display reddening/oedema. Healthy gingiva may occur at areas exhibiting gingival recession or alterations in gingival morphology (Fig. 8).

A visual inspection also allows for an assessment of plaque control practices through an assessment of visible plaque on tooth surfaces adjacent to the marginal gingiva. Similarly, a visual inspection allows for an assessment of the amount and extent of supragingival calculus, which is usually bulky and a creamy colour, although supragingival calculus may take up extrinsic stain and become dark (Fig. 9).

A visual inspection may allow the detection of some subgingival calculus, especially when situated on buccal and lingual tooth surfaces, which is evident as a darkening apparent on visually examining the gingiva. Similarly, many areas of inflamed periodontal pocketing on buccal and lingual tooth surfaces are apparent on careful visual inspection.

A visual inspection allows for an assessment of gingival recession (which is visual exposure of tooth root surfaces) and tooth anatomical features (furcations, cervical enamel projections, grooves) associated with periodontal attachment loss. Visual inspection is also essential in the assessment of gingival enlargements/overgrowths. These may be either localised, such as the various types of epulides, or generalised, such as what is often termed Drug Induced Gingival Overgrowth, but more appropriately termed Drug Influenced Gingival Enlargement – features that are really only evident on visual inspection, as is tooth drifting/pathological migration (Fig. 10).

A visual inspection of adequately illuminated marginal periodontal tissues, free of saliva, not only forms the initial periodontal examination at the stage of

establishing a periodontal diagnosis, but it forms the initial examination at every stage of periodontal reassessment during active therapy, at all formal reassessments of the periodontal status, and at recall appointments during long-term supportive periodontal care.

ASSESSMENT OF LOCAL FACTORS

Local tooth-related and soft tissue-associated anatomical, development or acquired factors, which may predispose to plaque accumulation and periodontal inflammation, are often assessed as part of a periodontal examination. However, these local factors generally do not contribute directly to the periodontal diagnosis, *per se*, but certainly may direct attention to their appropriate management during therapy.

Plaque deposits

Despite the unequivocal role of bacterial plaque in the aetiology of oral plaque mediated infections, an assessment of the amount and distribution of plaque has little significance in the diagnosis of periodontal disease, since it takes no account of the host response to its presence. Hence, plaque deposits are best scored during initial periodontal therapy when, following motivation, the patient is instructed in oral hygiene practices. Decreasing plaque scores indicate that the patient has learned to perform oral hygiene better (Fig. 11).

For long-term monitoring, plaque scores are of limited value since they only reflect the patient's capability at that moment, but not his/her performance and perseverance in removing plaque. Plaque, if being recorded, is best evaluated using a dichotomous (yes, no) scale that registers its presence or absence on gingival tooth surfaces. In assessing plaque accumulation in this fashion, percentages of surfaces covered by plaque can be calculated. Furthermore, the topographical distribution of sites covered with plaque can be obvious through the use of a recording chart. The 'yes' or 'no' scores can be determined by visual inspection, perhaps supplemented by the use of a periodontal probe to try to collect plaque on the working end of the probe at sites where it is not visible, or through the use of a disclosing agent, which stains plaque to make a visual assessment of its presence easier.



Fig. 8 Healthy gingival tissues in a patient with extensive toothbrush/dentifrice abrasion



Fig. 9 Extensive deposits of supragingival and subgingival calculus, with oedematous red gingival tissues



Fig. 10 Gingival hyperplasia induced by chronic inflammation from dental plaque in a patient prescribed immunosuppressive drugs



Fig. 11 Extensive plaque deposits are associated with obvious gingivitis and cervical enamel decalcifications

However, these assessments of plaque relate only to supragingival plaque, while it is subgingival biofilms at sites of periodontal pocketing which are of significance in continuing periodontal destruction.

Assessments of subgingival plaque presence on a 'yes' or 'no' basis can be determined by using a periodontal probe or a periodontal curette to bring plaque to the surface. While no recording systems for subgingival plaque presence have been described, in reality the determination of subgingival contamination (perhaps when supragingival plaque is not evident because of sporadic, but good plaque control), is a very important assessment.

Calculus

Calculus has to be considered as mineralised plaque deposits. It is the prime plaque retaining factor and, because of this undisputed role, its removal is crucial in periodontal therapy. Supragingival calculus is evident on visual inspection and its presence may be recorded tooth surface-by-tooth surface. Subgingival calculus can be detected through the use of periodontal probes on tooth root surfaces. Ball-ended probes are advocated as being of particular value in this assessment. Subgingival calculus may be evident on radiographs, although radiographic examination ought never to be performed solely for the assessment of subgingival calculus. The presence of subgingival calculus may be recorded tooth root surface-by-tooth root surface.

Overhangs

Overhanging and other plaque retentive margins of restorations may be detected by visual inspection, through the use of a periodontal probe (again, ball-ended probes have been advocated as being especially favourable in this regard), and through assessing whether or not dental floss catches and shreds/tears on attempted interproximal removal in a coronal direction. Interproximal overhangs may be visible on radiographs if the restorations are of radiopaque materials, but only seldom are radiographs prescribed solely for the assessment of marginal adaptation of restorations.

Local anatomical factors

Local anatomical factors that may predispose to periodontal inflammation or may alter the course or presentation of periodontal destruction are assessed, and these may be both tooth-related and associated with soft tissues.

Tooth-related local factors

Among tooth-related factors often recorded are exposed furcations, cervical enamel projections, root grooves, root concavities, cervical root resorptions, and evident longitudinal root fractures.

Soft tissue-associated local factors

Soft tissue features that may be recorded include (in addition to gingival recession), inconsistent heights of gingival margins (as in altered passive eruption), aberrant fraenal insertions, gingival enlargements/overgrowths, and oral hygiene induced lesions such as floss-induced gingival clefting.

PERIODONTAL PROBING ASSESSMENTS AND METHODS

Gingival bleeding

Bleeding following gentle running of a periodontal probe around the gingival margin area at the dento-gingival junction denotes inadequate marginal plaque control by a patient. When performed, this testing for gingival bleeding is often combined with the recording of visible plaque for a more comprehensive evaluation of a patient's sustained efforts at personal plaque control. However, more usually the assessment of bleeding is performed through noting bleeding following periodontal probing of the gingival sulcus or pocket.

Bleeding on probing (BOP)

Absence of bleeding on probing is a reliable parameter to indicate periodontal stability if the probing is performed using only gentle probing forces with a probe of suitable dimensions. Presence of bleeding upon probing indicates the presence of gingival inflammation. Since the absence of bleeding on probing with a gentle force has indicated periodontal stability with a negative predictive value of 98-99%, this clinical parameter is most reliable to monitor patients over time in daily practice. Non-bleeding sites may be considered as periodontally stable. On the other hand, bleeding sites seem to have an increased risk for progression of periodontitis, especially when the same site bleeds at repeated evaluations over time. Therefore, it is advisable to register the sites which bleed on probing in a dichotomous way

using a gentle probing force. This allows the calculation of a mean BOP score for the patient, and also yields the topographical location of the bleeding sites.

Probing depth and loss of attachment

Clinical probing is the most commonly used parameter both to document loss of attachment and to establish a diagnosis of periodontitis. There are some sources of error inherent to this method, which contribute to the variability in the measurements. Among these, the following factors are discussed: dimensions of the periodontal probe, placement of the probe and obtaining a reference point, crudeness of the measurement scale, probing force, and gingival/periodontal tissue conditions.

Dimensions of the periodontal probe

It is obvious that different sizes of periodontal probes will yield different penetration depths into the periodontal tissues, even if all other variables are controlled. Hence, the use of probing instruments with standardised dimensions is a prerequisite for repeated probing depth measurements. Usually, periodontal probes with a point diameter of 0.3-0.5 mm, and ball-ended probes with the ball-end having a diameter of 0.5 mm, have been used successfully.

Placement of the probe and obtaining a reference point

Manual probing involves variable measurements generated by the different angulations and site localisations of the probe, and by the difficulty in obtaining a fixed landmark as a reference point.

Crudeness of the measurement scale

Probing pocket depth measurements are generally assessed to the nearest millimetre or in ranges of 2.0-3.5 mm. Registering probing pocket depths by bands/ranges is meant to reflect that objective metric measurements of probing are not exact. However, when using banded probes a small difference such as 0.5 mm may change the assessment of probing pocket depth from one category of lesser severity of probing pocket depth to a more 'severe' category of probing pocket depth. But, on a metric scale such a small difference may not be registered or may only change the probing pocket depth recorded by 1.0 mm.

Probing force

Probing force is a significant variable that should be controlled to obtain reproducible measurements of probing depth. If a probing force of 0.25–0.30 N is applied, the apical termination of the probing tip lies usually within the junctional epithelium (epithelial attachment) in healthy gingival tissues. Probing forces of this magnitude have generally been accepted for use in electronic pressure sensitive probes. If treatment effects are to be monitored, the probing force will influence the clinical attachment levels. At least 0.25 N of probing force has to be applied to yield treatment-related differences in clinical attachment level measurements.

Gingival/periodontal tissue conditions

Attachment level and probing pocket depth measurements are significantly influenced by the density of the connective tissue collar around the teeth. In healthy tissues, or those with slight gingivitis, the probe tip generally reaches the most apical cell of the junction epithelium. However, in a periodontal pocket the probe tip routinely exceeds the level of the connective tissue attachment (gingival fibre attachment), by penetrating into the inflamed tissue, to be hindered in its apical penetration either by intact connective tissue fibres or eventually by the alveolar bone crest. The significant influence of the inflammatory infiltrate on probing pocket depth measurements has been clearly documented. If tight adaptation of the gingival tissues is obtained as the result of therapy, which may have produced a long junctional epithelium as the expected and beneficial outcome of therapy, the most apical cell of the junctional epithelium may not always be reached.

Clinical probing

In spite of it being recognised that periodontal probing does not really measure any particular aspect of interest (true pocket depth, true attachment loss, true attachment levels), this diagnostic procedure has not only been the most commonly used, but is also the most reliable method for the evaluation of the periodontal tissues in both health and disease. It has to be realised that increased probing depth and clinical attachment loss are conditions that

reflect the history of periodontitis rather than its current state of activity.

To obtain a more realistic assessment of disease progression, or healing following therapy, multiple evaluations should be performed. Obviously, the first evaluation before therapy will yield results confounded by a greater impact on measurements from inflammation than probing evaluations following therapy. The reference point (the cemento-enamel junction) may be obstructed by calculus or by dental restorations, and the condition of the gingival tissues may allow an easy penetration of the periodontal probe into the tissues, even though the probe position and gentle force applied are standardised.

Traumatic haemorrhage, in addition to readily-evoked inflammatory haemorrhage, resulting from the probing may make the registration of metric measurements imprecise, as blood may obscure both the gingival margin and the cemento-enamel junction at sites of initial recession. These biological variables (tissue conditions, bleeding and calculus) may be minimised following initial periodontal therapy. Hence, a repeat periodontal evaluation using probing after the initial therapy will improve the periodontal probing assessment. Therefore, the first periodontal evaluation after healing, following initial non-surgical periodontal therapy, should be taken as the baseline for long-term clinical monitoring.

Periodontal probing is routinely performed at six sites around each tooth/root (mesio-buccal, buccal, disto-buccal, disto-lingual, lingual and mesio-lingual), and in line with the direction of the long axis of the tooth, for recording purposes. However, for true diagnosis and for the appropriate treatment decisions to be made, periodontal probing may have to be performed at many more sites on a tooth and also the probe may have to be angled away from the long axis direction to explore periodontal pockets.

Periodontal probing with a graduated periodontal probe:

- **Step 1:** Determination of the distance from the free gingival margin (FGM) to the cemento-enamel junction (CEJ) to the nearest millimetre (Fig. 12). For recognition of the CEJ, the periodontal probe is angulated

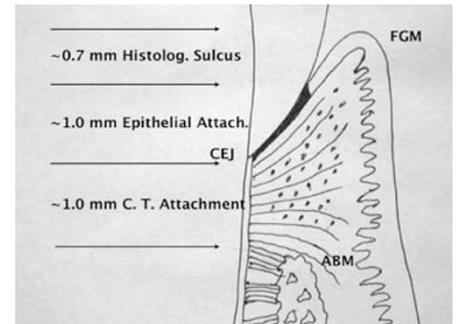


Fig. 12 Diagrammatic representation of periodontal landmarks. FGM: Free Gingival Margin. CEJ: Cemento-enamel Junction. ABM: Alveolar Bone Margin. Histolog. Sulcus: Histological Sulcus. Epithelial Attach.: Epithelial Attachment. C.T. Attachment: Connective Tissue Attachment (Gingival Fibre Attachment)



Fig. 13 The WHO (CPI/BPE) probe with a 0.5 mm ball end

at 45° to the long axis on the root surface and guided towards the CEJ.

If recession is present the metric value becomes negative

- **Step 2:** Assessment of the probing pocket depth (PPD) from the FGM to the bottom of the pocket or sulcus to the nearest millimetre. The periodontal probe is only slightly angulated at 0–10° and guided along the root surface until the first resistance of the gingival connective tissues is felt. Preferably, a standardised gentle probing force (0.25 N) is applied.

Clinical attachment loss (CAL) is calculated by subtracting the values FGM-CEJ from the PPD. In the presence of gingival recession, where the FGM-CEJ is a negative value, the subtraction of the negative value results in an addition of the values from Steps 1 plus 2. In other words, CAL is PPD plus recession when gingival recession is present, and PPD minus FGM-CEJ when the CEJ is covered by gingiva. Periodontal probing with a banded periodontal probe:

Table 5 BPE/PSR sextant approach (FDI tooth notation)

Sextants		
(18) 17, 16, 15, 14	(18) 17, 16, 15, 14	(18) 17, 16, 15, 14
(48), 47, 45, 44	(48), 47, 45, 44	(48), 47, 45, 44

A third molar is not usually examined unless another molar in the same sextant is missing and the third molar is fully erupted.

Table 6 Summary of scores based on findings used in BPE/PSR, and what clinical conditions these signify

Code	Examination findings	Clinical condition
0	No pockets exceeding 3 mm, no calculus or overhangs and no bleeding on gentle probing	Healthy periodontium
1	Coloured band remains totally visible, indicating no pockets exceeding 3 mm, no calculus or overhangs, but bleeding on gentle probing	Gingivitis
2	Coloured band remains totally visible, indicating no pockets exceeding 3 mm, but calculus or other plaque-retentive factors found at or below the gingival margin, with or without bleeding on probing	Gingivitis or plaque retention factors
3	Coloured band on the probe remains partially visible when inserted into the deepest pocket, indicating pocket depths greater than 3.5–4 mm but less than 5.5–6 mm	Mild periodontitis
4	Coloured band on the probe covered by gingiva, indicating a pocket of at least 6 mm in depth	Moderate to severe periodontitis
*	Attachment loss at any site is 7 mm or greater, furcation involvement	Severe periodontitis

- **Step 1:** When the banded periodontal probe has advanced until the first resistance from the gingival tissues is felt, note is taken of which band(s) of the probe are completely covered by the gingiva, and the probing depth range or score is recorded. The presence or absence of gingival recession has no influence in this step
- **Step 2:** At sites with gingival recession, with the banded periodontal probe in the position at which the probing depth range or score was recorded, the range in which the CAL lies can be recorded by noting within which band of the probe the exposed visible CEJ lies.

THE BASIC PERIODONTAL EXAMINATION (BPE)

Following the initial visual inspection, a basic periodontal examination (BPE) (also known in North America as the periodontal screening and recording (PSR) index) can be carried out. The BPE is a modified version of the original community periodontal index of treatment needs (CPITN) system. The BPE/PRS is a method of identifying the presence or absence of disease, as well as providing a time-efficient method of screening for periodontal treatment needs. Measures of gingival recession,

tooth mobility, intensity of inflammation, differentiation between supragingival and sub-gingival calculus, and precise pocket depths are not included.

It is advocated that the BPE/PRS involve the use of a special banded and ball-ended probe, the CPITN or WHO probe (Fig. 13). However, any periodontal probe can be used and the measurements capable of being recorded by that probe can be converted to be compatible with those of the BPE/PRS. The probe advocated has a 0.5 mm diameter ball at its tip, and is available either with a single coloured band that extends from 3.5 mm to 5.5 mm from the ball-end of the probe, or with two coloured bands with the second band extending from 8.5 mm to 11.5 mm. The probe with two coloured bands is used in the assessment of clinical attachment loss (CAL).

Each tooth should be examined at six sites (disto-buccal, buccal, mesio-buccal, disto-palatal, palatal and mesio-palatal), and the highest score for a sextant recorded in the chart (Table 5). For a sextant to qualify for recording it must contain at least two teeth. If only one tooth remains, for recording purposes it is included in an adjacent sextant. The codes used in the BPE/PSR are summarised in Table 6. The highest score in each sextant is recorded. As soon as a Code 4 or Code* is encountered, the examiner

can move on to the next sextant. However, if neither of these codes is recorded, the examiner must probe all sites to ascertain the highest code for that sextant.

If the BPE/PSR and/or the initial visual assessment indicate a severe periodontal condition a complete charted recording of periodontal findings should be recorded – BOP, PPD, Recession, CAL (all at six sites per tooth), furcation involvements, and perhaps also tooth mobility, suppuration on probing, and drifting. The charting discussed in chapter 4 of the related *BDJ* clinical guide is one example of such a recording.

FURCATION INVOLVEMENTS

These may be detected clinically through periodontal probing with ordinary periodontal probes or using specially designed furcation probes. The latter are not usually necessary, but it should be noted that examination for furcation involvements using the ordinary periodontal probes may require the probes to be inserted with angular or horizontal approaches to the anatomical furcation. Also, especially for maxillary molars and for multi-rooted premolars, the probing must be performed at further sites in addition to the usual six sites probed for the basic or complete periodontal examination. Furcation involvements are often graded into 3 (or 4) classes of severity:

- **Class 1** denotes initial involvement wherein the probe enters the furcation, but to less than one-third of the bucco-lingual or mesio-distal width of the furcation
- **Class 2** is partial involvement, with horizontal probing being possible for more than one-third of the furcation dimension, but the furcation cannot be probed in a through-and-through fashion. For exploration and confirmation of the lack of a through-and-through involvement a pair of periodontal curettes can be used to explore the furcation, hence a furcation probe is unnecessary
- **Class 3** is a through-and-through involvement with periodontal probes or periodontal instruments capable of passing through from one entrance all the way to exit at another furcation entrance without any periodontal attachment impeding the passage of the ‘exploring’ instrument/probe

- (Class 4 is a class/grade assigned by some authorities to a furcation completely visible in a through-and-through fashion as a result of recession).

In clinical practice, such as in the charting discussed in chapter 4 (of the associated *BDJ* clinical guide), many clinicians collapse classes/grades 1 and 2 together, indicating partial furcation involvement, and classes/grades 3 and 4 together, indicating complete furcation involvement.

MOBILITY

Increased tooth mobility (tooth hypermobility) may be the result of one or a combination of three phenomena:

- An increased width of the periodontal ligament space, resulting from a traumatic event or trauma from occlusion
- A decreased height of the supporting periodontal structures
- Inflammation anywhere within the periodontal attachment apparatus.

As periodontitis-affected teeth will always yield a different ratio of supporting structures to tooth-root length than healthy teeth with unaltered levels of attachment, increased tooth mobility may almost inevitably be expected, and may not relate to the current disease status. Therefore, tooth mobility is one of the least reliable assessments in diagnosing periodontal disease. If recorded, mobility is usually assessed on a 3-point scale as follows:

- *Grade I* is assigned when assessed mobility using instrument handles to displace a tooth is greater than physiological mobility, but less than 1.0 mm in a bucco-lingual direction and no vertical displacement of the tooth in its socket is possible
- *Grade II* is assigned when horizontal mobility is greater than 1.0 mm in a bucco-lingual direction, but no vertical displacement of the tooth in its socket is possible
- *Grade III* is assigned when vertical displacement of the tooth in its socket is possible.

SUPPURATION

Pus will develop in a proportion of periodontal lesions, and it may drain through the orifice of a pocket. This criterion for



Fig. 14 Advanced periodontal attachment loss with pathological tooth migration, and pus draining from a periodontal pocket

suppuration may be recognised while clinically probing the periodontal lesion, and the suppuration may be recorded.

TOOTH DRIFTING/PATHOLOGICAL MIGRATION

This manifestation of periodontal destruction is assumed to arise from reduced periodontal support failing to hold teeth in the positions into which they erupted. Teeth may drift in a buccal direction, may extrude in an incisal/occlusal direction, and sometimes may drift in a mesial or distal direction even in the absence of any tooth loss. Drifting should be evident on visual inspection, but comparison of the current teeth positions with those shown in photographs taken earlier of the patient when smiling can confirm that drifting has occurred. Drifting can be indicated on the periodontal chart (Fig. 14).

RADIOGRAPHS IN PERIODONTAL DIAGNOSIS

Basically a periodontal diagnosis is established on the basis of the case history and the clinical examination. Information gleaned from appropriate radiographic examinations, except for aspects such as the diagnosis of combined periodontal-endodontic lesions, do not play a determining role in the establishment of a periodontal diagnosis. But, radiographs are often an integral component of a thorough periodontal assessment. Clinical examination can determine what attachment has been lost. However, only radiographs that include the tooth apices can guide on how much bony support remains: 8 mm of CAL on a short conical root, with perhaps incomplete separation of roots on a multi-rooted tooth, is of much greater significance than 8 mm of CAL on the root of a tooth with long and divergent roots.

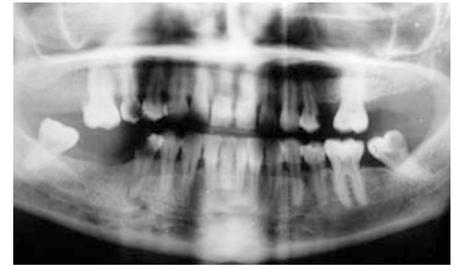


Fig. 15 Panoramic radiograph showing alveolar crestal bone loss, and subgingival calculus associated with the mandibular anterior teeth in particular

Radiographic films and digital sensors for determining periodontal bone loss as part of periodontal screening should only be exposed when the BPE/PSR clinical screening has indicated a Code 4 (or sometimes Code *), or when periodontal destruction is evident from either the initial visual inspection or the complete periodontal examination and charting of the periodontal findings. Panoramic radiography has a place in such circumstances (Fig. 15), supplemented where necessary by long-cone paralleling (rather than bisecting angle) method periapical radiographs and by bitewing (often vertical bitewing) radiographs. This is a practical approach, and studies confirm the value of panoramic radiographs for assessing bone levels when comparing them with actual bone levels and with bone levels as viewed on periapical radiographs. Patients should not be exposed to a greater radiation dose than required for assessing their condition, and any exposure should be clinically justified. Full-mouth periapical radiographs have in the past been advocated by some for comprehensive periodontal assessment. Historically, this approach has been considered to be the 'gold standard'. However, this approach is outdated and necessitates unnecessary exposure of patients to irradiation, with no diagnostic or therapeutic yield beyond that obtained by panoramic radiographs, supplemented with selected intraoral radiographs if necessary. Hence, there has been a pragmatic shift away from full-mouth periapical radiographs for periodontal assessments. Panoramic radiography results in greater efficiency and patient comfort. A panoramic radiograph of a patient can be supplemented by selected intraoral radiographs if, after studying the panoramic radiograph for a patient along with the patient's clinical

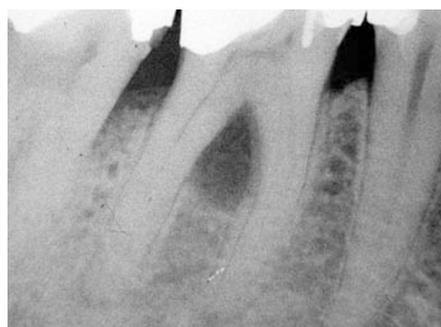


Fig. 16 Extensive bone loss in the root furcation of a mandibular molar. The mesial overhang of the pinned amalgam restoration is associated with crestal alveolar bone resorption

periodontal findings, doubt remains about a diagnosis (in the case of perhaps a combined periodontalendodontic lesion), or an appropriate treatment decision.

Alveolar bone loss

Radiographs can allow for an assessment of interdental crestal alveolar bone levels and for an appreciation of patterns of bone loss – horizontal and/or angular (a preferred term to vertical) bone loss. However, these assessments do not form part of the diagnostic process. Bone loss should be correlated with CAL findings, and it should be noted that bone destruction can be underestimated in patients with early periodontal destruction, because buccal and lingual cortical bone plates are still largely intact. Conversely, bone loss may be overestimated in patients with severe periodontal disease, perhaps especially on panoramic radiographs where the tooth roots and alveolar crest may be positioned largely within the focal trough of the X-ray beam (Fig. 15).

Radiographic features impinging upon treatment planning

As discussed previously, radiographs may show subgingival calculus and overhanging restoration margins, both of which require attention during non-surgical periodontal therapy. Furcation involvements can be detected clinically by periodontal probing, but the extent of bone loss in the furcation region can be estimated (and usually underestimated in early involvements) from appropriate radiographs (Fig. 16). A furcation ‘arrow’, which is an arrowhead-shaped radiolucency superimposed on either one or both of the buccal roots of a maxillary molar, is often an

indication of a mesio-palatal or disto-palatal furcation involvement that may have been overlooked in the clinical examination when probing at just the six standard sites around a tooth.

Radiographs can be particularly useful in the assessment of whether a tooth with severe CAL can be treated and saved, even if for a limited time, or whether extraction is indicated. Again, the radiographic appearance of the length and morphology of the tooth root(s) and the extent of the bone loss, along with any periapical bone loss, can greatly assist in appropriate treatment planning.

PERIODONTAL RECORD KEEPING

The basic BPE/PSR index may be the first periodontal probing examination performed in the assessment of a patient. If no scoring codes of 4 and no conditions designed with an asterisk (*) are encountered, the BPE/PSR may be the only periodontal probing examination required for a patient. However, this BPE/PSR should be repeated after initial non-surgical periodontal therapy.

If the BPE/PSR and/or the initial visual assessment indicate a severe periodontal condition, a complete charted recording of periodontal findings – BOP, PPD, recession, CAL (all at six sites per tooth), furcation involvements, and perhaps also tooth mobility, suppuration on probing, and pulpal response test results, should be recorded. The charting discussed in chapter 4 of the related *BDJ* clinical guide is one example of such a recording.

The basic requirement for recording the periodontal status for a patient is the sextant-by-sextant recording detailed in Tables 5 and 6 of the BPE/PSR. Information not captured by the BPE/PSR, or indeed by the charting as described in (chapter 4 of the associated *BDJ* clinical guide), can be captured by diagnostic casts. These can record gingival swellings/enlargements/overgrowths, gingival recession, the positions of gingival margins and discrepancies, and the positions of teeth affected by drifting/pathological migration. The baseline diagnostic casts can be a particularly useful reference for monitoring the later resolution of gingival swellings/enlargements/overgrowths, in monitoring the positions of gingival margins in relation to gingival recession and passive tooth eruption, and in

monitoring drifted/ pathologically migrated teeth for evidence of spontaneous repositioning or further drifting.

Clinical photographs are used increasingly to record the superficial periodontal appearance, and also for patient education. For a complete record, usually nine views are required, for all but one of which front-surfaced photographic mirrors are required. The standard views include a frontal view with the teeth in occlusion, except in the case of a deep anterior overbite. Then with the aid of long narrow photographic mirrors, one right and one left buccal view with the teeth in occlusion are taken. Then in the maxillary arch, three palatal mirror views are taken, two posterior (right and left) and one anterior. Similarly, in the mandibular arch, three lingual mirror views are taken. Digital photography allows for reasonably secure storage of the images.

FURTHER DIAGNOSTIC TESTING IN PERIODONTOLOGY

Microbiological

A wide variety of microbiological diagnostic approaches within periodontology have been investigated. These approaches have included microbiological culturing, microscopic identification possible within the limitations imposed using dark-field and phase contrast microscopy of ‘vital’ plaque samples, enzymatic assays, immunoassays, nucleic acid (DNA and 16S rRNA) probes, and polymerase chain reaction assays. Despite extensive research that has continued unabated for over two decades, it is still not possible to recommend when microbiological diagnostic testing for periodontal conditions be applied, nor indeed which investigative method to use. Perhaps microbiological investigation may have a place when routine periodontal therapy has failed to bring about resolution of the periodontal disease in patients practicing what would generally be considered to be excellent personal plaque control.

Host response testing

Periodontal destruction results from the interplay of pathogenic bacteria and the host’s response. Various levels of testing of elements of the host response have been researched. These include salivary and gingival crevicular fluid testing. What

has been investigated in these fluids has included antibody responses, inflammatory cell products (enzymes and their inhibitors, inflammatory mediators and host response modifiers), and tissue breakdown products. Despite over three decades of research there is little compelling evidence to show that such testing is of significant clinical benefit for patients or their dentists in the diagnosis of periodontal diseases, beyond what is learned from the history of previous disease experience gleaned from the clinical examination.

DIAGNOSES OF ACUTE PERIODONTAL LESIONS

Acute periodontal abscesses

Most, but not all, patients presenting with an acute periodontal abscess complain of pain. In the case history it is the history of previous periodontal therapy that is significant, as periodontal abscesses are known to occur in patients undergoing periodontal treatment. An explanation for this based on incomplete removal of calculus has been proposed, although the possibility of allowing microbial penetration of the soft tissue pocket wall during subgingival instrumentation, shown to occur in periodontal abscesses, also cannot be ruled out. Recent previous antibiotic therapy, often for non-oral reasons, may be a trigger for periodontal abscess formation. Patients also may recall traumatic intraoral events, because forceful impaction of foreign bodies or materials into a pocket can predispose toward periodontal abscess formation at previous periodontally involved sites.

The clinical findings associated with periodontal abscesses are swelling, oedema and redness of the affected periodontal sites. Bleeding on probing the affected site will invariably occur, and suppuration on pressure or on probing occurs in the majority of instances. That suppuration does not always occur in response to periodontal probing may be due to the tortuous nature of some pockets. However, a ready release of pus on periodontal probing with alleviation of the symptoms of pain, pressure and discomfort can be helpful towards establishing the diagnosis of a periodontal abscess. A tooth with an associated periodontal abscess often displays hypermobility, which can be helpful in determining

the tooth a periodontal abscess arises from, as periodontal abscesses may migrate from the involved tooth and present at a site some distance from the origin. Tenderness of the tooth to palpation may be present. Lymphadenopathy occurs only in a minority of patients, and fever and malaise are rare. Periodontal pocket probing depths, while increased, are variable. Although the majority of periodontal abscesses have been reported to occur interdentally, they may occur on any tooth surface.

Periodontal abscesses must be differentiated from periapical abscesses.

A positive response to pulp testing of an abscessed tooth usually indicates a periodontal abscess if the tooth is periodontally involved. Longitudinally fractured teeth may also present with what appears to be a periodontal abscess, so signs of what might have caused such a fracture should be noted. However, a tooth with previous and successful endodontic therapy or a post-retained restoration may also experience a periodontal abscess, so the diagnosis must be established with care (Fig. 17).

Acute necrotising ulcerative gingivitis/periodontitis (ANUG/P)

A patient presenting with ANUG/P almost invariably has a complaint of pain or discomfort, which may have had a rapid onset. Manipulations of the affected areas may be very painful and the patient may guard against physical disturbance of affected gingiva, and may resist investigations such as periodontal probing of affected sites. Invariably, there is ulceration of the interdental papillae. The ulcerations, which may spread from the interdental papillae to the marginal gingiva, may result in a reduction in width of attached gingiva because of the marginal tissue necrosis. Characteristically the ulcers are crater-like; 'punched out' is the term used to describe the crater-like ulcers of the interdental papillae. If undisturbed, the ulcerated surface is usually covered by a slough of necrotic debris (Fig. 18).

Further clinical features that can contribute to the establishment of the diagnosis of ANUG/P are not invariably present. Fetid breath is a variable clinical finding and, while not diagnostic, when present and characteristic it is helpful in establishing the diagnosis. Fever and malaise are



Fig. 17 Abscess resulting from the root fracture of a heavily restored maxillary central incisor



Fig. 18 ANUG showing 'punched out' ulcerated interdental papillae associated with acute gingivitis and subgingival calculus

not consistent findings in ANUG/P, and fever when present is usually not marked. Lymphadenopathy, if present, more commonly involves the submandibular lymph nodes and less commonly involves the cervical lymph nodes.

DIAGNOSIS OF COMBINED PERIODONTAL-ENDODONTIC LESIONS

The current classification of periodontal diseases and conditions does not consider it to be of importance to determine how such lesions arose. It is unimportant whether an endodontic lesion has affected, through lesion spread, the marginal as well as the periapical periodontium, or whether a periodontal lesion has, through whatever communication, brought about pulpal pathosis, which has then caused a lesion of endodontic origin. If a tooth has both a periodontal pocket and a lesion of endodontic origin, whether or not these two different types of lesion communicate directly with each other, then the tooth has a combined periodontal-endodontic lesion. Hence, the diagnosis is arrived at through the clinical examination of the periodontal clinical attachment loss, pulp testing of the tooth, and study of periapical radiographs of the tooth where a periapical radiolucency

should be evident. Radiographic markers, such as gutta-percha points can be helpful in demonstrating the extent of destruction, communications and the origin of lesions which present with sinus openings.

ASSESSMENT OF RISK TO PERIODONTAL DISEASE

Dental plaque is the causative agent for periodontal disease. Therefore, theoretically, the more plaque a person has or forms, the more disease that person is likely to experience. Although this is largely true for gingivitis, it is not true for destructive periodontal disease. Some persons are at greater risk of developing destructive periodontal disease in response to plaque, while others show great resistance to abundant plaque on their teeth. This is in part because the presence or absence of specific plaque periodontopathogens (microorganisms that are highly pathogenic for causing periodontal destruction), which is one of the factors that determine whether or not periodontal disease is destructive, is not related to the amount of plaque present. However, periodontal destruction is the result of the interplay between pathogenic bacteria in plaque biofilm and the inflammatory response evoked in the host person's periodontal tissues. The following attributes or exposures act as either risk factors or risk markers for periodontal destruction by influencing the host's inflammatory response. These attributes usually only place most persons at relatively greater risk for periodontal attachment loss if they do not control dental plaque adequately.

Tobacco smoking

Tobacco smoking is a well-recognised health hazard, having widespread adverse effects on all body systems. Smokers are at relatively greater risk than non-smokers for periodontal attachment loss. Smokers respond less well than non-smokers to all forms of periodontal therapy. Tobacco

smoking is a true risk factor in that it is causally related to the disease, and can be modified by persons quitting smoking.

Diabetes mellitus

Many studies have shown that diabetes mellitus is a risk factor for periodontal disease. The level of control of diabetes influences the risk of periodontal attachment loss. A poorly controlled diabetic is at relatively greater risk than a well-controlled diabetic who is, in turn, at relatively greater risk than a non-diabetic.

Family history in early onset forms of periodontal disease

Advanced periodontal attachment loss in a young person tends to show what is termed 'familial aggregation', which means that this condition tends to cluster in families.

Genetic susceptibility to periodontal destruction

Genetic factors, if present, directly increase the likelihood of periodontal disease developing in the absence of adequate plaque control and, if they are absent, then the susceptibility of the host is decreased. Some genes may be protective. Disease modifying genes associated with periodontitis have been studied. These studies have focused on gene polymorphisms in several aspects of the host immune response and the production of inflammatory mediators. Some evidence has come forward that genetic polymorphisms in the interleukin gene cluster, the Fc gamma receptor gene cluster and the genes encoding for Vitamin D receptors may be associated with periodontitis in some populations, but in general there is not yet good evidence for determining an individual's susceptibility to periodontitis on the basis of genetic testing.

Psychological stress

Psychological stress extending over long

periods can adversely affect all systems of the body. Chronic stress has been shown to place persons at greater risk of developing periodontal attachment loss.

Removable partial dentures

Wearing a removable partial denture places the arch in which the denture is worn at greater risk of periodontal attachment loss and further tooth loss. The abutment teeth also are at a higher risk to dental caries. The tissue damage caused by the partial dentures can be reduced by good denture design and good oral and denture hygiene.

Other factors

Some studies have shown that males are at greater risk than females of developing periodontal attachment loss. The reasons for this are not entirely clear. Malnutrition, alcoholism and some medications also have been shown to act as risk factors for periodontal destruction. A recent longitudinal study also supports periodontitis and missing molars in particular as risk markers for premature death. What this study showed was that ill-health and premature death clusters in the same subgroup of a European population.

FURTHER READING

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