

# Factors affecting decision making at reassessment of periodontitis. Part 3: interpretation of clinical findings – local factors

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## Key points

Local factors often account for localised residual periodontal probing depths.

Correction of these factors usually improves periodontitis.

The factors should be thoroughly assessed in order to guide the most appropriate intervention.

## Abstract

This paper is the third in a four-part series outlining treatment planning at periodontal reassessment. The first article focused on the information that should be gathered at the reassessment appointment. The second article discussed systemic factors that can relate to residual periodontal probing depths. This article outlines local factors that need to be assessed when faced with residual periodontal probing depths. Treatment can involve a range of non-surgical and surgical approaches. A variety of general, practical and local site factors can affect the choice of one option over another in choosing the most predictable treatment option.

## Introduction

Local factors are more likely to be associated with localised residual probing depths compared with systemic factors which are likely to result in generalised residual probing depths. Some local factors require correction for all cases whereas others can be more relevant when assessing the merits of alternative surgical approaches. The potential local causes for residual periodontal probing depths are outlined below.

## Inadequate plaque control

As plaque is the primary aetiological factor in periodontitis, residual probing depths after initial therapy could well be due to inadequate self-performed plaque control, whether localised or generalised. As mentioned in the first article,

this is best assessed via disclosing and recording the plaque levels which has the added benefit of providing a visual communication aid when re-enforcing oral hygiene instructions. If localised sites show poor plaque control, focused oral hygiene instruction (OHI) aiding the patient to combat these problem areas should be provided. Local anatomical factors that can complicate plaque control should be addressed. Tight lips can be difficult to correct; however, high fraenal attachments resulting in decreased keratinised gingivae, muscle pull and pain on brushing can benefit from a frenectomy. Malaligned teeth may also require addressing and if the patient cannot adapt plaque control measures to achieve adequate biofilm disruption in these sites, orthodontic treatment or extraction may require consideration.

If inadequate plaque control is more generalised, the clinician will need to ascertain the reasons for this. This could be due to issues with the way OHI was delivered, the capacity the patient has to understand their role in treatment or a true lack of compliance/motivation. Discussing the issue with the patient should allow the clinician to elucidate the cause and hence rectify this. A patient-centred approach should be taken.<sup>1</sup> Inevitably

some patients may take longer than others to achieve good plaque control and some may never do so. For these patients a further course of non-surgical therapy may well be indicated to allow further disruption of subgingival biofilm and further monitoring of plaque control with opportunities for repeated OHI re-enforcement. If plaque control is very poor it may be worth considering a number of appointments to assess this and re-enforce OHI as necessary; once improvements are shown debridement can be initiated. Achieving behaviour change is a challenging process with a need to be aware of the nuances of communication, this can take time to achieve.<sup>2,3</sup>

## Residual calculus deposits

While calculus removal would be expected to confer some benefit to the patient in terms of facilitating access for self-performed plaque control, calculus itself is the result of the periodontal lesion and not its cause.<sup>4,5</sup> Overall, biofilm disruption is far more important than calculus removal.<sup>6</sup> Debridement is not as straightforward as it may first appear and patients may require multiple courses of non-surgical therapy to

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Refereed Paper.

Accepted 10 June 2019

<https://doi.org/10.1038/s41415-019-0941-z>

### Box 1 Definitions of periodontal defects

#### Circumferential bony defect:

A vertical bony defect that includes more than one surface of a tooth, eg, a vertical defect that includes the mesial and lingual surfaces of a tooth

#### Infrabony defect:

A periodontal defect extending within the bone. Includes intrabony defects and craters.

#### Intrabony defect:

An intrabony defect primarily affecting one tooth. These can be surrounded by one, two or three bony walls or a combination of these.

#### One-wall intrabony defects:

Defects limited by one osseous wall and the tooth surface.

#### Two-wall intrabony defects:

Defects limited by two osseous walls and the tooth surface.

#### Three-wall intrabony defects:

Defects limited by three osseous walls and the tooth surface.

#### Crater bony defect:

A type of infrabony defect. A cup- or bowl-shaped defect in the interalveolar bone affecting two adjacent roots. The facial and lingual/palatal walls may be of unequal height. These can be surrounded by one, two or three bony walls or a combination of these.

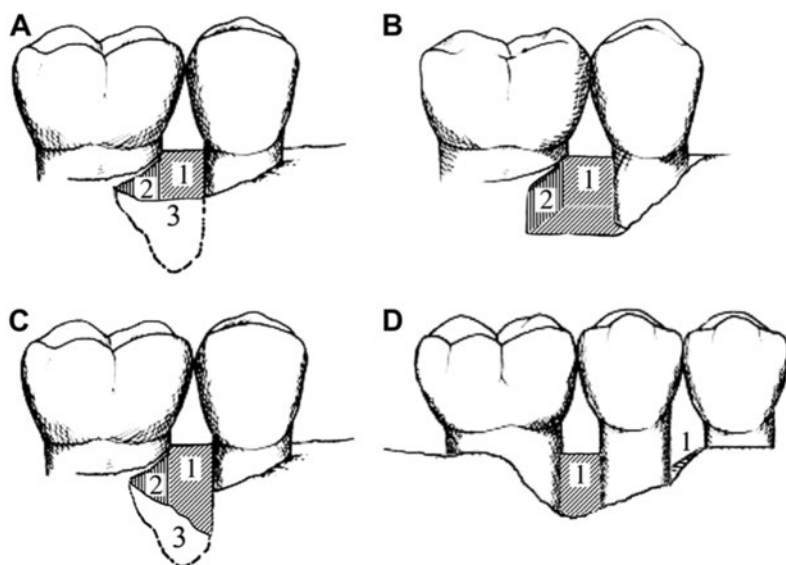
#### Suprabony pocket:

A periodontal pocket with a base coronal to the alveolar bone.

#### Intrabony pocket:

A periodontal pocket that extends into an intrabony periodontal defect.

Based on data in references<sup>17,21,23,25</sup>



**Fig. 1** Types of periodontal defects (a) Three-walled defect; (b) 2-walled defect; (c) combination defect; (d) 1-walled defect. (Reprinted from Reynolds M A, Aichelmann-Reidy M E, Branch-Mays G L. Regeneration of periodontal tissue: bone replacement grafts. *Dent Clin North Am* 2010; 54: 55–71, with permission from Elsevier<sup>55</sup>)

achieve the utmost benefit of this conservative approach. A comprehensive review paper on prevention and removal of calculus reports that debridement of single rooted teeth leaves deposits on 4.6–30% of treated surfaces.<sup>5</sup> The amount of calculus removal decreases with increasing periodontal probing depths, with approximately 45% of calculus left *in situ* in probing depths above 6 mm.<sup>7,8</sup> This rises to 68%

for molar teeth with deposits shown to be left mostly interproximally.<sup>9</sup> Furcations have been shown to have more residual deposits, with more deposits remaining around upper molar (50% of treated surfaces) rather than lower molar furcations (39.5% of treated surfaces).<sup>10</sup> The ability to remove calculus improves with a surgical approach allowing improved access and visualisation, this may need to be

considered where it is felt that a non-surgical approach has been exhausted despite optimised oral hygiene.<sup>11,12,13,14</sup> Level of experience has also been shown to improve the amount of calculus removed and may support referral where residual probing depths remain around complex anatomy.<sup>9,14</sup> Although disheartening to see after a course of non-surgical therapy, radiographs can indicate substantial deposits on the interproximal aspects of teeth (cf Fig. 11f in Part 1). Repeating non-surgical therapy can allow deposits that were previously difficult to instrument to be easier to access, as there is likely to already be some decrease in probing depth (Table 1 from Part 1) which would allow one to expect a higher percentage of calculus removal during a second course of therapy and fewer deposits that require removal compared with that initially. The alternative is a surgical approach to improve visualisation and access during debridement. Where the biofilm is regularly disrupted, residual calculus deposits may not prevent clinical healing; however where a residual probing depth remains and calculus deposits are evident, they are best removed.<sup>5,15,16</sup>

### Periodontal bony defects

Also known as osseous lesions, these are defined as alterations in the natural morphology of bone and are often associated with residual probing depths.<sup>17</sup> Relevant sub classifications and associated definitions are listed in Box 1 and displayed in Figure 1. Radiographic examples are shown in Figures 11a and 11b from Part 1.

These defects are formed due to differential bone loss in areas that are millimetres apart. Plaque located on a tooth surface results in destruction of hard and soft tissues in an apical and lateral direction of approximately 2 mm adjacent to the corresponding root.<sup>18,19,20,21</sup> The surrounding bone remains in a more coronal position forming the bony walls of the defect and holds the gingival tissues more coronally, even as the connective tissue and epithelial attachment drops within the defect. This results in increased periodontal probing depths with an infra-bony pocket.<sup>22</sup> Where the bone surrounding a tooth is narrow, for example if roots of adjacent teeth are located close to each other, all of the bone is lost rather than bony walls remaining and horizontal bone loss is seen with supra-bony pockets if the soft tissue is thick, otherwise recession manifests.<sup>19</sup> Sometimes, despite the presence of an infra-bony defect, the gingival tissue may be intact with no pocket formation.<sup>23</sup>

These defects are most commonly found in the posterior region of the mandible, followed by the posterior region of the maxilla. They are less commonly found in the anterior dentition.<sup>24</sup>

The defects can be made up of one, two or three bony walls or, most commonly, a combination of these at various heights of the defect. Various combinations of height and width are also reported.<sup>23</sup> The more bony walls that are present, the better the chance of periodontal ligament cell proliferation and hence healing.<sup>25</sup> A better outcome has also been reported for defects with an angle of 45 degrees or less.<sup>25</sup>

The number of bony walls can affect which therapy is likely to give the most favourable outcome. Three-wall intra-bony defects are usually located inter-proximally where buccal, lingual and proximal walls are intact. These are also found circumferentially, when they have affected more than one surface of a tooth. Two-wall defects are also usually located inter-proximally and are usually made up of buccal and lingual walls (termed a crater) or a buccal or lingual wall with a proximal wall. One-wall defects most commonly have a proximal wall, rather than buccal or lingual, remaining. All defects can be narrow coronally and wider apically.

Radiographs do not always clearly show the exact anatomy of the buccal and lingual walls and detailed assessment is required to make out the subtle outlines of these where possible. Radiographs have a high positive predictive value and low negative predictive value of bony defects; ie if a lesion is present radiographically it is probably there, if it is not evident radiographically it could well still be present clinically.<sup>26,27</sup> The most accurate assessment of infra-bony defect anatomy is made by a combination of assessment of the probing depths, bone sounding and radiographic examination.<sup>28</sup> Cone beam computed tomography assessment of bony defects may provide some advantages over traditional radiographs but the higher radiographic dose associated with this is generally not justified.<sup>29</sup>

In untreated cases, bony defects are associated with a higher risk of periodontal disease progression and tooth loss, with increased risks for deeper defects.<sup>30</sup> Treated cases undergoing maintenance have shown no greater risk for disease progression compared with supra-bony pockets when maintained up to 16 years.<sup>31</sup> This is seen as a general indication for treatment.<sup>21</sup>

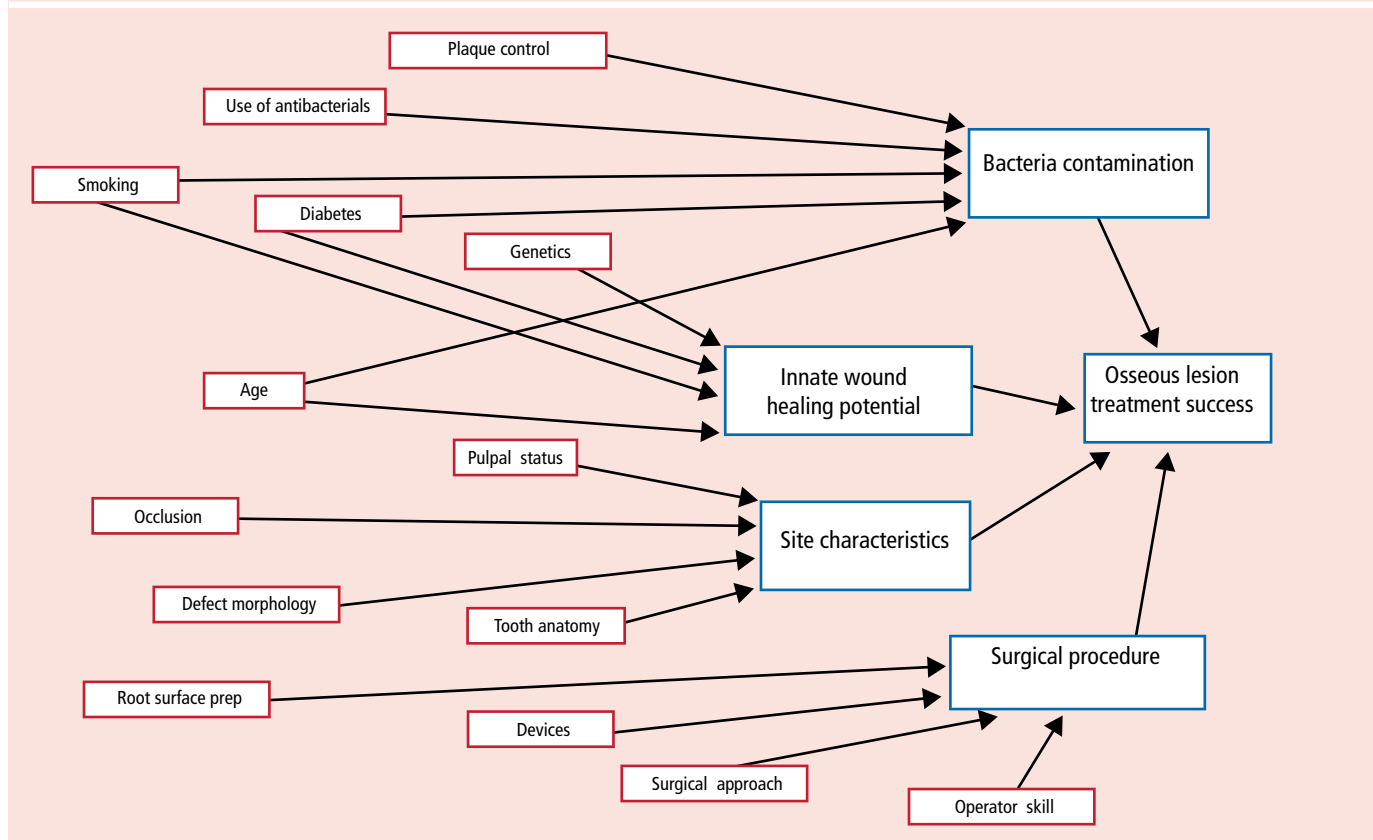
Sometimes these infra-bony defects can be resolved through non-surgical debridement in conjunction with correction of any other predisposing factors (see Fig. 2).<sup>32</sup> Where this does not occur, guided tissue regeneration

with a view to regenerating bone, periodontal ligament and cementum is usually preferable. The alternative is osseous resective surgery whereby the walls of the bone making up the defect are removed and the gingival attachment is moved



**Fig. 2** Examples of bone regeneration through non-surgical therapy. (a) Large infrabony defect associated with 46 distally; (b) Some regeneration of 46 distally following non-surgical therapy only; (c) Vertical bone loss associated with 41 mesially; (d) Some regeneration of 41 mesially following non-surgical therapy only; (e) Vertical bone loss associated with 35 mesially and evidence of calculus; (f) Some regeneration of 35 mesially following non-surgical therapy only; (g) Vertical bone loss associated with 38 distally; (h) Some regeneration of 38 distally following non-surgical therapy only

**Fig. 3** Factors influencing treatment outcomes for bony defects. (Reproduced from Kornman K S, Robertson P B. Fundamental principles affecting the outcomes of therapy for osseous lesions. *Periodontol* 2000 2000; 22: 22–43, with permission from John Wiley and Sons<sup>33</sup>)



apically. The factors that can influence treatment outcomes for bony defects have previously been summarised and are presented in Figure 3.<sup>33</sup>

### Furcation involvement

Furcation involvement can result in residual periodontal probing depths due to difficulty in access for debridement and self-performed plaque control complicated by their anatomy.<sup>9,34</sup> When there is bone loss in the furcation region it often has an irregular contour with an entrance that is usually smaller than the tip of a curette or most ultrasonic scaler tips.<sup>35</sup> Root concavities and depressions are also common in this region.<sup>36</sup> Furcation involvement of

periodontal origin needs to be distinguished from other causes including occlusal trauma, pulpal causes and root fractures.<sup>37</sup> A number of classifications for furcation involvement have been proposed.<sup>38</sup> Widely used horizontal and vertical classifications are summarised in Box 2.<sup>39,40</sup> The degree of horizontal and vertical furcation involvement has been shown to affect the likelihood of teeth being lost both with and without periodontal therapy.<sup>41,42</sup> A recent meta-analysis has reported furcation involvement of class II and III to approximately double the risk of tooth loss over 10 to 15 years of supportive periodontal therapy, with increased severity of involvement being associated with a higher

risk of tooth loss.<sup>43</sup> However, the authors did report that most of these teeth responded well to periodontal treatment and that 30% of teeth with grade III furcation were lost over a 5 to 15-year period. Furcation involvement can be managed surgically via tunnelling, furcation plasty or root resection in addition to access flaps, resective and regenerative periodontal surgery.<sup>38</sup> Assessment of treatment options is dictated by tooth position, root trunk length, degree of bone loss, root length and degree of divergence or convergence of roots.

### Defective restorations

Restorations that are overhanging or have reverse margins can act as plaque traps. These should have been corrected as part of the initial therapy but if initially present subgingivally, they can sometimes become more apparent at reassessment following recession. These should be corrected; however in some cases, the patient may wish to maintain the tooth as it is, for example if it is already heavily restored with a questionable prosthodontic prognosis. If this is the case, corrective therapy would not be indicated and supportive periodontal therapy should include adequate debridement of these sites.

#### Box 2 Common classifications of furcation involvement

##### Hamp Horizontal Classification

- Degree I: Horizontal loss of periodontal tissue support less than 3 mm
- Degree II: Horizontal loss of support >3 mm, but not encompassing the total width of the furcation
- Degree III: Horizontal through-and-through destruction of the periodontal tissue in the furcation

##### Tarnow & Fletcher Sub-classification based on the degree of vertical involvement

- Subclass A: 0–3 mm
- Subclass B: 4–6 mm
- Subclass C: >6 mm

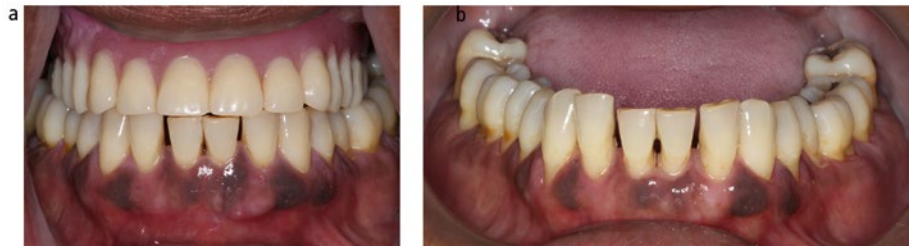
Based on data in references<sup>39,40</sup>

## Occlusal trauma

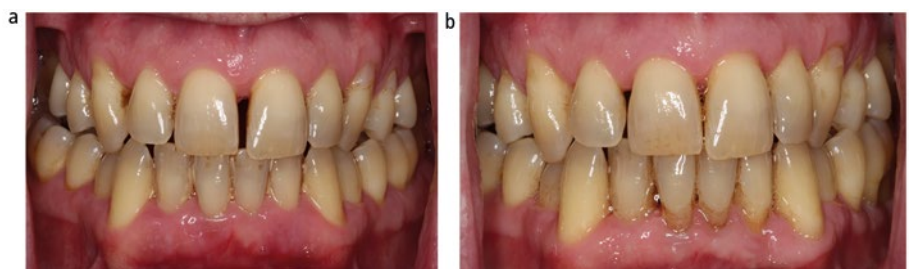
Occlusal trauma is defined as ‘injury resulting in tissue changes within the periodontal attachment apparatus as a result of occlusal forces’.<sup>17</sup> Primary occlusal trauma relates to injury due to *excessive* occlusal forces applied to teeth with *normal* periodontal support. In contrast, secondary occlusal trauma relates to injury from *normal* or *excessive* occlusal forces applied to teeth with *reduced* periodontal support. Secondary occlusal trauma is more relevant here, with it being commonly present in periodontitis cases and being increasingly common in more severe cases.<sup>44</sup> It is generally accepted that occlusal trauma can exacerbate periodontal attachment loss in the presence of inflammation.<sup>45,46</sup> Occlusal trauma can be associated with deeper probing depths and worse prognoses with probing depth increases over time. Occlusal adjustment can slow the rate of attachment loss for teeth suffering from occlusal trauma.<sup>47, 48</sup> Where generalised occlusal trauma is apparent, for example due to parafunction, an occlusal splint may be indicated. This should be considered once the self-performed plaque control is optimised as a splint can inevitably cause an increase in plaque accumulation. Figure 4 shows a case of generalised severe periodontitis managed via repeated non-surgical therapy. The patient was edentate in the maxilla and before treatment was wearing an upper complete denture overnight and reported bruxism. Cessation of wearing the denture overnight in conjunction with non-surgical therapy resulted in a drastic improvement in periodontal probing depths and mobility.

## Root grooves, enamel projections and enamel pearls

Root grooves can also result in residual pockets due to difficulty in instrumentation and acting as a tract for a biofilm to work more apically (Fig. 5). These can be detected by tactile exploration of the root surface with a periodontal or straight probe held in a light grip between thumb and index finger. This is easier under local anaesthesia and so should be borne in mind and assessed when debriding an area with increased pocketing in order to form a mental visualisation of the root anatomy. Maxillary incisors can have a palatal groove which is developmental in origin.<sup>17</sup> These are formed by folding of the inner enamel epithelium and Hertwig’s epithelial root sheath with prevalence reported to vary from 0.79–21%, with increased



**Fig. 4** Case of generalised severe periodontitis modified by occlusal trauma managed through non-surgical therapy and cessation of overnight upper complete denture wearing. This resulted in a profound decrease in periodontal probing depths and mobility. (a) Prior to treatment; (b) Following treatment



**Fig. 5** (a) Residual probing depth associated with lower left central incisor root groove distally. (b) This resolved after resective surgery which included smoothing of the groove with curettes

prevalence in lateral compared with central incisors.<sup>49</sup> Maxillary premolar teeth also show a high prevalence of mesial and distal root concavities, including the canine fossa of the upper first premolars mesially.<sup>50</sup>

Enamel projections are an apical extension of enamel, usually toward a furcation.<sup>17</sup> Connective tissue does not attach to enamel and hence where these projections extend subgingivally they can predispose to furcation involvement.<sup>49</sup> It has been estimated that 82% of teeth with enamel projections suffer furcation involvement compared with 17% of teeth where enamel projections are not present.<sup>51</sup> These are most common in mandibular first molar teeth and could dispose to a residual probing defect after initial therapy. Enamel pearls are small masses of enamel formed apical to the cemento-enamel junction.<sup>17</sup> These are mostly found on third molar teeth and are relatively rare. Due to being local anatomical factors complicating biofilm disruption, when present, they may require surgical intervention to remove them.

## Mouth breathing and xerostomia

This can result in drying out of the oral cavity and gingival tissues, with a subsequent decrease in the protective factors in saliva. This may cause gingival enlargement, particularly

affecting the anterior teeth. Patients should be informed of this potential factor that may limit the complete stabilisation of gingival inflammation in this region. They can be advised to breathe through their nose wherever possible. If they cannot carry this out due to a nasal obstruction it could be worth liaising with their general medical practitioner in case of the need for further investigation if the patient so wishes. Oral hygiene should be stressed and placing a lubricant over the gingivae after tooth cleaning has been suggested.<sup>52</sup>

General xerostomia may also put patients at an increased risk of periodontitis and if marked, input from oral medicine specialists may be indicated.<sup>53,54</sup>

## Summary

Where residual probing depths are present, they may be associated with a wide range of systemic and local factors or a combination of both. Local factors that require assessment include plaque, calculus, bony defects, furcation involvement, defective restorations, occlusal trauma, root grooves, enamel projections, enamel pearls, mouth breathing and xerostomia. When the causative factors have been determined, treatment options appraisal can be effectively undertaken followed by further detailed planning and treatment provision.

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