Detection of localized tooth-related factors that predispose to periodontal infections

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Periodontal diseases are bacterial infections that are present in approximately 70% of the U.S. population, with 20–30% being severely affected (16). Over the last century, numerous investigations have attempted to define the etiologic agents of these diseases and it is now clear that specific bacterial pathogens are the primary etiologic agents. These bacteria form a biofilm at or above the gingival margin. Supragingival irregularities such as crowding, calculus and rough restorations enhance the retention of the supragingival biofilm and protect organisms from the action of salivary enzymes and oral hygiene measures. When the bacteria are left undisturbed, the host response is to implement a defense reaction in the form of gingival inflammation, or gingivitis.

If, for whatever reason, the supragingival biofilm is left undisturbed and the bacteria begin to migrate subgingivally, the environment changes, allowing gram-negative anaerobes to flourish. Any irregularities such as root anatomy, subgingival restorative margins, overhanging dental restorations and other aberrations will enhance bacterial adhesion to the pocket epithelium and the tooth surface, thus allowing the growth of subgingival plaque. While potential pathogens may colonize a site for decades without causing disease (105), if the local environment changes in a manner that upsets the balance between health and disease, destruction rather than remodeling of the periodontium ensues. “Local” factors have been shown to produce these changes.

Local factors are defined as anything that influences the periodontal health status at a particular site or sites, with no known systemic effects. These may be anomalies in the root anatomy or iatrogenic features. This paper will review the detection and, to a limited extent, the role of local factors (66) in the pathogenesis of periodontal diseases.

Tooth anatomy

Inherent anatomic and morphologic features of teeth can have a significant impact on the management and prognosis of the involved tooth or teeth. To properly diagnose the severity of attachment loss in a patient with periodontitis, a thorough understanding of tooth root anatomy is crucial.

Molars

Furcations

Molars, particularly maxillary molars, are the teeth most frequently lost due to periodontal disease (48, 72, 75). The anatomy of the furcation favors retention of bacterial deposits and makes periodontal debridement, as well as oral hygiene procedures, difficult. Teeth that have lost attachment to the level of the furcation are said to have a furcation invasion, or involvement. Furcal invasions vary in horizontal and vertical depth as a result of such features as cervical enamel pearls, root trunk length, furcation entrance dimensions, root anatomy and variations in the anatomy of the roof of the furcation.

Several classification schemes have been devised to describe the degree of furcation involvement. Most are based on the amount of horizontal and/or
vertical probe penetration (38, 39, 44, 86, 95, 113), and are generally divided into three types:

- **Grade I**: Incipient lesion involving up to 3 mm of horizontal probing depth (Fig. 1).
- **Grade II**: “Cul-de-sac” with >3 mm of horizontal probing depth, without extending through to the opposite side (Fig. 1).
- **Grade III**: Through-and-through lesion (Fig. 2).

Detection of furcation involvements is not always straightforward. Good bitewing and periapical radiographs may aid in the diagnosis, but should not be used as the sole diagnostic tool (3, 61). For example, less than one quarter of furcation involvements are picked up on radiographs (98), although the likelihood of detection does increase with the degree of attachment loss (45).

Clinically, the degree of furcation involvement can be determined using any of a number of furcation probes. These probes are curved to allow access into the furca and have a blunted end for patient comfort. Clinical assessment, however, may overestimate the depth of furcation defects. Moriarty et al. (80) demonstrated that horizontal probing actually measured the depth of probe penetration into the inflamed connective tissue, rather than the true pocket depth. This is especially true the deeper the pockets are.

Position of the furcation entrance, particularly in maxillary molars, is important to remember. The mesiopalatal entrance of the maxillary first molar is located towards the palatal third of the tooth, while the distopalatal of the furcation is in the middle. In order to probe maxillary molars, therefore, a palatal or buccal approach can be used to detect distal furcation involvements (Fig. 3). To detect mesial furcation involvements, it is easiest to detect if probed from the palatal aspect.

Transgingival sounding under local anesthesia may be more accurate than regular probing in determining furcation anatomy. However, this is best accomplished at the time of initial periodontal therapy when the patient is anesthetized.

**Root trunk length**

The severity of furcation involvement is highly dependent on the relationship between the amount of attachment loss and the distance from the cementoenamel junction to the furcation entrance - the root trunk length. Hou et al. (53) developed a classification scheme that takes into account the length of the root trunk compared to total root length. Type A has the shortest root trunks, involving a third, or less, of the cervical area of the root (Fig. 2). Type B root trunks include up to half of the length of the root, while in type C, the furcation entrance is in the cervical two-thirds. This system can give a more realistic prognosis for the tooth, as it takes into consideration the vertical as well as the horizontal component of attachment loss. For example, less horizontal bone loss is required to expose a type A furca than either the B or C types. On the other hand, a grade I
furcation invasion on a type C root implies a very poor prognosis, since less than one-third of the root surface area remains covered by alveolar bone.

In terms of prevalence, Hou et al. (53) reported that maxillary first molars are more likely to exhibit either type B (47.1%) or type A (41.0%), than type C (11.9%). Mandibular first molars usually have type A root trunk lengths (83.5%), while maxillary and mandibular second molars most often have type B (60.8% and 52.6%, respectively). Others (93, 99) have confirmed this in that they found the mean height of the root trunk is greater in the maxillary molars (3.6–4.8 mm from the cementoenamel junction) than in mandibular molars (2.4–3.3 mm). The most apical furcations are the distal of the maxillary first molars. The shortest distance between the cementoenamel junction and furcation entrance is found in the mandibular first molars, permitting exposure of the furcation at an early stage of periodontitis.

Size of furcation entrance

The diameter of the furcation entrance is extremely important in predicting the success of periodontal therapy. Bower et al. (15) reported the majority of furcation entrances are less than the width of a new standard Gracey curette. They found that 81% of furcation entrances were <1.0 mm and 58% of were <0.75 mm. These findings are similar to those found by Chiu et al. (21), who found that 49% of furcation entrances were <0.75 mm. This anatomic feature presents additional challenges in the management of molar furcations. Even with a surgical approach, narrow furcations are difficult to completely debride (Fig. 4).

Bifurcation ridges

Using a stereomicroscope and extracted teeth, Svärdström & Wennström (110) developed complex topographic contour maps of the furcation areas of maxillary and mandibular first molars. Their study clearly showed the complexity of the anatomy in the furcation areas. They found various pits and ridges in the roof of the furcation that would further complicate therapy. These ridges run from one root to another and, in some maxillary molars, continue apically. Intermediate ridges connect the mesial and distal roots and are composed primarily of cementum. Buccal and lingual ridges are composed of dentin with overlying thin layers of cementum (3). In mandibular molars there may be a central bifurcation ridge that forms distinct pits in the roof of the furcation. Hou & Tsai (52) determined that these ridges are strongly associated with attachment loss in furcations. These reports emphasize the complexity of the furcation topography of molars that must be kept in mind when debriding teeth with furcal attachment loss.

Root concavities

Fluting of roots, or root concavities, are present to some degree in all molars. Concavities are present in the roof of furcations, coronal and apical to furcations and on interproximal root surfaces (Fig. 5). These are often difficult to diagnose unless the patient is anesthetized during nonsurgical therapy or the roots exposed. As with any other anatomic feature, their presence can affect the progression of attachment loss by harboring bacterial plaque.
Cervical enamel projections

Ectopic deposits of enamel apical to the level of the normal cementoenamel junction, with a tapering form and extending towards or into the furcation areas, are called cervical enamel projections (66). As with coronal enamel, connective tissue does not attach to cervical enamel projections, thus they have been implicated as etiologic factors in furcation defects (12, 112). Hou & Tsai (50) reported the prevalence of cervical enamel projections in molars with and without furcation involvement. In molars with cervical enamel projections, 82.5% exhibited furcation involvement, while this was true for 17.5% of molars that had no cervical enamel projections.

The influence of a cervical enamel projection is dependent on the extent of the projection. Masters & Hoskins (71) introduced a grading system in 1964 that is still in use today:

- Grade I: Short but distinct change in the contour of the cementoenamel junction extending towards the furcation.
- Grade II: cervical enamel projection approaches the furcation, without making contact with it.
- Grade III: cervical enamel projection extends into the furcation (Fig. 5).

Roussa (99) found that Grade I and III projections are more prevalent, and that cervical enamel projections are more often observed in mandibular second molars than either the maxillary or mandibular first

![Image of a mandibular first molar with a cervical enamel projection](image)

Fig. 5. Grade III cervical enamel projection on a mandibular first molar. This projection acts as a lip at the furcation entrance. Together with the mesial groove on the distal root, these anatomic anomalies compromise plaque removal.

<table>
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<th>Table 1. Significant anatomic features of teeth</th>
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<td>Tooth</td>
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<td>Maxillary incisors</td>
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<td>Maxillary first bicuspids</td>
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molars. These findings are in line with those of other studies (see Table 1).

Enamel pearls are less prevalent that cervical enamel projections. They contribute to the etiology of furcation involvements nonetheless. Moskow & Canut (81) reviewed the literature on the prevalence of enamel pearls and reported a range of 1.1–9.7%. Nearly three-quarters of enamel pearls are found on maxillary third molars. The mandibular third molar and maxillary second molar are the second most common sites. Figure 6 is a radiographic example of an enamel pearl and the resultant periodontal destruction.

Maxillary bicuspsids

Maxillary first bicuspsids often have two roots – buccal and palatal. Joseph et al. (57) examined the furcation anatomy of 100 of these teeth. A furcal concavity was seen on the palatal aspect of the buccal root in 62% of bifurcated teeth. This coincides with the prevalence of 78% reported by Gher & Vernino (35).

The mean furcation width was 0.71 mm; again, less than the diameter of a new curette. Concavities were found on the proximal surfaces of all teeth studied, with a deeper concavity on the mesial than the distal aspect. Maxillary bicuspsids may also display a V-shaped groove on the proximal surfaces (Figs 7 and 8). These often persist toward the apical region, and are associated with a greater loss of attachment than that found around non-grooved teeth (67).

Anterior teeth

Palatal grooves

The radicular lingual or palatal groove is a developmental anomaly in which an infolding of the inner enamel epithelium and Hertwig’s epithelial root sheath create a groove that passes from the cingulum of maxillary incisors apically onto the root (41). These grooves usually begin in the central fossa,
maxillary incisors (5, 49, 62, 124), and 1.9–14% in lateral incisors alone (30, 35, 49, 62, 124).

In contrast to maxillary bicuspids, incisors generally display a shallow U-shaped groove. Kogon (62) reported that over half of the grooves extend more than 5 mm apical to the cementoenamel junction. These grooves may act as “funnels” for the accumulation of microbial plaque in the depth of the groove, where they are inaccessible to both patient and clinician. The prognosis for teeth with palatal grooves with apical extension is poor (41).

Dental restorations

The relationship between dental restorations and periodontal status has been examined for some time. Research has shown that overhanging dental restorations and subgingival margin placement play an important role in providing an ecologic niche for periodontal pathogens.

Overhanging dental restorations

An overhanging dental restoration is primarily found in the Class II restoration, since access for interdental cleansing is often difficult in these areas, even for patients with good oral hygiene habits (Fig. 11). Many studies have shown that there is more periodontal attachment loss and inflammation associated with teeth with overhangs than those without. Overhangs cause an increase in plaque formation (55, 59, 60, 68, 89, 94, 97), and a shift in the microbial composition (64) from healthy flora to one characteristic of periodontal disease. In addition to their effect on the inflammatory process, overhangs may also cause damage by impinging on the interdental embrasure.

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**Fig. 9.** Periodontal pocket associated with palatal groove on mesial of central incisor; without probe in place (a), with probe in place (b).

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**Fig. 10.** Surgical view of distal palatal groove of maxillary lateral incisor.

**Fig. 11.** Poor quality restorations with overhanging margins.
and the biologic width. There appears to be no statistical relationship between the presence of an amalgam overhang and patient age (89) – meaning an overhang can be equally destructive to young and old alike.

Restorative matrices may not always adapt well interproximally, even with careful placement of the restorative material and tight wedging. Variations in root anatomy, particularly root concavities, may make perfect marginal adaptation impossible. It has been shown that removal of an overhang results in improved plaque control (97) and restoration of gingival health (40).

The prevalence of overhangs has been reported in many patient populations. The reported range on restored teeth is between 18% (55) and 87% (68). Criteria used to determine the presence of an overhang differ from study to study, which likely accounts for most of this variation (see Table 2). Lervik et al. (68) employed bitewing radiographs, a microscope and magnifying glass. They reported 96% of overhangs extended less than 0.5 mm from the tooth. This indicates that studies using the criterion of 0.5 mm have most likely underestimated overhang prevalence. Pack et al. (88) found the use of bitewing radiographs and clinical exploration detected only 35% of interproximal overhangs. Of these, 74% were found with radiographs alone, while 62% were found using only clinical inspection.

These studies confirm that removal of overhanging margins should be part of initial periodontal therapy. As well, it is obvious that early detection of overhanging dental restorations is an important part of preventive dental care. A sensitive tactile instrument, such as a fine explorer, should be used in conjunction with radiographs to facilitate this detection.

### Table 2. Prevalence of overhanging dental restorations (adapted from Brunsvold & Lane, 1990 (17))

<table>
<thead>
<tr>
<th>Reference</th>
<th>Diagnostic method for detection</th>
<th>% restored surfaces with overhangs (n = number of subjects)</th>
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<tr>
<td>Gilmore &amp; Sheiham, 1971 (37)</td>
<td>Bitewing radiographs</td>
<td>25% (n = 1976)</td>
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<tr>
<td>Burch et al., 1976 (19)</td>
<td>Bitewing radiographs</td>
<td>30% (n = 825)</td>
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<tr>
<td>Hakkarainen &amp; Ainamo, 1980 (43)</td>
<td>Orthopantomograms</td>
<td>50% (n = 85)</td>
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<td>Than et al., 1982 (114)</td>
<td>Calculus probe</td>
<td>60% (n = 240)</td>
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<tr>
<td>Lervik &amp; Riordan, 1984 (68)</td>
<td>Bitewing radiographs, microscope</td>
<td>25% (n = 175)</td>
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<tr>
<td>Keszthelyi &amp; Szabo, 1984 (60)</td>
<td>Bitewing radiographs, microscope</td>
<td>86% (n = 176)</td>
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<tr>
<td>Coxhead, 1985 (23)</td>
<td>Bitewing radiographs, mirror, probe</td>
<td>76% (n = 50)</td>
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<tr>
<td>Claman et al., 1986 (22)</td>
<td>Bitewing radiographs</td>
<td>27% (n = 826)</td>
</tr>
<tr>
<td>Jansson et al., 1994 (55)</td>
<td>Bitewing radiographs</td>
<td>18% (n = 162)</td>
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Subgingival restorative margins and biologic width

The location of the gingival margin of a restoration is directly related to the health status of the adjacent periodontium (116). Numerous studies (56, 58, 87, 96, 101, 115) have shown that subgingival margins are associated with more plaque, more severe gingival inflammation and deeper periodontal pockets than supragingival ones. In a 26-year prospective cohort, Schätzle et al. (101) followed middle-class Scandinavian men for a period of 26 years. Gingival indices and attachment level were compared between those who did and those who did not have restorative margins greater than 1 mm from the gingival margin. After 10 years, the cumulative mean loss of attachment was 0.5 mm more for the group with subgingival margins. This was statistically significant. At each examination during the 26 years of the study, the degree of inflammation in the gingival tissue adjacent to subgingival restorations was much greater than in the gingiva adjacent to supragingival margins. This is the first study to document a time sequence between the placement of subgingival margins and periodontal attachment loss, confirming that the subgingival placement of margins is detrimental to gingival and periodontal health.

Subgingival margins, in addition to influencing the progression of periodontitis, can have other effects on the attachment apparatus. Several authors have described the area between the depth of a healthy gingival sulcus and the alveolar crest as the “biologic width” (25, 26, 42, 54, 74, 84). This constitutes the junctional epithelium and the supracrestal connective tissue. Using cadaver specimens, Garguilo et al. (31) calculated the average distance to be 2.96 mm.
This is often rounded up to 3.0 mm when referring to the amount required for the biologic width. It has since been shown that this is not a magical number, and the biologic width may vary between teeth and individuals. The basis for the biologic width is the so-called “radius of inflammatory effect” in which there is a finite distance of approximately 1–2 mm over which the tissue-lytic properties of localized inflammation operate (117, 118). In other words, plaque at the apical margin of a subgingival restoration will cause periodontal inflammation that may in turn destroy connective tissue and bone approximately 1–2 mm away from the inflamed area.

When it is anticipated that placement of a subgingival margin will impinge on the biologic width (i.e., be within \(\approx 1–2\) mm from the alveolar crest), surgical crown-lengthening procedures should be considered. Herrero et al. (47) found that this is not always easy to achieve, even by experienced clinicians. In the most difficult areas to access, the lingual and distolinguinal, clinicians removed an average 0.4 mm of bone – far short of the 3 mm goal. Determination of the distance between the restorative margin and the alveolar crest is often done with bitewing radiographs; however, it is important to remember that a radiograph is a 2-dimensional representation of 3-dimensional structures. Thus, clinical assessment and judgment are important adjuncts in determining if, and how much, bone should be removed to maintain adequate room for the dentogingival attachment.

### Restorative materials

Although surface textures of restorative materials differ in their capacity to retain plaque (13), all can be adequately maintained if they are polished and accessible to patient care (65). This includes the underside of pontics. While there is little evidence to substantiate the use of specific materials or designs for pontics, Wang et al. (119) found that metal pontics harbor higher proportions of periodontal pathogens than porcelain ones. Although there is no evidence that subpontic plaque leads to attachment loss on abutment teeth, the accumulation of subpontic plaque for an extended period of time should be considered a risk factor.

In a trial of porcelain laminate veneers, Kourkouta et al. (63) found a decrease in the plaque index and bacterial vitality between teeth with and without veneers in the same patients. This finding is consistent with other studies that have shown highly glazed porcelain retains less plaque than enamel (85, 123).

Composite resins are difficult to finish interproximally and may be more likely to show marginal defects than other materials (92). As a result, they are more likely to harbor bacterial plaque (27). Intra-subject comparisons of unilateral direct composite “veneers” showed a statistically significant increase in plaque and gingival indices adjacent to the composites, 5–6 years after placement (92). In addition, when a diastema is closed with composite, the restorations are often overcontoured in the cervical-interproximal area, leading to increased plaque retention (91). As more plaque is retained, this could pose a significant problem for a patient with moderate to poor oral hygiene.

### Prostheses

Several investigations have noted that after the insertion of removable partial dentures, the mobility of the abutment teeth, gingival inflammation and periodontal pocket formation increases (10, 11, 120, 126). This may be because partial dentures, especially those with gingival coverage, have been shown to favor plaque accumulation (1, 108). Not only is there an increase in the amount of bacterial plaque, but a shift to more pathogenic microbiota, as well (100).

In a large case-control study, Zlataric et al. (126) examined 205 partial denture wearers. Abutment teeth had higher plaque scores and more severe gingival inflammation than non-abutment teeth. Probing depths of \(\leq 2\) mm were found on 82% of non-abutment teeth as compared to 54% of abutments. Not all studies concur with these findings. Mullaly & Linden (83) concluded that among regular dental attenders, those with partial dentures were no more likely to have periodontal disease than those who did not wear a partial. It is likely, however, that the sample size of 14 was too small to detect any potential difference.

### Effect of crowding and tooth position

Until the 1960s, the dental literature contained few reports that examined the relationship between malocclusion/malalignment and periodontal disease. Many studies have concluded that poorly aligned teeth themselves are not associated with a greater degree of gingivitis. Rather, crowding can complicate oral hygiene procedures, leading to an increased plaque accumulation and subsequent gingival inflammation (2, 34, 103). Although Behfet al. (9)
reported a direct relationship between tooth displacement and gingival inflammation, this was only evident in patients with moderate or poor plaque control. Similarly, there appears to be no relationship between crowding and alveolar bone loss in patients with excellent plaque control (6, 34, 103). Thus, it appears that malalignment may be more important in the patient with less than ideal oral hygiene.

However, if interproximal spaces are reduced as a result of crowding, root proximity may occur (Fig. 1). This leads to less effective removal of plaque and subgingival calculus in the inaccessible interproximal area. Even surgically, these teeth can be difficult to treat, leading to a compromised prognosis. Nonetheless, a well motivated and dexterous patient will likely prevent plaque accumulation regardless of tooth shape or position (106).

In some cases of extreme anterior overbite, direct trauma to the gingiva from the incisal edges of the mandibular incisors may result in palatal recession the maxillary incisors. Similarly, in severe Class II division 2 malocclusions, functional trauma can cause marginal recession of the facial gingiva of the mandibular incisors (33).

**Vertical root fractures**

Vertical root fractures are, by definition, longitudinal and confined to the root of the tooth. They may be in a mesiodistal or buccolingual plane, and may occur at any point along the root (Figs 12 and 13). The diagnosis of vertical root fracture is difficult because several of the associated signs and symptoms are shared with other dental conditions. In some instances, there may be a halo appearance at the fracture site of the affected tooth on a radiograph. However, unless the fractured segment has separated, radiographs are often of little use in localizing the lesion.

The patient may have masticatory pain, with or without concomitant pulpal pain. Transillumination may be helpful, or the diagnosis may be made with the use of a bite test, where a resilient material is placed between the teeth during gentle occlusion. Pathognomonic of a vertical fracture is the occurrence of a narrow, isolated periodontal pocket. The affected teeth may exhibit recurrent periodontal abscesses.

Teeth with cracked roots usually have a poor prognosis, although some success has been reported using regenerative membranes (82) or resin cement (109).
Assessment of mucogingival deformities

Gingival recession

Assessment of the mucogingival status of a patient is an essential part of an oral examination, particularly if there is major restorative or orthodontic work planned. Mucogingival status refers to the quality and quantity of keratinized gingival tissue, the amount of gingival recession, the presence of aberrant frena and the depth of the vestibules.

Aberrant frenal attachments may be a problem, especially in shallow vestibules or areas of minimal attached gingiva (Fig. 14). When the frenum is stretched, the muscle attachments may pull the marginal tissue away from the tooth. This then acts as a “funnel”, allowing accumulation and apical migration of bacterial plaque. This can lead to an increase in gingival recession on that particular tooth.

Gingival recession can be a problem for patients for esthetic reasons, dentinal hypersensitivity or interference with normal hygiene procedures. A number of factors have been implicated in the etiology of gingival recession. An extreme buccal or lingual positioning of the tooth in the dental arch, whether natural or due to orthodontic movement, can lead to thinning of the alveolar plate and associated gingival tissues. This makes the area more susceptible to recession, either from trauma or inflammation (73). Trauma is usually the result of vigorous toothbrushing, or the use of a medium to hard brush. Plaque-induced disease can also cause recession, particularly in patients with a thin periodontium (4).

Recession is measured from the midfacial or midlingual/palatal of each tooth to the most coronal aspect of the marginal gingiva. In multi-rooted teeth, recession can be measured for each root. Miller’s classification is the standard in categorizing marginal tissue recession and in predicting the likelihood of root coverage with periodontal plastic surgery techniques:

- Class I: Recession does not extend to the mucogingival junction. There is no loss of interdental bone or soft tissue (Fig. 15).
- Class II: Recession extends to or beyond the mucogingival junction. There is no loss of interdental bone or soft tissue (Fig. 16).
- Class III: Recession extends to or beyond the mucogingival junction. There is loss of interdental bone and/or soft tissue or malpositioning of the tooth (Fig. 17).
- Class IV: There is advanced loss of interdental bone and/or soft tissue or severe malpositioning of the tooth (Fig. 18).

Class I and II can be subclassified as narrow or wide. After gingival grafting procedures, full root...
coverage can usually be expected up to the level of the interdental bone in Classes I and in Class II narrow-type defects. For Class III, only partial coverage can be expected, while little or no coverage occurs in Class IV lesions treated with current grafting techniques.

Keratinized gingiva

Keratinized gingiva is differentiated from attached gingiva in that the former includes both attached and free gingival tissues. Attached gingiva is determined by subtracting the periodontal probing depth from the width of keratinized tissue at a given site. It is measured at the midfacial of mandibular and maxillary teeth and the midlingual of mandibular teeth. The clinical impression is that since the attached gingiva is firmly bound to the underlying periosteum, it will provide a protective barrier against inflammation and attachment loss. Augmentation of the attached gingiva is often recommended on this basis.

Several studies have challenged the view that a wide zone of attached gingiva is a more effective barrier against recession than a narrow or non-existent one. It has been demonstrated that in the absence of inflammation, gingival health and attachment levels can be maintained (28, 121, 122). One long-term study reported that the incidence of recession was no greater in areas without keratinized tissue than in areas with a wide zone of keratinized gingiva (120).

Stetler & Bissada (107) studied the relationship between the width of keratinized gingiva, the presence of subgingival margins and inflammation. Teeth with subgingival restorative margins and narrow (<2.0 mm) keratinized tissue were more likely to exhibit gingivitis, while those with restorative margins at or above the coronal aspect of the free gingiva showed no difference between wide and narrow bands of keratinized gingiva. These results suggest that particular attention should be paid to those subgingival restorations associated with <2.0 mm of keratinized tissue. For patients scheduled to receive subgingival restorations where narrow zones of keratinized tissue exist, and who cannot maintain optimal plaque control levels, it may be desirable to increase the width of keratinized tissue about those teeth.

There are other situations in which a wider zone of attached gingiva may be necessary. Teeth with a thin periodontium that are planned for orthodontic movement, particularly if there will be movement of teeth labially, are likely to have more recession in areas of minimal attached gingiva (32). Abutment teeth for removable prostheses are more likely to exhibit plaque, and therefore be at higher risk of gingivitis and attachment loss. These areas may be considered for gingival augmentation, particularly for patients with inadequate oral hygiene. Sites where the patient finds oral hygiene difficult because of the proximity of the mucosa to the cervical area of the tooth, may also benefit from a wider zone of keratinized tissue.

Effect of periodontally hopeless teeth on adjacent teeth

The ability to accurately predict the response of the dentition to periodontal therapy is essential in developing a definitive periodontal maintenance and restorative treatment plan. A prognosis is assigned to an individual tooth based on a number of factors including type and degree of bone loss, probing depths, presence and severity of furcations, mobility, crown–root ratio, root form and pulpal involvement.
In addition, systemic factors, patient compliance and type of periodontal disease are key determinants. Prognostication is a skill not easily acquired and is highly dependent upon the experience and skill of the clinician. There are several classification systems and definitions of prognoses (7, 8, 24, 48, 75). It is generally agreed that a tooth with a hopeless prognosis is one that, despite the patient’s and clinician’s best efforts, is not going to improve. In these situations, it is difficult, if not impossible, to arrest the disease process and restore periodontal health. Some believe that the presence of a hopeless tooth may also be detrimental to the health of adjacent teeth (29, 69, 104). Despite this, patients may choose to retain periodontally hopeless teeth for a variety of reasons – economics, esthetics or an aversion to extractions.

Several studies have shown that, when appropriate treatment is rendered and the patient is in a maintenance program, teeth previously diagnosed as hopeless may survive for many years with little or no effect on proximal teeth (24, 125). Wojcik et al. (125) examined periodontal maintenance patients, 8 years after the completion of active therapy. There was no difference in probing depths or alveolar bone levels between teeth adjacent to the hopeless tooth and not. Although a small study (n = 14), power calculations showed these results to be robust.

McGuire (76) and Ghiai & Bissada (36) both concluded that in cases where the prognosis is other than “good”, it is difficult to predict the long-term outcome of individual teeth. In cases of hopeless teeth, prognostication was no more accurate than flipping a coin (76). In McGuire’s study, 25% of teeth initially diagnosed as hopeless were reclassified as having a good or fair prognosis 5–8 years later. These findings suggest that periodontally involved teeth can be maintained for years in health, comfort and function (8, 24, 36, 46, 48, 77–79, 125).

### Summary

The primary goal of periodontal therapy is to produce an environment that is conducive to oral health. This is achieved by eliminating the subgingival infection and implementing supragingival plaque control measures designed to prevent the re-colonization of the sulcus (111). Local etiologic factors, as described above, may prevent the removal of subgingival plaque, and may even contribute to destruction of the periodontal tissues. Thus, it is crucial to be able to recognize and, when possible, eliminate any plaque-retentive factor that could contribute to disease progression. Iatrogenic factors such as subgingival margins, restorative overhangs, overcontoured restorations and unpolished surfaces can be altered. Similarly, cervical enamel projections, enamel pearls and, in certain instances, palatal grooves can be removed or recontoured to enable the patient to access the area for good plaque control. There are some things that we cannot alter. Anatomic anomalies, particularly in posterior teeth, cannot be changed. However, awareness of potential anatomic variations and early detection of them may be able to prevent future attachment loss.

### References


