The angular bony defect in the maintenance of the periodontal patient

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Abstract. The present retrospective study was performed to evaluate some long-term alterations of the alveolar bone level at periodontal sites with angular and even (“horizontal”) patterns of bone loss. The investigation included 48 patients who, following treatment for advanced periodontal disease, were placed in a maintenance care program which included recall appointments every 3-6 months for a period of 5 to 16 years. The material of the study comprised all teeth at which angular osseous defects (test sites) could be detected in a full-mouth series of radiographs obtained at the end of the active treatment phase. Alterations in the position of the marginal alveolar bone crest and the base of the osseous defect which took place during the maintenance period were assessed by comparing the post-treatment radiographs with a 2nd set of radiographs obtained at the final examination. In the same patients, an equal number of contralateral or neighboring teeth at which bone loss in the radiographs had an even or “horizontal” character were included as controls. The results from the assessments demonstrated that periodontal sites which, following active therapy displayed either angular or “horizontal” patterns of alveolar bone loss underwent, during a 5-16 year period of maintenance, only minor bone level alterations. Additional loss of supporting bone occurred equally frequently at sites with “horizontal” and angular patterns of bone loss. Thus, the findings reported failed to show up sites with angular bony defects as being particularly susceptible to recurrent destructive periodontitis.

Key words: Alveolar bone loss; radiographs; angular defect; “horizontal” defect; maintenance therapy

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Destructive forms of periodontal disease are characterized by the occurrence of symptoms such as gingival inflammation, loss of connective tissue attachment and alveolar bone. Bone loss around the teeth involved in the disease process can be of even, i.e., “horizontal”, or angular character.

The angular bony defect, its formation and treatment has for many years interested and confused the clinician. It has been suggested that an angular bony defect often occurs at periodontally involved teeth that are also exposed to trauma from occlusion (e.g., Glickman & Smulow 1962, 1965, Glickman 1967, Lindhe & Svanberg 1974), may develop at root surfaces with deficient cementum (Gottlieb 1923, 1946, Lindskog and Blomlöf 1983, Blomlöf et al. 1987), or simply forms as a consequence of apically migrating subgingival plaque (Lindhe et al. 1975, Waerhaug 1979).

It has been claimed that in the treatment of periodontal disease, angular bony defects must be eliminated, since otherwise deep pockets and destructive periodontitis invariably recur (for review see Barrington 1981). Consequently, measures are frequently included in periodontal therapy which are aimed at actively eliminating the bony defect. Such measures may involve bone resection or recontouring, the placement of grafts in the defects, orthodontic tooth movement, etc. It should be realized, however, that no research data have been presented which support the concept that a periodontal site, associated with an angular body defect, constitutes a locus minoris resistentiae for recurrent periodontitis.

The aim of the present retrospective study was to evaluate long-term alterations of the alveolar bone level at periodontal sites with angular and even patterns of bone loss in patients who, following treatment of advanced periodontal disease, harbored both types of defects.

Material and Methods

Sample

The investigation included 48 patients, who, during the phase of active treatment, were 26-66 years of age (mean age 46.3 years). Following treatment for advanced periodontal disease, they were all placed in a maintenance care program which included recall appointments every 3-6 months for a period of 5-16 years.

The material of the study comprised all teeth (all together 100) at which angular osseous defects (test sites) could be detected immediately after the active treatment phase in an ordinary full-mouth series of radiographs obtained with the use of a long-cone technique. Alterations in the marginal alveolar bone level and the apical level of the osseous defect which took place during the follow-up period were assessed by comparing these radiographs with a second set of radiographs obtained at the
final examination (5–16 years following active treatment). In the same patients, an equal number of contralateral or neighboring teeth at which bone loss in the radiographs had an even or “horizontal” character were included as control sites.

**Assessment of alterations of the alveolar bone level**

A lens providing 2× magnification was fixed to an illuminated screen. This device was used to examine all radiographs in the manner described by Albandar & Abbas (1986). A transparent ruler similar to the one described by Björn et al. (1969) was placed onto the radiographs in such a way that (1) the top line of the 20 consecutive lines on the grid coincided with the image of the tip of the crown of the tooth adjacent to the defect and (2) the bottom line coincided with apex of the tooth (Fig. 1B).

At sites where angular bony defects (test sites) were present, the following distances were measured (Fig. 1A).

1. The distance between the base of the defect and apex (B-A). The most coronal level where the periodontal space still retained its normal width was considered as the base of the defect (Björn et al. 1969).
2. The distance between the crest of the alveolar bone and the base of the defect (C-B).

In the control sites which exhibited an even pattern of bone loss, the distance between the bone crest and apex (b-a) was measured (Fig. 1B).

All measurements were made by the same examiner (R.P.) and were expressed in “bone score units” (1 unit = the distance between 2 lines on the grid). The measurements were made to the nearest half unit.

An angular bony defect should at the first examination have a depth equal to or exceeding 1 bone score unit to be included in the study.

**Statistical analysis**

A paired Student t-test was used for analyzing alterations that occurred during the maintenance period with respect to distances B-A, C-B, and b-a. A comparison was also made regarding alterations that occurred during the maintenance period between distances B-A (Test) and b-a (control).

**Results**

In the radiographs obtained immediately after the end of active therapy, it was observed that the distance:

1. between the base of the angular bony defect and apex of the tooth involved (B-A1; test site; Table 1) was on the average 3.02±1.1 (S.D.) bone score units (BSU);
2. between the crest of the alveolar bone and the base of the defect at the test site (C-B1) was on the average 1.41±0.5 BSU;
3. between the coronal level of the supporting bone at sites with “horizontal” pattern of bone loss and apex of the tooth involved (b-a1; control site; Table 1) was on the average 4.52±1.6 BSU.

The examination of radiographs obtained from the follow-up examination, i.e., 5–16 years after the end of active therapy, revealed that the distance:

1. B-A2 at test sites remained unchanged and was on the average 3.03±1.1 BSU;
2. C-B2 at the test sites was significantly reduced from an average of 1.41 to 1.17±0.5 BSU (P<0.001);
3. b-a2 at control sites remained almost unchanged and was on the average 4.36±1.6 BSU.

Table 2 presents the mean alterations (±S.D.) and the frequency of change.

Table 1. The length of distances B-A (base of angular bony defect and apex of test sites), C-B (crest of bone to base of defect at test sites), b-a (crest of bone to apex of control sites) measured in radiographs and expressed as bone score units.

<table>
<thead>
<tr>
<th>Test sites</th>
<th>Distance</th>
<th>B-A1</th>
<th>B-A2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \bar{x} )</td>
<td>S.D.</td>
<td>( \bar{x} )</td>
</tr>
<tr>
<td>C-B1</td>
<td>3.02±1.1</td>
<td></td>
<td>3.03±1.1</td>
</tr>
<tr>
<td>C-B2</td>
<td>( \bar{x} )</td>
<td>S.D.</td>
<td>( \bar{x} )</td>
</tr>
<tr>
<td>b-a1</td>
<td>4.52±1.6</td>
<td></td>
<td>4.36±1.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control sites</th>
<th>Distance</th>
<th>b-a1</th>
<th>b-a2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \bar{x} )</td>
<td>S.D.</td>
<td>( \bar{x} )</td>
<td>S.D.</td>
</tr>
</tbody>
</table>

A1, B1, a1 = initial examination. A2, B2, a2 = final examination.
Table 2. Average change \(\bar{x}\) of distances B-A and C-B in the test group and of distance b-a in the control group that occurred during the maintenance period

<table>
<thead>
<tr>
<th>Test sites</th>
<th>Distance</th>
<th>No. of patients</th>
<th>sites</th>
<th>(\bar{x}) BSU</th>
<th>Gain</th>
<th>Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-A</td>
<td></td>
<td>48</td>
<td>100</td>
<td>-0.02</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>C-B</td>
<td></td>
<td>48</td>
<td>100</td>
<td>-0.23</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Control sites Distance

<table>
<thead>
<tr>
<th>Distance</th>
<th>b-a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>-0.17</td>
</tr>
<tr>
<td></td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

The change \(\bar{x}\) is expressed in bone score units. The frequency (%) of sites with "loss" and "gain" of bone as well as of sites with no change ("0") is also reported.

Discussion

The present retrospective study demonstrated that periodontal sites which, following active therapy displayed either angular or horizontal patterns of alveolar bone loss, underwent, during a 5-16 year period of maintenance, only minor additional bone level alterations. The findings from the radiographic assessments furthermore showed that additional loss of supporting bone occurred equally frequently at sites with horizontal as at sites with angular pattern of bone loss. Thus, in this group of 48 patients with advanced periodontal tissue breakdown, additional bone loss which occurred during the long-term maintenance period failed to show up sites with angular bony defects as being particularly vulnerable for further breakdown.

The patients involved in the present retrospective study were selected from a larger group of patients who, between 1969 and 1981, were treated for advanced periodontal disease at the Department of Periodontology, University of Gothenburg, Sweden. The determining criteria for inclusion in this particular study were:

1. The patients must have teeth which after active therapy had <50% of alveolar bone support left;
2. The patient must have teeth with both angular and horizontal pattern of bone loss present in the same jaw and if possible in a contralateral position;
3. The patient must have a proper maintenance record both with respect to oral hygiene standard and frequency of scheduled appointments for prophylaxis.

Even if, however, the mean bone level alterations that occurred in the test and control groups were small (Table 2), several sites in both groups underwent measurable change. Thus, at 12% of sites with angular bony defect, the coronal position of the supporting bone shifted apically a distance of between 0.5 and 1.5 BSU (about 0.7-2 mm). The corresponding frequency of change at sites with horizontal bone loss was 28%. Furthermore, while at no sites in the control group did gain of bone occur, measurable amounts of bone fill took place at 14% of sites with angular bony defects. It can therefore be concluded that the alterations that took place over the 5-16 year period at the test and control sites were minor and that the data failed to support the concept that periodontal sites with angular bony defects over a 5-16 year period at the test and control sites were minor, and that the data have a higher tendency for disease recurrence and progression than sites with a horizontal pattern of bone loss.

The measurable change that could be detected in the radiographs occurred equally frequent in patients maintained less than 8 years as in patients monitored for more than 10 years (Table 3). In both categories of patients, the majority
of sites remained unchanged while a comparable number lost and gained bone. This finding indicates that the bone changes recorded may have occurred in the early period of the maintenance phase after active therapy, when a pronounced physiological remodelling of the bone may occur (Rosling et al. 1976a,b, Polson & Heijl 1976). It is also conceivable that some of the bone-level alterations may have occurred as the result of recurrent periodontitis which developed in this sample as a response to plaque infection at different sites at different time intervals during the phase of maintenance (Lindhe & Nyman 1984).

The bone level change observed in the present material was also calculated for different sites with different amounts of remaining alveolar bone recorded at the start of the maintenance period (Table 4). It was observed that the bone-level changes detected appeared to be unrelated to the height of the alveolar bone at the first examination. Thus, out of 51 sites with angular bony defects and <25% of the height of the alveolar bone remaining after therapy, 9 sites gained and 8 sites lost bone during the course of the maintenance period. Of 49 sites which had >25% of the bone left, 5 sites gained and 4 sites lost additional bone. This means that bone remodelling or disease recurrence seemed to be unrelated to the patient’s previous experience of destructive periodontitis.

The method used to evaluate bone-level alterations in the present material was comparatively crude. No attempts were made to standardize the radiographic procedure, i.e., no stents were used to obtain standardized conditions at the radiographic examinations. The films were not developed under standardized conditions. Furthermore, the use of the Björn’s method to identify minor alterations of the position of the bone crest may be inferior to the more absolute technique presented by Albandar & Abbas (1986). Since the bone level alterations that were detected occurred at a similar frequency at both test and control sites, however, it is unlikely that a methodological error would favor one type of defect over the other. Furthermore, the objective of the present study was not to describe the amount of change at sites with angular and horizontal bone loss, but merely to assess if one type of site was more prone to change than the other.

Following active treatment, the 48 patients included in the present material were enrolled in a carefully monitored maintenance care program. Thus, once every 3 to 6 months, all patients were recalled for meticulous prophylaxis. In addition, their self-performed plaque control was throughout the 5–16 years maintained at a very high standard. Results from previous studies have demonstrated that such patients can maintain periodontal health (Ramfjord et al. 1965, 1982, Knowles et al. 1979, Nyman & Lindhe, 1979, Axelsson & Lindhe 1981, Lindhe & Nyman 1984). In a study on the long-term maintenance of patients treated for advanced periodontal disease, Lindhe & Nyman (1984) reported that over a 14-year period of observation, only 43 sites in 61 patients lost attachment of more than 2 mm. Some of the 61 patients in the study referred to had angular bony defects and were included in the present material. In these 48 well-maintained patients, loss of alveolar bone amounting to more than 0.5 BSU occurred at only 9 sites (Table 2), 6 of which involved a reduction of the height of the lateral bone wall at an angular defect. Thus, the observation made in the present study and the results from probing pocket depth and attachment level measurements reported by Lindhe & Nyman (1984) support the conclusion that in carefully maintained patients, additional loss of periodontal tissue support can be almost entirely avoided.

Different methods have been used to eliminate the angular bony defect in the treatment of patients with periodontal disease. Such methods include bone recontouring to eliminate the lateral bone walls of the defect, grafting to fill the defect with bone or bone substitutes, eruption techniques to move the base of the angular defect in coronal direction, etc. None of the methods used in conventional periodontal therapy, however, results in a coronal displacement of the connective tissue attachment level but may merely change the topography of the marginal alveolar bone. The findings from the present study have demonstrated that the presence of an angular bony defect after active treatment does not make the site more prone to additional bone loss in well-maintained patients.

### Zusammenfassung

Der angulierte Knochendefekt bei der Nachsorge des periodontal behandelten Patienten

zontales" Knochenschwundmuster vorlag, während der 5–16 Jahre langen Nachsorgeperiode nur geringfügige Veränderungen des Knochenniveaus gesehen wurden. Die hier beschriebenen Ergebnisse zeigen, dass parodontale "Stellen" mit angulären Knochendefekten für die rezidivierende, destruktive Parodontitis nicht besonders empfindlich sind.

Résumé

Les lésions osseuses angulaires et la maintenance du patient en parodontologie

La présente étude rétrospective a été effectuée dans le but d’évaluer quelques unes des modifications à long terme du niveau de l’os alvéolaire dans des localisations présentant une perte osseuse de type angulaire ou de type uniforme ("horizontal"). L’étude portait sur 48 patients qui, après le traitement d’une maladie parodontale avancée, recevaient un programme de soins de maintien comportant des visites de rappel tous les 3–6 mois pendant une période de 5–16 ans. L’étude portait sur toutes les dents au niveau desquelles on pouvait constater des lésions osseuses angulaires (sites test) sur un bilan radiographique obtenu à la fin de la phase active du traitement. Les modifications de la position de la crête marginale de l’os alvéolaire et de la base de la lésion osseuse prenant place pendant la période de maintien ont été mesurées en comparant les radiographies après traitement avec un second bilan radiographique obtenu lors de l’examen final. Chez les mêmes patients, on utilisait comme témoins (control) un nombre égal de dents contralatérales ou voisines au niveau desquelles les lésions osseuses constatées sur les radiographies étaient de type uniforme ("horizontal"). Les résultats de ces mesures ont montré que les localisations parodontales présentant après le traitement actif une perte de l’os alvéolaire de type soit angulaire soit “horizontal” ne subissaient au cours des 5–16 ans de la période de maintien que des modifications mineures du niveau osseux. Une perte ultérieure de l’os de soutien se produisait avec la même fréquence dans les localisations à type “horizontal” ou à type angulaire de perte osseuse. Ces résultats n’ont donc pas permis d’accuser les lésions osseuses angulaires d’être particulièrement susceptibles aux récidives de parodontite destructrice.

References


