Probing considerations in relation to susceptibility to periodontal breakdown


Abstract. Both epidemiological and clinical studies indicate that not all individuals are equally susceptible to periodontal breakdown. Therefore, the clinical differences were investigated between subjects highly susceptible and subjects insensitive to periodontal breakdown. The highly susceptible group consisted of patients with a diagnosis of juvenile periodontitis. The insensitive group consisted of older individuals with gross amounts of plaque and no periodontal breakdown. Results indicated that a high value of the bleeding/plaque ratio may possibly act as a prognostic indicator for periodontal breakdown. However, longitudinal data are indispensable for substantiation of this hypothesis. Since longitudinal research takes many years, the experimental gingivitis model was chosen for further investigation. 4 groups of individuals were selected on the basis of a different history of inflammatory periodontal disease: 2 younger age groups without periodontal breakdown, having either a low or a high bleeding/plaque ratio – a hypothetically susceptible and a hypothetically insensitive group, respectively, one older age group with presence of gross amounts of plaque, no periodontal breakdown and a low bleeding/plaque ratio – an insensitive group, and an adult group who previously suffered from severe periodontal disease – a susceptible group. Results of the experimental gingivitis studies indicated that the older insensitive group developed only small amounts of bleeding, whereas the younger hypothetically insensitive group developed a comparable low bleeding index. The younger hypothetically susceptible group developed a much higher bleeding index comparable to that of the susceptible group, the periodontal patients. In conclusion, comparison of the results of the experimental gingivitis studies in subjects with differing histories of inflammatory periodontal disease supports the concept that the bleeding/plaque ratio may act as a prognostic indicator for periodontal breakdown.

Key words: Age – experimental gingivitis – prognostic indicator for periodontal breakdown.

The periodontal probe may be regarded as one of the most useful diagnostic tools in periodontology. Traditionally, the probe is used for the diagnosis of inflammatory periodontal disease and for response to treatment. In relation to this, the probe is used for the assessment of the amount of plaque, pocket depth, loss of attachment and bleeding tendency of a pocket. During the last decade, a great amount of research on the meaning and value of these measurements has been published. For reviews see Listgarten (1980), Greenstein (1984) and Polson & Goodson (1985). Basically, not much has changed. The Silness & Löe (1964) plaque index is still the most widely used index for the assessment of plaque and the traditional periodontal probe is still the most widely used tool for the diagnosis of periodontal breakdown. A new development was the introduction of force-controlled probes (Armitage et al. 1977, Van der Velden & De Vries 1978, Vitek et al. 1979, Polson et al. 1980, Borsboom et al. 1981). Results of clinical studies showed that the use of a standardized probing force does not lead to more reproducible pocket depth measurements (Van der Velden & De Vries 1980, Badersten et al. 1984). However, it was also demonstrated that a standardized probing force does contribute to more reproducible bleeding tendency measurements (Van der Velden 1980). Therefore, although some progress has been made concerning the effects of probing the periodontal pocket, it is still impossible to assess the state of disease activity and/or to predict future periodontal breakdown. With regard to prevention, it is essential to know at an early age whether or not an individual is susceptible to periodontal breakdown. A few years ago, research was started towards the development of prognostic indicators for periodontal breakdown. The basic idea underlying this research was that comparison of specific groups of individuals with a varying history of inflammatory periodontal disease might provide information as to why their disease developed in a different way. The present paper is a review of the research which has been performed on this topic at the Depart-
bleeding/plaque ratio

It is generally agreed that not everybody susceptible to periodontal breakdown in this respect, susceptibility can be defined as the likelihood that one develops periodontal breakdown to the presence of highly virulent microorganisms in the dental plaque, in addition to a possible inadequate response to these micro-organisms. Epidemiological and clinical studies indicate that differences in susceptibility do exist. For instance, Trent & Lees (1966) investigated the principal reasons for tooth extraction in over 50% of patients. On the basis of their findings, it can be concluded that the % of teeth lost due to periodontal breakdown is always higher than the % of patients at risk of losing teeth due to periodontal breakdown. This means that relatively many teeth are lost in relatively few patients. The same phenomenon was found in a longitudinal study evaluating periodontal therapy over more than 15 years of treatment. The studies of both Hirschfeld & Gersman (1978) and McFall (1982) show that 20% of their patient populations accounted for about 75% of all teeth. Apparently, these patients are highly susceptible to periodontal breakdown.

In order to investigate the clinical differences between subjects highly susceptible and relatively insensitive to periodontal breakdown, 2 groups of individuals were selected. The highly susceptible group consisted of 7 subjects with a diagnosis of untreated juvenile periodontitis. The diagnosis was made on the basis of age (18 years or younger) and presence of periodontal breakdown; radiographic evidence of more than 3 bone loss associated with the periodontal disease and/or incisors. In the same group, gingival recession was present. The age of this group ranged from 18 to 58 years, with a mean of 28 years, and 59% of the susceptible group consisted of individuals selected on the basis of age (18 years or younger), presence of at least 2 teeth, no evidence of extractions in the last 5 years, no loss of attachment, shallow pockets, gross plaque and no history of periodontal treatment. The susceptible group showed an age range from 52 to 72 years, with a mean age of 58 years. During clinical examination, the following parameters were assessed buccally, inter- and intrproximally:

1. Oral hygiene (plaque index, Silness & Loé (1964));
2. Bleeding upon probing using a standardized probing pressure of 240 N/㎜ per periodontal pocket bleeding index, Van der Velden (1979);
3. Pocket depth using a pressure probe with a standardized probing pressure of 240 N/㎜ and electronic pocket depth read out (resolution 0.1 mm, Van der Velden & De Vries (1980)).

For the evaluation of the different parameters, the Mann-Whitney U-test was used.

Within the scope of the present communication, only the mean values of the clinical parameters are presented at the sites with a probing pocket depth of 3.0 mm and less (Table 1). Analysis revealed that the susceptible group had more bleeding (p = 0.019) and less plaque (p = 0.001) than the insusceptible group. Since the 2 groups seem to behave differently with regard to bleeding upon probing and amount of plaque, bleeding/plaque ratios were calculated. The mean values of the bleeding/plaque ratios for each group are presented. Testing showed a highly significant difference between the 2 groups (p = 0.000).

Obviously, in the susceptible group, the equilibrium between plaque attack and host response is disturbed and as a consequence, juvenile periodontitis developed. These patients may have specific virulent microorganisms like Actinobacillus actinomycetemcomitans (Mandel & Socransky 1981, Zigmond et al. 1983), as well as an impaired function of polymorphonuclear leukocytes (Cianciola et al. 1977, Clark et al. 1977). In the older susceptible individuals, apparently the equilibrium between plaque attack and host response has not been disturbed. Whether this is due to a lack of virulent periodontal pathogens or to a highly effective host response is part of a further investigation.

In this study, an attempt was made to compare the periodontal condition of individuals susceptible and insusceptible to periodontal breakdown. A major finding was the difference between the 2 groups in the clinical condition of sites with shallow pockets. At these sites, the highly susceptible patients showed higher bleeding/plaque ratios than the insusceptible subjects. Most likely, the composition of the plaque of the 2 groups is completely different, but the host response in terms of bleeding upon probing is also different. Therefore, it may be hypothesized that a high bleeding/plaque ratio possibly reflects a disturbed equilibrium between plaque attack and host response. Herrmann & Frandsen (1979) stated that the typical pathogenesis of juvenile periodontitis comprises an initial involvement of first molars and/or incisors and subsequent involvement of other teeth. On the basis of high bleeding/plaque ratios of sites with shallow pockets in the juvenile periodontitis group of the present study and the supposed spread of periodontal breakdown in these patients, it is tempting to speculate that patients with a high bleeding/plaque ratio are at risk to future periodontal breakdown. This speculation would imply that the bleeding/plaque ratio may possibly act as a prognostic indicator for periodontal breakdown. However, longitudinal data are indispensable in order to substantiate this hypothesis.

Experimental gingivitis in relation to susceptibility to periodontal breakdown

Since longitudinal research takes many years, the experimental gingivitis model was chosen for further investigation. It was hypothesized that the development of...
of gingival inflammation during experimental gingivitis may be related to the degree of susceptibility to periodontal breakdown. By using the same clinical parameters as in the previous study, 4 different experimental groups were selected on the basis of a different history of periodontal disease. The experimental material consisted of individuals hypothetically susceptible, hypothetically insusceptible, susceptible and insusceptible to periodontal breakdown. In these 4 groups, the experimental gingivitis model was introduced. For the evaluation of the different parameters, the Mann-Whitney U-test was used.

Hypothetically susceptible and insusceptible groups

In order to be able to select individuals hypothetically susceptible and insusceptible to periodontal breakdown, 132 first year dental students were screened within the 1st week they entered dental school. The age of the students varied between 18–22 years with a mean age of 19.8 years. In each individual, the plaque index (PII – Silness & Löe (1964)) and the periodontal pocket bleeding index (PPBI – Van der Velden (1979)) were determined on the vestibular, lingual, mesial and distal aspect of the 16, 21, 24, 36, 41 and 44. Subsequently, the bleeding/plaque ratio was calculated for each individual. The individual bleeding/plaque ratios of all subjects are shown graphically in Fig. 1. The experimental groups were selected in the following way.

- Hypothetically susceptible group: 7 volunteers with a bleeding/plaque ratio >0.5 and no loss of attachment. In this group, the age varied between 19–22 years with a mean age of 20.9 years.
- Hypothetically insusceptible group: 8 volunteers with a bleeding/plaque ratio <0.2 and no loss of attachment. The individuals in this group were in the age of 18–22 years with a mean age of 19.7 years. Both groups were subject to a carefully controlled oral hygiene program in order to reduce pre-existent inflammation as much as possible and to obtain a high level of plaque control. Next, the experimental gingivitis model was introduced for a period of 23 days. The plaque accumulation of both groups can be seen in Fig. 2. During the oral hygiene abstinence period, plaque accumulated rapidly in both groups. At the end of the experimental period, both groups had equal amounts of plaque (p=0.96). In Fig. 3, the development of bleeding on probing can be seen. Testing revealed that at baseline, the hypothetically susceptible group showed more bleeding (p=0.012). Furthermore, both groups showed a significant increase in bleeding on probing during the experimental period. At the end of the experimental period, the hypothetically susceptible group still showed more bleeding (p=0.0053).
Susceptible and Insusceptible groups

Adults susceptible to periodontal breakdown were selected on the basis of age, 25-39 years, (2) generalized but healthy periodontium, (4) pockets of 3 mm or less and (5) no history of periodontal surgery or tooth loss. The groups were selected on the basis of (1) age, 2 years, (2) presence of at least 2 teeth, (3) no evidence of extractions due to periodontal breakdown, (4) no loss of attachment, (5) shallow pockets, (6) amounts of plaque and no history of periodontal cleaning.

The start of the experiment, groups were subjected to a care-controlled oral hygiene program to reduce pre-existent inflammation as much as possible and to keep an increased level of plaque control. In susceptible groups, the experimental gingivitis model was introduced for 18 weeks, whereas the susceptible group was unable to abtain from oral hygiene for a period of 33 days. In the present paper, only the data are for the first 18 days. Fig. 4 shows that both groups, plaque accumulation rapidly, although the susceptible group developed more plaque than the susceptible group (p = 0.002). With respect to bleeding on probing, results showed that in both susceptible and insusceptible groups, the PPBI increased with time (Fig. 5). However, considerable differences can be seen regarding the onset and the rate of development of the bleeding scores. At the end of the experiment, the mean PPBI of the susceptible group was twice as high as the mean PPBI of the susceptible group (p = 0.006). Comparing the results of the 4 groups, it must be kept in mind that due to technical circumstances, the measurements could not be made at identical points in time during the oral hygiene abstinence period.

Therefore, the results for the susceptible and insusceptible groups at day 18 are compared with the calculated values of the 2 hypothetical groups for day 18. With regard to the amount of plaque present at day 18, no differences could be assessed between the susceptible group and the hypothetically susceptible and insusceptible groups (p = 0.24 and p = 0.23, respectively). Furthermore, the plaque index of the susceptible group was higher than the plaque index of the susceptibility group as well as the plaque index of the hypothetically susceptible and susceptible groups (p = 0.002, p = 0.000 and p = 0.000, respectively). Results for the bleeding scores at day 18 show that the susceptible group had a mean PPBI value comparable to that of the hypothetically susceptible group (p = 0.35). In addition, the susceptible group had a mean PPBI value comparable to the hypothetically susceptible group (p = 0.30).

Discussion

Longitudinal and cross-sectional studies have shown that the prevalence and severity of inflammatory periodontal disease increase with age (Porritt 1957, Loe et al. 1978, Kelley & Harvey 1979, Husgason et al. 1981). By means of the experimental gingivitis model, it has also been demonstrated that with similar levels of plaque accumulation, the tendency to develop gingivitis gradually increases from early childhood to adult age (Malthan 1978, Masson & Goldberg 1985). Comparing adults (20–24 years) with individuals of older age (65–78 years), the same phenomenon was found by Holm-Pedersen et al. (1975). However, it should be noted that the older individuals exhibited more recession of the gingiva and showed a greater amount of plaque accumulation. This phenomenon, that with increasing age inflammation of the periodontium tends to develop more rapidly, could not be confirmed in a recent study of Winkel et al. (1985). In this study, experimental gingivitis was introduced in younger (33–41 years) and older (52–72 years) subjects without loss of attachment and no recession of the gingiva. Their results showed no differences with regard to the amount of plaque accumulation and the rate of development of gingival inflammation between the 2 age groups. Results of another experimental gingivitis study (Van der Velden et al. 1985b) differed even more. In this investigation, experimental gingivitis was introduced in younger (25–39 years) and older (45–54 years) patients with a comparable reduced healthy periodontium. Results of their study showed that there was no difference with regard to plaque accumulation, whereas bleeding on probing developed more rapidly in the younger age group. It was concluded that a possible age effect was overruled by the degree of susceptibility to periodontal breakdown.

In the present study, the manner of patient selection may have introduced age effects with regard to the plaque accumulation. Comparison of the 4 groups showed that during the oral hygiene abstinence period, the susceptible group (52–72 years) developed the same level of plaque accumulation as the 2 hypothetical groups (18–23 years). The only group in the present study which developed more plaque was the susceptible group. As in the study of Holm-Pedersen et al. (1975), these indi-
vials exhibited gingival recession and consequently plaque accumulation on the root surface instead of the enamel. Since it has been shown that plaque accumulation more rapidly on a rough surface (Mierau 1984), it may be suggested that the rougher surface of the root is responsible for the greater amount of plaque accumulation. Therefore, it seems unlikely that the factor of age is of importance with regard to the amount of plaque accumulation during experimental gingivitis. In the first part of this paper, it was hypothesized that a high bleeding/plaque ratio may act as a prognostic indicator for periodontal breakdown. In order to substantiate this hypothesis, experimental gingivitis studies were carried out in 4 different groups of individuals: 2 younger age groups without periodontal breakdown having either a low or a high bleeding-plaque ratio—the hypothetically susceptible and insusceptible groups respectively; 1 older age group with a low bleeding-plaque ratio and no periodontal breakdown and a low bleeding-plaque ratio— the insusceptible group; and 1 adult age group which had suffered previously from severe periodontal disease—the susceptible group. In relation to the selection procedure, it must be realized that the bleeding/plaque ratio is based on measurements performed at sites which showed no loss of attachment. Therefore, the bleeding/plaque ratio can only be determined if a subject has sufficient sites without loss of attachment. This implies that in patients with generalized periodontal breakdown and deep pocketing, it is not possible to assess this bleeding/plaque ratio. Results of the present study show that the older insusceptible group with a low bleeding-plaque ratio developed only small amounts of bleeding during the oral hygiene abstention period. The younger hypothetically susceptible group developed a comparable low bleeding index. The younger hypothesi sally susceptible group developed a much higher bleeding index comparable to that of the susceptible group, the periodontal patients. These results suggest again that both the amount of plaque accumulation and the development of bleeding on probing seem not to be related to age but rather to the degree of susceptibility to periodontal breakdown. In conclusion, comparison of the results of the experimental gingivitis studies in subjects with a different history of inflammatory periodontal disease support the concept that the bleeding/plaque ratio may act as a prognostic indicator for periodontal breakdown.

Zusammenfassung

Überlegungen über das Sondieren und die Empfindlichkeit für Parodontalzustände


Résumé

Sondage et susceptibilité à la destruction parodontale

Des études épidémiologiques et des études cliniques indiquent qu'il existe des différences

References


