

Comparison of gingival index and sulcus bleeding index as indicators of periodontal status

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Although the gingival index and sulcus bleeding index have been widely used as indicators of periodontal status, there is some disagreement among investigators as to their meaning and significance. A clinical study was undertaken to monitor the occurrence of gingival bleeding, oedema, and change in colour in subjects with and without periodontal disease, and it was found that the combinations of these clinical symptoms often did not correspond exactly with an index score. It is therefore suggested that any study of periodontal disease should be based on fundamental criteria, such as bleeding or oedema, rather than on composite indices.

Any epidemiological survey of periodontal status requires that the state of the gingiva can be accurately defined, in order to be able to compare different population groups at a given time, to determine and control risk factors, and to assess treatment efficacy. In our laboratories, the indices of gingival status most frequently employed are the gingival index (GI) (1, 2) and the sulcus bleeding index (SBI) (3). This report presents a comparison of these two indices and outlines the problems associated with their use.

From personal communication with staff of several periodontology departments at odontology research and training centres in France, it was found that there is disagreement among skilled investigators as to the exact meaning of the two indices. We have, therefore, reexamined the components used to define them.

DEFINITION AND ANALYSIS OF THE GI AND SBI

The GI was proposed by Løe & Silness in 1963 (1), and modified slightly in 1967 (2). It is defined as follows:

- score 0 —normal gingiva;
- score 1 —mild inflammation, slight change in colour, slight oedema, no bleeding on probing;
- score 2 —moderate inflammation, redness, oedema, and glazing, bleeding on probing;
- score 3 —severe inflammation, marked redness and oedema, ulceration tendency to spontaneous bleeding.

The GI is based on two of the characteristic signs of inflammation—swelling (oedema) and redness. An important sign is bleeding. According to the GI, the appearance of induced bleeding constitutes a worsening of the early symptoms (score 1). However, it is not specified whether a score of 2 is given only if all criteria are fulfilled, or if one qualifying symptom is sufficient. In a personal communication, Løe has stated that “the gingiva should be probed for bleeding only if it shows moderate inflammation, redness, oedema, and/or glazing”.

If the bleeding is spontaneous, the index score must be 3 regardless of the other signs.

The description of gingival status given by the GI assumes that the condition progresses in a frank and stereotyped way. If this is not the case, a particular score may be accorded on the basis of symptoms that differ greatly in nature and significance.

In 1958, Muhlemann & Mazor (3) had stressed that bleeding was a much more sensitive indicator of disease than either oedema or colour change. They considered that bleeding occurred before the other signs were present and ought to be taken as the

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determining factor in any study of the morbidity and prevalence of gingival disorders.

In 1971, Muhlemann & Son (4) introduced the SBI which was defined as follows:

score 0 — gingiva of normal texture and colour, no bleeding;

score 1 — gingiva apparently normal, bleeding on probing;

score 2 — bleeding on probing, change in colour, no oedema;

score 3 — bleeding on probing change in colour, slight oedema;

score 4 — either:

(a) bleeding on probing, change in colour, obvious oedema; or

(b) bleeding on probing, obvious oedema;

score 5 — bleeding on probing and spontaneous bleeding, change in colour, marked oedema.

Here too, there is a clear-cut progression, but the distinctions are finer.

Bleeding is the determining factor in the SBI and is the first sign to appear. There is thus no category that allows for oedema or change in colour without bleeding and there is no simple correspondence between the GI and SBI scores, mainly because of the different roles assigned to bleeding in each case.

In addition, the definition of the criteria determining the different scores is not accurate enough to ensure consistency of scoring of a given gingival state by trained examiners.

In view of these difficulties, we have attempted to analyse the individual components of the indices, as follows:

(1) *Oedema*. Both indices describe four stages of oedema that correspond fairly well: none, slight, moderate or visible, and marked or obvious (codes 0, 1, 2, and 3).

(2) *Colour*. The GI gives four stages: normal, slight change in colour, moderate redness, and marked redness. The SBI allows for only two classifications: normal and change in colour. Note that assessment of change in gingival colour is subjective particularly in view of the wide range of individual variations and conditions of examination. We grouped "slight change in colour" with "moderate redness" to give the following coding system:

| | |
|---------------------|---|
| no change in colour | 0 |
| moderate change | 1 |
| marked change | 2 |

(3) *Bleeding*. Both indices recognize three stages: none, induced, and spontaneous (coded respectively 0, 1, and 2).

The above coding system was used in a practical clinical study to investigate the occurrence of the three symptoms separately and to determine the frequency of the various possible combinations.

MATERIALS AND METHODS

The study group comprised 164 patients attending the Nancy Dental School for treatment of various conditions that were not necessarily periodontal. Two-thirds of the persons examined were between 20 and 30 years of age, and the remaining third were in the age group 30 – 50 years. In each case four surfaces of six teeth were examined. The six teeth were:

maxillary right second incisor, left first bicuspid, right first molar;
mandibular left second incisor, right first bicuspid, left first molar.

A data collection form was completed for each subject, recording general information (i.e., civil status, oral hygiene, smoking, etc.) as well as the clinical findings.

The investigations were carried out in 1979 – 80 by two members of the teaching staff of the Department of Periodontology and two final-year students, who were carefully trained to recognize the various stages of each criterion. It was found that, although bleeding and oedema could be clearly defined, assessment of change in colour was still fairly subjective. A preliminary study of 40 persons was carried out in 1979, during which the investigators were unaware that one of the aims of the work was to determine any discrepancies in the scores awarded.

Table 1. Frequency of occurrence (%) of gingival bleeding, oedema, and change in colour in 164 subjects

| Symptom | Score | | | |
|------------------|-------|------|-----|-----|
| | 0 | 1 | 2 | 3 |
| Bleeding | 80.8 | 17.3 | 1.9 | |
| Oedema | 69.7 | 23.5 | 6.7 | 0.1 |
| Change in colour | 66.3 | 26.5 | 7.2 | |

Table 2. Frequency of occurrence of combinations of symptoms, and correspondence of clinical findings with GI and SBI

| Symptom | | | Correspondence with GI score | | | Correspondence with SBI score | | | Frequency | |
|----------|--------|--------|------------------------------|---------|------|-------------------------------|---------|------|------------------|-------------------------------------|
| Bleeding | Oedema | Colour | Strict | Approx. | None | Strict | Approx. | None | % of total cases | % of cases with same bleeding score |
| 0 | 0 | 0 | 0 | | | 0 | | | 56.57 | 68.35 |
| 0 | 0 | 1 | | 0 | | | 0 | | 7.55 | 9.34 |
| 0 | 0 | 2 | | | — | | | — | 0.19 | 0.37 |
| 0 | 1 | 0 | | 1 | | | 0 | | 5.37 | 6.65 |
| 0 | 1 | 1 | 1 | | | | 0 | | 8.60 | 10.65 |
| 0 | 1 | 2 | | 1 | | | | — | 1.49 | 1.85 |
| 0 | 2 | 0 | | | — | | | — | 0.03 | 0.03 |
| 0 | 2 | 1 | 1 | | | | | — | 0.95 | 1.18 |
| 0 | 2 | 2 | | | — | | | — | 1.11 | 1.38 |
| 0 | 3 | 0 | | | — | | | — | 0 | — |
| 0 | 3 | 1 | | | — | | | — | 0 | — |
| 0 | 3 | 2 | | | — | | | — | 0.16 | 0.20 |
| 1 | 0 | 0 | | | — | 1 | | | 4.20 | 24.33 |
| 1 | 0 | 1 | | | — | 2 | | | 2.25 | 13.03 |
| 1 | 0 | 2 | | 2 | | 2 | | | 0.14 | 0.78 |
| 1 | 1 | 0 | | 2 | | | 1 | | 1.41 | 8.16 |
| 1 | 1 | 1 | 2 | | | | 1 | | 5.18 | 29.99 |
| 1 | 1 | 2 | 2 | | | | | — | 0.87 | 5.02 |
| 1 | 2 | 0 | | 2 | | | | — | 0.11 | 0.63 |
| 1 | 2 | 1 | | 2 | | 3 | | | 1.36 | 7.85 |
| 1 | 2 | 2 | | 2 | | 4a | | | 1.69 | 9.42 |
| 1 | 3 | 0 | | | — | 4b | | | 0 | — |
| 1 | 3 | 1 | | | — | 4a | | | 0 | — |
| 1 | 3 | 2 | | | — | | 4a | | 0.14 | 0.78 |
| 2 | 0 | 0 | | | — | | | — | 0 | — |
| 2 | 0 | 1 | | | — | | | — | 0.03 | 1.41 |
| 2 | 0 | 2 | | | — | | | — | 0.03 | 1.41 |
| 2 | 1 | 0 | | 3 | | | 5 | | 0 | — |
| 2 | 1 | 1 | | 3 | | | 5 | | 0.36 | 16.90 |
| 2 | 1 | 2 | 3 | | | | 5 | | 0.22 | 11.27 |
| 2 | 2 | 0 | | 3 | | | 5 | | 0 | — |
| 2 | 2 | 1 | 3 | | | 5 | | | 0.27 | 14.08 |
| 2 | 2 | 2 | 3 | | | 5 | | | 0.98 | 50.78 |
| 2 | 3 | 0 | | | — | | 5 | | 0 | — |
| 2 | 3 | 1 | 3 | | | 5 | | | 0 | — |
| 2 | 3 | 2 | 3 | | | 5 | | | 0.08 | 4.26 |

RESULTS

Analysis of the results of the preliminary survey in 40 subjects revealed a number of combinations of symptoms that did not fit in with one of the indices, such as bleeding without oedema or change in colour, or marked oedema without bleeding; the investigators were asked to have such combinations confirmed by their colleagues.

In the main investigation 4 surfaces of 6 teeth were examined in each of 164 persons; in fact, 63 teeth were missing, so that a total of 3684 surfaces were examined. Table 1 shows the frequency of occurrence of each of the three symptoms.

Table 2 shows the frequency of occurrence of the various combinations of symptoms, and their correspondence with the GI and SBI. Each combination is described by three numbers, giving in order, the severity of bleeding, oedema, and change in colour.

Some combinations were not found in any of the clinical examinations made on the study group (030, 031, 130, 131, 200, 210, 220, 230, and 231), while others that occurred occasionally confirmed the lack of correspondence between the indices. It is considered that the following combinations are particularly important—002, 020, 102, 132, 201, 202, 211, and 212.

These results show that although oedema and change in colour are often found together, bleeding can occur independently of oedema. Even spontaneous bleeding may occur with only slight accompany-

ing signs (15% of cases of spontaneous bleeding were coded 211 and there was one case of 201 and one case of 202).

In general, however, on the lingual surfaces, bleeding and oedema were usually seen together when the score was 1 or 2, regardless of the tooth involved. There was thus a definite relationship between the symptoms, despite the individual variations. It is possible that, in addition to local factors, bleeding is a result of individual predisposition.

CONCLUSION

It is therefore concluded that the GI and SBI correspond only approximately with clinical findings. In 4.2% of cases there was induced bleeding without gingival modification—a condition that is not allowed for in the GI. Equally, over 25% of cases showed some gingival modification without bleeding, which cannot be reflected by the SBI.

Consequently, it is suggested that epidemiological surveys should discard the use of these combined indices, and should examine the components individually. Of the three basic criteria, bleeding and oedema can be assessed fairly objectively, but assessment of change in colour is subjective and should not be used. This is in agreement with the recommendations of the World Health Organization (5) that objective descriptive criteria (e.g., supra- and subgingival calculus, bleeding, and pocket depth) should be used in any epidemiological survey of periodontal status.

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RÉSUMÉ

COMPARAISON ENTRE L'INDICE GINGIVAL ET L'INDICE DE SAIGNEMENT DU SILLON EN TANT QU'INDICATEURS DE L'ÉTAT PARODONTAL

Les études épidémiologiques parodontales supposent une définition correcte et précise de l'état gingival pour permettre de comparer des populations entre elles, étudier l'évolution pathologique, détecter et surveiller les facteurs de risque, ou suivre l'effet d'un traitement.

Dans ce but, on utilise souvent des indices, dont les plus généralement répandus et utilisés sont des indices globaux tels que le «gingival index» ou GI et le «sulcus bleeding index» ou SBI. Ceux-ci traduisent, avec une même échelle de valeur, les modalités de plusieurs signes lésionnels. Ce sont

des indices composites. Malheureusement, ils présentent des ambiguïtés qui rendent leur utilisation clinique délicate, et laissent une trop large place à l'interprétation de l'examineur.

Envisagés du point de vue logique, les indices GI et SBI combinent chacun entre eux 3 signes fondamentaux: le saignement, l'œdème et la teinte de la gencive; il y aurait 36 combinaisons distinctes possibles. Celles-ci sont représentées en 4 stades pour le GI et en 6 pour le SBI.

Si l'on considère en détail les définitions théoriques de ces

indices, on s'aperçoit que parmi les combinaisons logiques possibles des signes, 15 ne sont pas prises en compte, à notre sens, dans le GI, alors que certaines d'entre elles sont observées en pratique: par exemple, absence de saignement avec présence d'œdème et de changement de teinte marqués (1,1% des cas dans l'enquête de Nancy). De même, pour le SBI, 13 combinaisons logiques (pas toutes observables) ne sont pas prises en compte dans l'indice. Il semble que ce soit l'absence de saignement malgré la présence d'œdème et d'un changement de teinte de la gencive qui soit mal évaluée. Il faut noter que la fréquence de ces combinaisons est assez faible, comme l'a montré notre enquête faite en 1979 – 1980 sur 164 sujets.

Il est plus simple, précis et rapide pour l'examineur de

recueillir séparément chaque signe lésionnel et de l'indiquer directement sur le bordereau d'enquête. Cela évite, en outre, toute possibilité d'erreur dans l'interprétation des définitions des indices composites. Ultérieurement, l'outil informatique permet de recombinaisonner ces données, soit selon un schéma imposé (GI, SBI, ou autre...), soit en fonction de résultats d'analyses statistiques pondérant l'importance et la contribution de chaque signe élémentaire. Cela permet de plus l'analyse de chaque signe isolé, et de leurs associations au niveau des faces de dents, des dents et de la bouche.

Il est donc préférable, dans les études épidémiologiques parodontales, d'utiliser, à la place des indices composés globaux, l'enregistrement séparé de chaque signe lésionnel.

REFERENCES

1. LÖE, H. & SILNESS, J. Periodontal disease in pregnancy. 1. Prevalence and severity. *Acta odontologica Scandinavica*, **21**: 533 – 551 (1963).
2. LÖE, H. The gingival index, the plaque index, and the retention index systems. *Journal of periodontology*, **38**: 610 – 616 (1967).
3. MUHLEMANN, H. R. & MAZOR, Z. S. Gingivitis in Zurich schoolchildren. *Helvetica odontologica acta*, **2**: 3 – 11 (1958).
4. MUHLEMANN, H. R. & SON, S. Gingival bleeding — a leading symptom in initial gingivitis. *Helvetica odontologica acta*, **15**: 107 – 113 (1971).
5. WHO Technical Report Series, No. 621, 1978 (*Epidemiology, etiology and prevention of periodontal diseases: report of a WHO Scientific Group*).