

# Gingival Indices: State of Art

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## 1. Introduction

Gingivitis, which is prevalent in a large proportion of the child and adult populations, is an inflammatory lesion of the gingival tissues, which usually precedes periodontitis. It has been shown to be reversible (Løe et al., 1967) and, although progression is not predictable, the prevention of gingivitis, in the individual patient or in populations, is still the first step toward preventing periodontitis (Burt et al., 2005). According to Mariotti (1999), the characteristics of biofilm-induced gingivitis are: (1) biofilm present at gingival margin; (2) change in gingival color; (3) change in gingival contour; (4) sulcular temperature change; (5) increased gingival exudate; (6) bleeding upon provocation; (7) absence of attachment loss; (8) absence of bone loss; and (9) histological changes. The intensity of the clinical signs and symptoms will vary among individuals as well as among sites within a dentition.

Surveys in different parts of the world have reported that gingivitis is prevalent in children, adolescents and adults (Baelum & Scheutz, 2002; Gjermo et al., 2002; Oliver et al., 1998; Sheiham & Netuveli, 2002). To assess these data, the state of the gingiva should be accurately defined, in order to be able to compare different population group at a given time, to determine and control risk factors, and to evaluate treatment efficacy (Benamghar et al., 1982). Quantitative measurement of disease most commonly is based on indices systems. An efficient index system should be quick and easy to use, with minimal instrumentation. It must be reproducible and must reflect accurately degrees of pathology (Engelberger, 1983). Several gingival indices have been proposed in literature, all of which have relied on one or more of the following criteria: gingival color (redness), gingival contour, gingival bleeding, gingival stippling and gingival crevicular fluid flow (Ciancio, 1986; Fischman, 1988; Newbrun, 1996). These clinical features can be assessed non-invasively, only visually, (e.g., color, contour, spontaneous bleeding) and/or invasively, with the use of an instrument (e.g., bleeding on provocation). Whereas some of the indices include both visual and invasive components, others are based on either visual features alone or bleeding on provocation alone. Thus, gingivitis can be evaluated by either quantitative clinical indices that are based on a combination of inflammation symptoms or extent of gingival involvement or on bleeding as a single variable (Barnett, 1996; Lorenz et al., 2009). Moreover, several investigators have used variations of "present or absent" indices which do not consider the severity of gingival inflammation. The observation of whether or not inflammation is present in the gingiva might be a useful approach in clinical studies. Such an index would be simple, reproducible with little examiner training and require relatively little time (Hazen, 1974). Although several indices have been proposed, with many different

methodologies, no one has universal application or acceptance. The purpose of this chapter is to describe the main gingivitis indices introduced over the past years, exposing its principles, methods and applicability.

## 2. Gingival indices

### 2.1 PMA Index

The PMA index, developed by Schour & Massler (1947) and described by Massler (1967) is probably the first successful attempt to design a numerical system for recording gingival health. The index scores gingival units as separate entities and is based on the premise that inflammation commences in the interdental papilla (P) from where it spreads to the marginal (M) and ultimately the attached gingiva (A). Each gingival unit is scored on the basis of 0-4. Only the labial surfaces are examined. The number of affected Papillary, Marginal and Attached units are counted for each individual and recorded. Its major purpose has been the evaluation of gingival inflammation in children.

### 2.2 Gingival Index (GI)

The Gingival Index (Löe and Silness, 1963) was created for the assessment of the gingival condition and records qualitative changes in the gingiva. It scores the marginal and interproximal tissues separately on the basis of 0 to 3. The criteria are:

0= Normal gingiva;

1= Mild inflammation – slight change in color and slight edema but no bleeding on probing;

2= Moderate inflammation – redness, edema and glazing, bleeding on probing;

3= Severe inflammation – marked redness and edema, ulceration with tendency to spontaneous bleeding.

The bleeding is assessed by probing gently along the wall of soft tissue of the gingival sulcus. The scores of the four areas of the tooth can be summed and divided by four to give the GI for the tooth. The GI of the individual can be obtained by adding the values of each tooth and dividing by the number of teeth examined. The Gingival Index may be scored for all surfaces of all or selected teeth or for selected areas of all or selected teeth. The GI may be used for the assessment of prevalence and severity of gingivitis in populations, groups and individuals. A score from 0.1-1.0 = mild inflammation; 1.1-2.0 = moderate inflammation from, and 2.1-3.0 signifies severe inflammation. The GI has been used frequently in clinical trials of therapeutic agents. The sensitivity and reproducibility is good provided the examiner's knowledge of periodontal biology and pathology is optimal (Löe, 1967).

### 2.3 Sulcus Bleeding Index (SBI)

An early sign of gingivitis is bleeding on probing and, in 1971, Muhlemann and Son described the Sulcus Bleeding Index (SBI). The criteria for scoring are as follows:

Score 0 – health looking papillary and marginal gingiva no bleeding on probing;

Score 1 – healthy looking gingiva, bleeding on probing;

Score 2 – bleeding on probing, change in color, no edema;

Score 3 – bleeding on probing, change in color, slight edema;

Score 4 –bleeding on probing, change in color, obvious edema;

Score 5 –spontaneous bleeding, change in color, marked edema.

Four gingival units are scored systematically for each tooth: the labial and lingual marginal gingival (M units) and the mesial and distal papillary gingival (P units). Scores for these units are added and divided by four. Adding the scores of the undivided teeth and dividing them by the number of teeth can determine the sulcus bleeding index.

#### **2.4 Gingival Bleeding Index (GBI)**

In 1974, Carter and Barnes introduced a Gingival Bleeding Index, which records the presence or absence of gingival inflammation after passing unwaxed dental floss into the proximal sulci. It is readily available, disposable, and can be used by the instructed patient for self-evaluation. The mouth is divided into six segments and flossed in the following order; upper right, upper anterior, upper left, lower left, lower anterior and lower right. Bleeding is generally immediately evident in the area or on the floss; however, thirty seconds is allowed for reinspection of each segment. If copious hemorrhage occurs the patient may be allowed to rinse in between segments. Bleeding is recorded as present or absent. For each patient a Gingival Bleeding Score is obtained by noting the total units of bleeding and the total susceptible areas at risk.

#### **2.5 Gingival Bleeding Index (GBI - Ainamo & Bay, 1975)**

This Gingival Bleeding Index (GBI), introduced by Ainamo & Bay (1975), is performed through gentle probing of the orifice of the gingival crevice. If bleeding occurs within 10 seconds a positive finding is recorded and the number of positive sites is recorded and then expressed as a percentage of the number of sites examined. Bleeding can also function as a motivating factor in activating the patient to better oral home care. It has been shown that the scores obtained with this index correlate significantly to GI (Löe and Silness, 1963) and has been used in profile studies and short-term clinical trials.

#### **2.6 Papillary Bleeding Index (PBI)**

The Papillary Bleeding Index was first introduced by Saxer and Muhlemann (1975), as cited by Muhlemann (1977). This index permits both immediate evaluation of the patient's gingival condition and his motivation, based upon the actual bleeding tendency of the gingival papillae. A periodontal probe is inserted into the gingival sulcus at the base of the papilla on the mesial aspect, and then moved coronally to the papilla tip. This is repeated on the distal aspect of the papilla. The intensity of any bleeding is recorded as:

Score 0 - no bleeding;

Score 1 - A single discreet bleeding point;

Score 2 - Several isolated bleeding points or a single line of blood appears;

Score 3 - The interdental triangle fills with blood shortly after probing;

Score 4 - Profuse bleeding occurs after probing; blood flows immediately into the marginal sulcus.

#### **2.7 Papillary Bleeding Score (PBS)**

This is performed using a Stim-U-dent®, which is inserted interproximally (Loesche, 1979). Essentially, the PBS expands the score 2 of the Gingival Index (Löe and Silness, 1963) into three recognized clinical conditions. The criteria are:

0 = healthy gingiva, no bleeding upon insertion of Stim-U-dent® interproximally;

- 1 = edematous, reddened gingiva, no bleeding upon insertion of Stim-U-Dent® interproximally;
  - 2 = bleeding, without flow, upon insertion of Stim-U-dent® interproximally;
  - 3 = bleeding, with flow, along gingival margin upon insertion of Stim-U-dent® interproximally;
  - 4 = copious bleeding upon insertion of Stim-U-dent® interproximally;
  - 5 = severe inflammation, marked redness and edema, tendency to spontaneous bleeding.
- The PBS is determined on all papillae anterior to the second molars.

### **2.8 Modified Papillary Bleeding Index (MPBI)**

Barnett et al. (1980) modified the PBI index (Muhlemann, 1977) by stipulating that the periodontal probe should be gently placed in the gingival sulcus at the mesial line angle of the tooth surface to be examined and carefully swept forward into the mesial papilla. They timed the appearance of bleeding and graded it as follows:

- 0 = no bleeding within 30 s of probing;
- 1 = bleeding between 3 and 30 s of probing;
- 2 = bleeding within 2 s of probing;
- 3 = bleeding immediately upon probe placement.

The mesial papillae of all teeth present from the second molar to the lateral incisor were assessed. Indices were derived for the maxillary left and mandibular right buccal segments, and the maxillary right and mandibular left lingual segments, and from these a full-mouth index was calculated. This distribution of test sites was utilized since each mesial papilla could only be tested once, i.e. from either the buccal or lingual side. They showed that the modified PBI may be more sensitive than the visual aspects of the GI in assessing changes in gingival health.

### **2.9 Bleeding Time Index (BTI)**

Nowicki et al. (1981) concluded that a gingival index bleeding would be useful for detecting the first clinical evidence of gingival inflammation. The method consisted of inserting a Michigan "0" probe in the sulcus until slight resistance was felt and then the gingiva was stroked back and forth once over an area of approximately 2 mm. The following scores are applied:

- 0= no bleeding within 15 seconds of second probing (i.e. 30 seconds total time);
- 1= bleeding within 6 to 15 seconds of second probing;
- 2= bleeding within 11 to 15 of seconds of first probing or 5 seconds after second probing;
- 3= bleeding within 10 seconds after initial probing
- 4= spontaneous bleeding.

### **2.10 Eastman Interdental Bleeding Index (EIBI)**

Caton & Polson (1985) developed the Eastman Interdental Bleeding Index (EIB). A wooden interdental cleaner is inserted between the teeth from the facial aspect, depressing the interdental tissues 1 to 2 mm. This is repeated four times and the presence or absence of bleeding within 15 s is recorded. Considering the over-all high levels of reliability between and within examiners, this method would be suitable for use in clinical trials and epidemiological studies (Blieden et al., 1992).

### 2.11 Quantitative Gingival Bleeding Index (QGBI)

In 1985, Garg & Kapoor formulated a quantitative gingival bleeding index. This index takes into consideration the magnitude of blood stains covering tooth brush bristles on brushing and squeezing gingival tissue units in a segment, with one score for entire one segment (canine to canine, or left or right pre-molars and molars in maxillary or mandibular arches – six segments in all). The criteria scores are:

- 0 – no bleeding on brushing; bristles free from blood stains;
- 1 - slight bleeding on brushing; bristle tips stained with blood;
- 2 - moderate bleeding on brushing; about half of bristle length from tip downwards stained with blood;
- 3 – Severe bleeding on brushing; entire bristle length of all bristles including brush head covered with blood.

Bleeding is generally immediately evident on the bristles of the brush; however, 30 seconds were allowed for reinspection of each segment. According with authors, this index has good reproducibility, reliability, objectivity and simplicity of use.

### 2.12 Modified Gingival Index (MGI)

The Modified Gingival Index (MGI), devised by Lobene et al. (1986), introduced changes in the criteria of the Gingival Index (Löe and Silness, 1963) through a non-invasive (no probing) and resetting the rating for mild and moderate inflammation. This way, the following criteria are adopted:

- 0 = absence of inflammation;
- 1 = mild inflammation or with slight changes in color and texture but not in all portions of gingival marginal or papillary;
- 2 = mild inflammation, such as the preceding criteria, in all portions of gingival marginal or papillary;
- 3 = moderate, bright surface inflammation, erythema, edema and/or hypertrophy of gingival marginal or papillary;
- 4 = severe inflammation: erythema, edema and/or marginal gingival hypertrophy of the unit or spontaneous bleeding, papillary, congestion or ulceration.

Gingival units as well as the calculation of the index follow the same criteria described in GI.

### 2.13 Bleeding on Interdental Brushing Index (BOIB)

Whereas measures of gingival inflammation through indices of bleeding with polling can be influenced by factors such as angulation of the probe, the probe insertion depth, direction, and motion of the probe and probing force and indices that use wooden spatulas, according to its shape and rigidity, may represent a potential for trauma, Hofer et al. (2010) developed the Bleeding on Interdental Brushing Index (BOIB). This index is performed by inserting a light interdental brush placed buccally, just under the contact point and guided between the teeth with a jiggling motion, without force. Bleeding is scored as either present or absent, for each interdental site, after 30 s. The authors describe like advantages: atraumatic manipulation of the papillae, ease of application, integration into existing oral hygiene instruction and motivating patients to monitor their own progress at home, while at the same time performing a beneficial oral hygiene procedure and removing any interdental plaque that may be present.

| Index Name (Abbreviation)                     | Author (s)         | Year | Instrument                 | Graded response               | Time delay (seconds)                         |
|---|--------------------|------|----------------------------|-------------------------------|--|
| PMA Index                                     | Schour and Massler | 1947 | Probe                      | 0-5                           | Not stated                                   |
| Gingival Index (GI)                           | Löe and Silness    | 1963 | Probe                      | 0-3                           | Not stated                                   |
| Sulcus Bleeding Index (SBI)                   | Muhlemann and Son  | 1971 | Probe                      | 0-5                           | Not stated                                   |
| Gingival Bleeding Index (GBI)                 | Carter and Barnes  | 1974 | Unwaxed dental floss       | Dichotomous (yes/no bleeding) | Not stated; 30 s is allowed for reinspection |
| Gingival Bleeding Index (GBI)                 | Ainamo and Bay     | 1975 | Probe                      | Dichotomous (yes/no bleeding) | 10   |
| Papillary Bleeding Index (PBI)                | Muhlemann          | 1977 | Probe                      | 0-4                           | Not stated                                   |
| Papillary Bleeding Score (PBS)                | Loesche            | 1979 | Wooden interdental cleaner | 0-5                           | Not stated                                   |
| Modified Papillary Bleeding Index (MPBI)      | Barnett et al.     | 1980 | Probe                      | 0-3                           | 0-30   |
| Bleeding Time Index (BTI)                     | Nowicki et al.     | 1981 | Probe                      | 0-4                           | 0-15   |
| Eastman Interdental Bleeding Index (EIBI)     | Caton and Polson   | 1985 | Wooden interdental cleaner | Dichotomous (yes/no bleeding) | 0-15   |
| Quantitative Gingival Bleeding Index (QGBI)   | Garg and Kapoor    | 1985 | Tooth brush                | 0-3                           | Not stated                                   |
| Modified Gingival Index (MGI)                 | Lobene et al.      | 1986 | No instrument (visual)     | 0-4                           | Not applicable                               |
| Bleeding on Interdental Brushing Index (BOIB) | Hofer et al.       | 2010 | Interdental brush          | Dichotomous (yes/no bleeding) | 30   |

Table 1. Gingival Indices

### 3. Discussion

Since periodontal diseases are primarily inflammatory in nature, the ability to detect inflammatory lesions in gingival tissues is essential for the diagnosis and monitoring of changes in gingival status. Clinical indices provide a means of converting observed clinical data into numerical data for statistical analysis. Gingivitis indices have been based on clinical features of inflammation, and they contain components that are assessed non-invasively, by visual examination (e.g., color, texture, changes in form, spontaneous bleeding) and components that are assessed invasively (e.g., bleeding on stimulation or provocation) (Armitage, 1996).

Hazen et al. (1974) set guidelines for the choice of "most suitable or ideal" index. These were that (1) an index should be simple to use and low cost; (2) the criteria that describes the components of the index must be clear and easily understood; (3) the index should be equally sensitive across its range indicating the clinical phases of the disease; (4) the index must be amenable to statistical analysis. In addition, Carter and Barnes (1974) considered that a good index should measure those things that it purports to measure and at the same time be sensitive enough to recognize small degrees of change. For clinical trials, the precision, accuracy, reliability and the validity of the measurements produced must be evaluated. The validity of the indices, which can be estimated by calculating its sensitivity and specificity, must be considered when comparing different indices. The sensitivity of a diagnostic test refers to the probability of the test being positive when the disease is truly present. A perfect test would be able to detect the disease in all cases without registering a false negative. The specificity of a diagnostic test refers to the probability of the test being negative when the disease is not present. A perfect test would be able to correctly identify all instances in which the disease was absent without registering a false positive. The positive predictive value of a test refers to the probability that the disease is present when the test is positive. The negative predictive value refers to the probability that the disease is absent when the test is negative (Armitage, 2003).

One of the first clinical signs of gingival inflammation, besides the exudation of gingival fluid, is the redness of the gingival margin. It arises partly from the aggregation and enlargement of blood vessels in the immediate subepithelial connective tissue and the loss of keratinization of the facial aspects of gingiva. Swelling and loss of texture of the free gingiva reflect the loss of fibrous connective tissue and the semi liquidity of the interfibrillar substance. Bleeding occurs because of frequent micro-ulcerations in the epithelium that lines the gingival sulcus/periodontal pocket. Gingival bleeding has been used as a key parameter in the evaluation of gingivitis because of its objectivity and ease of clinical access. The fact that the gingival tissues can be provoked to bleed just by touching the gingival margin with a blunt instrument suggests that the epithelial changes and the vascular changes are well established. These findings support the importance and applicability of using indices of visual and bleeding changes (Chaves et al., 1993; Newbrun, 1996; Lang et al., 2009).

In one sense, gingival indices may be considered arbitrary in that any choice of criteria represents only one of many possible representations of the reality of the disease (Barnett, 1996). Nevertheless, in order to be useful, an index must have a substantiated relationship between signs, as defined by the index criteria, and actual clinical changes accompanying the progression of disease. Analyses of gingival biopsies with an inflammatory cell infiltrate in the gingival tissues are correlated with visual signs of inflammation and bleeding on

probing (Barendregt et al., 2002). This validation can also be done by correlating results using a new or modified index with results obtained using a previously accepted and validated index when both are included in the same study (Barnett, 1996).

Most of the indices include an invasive component, that is, they demand the use of an instrument. Periodontal probes (Massler, 1967; Løe & Silness, 1963; Muhlemann & Son, 1971; Ainamo & Bay, 1975; Muhlemann, 1977; Nowicki et al., 1981; Barnett, 1980), wooden interdental cleaners (Loesche, 1979; Caton & Polson, 1985), dental floss (Carter & Barnes, 1974) and tooth brushes (Garg & Kapoor, 1985; Hoffer et al., 2010) have all been utilized.. Unwaxed floss is simple to use and may be used by the dentist and patient. The GBI, which uses unwaxed floss, has good validity and reliability and can register subtle gingival changes. However, it has the disadvantage of not being immediately reproducible (Carter and Barnes, 1974).

Comparisons between clinical indices are difficult to assess. When probing is used for bleeding response, the force used, the probe size and probe position are factors that must be taken into consideration (reviewed in Listgarten, 1980). Regarding "bleeding on pressure", Bollmer et al. (1986) compared the intrusive gingival index (GI) for estimating gingivitis with a noninvasive visual index. The results indicated that the methods were similar and the number of bleeding sites per subject did not diminish after manipulation. Thus, for those studies where it is desirable to measure bleeding sites, the GI index is recommended. The pressure used for probing must be standardized since the percentage of sites with bleeding on probing increases linearly with an increase in probing force. A maximum force of 0.25 N has been suggested in order to limit the number of false positive readings. According to Armitage (2003), bleeding on probing could, in several instances, be the effect of mechanical trauma of healthy sites. However, to date the appropriate probing pressure to be applied to minimize false positives and hence, distinguish between health and disease in the gingival tissues has not been definitely determined.

Another common variation is whether probing is performed in the marginal gingiva or in the bottom of the pocket. From a diagnostic perspective, it is unclear as to which of these is the more sensitive indicator of early gingival pathology. Van der Weijden et al. (1994) assessed gingival bleeding by running a probe along the marginal gingiva, at an angle of approximal 60° to the longitudinal axis of the tooth. This method was compared to probing to the bottom of the pocket. They considered that marginal probing more accurately evaluated a healthy gingival condition and was the most appropriate method to detect differences in the development of gingivitis between experimental groups.

The following objections to the use of invasive procedures for indices used in clinical trials are (1) the effect of probing on disrupting plaque at the gingival margin and on producing trauma to the gingiva; (2) the impediment to calibrating examiners or assessing the reliability of a single examiner using the same subjects and gingival areas; (3) the obscuring of specific bleeding sites by blood oozing from previously probed areas on the opposite or adjacent tooth surfaces. Divergent schools of thought have developed with regard to selecting the appropriate gingival index. One opinion maintains that only invasive indices should be utilized, since indices that include a bleeding-on-provocation component are, by definition, the most objective. These clinical investigators hold the view that visual indices are not appropriate because of their "subjectiveness" (Barnett, 1996). An alternative opinion maintains that, for longitudinal plaque and gingivitis studies, non-invasive indices are the most appropriate because invasive procedures will not only disrupt the plaque but also



could mildly traumatize the tissue and present an impediment to assessing examiner standardization and reproducibility. Also, a variety of measures are used to elicit bleeding and can vary a lot between studies. Variable factors include the time between provocation and bleeding, the depth of sulcular insertion of the probe, the probing technique, the angle of insertion, and the probing force (Lorenz et al., 2009). The non-invasive index developed by Lobene et al. in 1986 (MGI) satisfies the criteria for a gingival index specified in the A.D.A. Council on Dental Therapeutics guidelines and has been generally accepted for use in clinical trials (Barnett, 1996). The authors showed that MGI increases the sensitivity of assessing early visual changes, which occur during the onset or regression of gingivitis. According to Lorenz et al. (2009), there is no doubt that indices containing a bleeding component can successfully be used in clinical trials. On the other hand, as discussed by Barnett (1996), the data presented indicate that non-invasive and invasive gingival indices contain both subjective and objective aspects to their use and the evidence does not support the assumption that invasive indices are truly objective. Therefore, utilizing a pure visual index in assessing gingivitis can be an alternative to an invasive index.

Some of the bleeding indices described are dichotomous; they record the presence or absence of bleeding (Carter & Barnes, 1974; Ainamo & Bay, 1975; Caton & Polson, 1985; Hoffer et al. 2010). However, clinicians who perform periodontal examinations recognize that a range of bleeding responses occurs in relation to extent and time bleeding occurs after provocation (Newbrun, 1996). Several bleeding indices, described previously, use different scales of bleeding response (Schour & Massler, 1947; L e & Silness, 1963; Muhlemann & Son, 1971; Muhlemann, 1977; Nowicki et al., 1981; Barnett, 1980; Loesche, 1979; Garg & Kapoor, 1985; Lobene et al., 1986). The results of GBI (Ainamo and Bay, 1975) showed that the score obtained correlate significantly with the GI index (L e and Silness, 1963) scores of the same persons and the simplification of GI (with a simple dichotomous score) did not seem to reduce the accuracy of the results obtained.

A striking problem in developing a gingivitis index is the lack of agreement as to the measurement criteria to be used and the evaluation standards to be employed. Examiner subjectivity as to what constitutes inflammation and the difficulty in accurately registering the related signs of gingival disease are among the major obstacles. Reports described in the literature have suggested that successive measures of gingival inflammation, evaluated by bleeding, performed by one or more examiners may not be reproducible (Feldman et al., 1982). Consequently the reproducibility of bleeding measurements has been a problem. It is important to note that the degree of intra- and inter-examiner reliability achievable is fundamental in deciding which index is appropriate for use in clinical trials and epidemiological studies (Kingman, 1986). The EIBI have been shown to have high levels of examiner agreement and a reason for this reliability may be due to the method of stimulation used for bleeding and the location (mid-interproximal tissue) of the inflammatory lesions that were examined (Blieden et al., 1992).

The choice of index should depend on the purpose of a study. For epidemiological surveys, partial recording of selected teeth or sites may be sufficient. On the other hand, for research and clinical trials, a quantitative measurement of bleeding is more informative than a dichotomous index of presence or absence of bleeding on stimulation. For patient education and motivation, a dichotomous index will suffice (Newbrun, 1996; Barnett, 1996). Although some clinical investigators may favor a given index to the exclusion of all others, a variety of indices could be appropriate for use in clinical trials

(Barnett 1996). As argued by Lobene (1986), it is clear from the number of indices that no one index universal application. The most important quality that an index must have is validity; does the scoring system measure what it purports to measure? If it does, then the index selected is the appropriate measurement for evaluating the outcome of the study. Another point that must be considered is the examiner's training. McClanahan et al. (2001) demonstrated that clinicians develop a specific style when recording gingival indices. This behavior strongly influences the recorded data and impacts on a number of important outcomes, which include measurement of disease levels, examiner calibration, power calculations, treatment differences, and determination of clinical significance. It is tempting to try to identify one particular style of examining as "correct." However, a judgment of this kind would be arbitrary in the absence of a common objective standard for examiner calibration. Therefore, it should not be assumed that an individual, untrained in either the conduct of clinical investigations or in the use of a given index, can successfully conduct a clinical trial without prior training. Thus, irrespective of the index utilized, the rigorous calibration and standardization of examiners by an investigator experienced in the use of the index is essential for its successful use in a clinical trial (Barnett, 1996). An absence of interexaminer calibration will impact on the structure of the resulting data set. It is particularly relevant to dental researchers, practicing dentists, and organizations such as the FDA and ADA where global assessments of the clinical effectiveness of products and treatments are routinely made by examining the results of independent clinical trials conducted by different sponsoring organizations. In these situations, interexaminer calibration of examiners is not routinely possible (McClanahan et al., 2001)

Periodontal diagnoses are determined by analyzing the information collected during a clinical examination. The information collected during such an examination includes demographic data (e.g., age, gender, etc.), medical history, history of previous and current periodontal problems, periodontal probe measurements (i.e., probing depths, clinical attachment loss, etc.), radiographic findings, and miscellaneous clinical features or observations (e.g., gingival inflammation, biofilm/calculus, mobility, occlusal problems). In some situations, supplemental qualitative or quantitative assessments of the gingival crevicular fluid (GCF) and subgingival microflora are performed. In addition, a genetic test for susceptibility to chronic periodontitis has become commercially available (Armitage, 2003). According to the American Academy of Periodontology (Burt et al., 2005), the most promising disease markers are the inflammatory cytokines that are expressed in gingival crevicular fluid (GCF) as part of the host response to inflammation. These cytokines include prostaglandin E2 (PGE2), tumor necrosis factor-alpha (TNF- $\alpha$ ), IL-1 alpha (IL-1 $\alpha$ ), IL-1 beta (IL-1 $\beta$ ), and others. While it has been documented that these and other constituents of GCF are associated with inflammatory response, actually quantifying these associations and determining the sensitivity of the measures (i.e., the extent to which the quantity of expressed cytokine goes up or down as inflammation goes up and down) is proving more difficult. New methods for assessing early gingival changes are being investigated. Gleissner et al. (2006) used the laser Doppler flowmeter to evaluate non-invasively changes in gingival blood flow (GBF). The authors observed that although it is a valuable, non-invasive method for clinical research of gingival microcirculation modifications of the probe are needed to improve its clinical applicability.

At the present time, supplemental information on GCF components, the subgingival microflora, and genetic susceptibility and other methods, such as laser Doppler flowmeter, are still being evaluated (Armitage, 2003; Burt et al., 2005). Until these and other new, valid and reliable measures of disease are available the clinical visual-tactile indices will continue to be the most widely used and accepted methods of assessment.

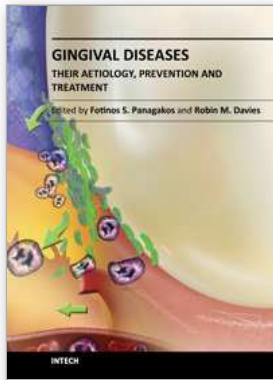
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## **Gingival Diseases - Their Aetiology, Prevention and Treatment**

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Gingival diseases are a family of distinct pathological entities that involve the gingival tissues. These signs and symptoms of these diseases are so prevalent in populations around the world that they are often considered to be "normal" features. The diseases are now classified into two main groups namely: Plaque-Induced and Non-Plaque Induced Gingival Diseases. This book provides dentists, dental hygienists, dental therapists and students with a comprehensive review of gingival diseases, their aetiology and treatment.

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