Correlations Among Gingival Indices:

A Methodology Study

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USING AN EXPERIMENTAL GINGIVITIS MODEL, 99 subjects completed a 3-week study to determine the correlations between a visual index of gingivitis, the Modified Gingival Index (MGI), and the Gingival Index (GI), the Interdental Bleeding Index (IBI), and the Papillary Bleeding Index (PBI).

Following a baseline examination consisting of the MGI and either the GI, IBI, or PBI, each subject received a full mouth scaling and rubber cup polishing to render the teeth plaque and calculus free. Subjects then rinsed twice daily for 30 seconds with 20 ml of either an active antimicrobial or control mouthrinse for 3 weeks while abstaining from all other oral hygiene.

The MGI correlated significantly with the GI, IBI, and PBI, both at baseline and at 3 weeks for all subjects.

A variety of indices or schemes for evaluating the extent and severity of gingivitis have been formulated during the past four decades.[1-4] All are to some degree subjective in nature, depending on individual examiner dexterity, perceptions, and judgments of gingival appearance. Among these scoring systems, the Gingival Index (GI), developed by Löe and Silness[5] has gained the most widespread acceptance and use.

Bleeding has been correlated with the visual clinical signs of gingivitis and with histologically determined inflammation of the gingivae.[6-10] The Modified Gingival Index (MGI) is a modification of the GI which was developed to increase sensitivity in the low-region of the scoring scale and eliminate the "bleeding on pressure" component of the GI, providing a completely noninvasive scoring procedure.[11] Some authors conclude that either the observed signs of inflammation or bleeding on probing can be used to detect inflammatory lesions of the gingivae.[10] Therefore, this double-blind, controlled clinical methodology study was undertaken to determine the relationships among the MGI and indices of gingival inflammation which incorporate a bleeding component.

MATERIALS AND METHODS

Subjects were healthy male and female adult volunteers, aged 18 to 55, with type I or II periodontal disease. Subjects had a minimum of 20 sound, natural teeth. Excluded were grossly carious, fully crowned, restored or orthodontically banded, abutment, and third molar teeth. Subjects with gross oral pathology or those on antibiotic, antibacterial, or antiinflammatory therapy were excluded from the study.

One hundred and one (101) volunteers were entered into the study. Gingival index scores were recorded at the baseline examination for use as covariates in the final analyses. Following the baseline examinations, subjects were given a full mouth scaling and rubber cup polishing to render the crowns plaque and calculus free. They were assigned to either a treatment or control group and to one of three gingival index subgroups according to a randomized code, by which double-blinding was maintained.

On the same day as the prophylaxis, subjects began their assigned regimen of rinsing with 20 ml of either an antiseptic or control mouthrinse for 30 seconds, twice daily for 3 weeks, as the sole oral hygiene measure. Rinsings were conducted under supervision Monday through Friday. Subjects followed their usual dietary habits but were instructed to refrain from using oral hygiene methods including toothbrushing, flossing, or other mouthrinses. Gingivitis was scored for all subjects at baseline and at 3 weeks using the MGI[11] on the facial and lingual surfaces and the interdental papillae of all scorable teeth as follows:

0 normal (absence of inflammation)
1 mild inflammation (slight change in color, little change in texture) of *any portion* of the gingival unit

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2 mild inflammation of the *entire* gingival unit
3 moderate inflammation (moderate glazing, redness, edema, and/or hypertrophy) of the gingival unit
4 severe inflammation (marked redness and edema/hypertrophy, spontaneous bleeding, or ulceration) of the gingival unit

The GI[5] PBI,[12] or the IBI[8,13] were also scored at baseline and at 3 weeks on the subjects in three respective subgroups.

The GI[5] was scored on the buccal, mesial, lingual, and distal surfaces of six selected teeth (3,7,12,19,23,28) according to the following criteria:

0 absence of inflammation
1 mild inflammation; there was a slight change in color and little change in texture; no bleeding on pressure
2 moderate inflammation; there was moderate glazing, redness, edema, and hypertrophy; bleeding on pressure
3 severe inflammation; there was marked redness and hypertrophy; tendency to spontaneous bleeding; ulceration

Scores were determined by inserting the probe at a 45° angle to the tooth to initial tissue resistance. Mesial and distal scores were determined at a point midway between the line angle and the col area.

The PBI was determined using a blunt Williams probe inserted into the gingival sulcus at the base of the papilla on the mesial aspect of the posterior tooth until initial tissue resistance was felt, and then moved coronally to the papilla tip. This stroke was repeated on the same papilla from the distal aspect of the anterior tooth. The intensity of bleeding within 15 seconds on the upper right palatal, upper left facial, lower left lingual, and on the lower right facial aspects was scored as follows:

0 no bleeding
1 a single discreet bleeding point appeared
2 several isolated bleeding points or a single fine line of blood appeared
3 the interdental triangle filled with blood shortly after probing
4 profuse bleeding occured after probing; blood flowed immediately into the marginal sulcus

The IBI[8,13] was scored using a wooden interdental cleaner* inserted between the teeth from the facial aspect, beginning with the papilla between the first molar and second premolar and moving anteriorly in such a way as to depress the interdental papilla 1 to 2 mm, or until tooth resistance was felt. The path of insertion was horizontal, with care being taken not to direct the point in an apical direction. The interdental cleaner was inserted and removed four times. Presence (1) or absence (0) of bleeding within 15 seconds was recorded.

All intraoral examinations were performed by a single examiner. Prior to initiation of examinations, the investigators reviewed the indices and participated in calibration exercises. The study was designed to provide a minimal power of 0.80 for detecting a clinically important difference to be statistically different at $P=.05$. Average indices or scores were determined for each subject. The averages were analyzed by analysis of covariance. Correlation coefficients were tested for statistical significance by comparison with their theoretical distribution.

RESULTS

Initially, 101 subjects were recruited and randomly assigned to the MGI and one of the other three gingivitis index subgroups (GI, PBI, or IBI), as well as to either an active or control mouthrinse group. Ninety-nine (99) subjects completed the 3-week experimental gingivitis study; 30 were in the GI, 36 were in the PBI, and 33 were in the IBI group. Two subjects were dropped for noncompliance. The groups were balanced for age and sex (Table 1).

Table 2 presents the adjusted mean whole mouth scores for the MGI, GI, IBI, and PBI for each group, at baseline and at 3 weeks. For each index, the baseline mean scores for the control and active groups showed

Table 1
Demographic Variables

	Papillary Bleeding Index		Interdental Bleeding Index		Gingival Index	
	No.	%	No.	%	No.	%
Sex						
Male	13	36.1	6	18.2	8	26.7
Female	23	63.9	27	81.8	22	73.3
Total	36		33		30	
Age						
Average	32.25		31.88		30.77	
Std. Error	1.41		1.50		1.33	
Range	21–51		19–54		19–52	

Table 2
Mean Whole Mouth Baseline and Adjusted 3-Week Scores

Index	N	Group	Baseline	S.E.	3-Week Adj. Mean	S.E.
MGI	48	Control	1.80	0.06	1.82	0.06
	51	Active	1.89	0.06	1.28	0.06
GI	15	Control	1.32	0.07	1.40	0.08
	15	Active	1.31	0.08	1.25	0.08
IBI	15	Control	0.70	0.07	0.93	0.04
	18	Active	0.79	0.04	0.70	0.04
PBI	18	Control	1.46	0.13	1.81	0.12
	18	Active	1.62	0.15	1.49	0.12

* Stim-U-Dent, Johnson & Johnson Products, Inc., New Brunswick, NJ.

Table 3
Correlations Between MGI and GI, IBI, and PBI

		r-Values		
		Gingival Index	Interdental Bleeding Index	Papillary Bleeding Index
Whole Mouth	Baseline	0.849	0.616	0.650
	3 Weeks	0.923	0.658	0.784
Common Units	Baseline	0.844	0.695	0.695
	3 Weeks	0.932	0.698	0.823

no significant differences at the outset of the study. At 3 weeks, the adjusted mean scores indicated that each index performed similarly in detecting trends in the active and control groups.

Correlations between the MGI and the GI, the IBI, and the PBI were determined for the whole mouth and for the gingival units (i.e., margin and/or papilla) common to the indices being compared (Table 3). The r-values for the 99 subjects who completed the study showed highest correlations between the MGI and GI with a range of 0.844 to 0.932. Correlations between the MGI and the IBI were 0.616 to 0.698 and between the MGI and PBI were 0.650 to 0.823.

DISCUSSION

A number of indices have been developed in order to facilitate the study of periodontal diseases in epidemiological and clinical trial populations. These indices provide numerical schemes for scoring the severity and/or distribution of disease which can be subjected to statistical analysis. In selecting an appropriate index for use in clinical studies, it is important to consider such factors as the nature of the study (e.g., cross-sectional vs. longitudinal), the disease to be studied (e.g., gingivitis vs. periodontitis), and in the case of longitudinal studies, whether a worsening or improvement of the disease might be anticipated as a result of therapeutic intervention.

The Löe and Silness Gingival Index is probably the most widely used index in therapeutic trials.[14] This index was originally introduced in a cross-sectional study of pregnancy gingivitis,[5] and by virtue of its including a bleeding component in addition to visual criteria, is generally considered to provide a more objective assessment of gingivitis than do indices which rely solely on visual criteria. However, it should be recalled that the bleeding component is present only in the higher end of the scale (GI = 2 or 3), and that the differentiation between normal gingiva and mild inflammation (GI = 0 and 1, respectively) is dependent upon visual criteria alone. Moreover, it has been noted that variability exists in the actual use of the Gingival Index.[10,14] For example, the bleeding component may not always be included and, when it is used, considerable variation can exist[14] in probing force, probe placement, and the motion used to elicit bleeding. When multiple examinations are required, as in the case of longitudinal studies, there is additional concern that an invasive index might introduce additional variability by injuring the sulcular tissue and/or inadvertently disturbing bacterial plaque.[15] Furthermore, the calibration of examiners, which involves repetitive examinations of the same subject, cannot be readily accomplished if a bleeding criterion is included.

The value of bleeding as the most sensitive indicator of gingivitis has been questioned, with some authors noting that in the early stages of gingivitis, changes in color and contour have been observed to precede bleeding on probing.[16,17] Therefore, an effort has been made to identify a visual index for assessing the severity of gingivitis which will yield information comparable to that of the Löe-Silness Index while providing advantages for use in clinical trials. A previous study[15] has confirmed that a noninvasive index (PMGI) can, in fact, be utilized successfully. Our findings of a strong correlation between the MGI and GI, as well as significant correlations between the MGI and each of two other bleeding indices, further support the validity of using a purely visual gingival index for the assessment of gingivitis.

The MGI has a number of advantages for use in clinical trials, including the following:

1. It is noninvasive, thereby eliminating concerns about the disruption of soft tissue or plaque in the gingival region, as well as obviating the need for infection control practices which would be required if sulcular probing were done.
2. It is logistically simpler. Decision making is simplified if bleeding considerations do not have to be superimposed on visual determinations.
3. There is less variability in its implementation if bleeding on pressure is excluded. This feature in combination with item 2 can result in greater accuracy in inter-examiner caliabration.
4. It affords greater sensitivity in detecting therapeutic efficacy. The expansion of the scale at its low end makes the MGI more sensitive to improvements in gingival health following treatment.

In summary, this study demonstrates that the MGI correlates well with indices traditionally utilized in studies of gingivitis. Because it is noninvasive and affords greater sensitivity at the low end of the scale, it can be advantageous in certain applications, e.g., clinical trials. Although the MGI has been shown to correlate with two bleeding indices, if a bleeding determination is desired as well, we feel that a separate determination of the presence or absence of bleeding should be employed.

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