

Comparison of the bleeding on marginal probing index and the Eastman interdental bleeding index as indicators of gingivitis

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Abstract

Aim: The purpose of the present study was to compare 2 indices, i.e., the Eastman interdental bleeding (EIB) index and the bleeding on marginal probing (BOMP) index. The comparison was made (a) in terms of the degree of bleeding provoked and the relationship with plaque in natural gingivitis and (b) for the ability of these 2 methods to detect differences between the development of experimental gingivitis in a control group and a group in which the development of gingival inflammation was suppressed by treatment. For the present studies, subjects were selected without interdental recession of the gingival tissues.

Methods experiment 1: In this experiment, 43 subjects having established moderate gingivitis were assessed using a random splitmouth design (1st and 3rd/2nd and 4th quadrant). Plaque was scored on all approximal sites after which the BOMP index was assessed in one half of the mouth and the EIB index in the other.

Results experiment 1: The BOMP index showed a bleeding score of 84% and the EIB index of 87%. The significant correlation between plaque and gingival bleeding for the BOMP index (0.55) was higher than for the EIB index (0.44).

Methods experiment 2: For this experiment, 25 subjects participated in an experimental gingivitis trial of the lower jaw. At baseline, first the BOMP index and immediately thereafter the EIB index were assessed at all approximal sites. Experimental gingivitis (EG) was carried out in one randomly assigned quadrant and as a treatment modality only floss was used in the other (FL).

Results experiment 2: In the EG quadrant, the BOMP index increased to 69% and the EIB index to 73%. Both indices showed a significant correlation with plaque; 0.60 and 0.64 respectively. In the FL quadrant, the BOMP index increased to 38% and the EIB index to 30%. No significant correlation between both gingivitis indices and the amount of plaque was present in the FL quadrant.

Conclusion: The ability of the BOMP index and the EIB index to assess the level gingival inflammation appears to be comparable.

Key words: gingivitis; plaque; probe; bleeding index

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Diagnostic indicators to assess periodontal status are targeted towards identifying various characteristics of the disease process (Cowell et al. 1975). Since periodontal diseases are primarily inflammatory in nature, the ability to detect inflammatory lesions in gingival

tissues is essential for diagnosis and monitoring therapeutic effectiveness.

Gingivitis indices have been based on generally accepted clinical features of inflammation, and they contain components that are assessed non-invasively visually (e.g., color, texture, changes in

form, spontaneous bleeding) and components that are assessed invasively (e.g., bleeding on stimulation or provocation) (Armitage 1996). Visual signs of inflammation and bleeding on probing both can be used to detect gingivitis as shown by analysis of gingival biopsies

(Greenstein et al. 1981, Cooper et al. 1983, Caton et al. 1989), and both correlate with the presence of an inflammatory cell infiltrate in the gingival tissues (Oliver et al. 1969, Appलगren et al. 1979, Rudin et al. 1970, Greenstein et al. 1981, Davenport et al. 1982, Abrams et al. 1984, Amato et al. 1986).

Clinical indices represent methods of converting observed clinical symptoms into an acceptable numerical form for statistical analysis. In some 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. The continued use of indices that pool clinical signs is to be discouraged and quantitative measures of gingival inflammation should be validated for use in clinical trials (Van Dyke et al. 1998).

In the search for objective clinical parameters, to diagnose periodontal status, bleeding on probing has received much attention. Methods frequently employed to provoke bleeding are: (1) bleeding on probing to the "bottom" of the pocket (Van der Velden 1979, Lang et al. 1991), by inserting the probe parallel to the root surface directed apically towards the perceived location of the root apex; (2) Bleeding on probing of the marginal gingival tissues by running a probe along the soft tissue wall at the orifice of the pocket (Löe 1967, Mühlemann & Son 1971, Saxton & Van der Ouderaa 1989, Van der Weijden et al. 1994a); (3) bleeding of the interdental papilla by insertion of a wooden interdental cleaner (Eastman Interdental Bleeding (EIB) index (Caton & Polson 1985). The forementioned methods have been used in patients with and without periodontal breakdown. The present paper will focus on the evaluation of bleeding on probing in subjects without periodontal breakdown.

Van der Weijden and co-workers have assessed gingival bleeding on marginal probing by running the probe along the marginal gingiva, at an angle of approximately 60° to the longitudinal axis of the tooth (Van der Weijden et al. 1994a). This method was compared to probing with a periodontal probe to the bottom of the pocket (Van der Weijden et al. 1994a). Bleeding on marginal

probing was found to be the most appropriate method, to detect differences in the development of gingivitis between experimental groups (Van der Weijden et al. 1994a). In a subsequent study, bleeding indices were found to be hardly reproducible when tested on a site basis (Van der Weijden et al. 1994b). A better intra-/inter-examiner agreement was observed when considering quadrants (Janssen et al. 1986). Caton et al. (1988) compared the EIB index, using a woodstick to provoke bleeding, with the papilla bleeding index, which is a method of bleeding on marginal probing (PBI, Mühlemann & Son 1971). They concluded that the EIB index detected significantly more interproximal inflammatory lesions.

Since in the case of "bleeding provoked with a probe running along the gingival margin" and "bleeding provoked with a wooden interdental cleaner", the provocation on the gingival tissues is carried out in an entirely different manner, the purpose of the present study was to compare 2 indices, i.e., the Eastman interdental bleeding (EIB) index and the bleeding on marginal probing (BOMP) index. The comparison was made (a) in terms of the degree of bleeding provoked and the relationship with plaque in natural gingivitis and (b) for the ability of these two methods to detect differences between the development of experimental gingivitis in a control group and a group in which the development of gingival inflammation was suppressed by treatment.

Material and Methods **Bleeding Indices**

With the BOMP index the gingiva was scored according to the method described by Van der Weijden et al. (1994a). In short, a Williams periodontal probe (tapered tine, tip diameter 0.5 mm; Hu-Friedy, Liemen, Germany) was inserted into the gingival crevice to a depth of approximately 2 mm and was run at an angle of approximately 60° to the longitudinal axis of the tooth. Presence or absence of bleeding was scored within 30 s after probing.

Scoring the EIB index was performed by inserting the wooden interdental cleaner between the teeth from the facial aspect, depressing the interdental tissues 1 to 2 mm. The path of insertion was parallel to the occlusal

plane with care being taken not to direct the point of the cleaner apically. The cleaner was inserted and removed four times, and the absence or presence of bleeding within 15 s was recorded (Caton & Polson 1985, Caton et al. 1988).

Comparison study

For this study, 45 volunteers (non dental University students) were recruited on the basis of having moderate gingival inflammation and the absence of periodontal breakdown. In addition, at least 20 teeth had to be present with no pockets exceeding 5 mm. Moderate gingivitis was defined as at least 40% of the test-sites showing bleeding on probing at screening. The following clinical indices were assessed at the vestibular, mesio-vestibular, disto-vestibular and lingual surfaces of all teeth; first for all sites the plaque index (Silness & Löe, 1964) was assessed, after which the 2 bleeding indices were assessed; i.e., the BOMP index or the EIB index. The participants were scored for bleeding using a "split mouth" design. In 2 contra-lateral quadrants (either 1st and 3rd or 2nd and 4th), one randomly allocated method was used being either the BOMP index or the EIB index. In the opposing quadrants the alternative method of probing was used.

Experimentally induced gingivitis study

The 2nd part of the study was initiated based on the assumption that a decrease in gingival health follows a predictable sequence of signs in an index (Cowell et al. 1975). It intended to compare both indices within the experimental gingivitis model (Löe et al. 1965), and evaluate the sensitivity to detect a treatment effect.

For this part, 25 volunteers (non-dental University students being non-smokers) in good general health were selected on the basis of an intra-oral examination after which the purpose, procedures and duration of the study were explained to the participants eligible for the study. They were requested to sign an informed consent and to fill out a medical questionnaire. Subject selection was based on the criteria that they had 20 or more natural teeth, including at least 4 posterior teeth free of pockets >5 mm and no interdental recession of the gingival tissues. The subjects were excluded when orthodontic bands were

present on the teeth or if they were using any medication that might interfere with the outcome of the study (e.g., antibiotics, NSAIDs).

After the screening, examination the subjects entered a 4-week pre-trial period of professional prophylaxis and supervised oral hygiene care to obtain optimal gingival health. Subjects were carefully instructed in the use of a toothbrush and dental floss. At baseline the subjects received dental-floss (Johnson & Johnson®) and a new manual toothbrush (Oral-B® p30). The desired degree of gingival health was equal or less than 25% sites bleeding on marginal probing (Jones et al. 1990, Putt et al. 1993).

At baseline, gingival bleeding was assessed in the lower jaw; first the BOMP index and next the EIB index. Scoring was limited to the second incisor, canine, bicuspids and molars. 4 areas per tooth were scored; mesio-vestibular, disto-vestibular, mesio-lingual and disto-lingual. With the EIB index the interdental aspect was scored as 1 unit. Residual plaque was removed before starting the experimental period. The subjects were requested not to brush the lower jaw for the next 21 days but were allowed to continue brushing the upper jaw with standard toothpaste (Zendium®). In order to introduce a treatment effect, subjects were instructed to floss one randomly assigned quadrant in the lower jaw once a day (treatment sites). The contra-lateral quadrant in the lower jaw served as a control (non-treatment sites). No other oral hygiene measures other than dental floss were allowed.

After 21 days, the 25 subjects were scored for accumulated plaque (Silness & Løe, 1964) and gingival bleeding, using the same 2 bleeding indices in the same order (BOMP index and EIB index) as at the start of the experiment. Subject were requested to use the floss 3 hours before their appointment to minimize trauma and increased bleeding tendency (Abbas et al. 1982).

Data analysis

The EIB index results in one value per approximal area. Therefore the approximal bleeding scores obtained by means of the BOMP index were converted into a single score per approximal area by adding the 4 scores per approximal area and considering an ap-

proximal area positive for bleeding if at least one of the sites showed bleeding on probing. Next the proportion of bleeding approximal sites was calculated. For the statistical analysis of the data of the "comparison study" correlation coefficients between the plaque and the two indices were calculated and tested. An analysis of variance and covariance with repeated measures (BMDP 2V) was performed on the data of the "experimental study" in order to determine the difference between the indices in both the treatment and non-treatment areas. *p*-values <0.05 were accepted as statistically significant.

Results

Comparison study

Table 1 shows mean plaque and bleeding scores as assessed within the split-mouth design of this part of the study. Plaque scores represent a mean of a random allocation of a quadrant set of either the 1st and 3rd or 2nd and 4th quadrant in relation to the assigned bleeding index. The plaque scores as assessed on the BOMP index sites was 1.42 and 1.43 on the EIB index sites. No statistically significant difference was found between the proportion of bleeding sites of the 2 indices. Table 1 shows the correlation coefficients between plaque and bleeding scores. A

good correlation was observed between plaque scores of the 2 contralateral quadrants as assigned to the BOMP index and those assigned to the EIB index (correlation coefficient 0.90). The correlation between the BOMP index and plaque (0.55) was higher than with the EIB index and plaque (0.44).

Experimentally induced gingivitis study

Table 2 shows the bleeding scores as assessed at day 0 and plaque and bleeding scores at day 21 of the experimentally induced gingivitis in the lower jaw. Data are presented for sites where no oral hygiene measures whatsoever were used (non-treatment sites) and for sites where only dental floss was used (treatment sites). At baseline the percentage of bleeding sites with the BOMP index for treatment and non-treatment sites was 14% and 12% respectively and with the EIB index 23% and 21%. All subjects received a professional prophylaxis at day 0. Therefore after 21 days the amount of plaque increased from zero to 0.67 at treatment sites and to 1.57 at non-treatment sites. The difference in the plaque index between the treatment and non-treatment sites was significantly different at day 21. Accordingly bleeding increased to 38% and 69% in treatment and non-treatment sites respectively with the BOMP index and to

Table 1. Mean plaque and bleeding scores and correlation coefficients between plaque and bleeding scores as assessed within a splitmouth design

	Plaque	Bleeding	Correlation coefficient
BOMP quadrant sites	1.42 (0.40)	84% (14%)	0.55*
EIB quadrant sites	1.43 (0.40)	87% (15%)	0.44*
Correlation coefficient	0.90*	0.62*	

Standard deviations in parentheses.

* *p*<0.01.

BOMP: bleeding on marginal probing index, proportion of bleeding sites.

EIB: Eastman interdental bleeding index, proportion of bleeding sites.

Table 2. Mean plaque and bleeding scores as assessed at day 0 and day 21 of the experimentally induced gingivitis in the lower jaw

	Treatment		Non-treatment	
	day 0 [□]	day 21	day 0 [□]	day 21
BOMP	14%	38%	12%	69%*
EIB	23%	30%	21%	73%*
plaque	—	0.67	—	1.57*

Standard deviations in parentheses.

□ Plaque before entering the experimental gingivitis phase was "0" after a professional prophylaxis.

* *p*<0.05 comparison using analysis of variance between treatment and non-treatment.

BOMP: bleeding on marginal probing index, proportion of bleeding sites.

EIB: Eastman interdental bleeding index, proportion of bleeding sites.

30% and 73% with the EIB index. The difference between the treatment sites and the non-treatment sites was for both the BOMP index and the EIB index statistically significant.

When comparing the data from day 0 to day 21 in both treatment and non-treatment sites for the BOMP index, it shows a significant increase. For the EIB index, this was only true for the non-treatment sites. In the treatment sites no significant difference was found between baseline and day 21. Therefore when comparing both indices in treatment sites the increase in bleeding from day 0 to day 21 is, when using the BOMP index, significantly higher (14% → 38%) in comparison to the EIB index (23% → 30%). The increase in non-treatment-sites was comparable the BOMP index (12% → 69%) and the EIB index (21% → 73%).

Table 3 shows correlation coefficients between both bleeding scores at day 0 and day 21. The two bleeding indices at day 0 correlated significantly with each other, both in treatment (0.38) and non-treatment sites (0.17). Higher correlations were found at day 21 (0.45 and 0.63, respectively). Table 3 also shows correlation coefficients between plaque and bleeding scores in treatment and non-treatment sites at day 21. The correlation with plaque in the non-treatment sites was significant and substantial for both the BOMP index (0.64) and the EIB index (0.60). In contrast in treatment sites no correlation between plaque and bleeding scores was observed at day 21 (BOMP index 0.04 and EIB index 0.06, respectively).

Discussion

The present study aimed at comparing 2 bleeding indices (BOMP index and EIB index) which differ in their method

to elicit bleeding, and assess their relation to the level of plaque. For the present studies subjects were selected without interdental recession of the gingival tissues. In case of recession the EIB index can not be properly assessed since in that case the interdental tissues can not be depressed and obviously no bleeding can be provoked.

The 2 indices were evaluated in natural gingivitis and in case of experimental gingivitis. In the comparison study (first part), where subjects with natural gingivitis were selected, the mean % bleeding scores were comparable for the BOMP index and the EIB index. In relation to the level of plaque the BOMP index correlated better with plaque than the EIB index. This suggests that the BOMP index could be a more appropriate index evaluating the relationship between plaque and natural occurring gingival inflammation. Lie et al. (1998) in a comparable age group of non-smokers using the BOMP index observed a correlation with plaque of 0.66 in relatively healthy conditions at baseline of a experimental gingivitis study. A non-significant correlation of 0.35 in the same subjects was observed after 14 days of full mouth experimental gingivitis, whereas in the present 21-day experimental gingivitis study, there was a significant correlation of 0.64 for the non-treated sites. Whether the 7-day longer time span of the experimental gingivitis in the present study is responsible for the difference in the correlation coefficients remains unknown. However it must be kept in mind that the amount of plaque was assessed by means of the Silness & L oe (1964) plaque index and that different results might have been obtained if other methods of evaluating plaque would have been used.

Although a bleeding component is commonly thought to confer "objec-

tivity" to a gingival index, all possible variations associated with the details of how bleeding determinations are accomplished, can, in fact, be a rather imprecise determination subject to the interpretation of individual investigators (Barnett 1996). In this respect, bleeding due to trauma may play an important role as has been suggested by Lang et al. (1991). These authors showed in subjects with a healthy periodontium that the bleeding provoked in that case, was due to trauma. Most likely the higher bleeding values as found by means of the EIB index compared to the PBI in the study of Caton et al. (1988) could also be the result of trauma. Apparently, bleeding on marginal probing as employed in the PBI is less traumatic than bleeding on inserting a wooden interdental cleaner as used in the EIB index. Based on the above considerations, it was decided to evaluate in the experimental gingivitis study first the BOMP index and secondly the EIB index. In this comparison it must also be kept in mind that, when using the BOMP index, one approximal area was already considered to be bleeding, when 1 out of 4 assessment per papilla showed bleeding upon probing.

The phenomenon that the insertion of a wooden interdental cleaner is more traumatic than marginal probing was not confirmed in the first part of the present study in natural gingivitis. Therefore the higher bleeding scores at baseline in the experimental study as obtained by means of the EIB index subsequently to the BOMP index, could be the result of 2 phenomena (1) more trauma by means of the EIB index compared to the BOMP index and (2) the effect of repeated trauma. However, as in both the study of Caton et al. (1988) and the present study no standardised forces were used to score bleeding, no conclusions can be drawn on the effect of trauma when using the EIB index or the BOMP index.

The experimental gingivitis model was chosen because it is frequently used to evaluate the effect of antimicrobial agents on developing plaque and gingivitis (Wennstr om 1988). In the present 21-day experimental gingivitis study, the correlation between plaque and the 2 bleeding indices was comparable in the non-treated sites. This suggests that in this particular model both indices are appropriate. Interestingly in the treated sites no correlation was observed be-

Table 3. Correlation coefficients between both bleeding scores at day 0 and day 21; correlation coefficients between plaque and bleeding scores in treatment and non-treatment sites at day 21

	Treatment	Non-treatment
<i>Day 0</i>		
EIB versus BOMP	0.38*	0.17*
<i>Day 21</i>		
EIB versus BOMP	0.45*	0.63*
BOMP versus Plaque	0.04	0.64*
EIB versus Plaque	0.06	0.60*

* Significant correlation $p < 0.05$.

BOMP: bleeding on marginal probing index, proportion of bleeding sites.

EIB: Eastman interdental bleeding index, proportion of bleeding sites.

tween plaque and bleeding with either index. The reason for this absence of a correlation is not fully understood. An explanation could be found in the possibility of trauma caused by flossing itself. If flossing is performed in a traumatising manner or shortly before the assessment of the bleeding indices, part of the scored bleeding could be of a traumatic nature due to flossing (Abbas et al. 1982). The observation of no correlation between plaque and bleeding with either index indicates that with this experimental gingivitis model care should be taken when testing therapeutic products which affect plaque growth and are evaluated based on bleeding indices only. This also underlines the importance of not only looking at plaque but also scoring bleeding in case one wants to evaluate the anti-gingivitis potential of a therapeutic product.

In conclusion

The correlation of both bleeding indices with plaque in natural gingivitis was good, whereas the level of bleeding as assessed with the EIB index was slightly higher. When treatment modalities based on plaque removal are evaluated during experimental gingivitis there appears to be a chance that the correlation of these bleeding indices with plaque is lost. In the absence of treatment both indices responded similarly within the experimental gingivitis design. Based on the results of this study it can be concluded that the ability of the BOMP index and the EIB index to assess the level of gingival inflammation appears to be comparable.

Zusammenfassung

Vergleich zwischen dem Bleeding on Marginal Probing Index und dem Eastman Interdental Bleeding Index als Indikatoren einer Gingivitis

Ziel: Der Zweck der vorliegenden Studie war es, die 2 Indizes, den Eastman Interdental Bleeding (EIB) Index und den Bleeding On Marginal Probing (BOMB) Index zu vergleichen. Der Vergleich erfolgte. (A) hinsichtlich des provozierten Blutungsgrades und der Relation zwischen Plaque und natürlicher Gingivitis sowie: (B) bezüglich der Fähigkeit dieser 2 Methoden hinsichtlich des Nachweises von Unterschieden zwischen der Entwicklung einer experimentellen Gingivitis in einer Kontrollgruppe und einer Gruppe in der die Ausbildung einer gingivalen Entzündung durch die Behandlung unterdrückt wurde. Für die vorliegende Studie wurden Personen

ohne interdental Gingivarezession ausgewählt.

Methoden Experiment 1: Bei diesem Experiment wurden 43 Personen mit etablierter moderater Gingivitis nach einem randomisierten Splitmouth-Design untersucht (1. Und 3./2. Und 4. Quadrant). Die Plaque wurde an allen approximalen Flächen bestimmt und anschließend wurde BOMP-Index in der einen Hälfte des Gebisses und der EIB-Index in der anderen erhoben.

Ergebnisse Experiment 1: Der BOMP-Index zeigte einen Blutungswert von 84% und der EIB-Index einen von 87%. Die signifikante Korrelation zwischen der Plaque und einer gingivalen Blutung war für den BOMP-Index (0.55) höher als für den EIB-Index (0.44).

Methoden Experiment 2: Für diese Experiment wurde bei 25 Personen eine experimentelle Gingivitis im Unterkiefer erzeugt. Bei der Eingangsuntersuchung wurde an allen Approximallflächen zuerst der BOMP-Index und sofort anschließend der EIB-Index erhoben. Die experimentelle Gingivitis (EG) wurde in einem randomisiert bestimmten Quadranten erzeugt und als Behandlungsart wurde im anderen Quadranten nur Zahnseide (FL) verwendet.

Ergebnisse Experiment 2: Im EG-Quadranten stiegen der BOMP-Index auf 69% und der EIB-Index auf 73% an. Beide Indizes zeigten eine signifikante Korrelation mit der Plaque, die bei 0.60 bzw. 0.64 lag. Im FL-Quadranten stiegen der BOMP-Index auf 38% und der EIB-Index auf 30% an. Zwischen beiden Gingivitis-Indizes und der Plaquemenge, die im FL-Quadranten vorhanden war, gab es keine signifikante Korrelation.

Schlussfolgerung: Die Möglichkeit mit dem BOMP-Index und den EIB-Index das Niveau der gingivalen Entzündung zu Bestimmen scheint vergleichbar zu sein.

Résumé

Comparaison entre l'indice du saignement au sondage marginal et l'indice du saignement interdentaire d'Eastman comme indicateurs de la gingivite

But: Le but de cette étude a été de comparer 2 indices, c-à-d. l'indice du saignement interdentaire d'Eastman (EIB) et l'indice du saignement au sondage marginal (BOMP). La comparaison a été effectuée (a) en termes de saignement provoqué et de relation avec la plaque dentaire dans la gingivite naturelle et (b) sur l'aptitude de ces 2 méthodes à détecter des différences lors du développement d'une gingivite expérimentale dans un groupe contrôle et dans un groupe test dont le développement de l'inflammation gingivale a été entravé par un traitement. Pour ces études, des sujets qui ne présentaient pas de récession interdentaire ont été sélectionnés.

Méthodes, expérience 1: Dans la première expérimentation, 43 sujets étant porteurs d'une gingivite modérée ont été enregistrés en utilisant un modèle de bouche divisée au hasard (1er et 3ième quadrants VS 2ième et 4ième

quadrants). La plaque dentaire a été estimée sur tous les sites interproximaux.

Résultats expérience 1: L'indice BOMP a ensuite été relevé sur une partie de la bouche et l'indice EIB sur l'autre. L'indice BOMP a eu un score de 84% et l'EIB de 87%. La corrélation significative entre la présence de plaque dentaire et le saignement gingival était pour l'indice BOMP de 0.55, supérieur donc à celui de l'EIB qui était de 0.44.

Méthodes expérience 2: Lors de la seconde expérience, 25 sujets ont participé à une gingivite expérimentale au niveau de la mandibule. Lors de l'examen de départ l'indice BOMP a été relevé en premier suivi de celui de l'EIB au niveau de tous les sites interproximaux. La gingivite expérimentale (EG) a été effectuée sur un quadrant choisi de manière randomisée et un traitement avec de la soie dentaire uniquement a été utilisé dans l'autre (FL).

Résultats expérience 2: Dans le quadrant avec EG l'indice BOMP atteignait 69% et l'indice EIB à 73%. Les deux indices avaient une corrélation significative avec la plaque dentaire, respectivement de 0.60 et 0.64. Dans le quadrant FL, l'indice BOMP grimpa à 38% et l'indice EIB à 30%. Aucune corrélation significative entre les deux indices de gingivite et la quantité de plaque n'a été trouvée dans le quadrant FL.

Conclusions: L'aptitude des indices BOMP et EIB à mesurer le niveau d'inflammation gingivale semble comparable.

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