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ORIGINAL ARTICLE

Applicability of Community Periodontal Index Teeth and Random Half-mouth Examination to Gingival Bleeding Assessment in Untreated Adult Population in Beijing

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Key words: Community Periodontal Index; half-mouth examination; full-mouth examination; Gingival Bleeding Index; Sulcus Bleeding Index; epidemiology

Objective To assess whether Community Periodontal Index (CPI) teeth and random half-mouth methods are representative of full-mouth method in gingival bleeding examination.

Methods Data from 1000 untreated adults (age > 18) collected in Beijing from January 2000 to January 2001 were utilized in the analysis. Half of the subjects were examined by Gingival Bleeding Index (GBI) and the other half by Sulcus Bleeding Index (SBI). The data were sorted out and calculated according to CPI teeth and random half-mouth teeth methods. The results of the 2 methods were separately compared with those of full-mouth examination.

Results There was a significant difference between CPI teeth method and full-mouth examination ($P < 0.05$) in both GBI and SBI. In contrast, compared with full-mouth examination, significant difference was not observed in diagonal or ipsilateral half-mouth results in SBI ($P > 0.05$), nor in diagonal half-mouth results in GBI ($P > 0.05$).

Conclusions The results of CPI teeth method on gingival bleeding could not reflect the full-mouth situation. Ipsilateral and diagonal half-mouth results can serve as a substitute for full-mouth results in SBI, while diagonal half-mouth results in GBI.

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PERIODONTAL disease and dental caries are 2 major dental diseases. In periodontal diseases, periodontitis is an infective one caused by plaque. Chronic periodontitis is the most common form of

destructive periodontal disease in adults in China.¹ Clinical parameters, including bleeding on probing, are employed to characterize the severity and prevalence of chronic periodontitis. In longitudinal observation, the long-term no-bleeding gums can be a predictor of stable condition of periodontal disease, indicating that the examination of bleeding gums is important for periodontal maintenance.² Most survey methods use full-mouth assessment of

periodontal diseases, which involves the examination of 6 sites on all teeth. Data from full-mouth examination are the gold standard for accurate assessment of periodontal disease. However, because of the restraints in time, logistic, and cost of full-mouth assessment, this clinical assessment of periodontal diseases is impractical in epidemiological surveys involving large population samples.³

Community Periodontal Index (CPI) is easy to operate and has good repeatability. It is stored in the World Health Organization (WHO) Global Oral Health Data Bank and is recommended by WHO.⁴ In addition, since periodontal destruction exhibits left-right symmetry,⁵ it is hypothesized that a half-mouth examination provides an appropriate alternative to whole-mouth assessment, with considerable advantage over a more limited partial-mouth assessment of index teeth. Therefore, the present study compared CPI teeth method and random half-mouth method with full-mouth examination in assessing gingival bleeding, to identify an examination which not only can represent but also is suitable for epidemiological investigations of periodontal disease.

SUBJECTS AND METHODS

Subject selection

By random sampling method, 1000 adults aged 18-60 were selected in Haidian District, Beijing from January 2000 to January 2001. And they were randomly divided into Gingival Bleeding Index (GBI) group ($n=500$) and Sulcus Bleeding Index (SBI) group ($n=500$) with random number table.

Inclusion criteria: 1. above 18 years; 2. having at least 16 teeth viable for the periodontal examination, among which 4 must be molars. Exclusion criteria: 1. with chronic systemic diseases or the need of long-term medication due to systemic conditions, and requiring prophylactic use of antibiotics and other drugs before the periodontal examination; 2. suffering acute necrotizing gums, apical or periodontal abscess, or extreme teeth loss; 3. with orthodontic devices. Each subject signed an informed consent to participate in this study.

Examination methods

The subjects were examined by a dentist with 12 years of clinical experience and qualified by the repetitive calibration inspection (KAPPA value is 0.82), using a plane mouth mirror and CPI probe (Hu-friedy, Chicago, IL, USA). All the subjects' teeth were examined one by one (except the third molars). Each tooth was examined at 6 sites: mesial, central, and distal sites for both buccal and lingual sides.

Residual crown and root, dentures, filling body at dental neck, overcrowding teeth, and other teeth that can not be examined were recorded as 8, and the missing teeth as 9, which were all not used for the numerical calculation.

GBI ranges from 0-3: 0, no bleeding; 1, bleeding after 30 seconds on probing; 2, bleeding immediately on probing; 3, spontaneous bleeding before probing. SBI ranges from 0-5: 0, gingiva of normal texture and color, no bleeding; 1, no bleeding on probing, change in color; 2, bleeding on probing, change in color, no edema; 3, bleeding on probing, change in color, slight edema; 4, bleeding on probing, change in color, obvious edema; 5, bleeding on probing and spontaneous bleeding, change in color, marked edema.

Data consolidation

According to the following methods, the data of the full-mouth teeth examination were consolidated in different ways.

CPI teeth method: Calculate the data of all sites for the first central incisors at the upper right and lower left, and the first and second molars at the 4 quadrants (11, 16, 17, 26, 27, 31, 36, 37, 46, 47).

Random half-mouth method: Calculate the data of all sites by any combination of the half-mouth teeth at the upper, lower, left, and right quadrants. There are altogether 6 combinations, namely 1+3 section (the upper right and the lower left quadrants), 2+4 section (the upper left and the lower right quadrants), 1+4 section, 2+3 section, 1+2 section, and 3+4 section.

Statistical analysis

Microsoft Excel 2007 was used for statistical analysis, and the data obtained from the 2 different methods were compared with the full-mouth's data using *t*-test, and the α level was 0.05. $P<0.05$ was considered statistically significant.

RESULTS

Demographic features of included subjects

GBI group included 123 males and 377 females, the mean age being 28.87 ± 6.89 years. SBI group included 115 males and 385 females, aged at 30.29 ± 5.74 years.

Comparison of CPI teeth method and full-mouth examination

In both GBI and SBI groups, the differences between the data by CPI teeth and those by full-mouth examination were statistically significant (both $P<0.05$, Table 1).

Table 1. Comparison of the GBI and SBI by CPI teeth method and full-mouth examination[§]

Group	Full-mouth examination	CPI teeth method
GBI (<i>n</i> =500)	0.38±0.45	0.32±0.60*
SBI (<i>n</i> =500)	1.70±1.18	1.88±1.27*

§: Plus-minus values are means±SD.

GBI: Gingival Bleeding Index; SBI: Sulcus Bleeding Index; CPI: Community Periodontal Index.

**P*<0.05 compared with full-mouth examination.

Comparison of random half-mouth method and full-mouth examination

In GBI group, the data of 1+3 section and 2+4 section by random half-mouth method were not significantly different from those by full-mouth examination (*P*>0.05). While

compared with the full-mouth examination, the data of the combinations of the ipsilateral upper and lower quadrants (i.e. 1+4 section and 2+3 section), the upper right and left quadrants (1+2 section), and the lower right and left quadrants (3+4 section) were significantly different (*P*<0.05).

In SBI group, whether it was a diagonal or an ipsilateral combination of the upper and lower quadrants of the mouth, the data calculated by random half-mouth method were similar with those by full-mouth examination (*P*>0.05). While for the upper half-mouth or the lower half-mouth, there were significant differences between the data by random half-mouth method and those by full-mouth examination (*P*<0.05, Table 2).

Table 2. Comparison of the GBI and SBI by random half-mouth method and full-mouth examination[§]

Group	Full-mouth examination	Half-mouth method					
		1+3 section	2+4 section	1+4 section	2+3 section	1+2 section	3+4 section
GBI (<i>n</i> =500)	0.38±0.45	0.36±0.53	0.38±0.45	0.34±0.71*	0.39±0.44*	0.29±0.56*	0.46±0.72*
SBI (<i>n</i> =500)	1.70±1.18	1.70±1.18	1.71±1.18	1.72±1.19	1.68±1.17	1.52±1.06*	1.88±1.26*

§: Plus-minus values are means±SD.

1: the upper right quadrant; 2: the upper left quadrant; 3: the lower left quadrant; 4: the lower right quadrant.

**P*<0.05 compared with full-mouth examination.

DISCUSSION

Periodontal disease is a common oral disease that brings serious impact on oral health among the general population. According to China's third oral epidemiological survey, the incidence of gingival bleeding was 57.7% among 12-year-old adolescents, 77.4% in 35-44 age group, and only 13.6% in 65-74 age group, with no pockets or severe periodontal attachment loss.⁶

The survey of periodontal conditions in the oral is an important means to assess the oral health status and monitor efficacy of a given treatment, by the detection of periodontal clinical parameters, which can be used to evaluate the severity and prevalence of periodontal diseases. There are many indexes to assess periodontal disease, including bleeding on probing, pocket depth, and attachment loss. However, periodontal disease often causes multiple aspects of destruction to the gums, alveolar bone, and periodontal membrane, the clinical manifestations are thus complex. Currently there is no index that can provide a comprehensive quantitative evaluation of the change by all the damages. Most periodontal disease indexes were chosen by researchers for different purposes, making a partial assessment of the periodontal tissue changes. Among those indexes, the

examination of bleeding gums is important for periodontal maintenance, the results of which can help clinicians to develop treatment decisions.²

In clinical investigations of periodontal disease, full-mouth examination is the best method for accurate assessment of periodontal status, but it entails a large amount of work, requiring examination of 6 sites of each tooth (168 sites in the full mouth, excluding the third molars), which is time-consuming, laborious, and expensive, thus not suitable for large-scale epidemiological investigations. Therefore, the programs to examine part of teeth are proposed,⁵ such as community periodontal index teeth of need, CPI, and simplified oral hygiene index. Among them, CPI is simple, rapid, reproducible, and suitable for large-scale epidemiological survey of oral diseases.⁷ However, it has been suggested that CPI estimation of the periodontal status was not accurate. Vettore et al⁸ applied both CPI and full-mouth examination to examine the periodontal pocket depth and the degree of periodontal attachment loss, finding that compared with the full-mouth examination, CPI underestimates the incidence, while overestimates the severity of the disease, reaching results significantly different from those by full-mouth examination. A study suggested that CPI teeth could be an appropriate source of samples for the subgingival detection. CPI teeth were showed to be repre-

sentative of *Actinobacillus actinomycetemcomitans* subgingival colonization.⁹ Moreover, blood test values tended to be correlated with CPI scores as well.¹⁰

A recent study in China compared CPI teeth method and full-mouth examination in examining the periodontal status among the same population, noticing that the results of dental calculus detected by the 2 methods were consistent, while the results of bleeding gums and periodontal pocket detections showed significant differences.¹¹ In this study, GBI and SBI were employed to examine and record the status of the full-mouth bleeding gums. The mean value of SBI by CPI teeth method was higher than that by full-mouth examination ($P<0.05$), while the mean value of GBI by CPI teeth method was lower ($P<0.05$), similar to the results of a previous report.¹²

SBI examination is characterized by its subtle classification of bleeding, while CPI index include 8 molars, which are the most serious bleeding sites in the full-mouth teeth, thus overestimating the severity of the disease. The lower GBI by CPI teeth method may be because 3 sites of each tooth are examined. The results of both indexes indicate that CPI can not represent bleeding gums status of the full-mouth. In recent years, some studies have shown that periodontal diseases are site-specific,^{3,13} that periodontal destruction does not affect all the teeth in the mouth at the same time, but may occur in a few teeth at one time, and in some other sites at another time. When periodontal disease exists in non-index teeth, using a simple index teeth method may lead to inaccurate estimation of the disease status.

Over the years, periodontal epidemiologists had proposed new programs for periodontal epidemiological investigation. Löe et al¹⁴ only examined the mesial and central sites of the buccal sides among tea workers in Sri Lanka. Mills et al¹⁵ compared 8 kinds of simplified index with the full-mouth index, finding no significant difference and good correlation. Silness et al¹⁶ believed that Ramfjord index had a strong correlation with the full-mouth index in recording plaque, gingivitis, and other periodontal indicators. However, due to the site-specificity of periodontal diseases, a part of the teeth does not fully reflect the status of full-mouth teeth, and there is still no consensus about which specific teeth could replace the CPI teeth.

Because there is right and left symmetry in periodontal damage,⁵ half-mouth teeth method has been used to replace full-mouth examination.¹⁷ Bentley et al¹⁸ found that the record of plaque and gingivitis index values by half-mouth method were close to those by full-mouth examination. Some scholars also advocated the use of random diagonal half-mouth program to examine the

full-mouth periodontal status in periodontal epidemiology inspection in adults.¹⁹ Dowsett et al⁵ and Owens et al²⁰ suggested that half-mouth index was better than Ramfjord index in evaluating the extent and prevalence of periodontal disease, and Plaque Index, Gingival Index, Probing Depth, and Attachment Level in half-mouth examination had a good consistency with the full-mouth examination. In the present study, for the diagonal and ipsilateral combinations of the upper and lower quadrants (1+3 section, 2+4 section, 1+4 section, and 2+3 section), SBI by random half-mouth teeth method was similar to those by full-mouth examination ($P>0.05$); while in GBI, the similarity between half-mouth and full-mouth examinations was observed in the diagonal combinations ($P>0.05$). These results were consistent with a previous report.¹²

In conclusion, although full-mouth examination is accurate and comprehensive, and has obvious advantages over simplified index, it is not suitable for large-scale epidemiological survey of oral diseases. Despite the recommendation of WHO, the application of CPI as a substitute for full-mouth examination was not supported by the results of the present study. We suggest that different index teeth be selected depending on the purpose of survey so as to not only assesses both the incidence and severity of the disease correctly, but also improve the sensitivity and reduce the bias. Further studies are still needed to provide strong evidence to choose the teeth with the best features in large-scale epidemiological surveys.

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