Comparison of Partial Recording Protocols in Disease Assessment among Periodontitis Patients in a Central Indian Population

Pradeep S. Anand [1], Kavitha P. Kamath [2], Neevan D R D'Souza [3]

[1] MDS. Assistant Professor, Department of Periodontics, People's College of Dental Sciences & Research Centre, Bhopal, Madhya Pradesh State, India.
[2] MDS. Senior Lecturer, Department of Oral Pathology, People's Dental Academy, Bhopal, Madhya Pradesh State, India.
[3] M. Sc. Lecturer, Department of Community Medicine, Yenepoya Medical College, Nithyanand Nagar, Deralakatte, Mangalore, Karnataka State, India.

Correspondence:
Department of Periodontics,
People's College of Dental Sciences & Research Centre,
Bhopal, Madhya Pradesh State, India.
PIN Code: 462037
E-mail: deepusanand@yahoo.co.in

Abstract

Objectives: Partial recording protocols may be used for the purpose of assessing periodontal disease extent and severity in epidemiological studies. As there is very little data at present regarding the reliability of any partial examination methods among Indian populations, as an initial study, an attempt was made to determine the reliability of 9 different protocols in estimating the extent and severity of periodontal disease among periodontitis patients in a central Indian population.
Study Design: Probing depths (PD) and clinical attachment levels (CAL) were recorded in 85 periodontitis patients on 6 sites on all the teeth excluding the third molars. Nine partial recording protocols (PRP) were compared with the full-mouth examination. Intra-class correlation coefficients (ICC) were calculated for mean PD, mean CAL, and percentage of sites with various thresholds of PD and CAL to determine the agreement between the PRP and the full-mouth examination. The sensitivity of different PRP for defining prevalence of sites with PD ≥ 6 and ≥ 7 mm and CAL ≥ 7 and ≥ 8 mm was also determined.
Results: For all the tested PRP, the ICCs were consistently >0.9. The methods involving examination of 4 sites/tooth slightly over-estimated the disease extent and severity in comparison with the full-mouth examination as well as PRP involving examination of 6 sites/tooth.
Conclusions: The findings of the present study suggest that the tested PRP are in good agreement with the full-mouth examination. However, further studies need to be conducted with an improved methodology in a larger sample of subjects from the general population.

Key Words: Diagnosis; periodontal pockets; periodontal index; epidemiology.

Introduction

Information regarding the severity and prevalence of periodontal diseases is usually obtained by recording pocket depth and clinical attachment level measurements. Full-mouth examination of 6 sites per tooth is generally considered to be the ideal method of recording these variables (1). However, when employed for epidemiological studies, this method is disadvantageous in that it is time consuming and fatiguing to both the patient and the examiner. Hence, for the purpose of epidemiological studies, investigators may have to rely on different indices or partial recording protocols (PRP) which involve examinations of subsets of teeth rather than the entire dentition. Various PRP can be generated by reducing the number of quadrants, teeth or site to be examined. Thus, different partial recording methods such as full-mouth examination of 3 or 4 sites per tooth (2, 3), half-mouth examination of 2 or 3 sites per tooth (4, 5), and examination of index teeth as in Ramfjord index (6), Community Periodontal Index of Treatment Needs (CPITN) (7), and Community Periodontal Index (CPI) (8) have been employed in different epidemiologic studies. These protocols are utilized based on the assumption that these will help minimize the time required for examination without significantly altering the results. However, as the pattern of periodontal disease is different in different populations, partial examination methods which are reliable in certain populations may not be reliable in other populations. Hence, the PRP intended to be used in any population need to be tested for their validity in that population before they can be used for epidemiological purposes. Several PRP and indices have been tested with varying results for their reliability in different populations. The tested methods include half-mouth examination of 6 sites per tooth (9-13), full-mouth or half-mouth examination of 1, 2 and 3 sites per tooth (9, 10, 12, 14, 15), and CPITN (15-18) and Ramfjord (18, 19) indices. These studies differed in their methodology regarding data collection as well as the study variables. Some of these studies were done in a retrospective manner utilizing data collected from subjects examined for other study purposes (11) or from records of patients who had reported for periodontal treatment (19) while in other studies, the subjects were recruited from the general population (12). The study variables compared in different studies were also varied and include comparison of mean values of pocket depth and clinical attachment level, prevalence estimates of attachment loss, and percentage of sites with different ranges of diseases. Studies testing the applicability of half-mouth examination of 6 sites per tooth in various populations have shown that it is an acceptable method for periodontal examination in epidemiological studies. At present, there is very little data regarding the reliability of any partial examination methods among Indian populations. Hence, as an initial study, an attempt was made to determine the reliability of 9 different PRP in estimating the extent and severity of periodontal disease among periodontitis patients in a central Indian population.

Materials and Methods

The study was conducted in the Department of Periodontics, People's College of Dental Sciences & Research Centre, Bhopal, India. Eighty-five patients above the age of 18 years with varying severities of periodontal disease who had reported for periodontal treatment at the Department were examined for the purpose of the study. Patients were considered to have periodontal disease if they had proximal attachment loss of ≥3mm on at least 2 non-adjacent teeth (20). Prior to the study, the sample size was calculated as 84 by power analysis with power of 85% for a 68% prevalence of periodontitis in central Indian populations. The study protocol was approved by the Institutional Human Ethics Committee and written informed consent was obtained from the prospective study participants.

The variables recorded include probing depth (PD) and recession (REC) on all the teeth excluding the third molars. PD was defined as the distance from the gingival margin to the bottom of the pocket/sulcus. REC was defined as the distance of the gingival margin to the cemeto-enamel junction (CEJ) and the values were recorded as positive entries when the margins were located apical to the CEJ and as negative entries when the margins were located coronal to the CEJ. The recordings were done on 6 sites per tooth: mesio-buccal (MB), mid-buccal (B), disto-buccal (DB), disto-lingual (DL), mid-lingual (L), and mesio-lingual (ML). All the recordings were done using a UNC-15 (Hu-Friedy Manufacturing Co., Chicago, IL.) probe by a single examiner. From the recordings of PD and REC, clinical attachment level (CAL) at each site was calculated as the sum of PD and REC values at that site. Data thus recorded by full-mouth examination was used as the reference against which the nine PRP were tested.

Nine PRP were assessed in this study. These include four methods in which six sites were considered and five methods in which four sites were considered (MB, DB, DL, ML). Thus, the nine PRP tested in this study were: 1) six sites per tooth on all teeth examined in upper right and lower left quadrants (UR/LL6); 2) six sites per tooth on all teeth examined in upper left and lower right quadrants (UL/LR6); 3) six sites per tooth on all teeth examined in upper and lower right quadrants (UR/LR6); 4) six sites per tooth on all teeth examined in upper and lower left quadrants (UL/LL6); 5) four sites per tooth on all teeth examined (FM4); 6) four sites per tooth on all teeth examined in upper right and lower left quadrants (UR/LL4); 7) four sites per tooth on all teeth examined in upper left and lower right quadrants (UL/LR4);

Parameter	Mean (SD)	Range
PD		
Mean	3.33 (0.85)	1.83-5.53
% sites ≥4 mm	35.09 (21.28)	0.00-86.4
% sites ≥5 mm	24.54 (19.06)	0.00-80.4
% sites ≥6 mm	10.93 (12.49)	0.00-51.8
% sites ≥7 mm	5.65 (7.84)	0.00-34.5
CAL		
Mean	4.06 (0.94)	2.33-6.73
% sites ≥3 mm	75.46 (14.95)	35.1-99.2
% sites ≥4 mm	51.57 (20.34)	5.4-93.3
% sites ≥5 mm	36.67 (20.13)	2.4-88.1
% sites ≥6 mm	21.47 (16.75)	0.00-68.0
% sites ≥7 mm	11.74 (11.51)	0.00-50.0
% sites ≥8 mm	5.53 (6.45)	0.00-30.8

PD= Probing Depth; CAL= Clinical Attachment Level

Table 1- Data from the sample population by full-mouth examination

8) four sites per tooth on all teeth examined in upper and lower right quadrants (UR/LR4); 9) four sites per tooth on all teeth examined in upper and lower left quadrants (UL/LL4).

Statistical analysis of the study data was performed using a software program (SPSS Software Version 15, SPSS Inc., Chicago, IL.). Intra-class correlation coefficients (ICC) were calculated for mean PD; mean CAL; percentage of sites with PD ≥4, ≥5, ≥6, and ≥7 mm; and percentage of sites with CAL ≥3, ≥4, ≥5, ≥6, ≥7, and ≥8 mm to determine the agreement between the PRP and the full-mouth examination. For the mean percentage of sites with specific thresholds of diseases, over-estimation or under-estimation of different PRP compared to full-mouth assessment was determined and expressed as a percentage as follows:

Percentage over-estimation/under-estimation = $(P_{PRP} - P_F)/ P_F \times 100$

P_{PRP} = mean percentage of sites of specific disease threshold as determined by the various PRP

P_F = mean percentage of sites of specific disease threshold as determined by the full-mouth examination

The prevalence of sites with PD ≥6 and ≥7 mm and CAL ≥7 and ≥8 mm was determined by all the methods and the sensitivity of different PRP for defining prevalence was calculated as a ratio of the prevalence as determined by the PRP to the prevalence as determined by the full-mouth assessment.

Results

Of the 85 patients examined for the study, 37 were males and 48 were females. The mean age of the study population was 35.7 years (SD 9.1 years), and the age range was 19-62 years.

The clinical data obtained from full-mouth examination is shown in Table 1. Mean PD and CAL obtained by various PRP and the corresponding ICCs are shown in Table 2. The ICCs as a measure of intra examiner reproducibility for mean PD and CAL for all the tested PRP was greater than 0.97. In regard to mean PD and CAL, the methods involving examination of 4 sites per tooth slightly overestimated disease severities compared to other methods. Figure 1 shows the mean percentage of sites above specific thresholds of PD (A) and CAL (B) by all methods of assessment. It was found that methods involving 4 sites per tooth generally resulted in a greater mean percentage of sites with specific thresholds of disease while half-mouth examination of 6 sites per tooth showed closest estimate to the full-mouth examination. The ICCs for different methods are shown in Table 3.

For the mean percentage of sites with specific thresholds of diseases, over-estimation or under-estimation of different PRP compared to full-mouth assessment was determined (Figure 2). It was found that there was a slight over-estimation or under-estimation by PRP involving examination of 6 sites per tooth while PRP involving 4 sites per tooth consistently over-estimated the percentage of sites with various thresholds of disease.
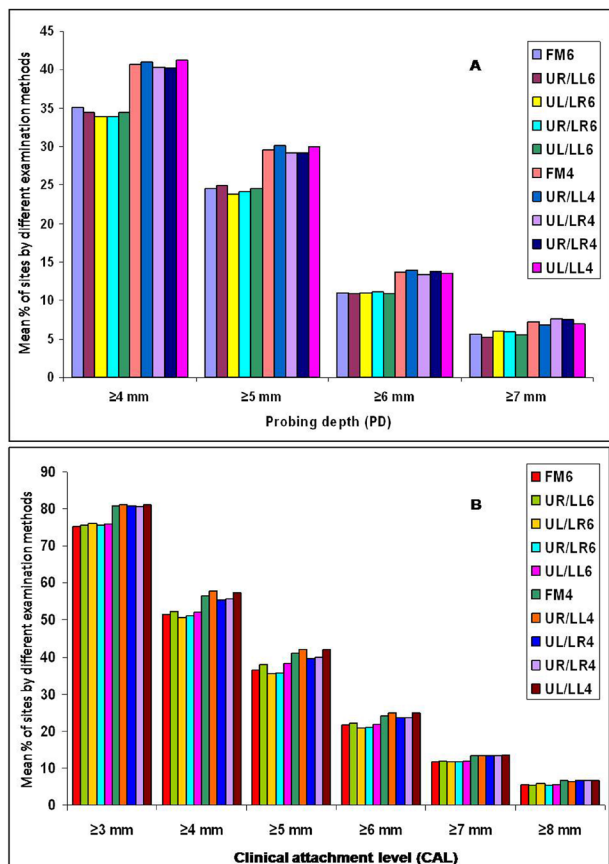
Fig. 1. *Mean percentage of sites above a specific threshold of PD (A) and CAL (B) by different methods of assessment*
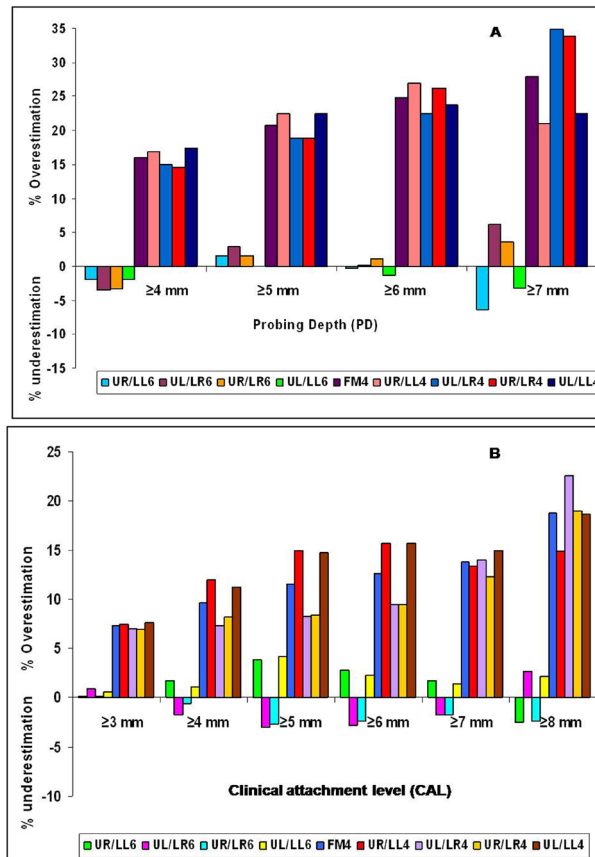

Fig. 2. *Over-estimation and under-estimation of different PRP for the mean percentage of sites above a specific threshold of PD (A) and CAL (B)*

Examination method	Mean PD	Mean CAL
Full-mouth	3.33	4.06
UR/LL6	3.33 (0.99)	4.09 (0.99)
UL/LR6	3.33 (0.99)	4.03 (0.99)
UR/LR6	3.31 (0.99)	4.02 (0.98)
UL/LL6	3.35 (0.99)	4.10 (0.98)
FM4	3.61 (0.99)	4.29 (0.99)
UR/LL4	3.62 (0.99)	4.32 (0.98)
UL/LR4	3.61 (0.99)	4.26 (0.98)
UR/LR4	3.60 (0.98)	4.25 (0.97)
UL/LL4	3.63 (0.98)	4.34 (0.98)

UR/LL6= upper right and lower left quadrants, six sites per tooth; UL/LR6= upper left and lower right quadrants, six sites per tooth; UR/LR6= upper and lower right quadrants, six sites per tooth; UL/LL6= upper and lower left quadrants, six sites per tooth; FM4= full-mouth, four sites per tooth; UR/LL4= upper right and lower left quadrants, four sites per tooth; UL/LR4= upper left and lower right quadrants, four sites per tooth; UR/LR4= upper and lower right quadrants, four sites per tooth; UL/LL4= upper and lower left quadrants, four sites per tooth.

Table 2. *Mean Probing Depth (PD) and Clinical Attachment Level (CAL) and the corresponding ICCs by different examination methods*

Sensitivities of PRP of disease prevalence are shown in Table 4. At lower disease thresholds, there was no difference in disease prevalence as determined by the full-mouth assessment and as determined by the PRP. But the sensitivities decreased when higher disease thresholds were considered but they were still >0.75.

Discussion

Although partial assessment methods have been used to estimate the levels of periodontal disease, reliability of information generated from such methods depends on the validity of the method employed in the particular population. At present, there is very little data regarding the reliability of any partial assessment method for the diagnosis of periodontal disease among an Indian population. Hence, as an initial study, we attempted to test the reliability of 9 different PRP in the estimation of periodontal disease among periodontitis patients in a central Indian population. The PRP tested include methods which involved examination of 4 and 6 sites per tooth.

In the present study several parameters associated with periodontal disease extent and severity were used to compare the agreement between the tested PRP and full-mouth examination. The ICCs, which were used as a measure of agreement, showed that all methods had

Examination method	PD (in mm)				CAL (in mm)					
	≥4	≥5	≥6	≥7	≥3	≥4	≥5	≥6	≥7	≥8
UR/LL6	0.95	0.97	0.99	0.98	0.98	0.99	0.99	0.99	0.98	0.97
UL/LR6	0.95	0.97	0.99	0.98	0.97	0.99	0.99	0.99	0.98	0.97
UR/LR6	0.94	0.97	0.98	0.98	0.96	0.97	0.98	0.98	0.97	0.95
UL/LL6	0.95	0.96	0.98	0.98	0.97	0.98	0.97	0.98	0.97	0.96
FM4	0.95	0.97	0.99	0.98	0.98	0.99	0.99	0.99	0.99	0.99
UR/LL4	0.94	0.96	0.97	0.97	0.96	0.98	0.98	0.98	0.98	0.96
UL/LR4	0.94	0.96	0.98	0.97	0.97	0.98	0.98	0.98	0.97	0.95
UR/LR4	0.93	0.96	0.97	0.95	0.95	0.97	0.97	0.96	0.95	0.94
UL/LL4	0.94	0.95	0.97	0.96	0.95	0.97	0.97	0.97	0.97	0.95

UR/LL6= upper right and lower left quadrants, six sites per tooth; UL/LR6= upper left and lower right quadrants, six sites per tooth; UR/LR6= upper and lower right quadrants, six sites per tooth; UL/LL6= upper and lower left quadrants, six sites per tooth; FM4= full-mouth, four sites per tooth; UR/LL4= upper right and lower left quadrants, four sites per tooth; UL/LR4= upper left and lower right quadrants, four sites per tooth; UR/LR4= upper and lower right quadrants, four sites per tooth; UL/LL4= upper and lower left quadrants, four sites per tooth.

Table 3. *ICCs for mean percentage of sites with different specific thresholds of Probing Depth (PD) and Clinical Attachment Level (CAL) by various partial recording protocols*

Examination method	PD		CAL	
	≥6 mm	≥7 mm	≥7 mm	≥8 mm
UR/LL6	0.94	0.89	0.95	0.81
UL/LR6	0.94	0.92	0.96	0.9
UR/LR6	0.92	0.78*	0.92	0.81
UL/LL6	0.94	0.91	0.94	0.81
FM4	1	1	0.96	0.98
UR/LL4	0.94	0.88	0.92	0.81
UL/LR4	0.94	0.91	0.9	0.87
UR/LR4	0.92	0.83	0.88	0.78*
UL/LL4	0.95	0.89	0.89	0.81

*- <0.8

PD= Probing Depth; CAL= Clinical Attachment Level

UR/LL6= upper right and lower left quadrants, six sites per tooth; UL/LR6= upper left and lower right quadrants, six sites per tooth; UR/LR6= upper and lower right quadrants, six sites per tooth; UL/LL6= upper and lower left quadrants, six sites per tooth; FM4= full-mouth, four sites per tooth; UR/LL4= upper right and lower left quadrants, four sites per tooth; UL/LR4= upper left and lower right quadrants, four sites per tooth; UR/LR4= upper and lower right quadrants, four sites per tooth; UL/LL4= upper and lower left quadrants, four sites per tooth.

Table 4. *Sensitivity of partial recording protocols compared to full-mouth examination*

good correlation with the full-mouth examination.
In regard to half-mouth examination of 6 sites per tooth, the mean PD and CAL, as determined by the four PRP were in good agreement with the full-mouth examination. Among the 4 methods, 2 methods (UL/LR6 and UR/LR6) slightly over-estimated percentage of sites with higher thresholds of PD, particularly sites with PD ≥7 mm, while the other 2 methods (UR/LL6 and UL/LL6) slightly under-estimated these variables. However,

this trend was reversed when percentage of sites with different thresholds of CAL was considered. The variation between these 4 PRP and the full-mouth examination for the percentage of sites with different thresholds of CAL was <5%. Sensitivities of half-mouth examination of 6 sites per tooth for disease prevalence were >0.8 except when the prevalence of sites with PD ≥7 mm was considered by the method involving teeth on the right side quadrants where the sensitivity was 0.78.

Since examination of 6 sites per tooth (4 proximal and 2 mid-sites) is considered to the "gold standard" in periodontal disease assessment, PRP involving half-mouth assessment of 6 sites per tooth were considered for the present study (1, 10). Half-mouth examination, when compared to full-mouth examination, will save considerable amount of time, which will be helpful in examining more number of subjects (10). The findings in the present study suggest that half-mouth examination of 6 sites per tooth can be a good alternative to full-mouth examination for epidemiological purposes in the studied population. Numerous studies have tested the reliability of half-mouth examination of 6 sites per tooth in different populations (10-12, 15). Generally, all these studies have also reported good agreement between full-mouth examination and half-mouth examination of 6 sites per tooth in one maxillary and one mandibular quadrant.

Besides reducing the number of quadrants, a reduction in the number of sites to be examined will further decrease the examination time (10). Hence, in the present study five different PRP were also tested in which 4 sites per tooth were considered.

When the mean PD and CAL were considered, it was observed that the methods involving examination of 4 sites per tooth slightly over-estimated the disease severity in comparison with the full-mouth examination as well as PRP involving examination of 6 sites per tooth. A similar trend was observed when percentage of sites with various thresholds of disease by different methods was compared. This may be explained by the fact that greater periodontal destruction usually occurs on the proximal aspects of the teeth, the sites which were considered in the methods involving examination of 4 sites per tooth. But this can be confirmed only if the pattern of destruction at various sites on the teeth in the study population is determined. However, this pattern of destruction was not assessed in the present study. In a study in a population in United States, the investigators had assessed the periodontal destruction occurring at various sites on the teeth (10). It was reported that the proximal sites generally contributed more to PD and CAL measures than mid-sites, particularly in the anterior teeth. However, depending on the pattern of disease in different populations, the pattern of destruction on individual sites and individual teeth may vary from one population to another. At present, a study is in progress to determine the pattern of periodontal destruction among periodontitis patients in the central Indian population. Sensitivities of methods involving examination of 4 sites per tooth for disease prevalence were >0.8 except when the prevalence of sites with CAL ≥ 8 mm was considered by the method involving teeth on the right side quadrants where the sensitivity was 0.78.

Several studies have assessed the reliability of partial examination methods in which less than 6 sites per tooth are examined. Majority of these studies have tested methods involving full-mouth or half-mouth examination of 2 or 3 sites per tooth (9, 10, 12, 15). The results of studies examining these methods have been varied. It has been reported that methods involving examination of 2 sites per tooth are generally not reliable for assessing disease severities and prevalence (10). Results for methods involving examination of 3 sites per tooth were varied depending upon the sites considered (9, 12, 15). To the best of our knowledge, this is perhaps the first study in which methods involving examination of four proximal surfaces of the teeth was considered. Although the measurement of a subset of sites may result in underestimation of prevalence of disease, the degree of underestimation is not directly proportional to the number of sites measured (1). This is because some sites (proximal) are more likely to exhibit pocketing than others (mid-sites) (1). Although the site-specific pattern of periodontal disease was not determined among subjects in the present study, studies in other populations have suggested that greater attachment loss occurs on the proximal aspects of the teeth (21). As other investigators have suggested that an alternative approach of partial examination is to limit examination to sites exhibiting most periodontal destruction (10), methods involving the 4 proximal sites were considered for the present study.

Although the findings of the present study suggest that the tested PRP are in good agreement with the full-mouth examination, the methods involving examination of 4 sites per tooth generally over-estimated the disease extent and severity. Moreover, the fact that the present study was conducted among periodontitis patients, who have a higher disease experience than the general population, may have influenced the study results. As the reliability of the partial assessment methods may depend on the disease prevalence of the sample population, the methods tested in the present study need to be further evaluated in a sample of general population where the disease prevalence may be lower. Another limitation of the study is that, although all participants were examined by single examiner, examiner calibration and intra-examiner variability assessment was not a part of the study methodology. Hence, further studies need to be conducted with an improved methodology in a larger sample of subjects from the general population and future studies are being planned in this regard.

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