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Accuracy of probing attachment levels using a CEJ Probe versus traditional probes

K. Karpinia[1], I. Magnusson[1], C. Gibbs[1] and M. C. K. Yang[2]

[1]Periodontal Disease Research Center and [2]Department of Statistics, University of Florida, Gainesville, FL, USA

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Abstract

Background: Current interest in the assessment of probing attachment level measurements has been stimulated by recent introduction of novel periodontal probes as well as by the reclassification of periodontal diseases. Clinical attachment level (CAL) is currently the ''gold standard'' for diagnosing and monitoring periodontal diseases.

Aim: To evaluate the performance of the newly introduced cementoenamel junction (CEJ) Probe in detecting CAL using the CEJ as a fixed reference point, and to compare the CEJ Probe with the Florida Disk Probe and a standard Manual Probe (North Carolina Probe).

Material and Methods: Three examiners probed 12 periodontal patients to determine intra- and inter-consistency of both the probes and the examiners, over a 4-week time interval. Subjects ranged in age from 22 to 74 years. The experimental design was structured to balance the intra- and inter-examiner consistency at the same site during the two visits.

Results: Using the PROC MIXED of SAS, a strong interaction ($p<0.001$) between the examiner and probes was found. The consistency of probing (repeatability of measurements) depended upon the type of periodontal probe used as well as the skill (experience) of the examiner. Overall, the CEJ Probe displayed a more consistent performance. The CEJ Probe demonstrated greater intra-examiner consistency than the Disk Probe for two examiners ($p<0.01$). The CEJ Probe also showed increased inter-examiner consistency ($p<0.01$).

Conclusions: The CEJ Probe has the potential to offer the dental team an efficient, accurate mechanism to chart and monitor attachment level measurements over time. Additional studies, using large numbers of examiners, are needed to assess more clearly the performance of each individual probe.

Key words: attachment level; clinical trial; periodontal diagnosis; periodontal diseases; periodontal probes

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Recently, a modification of the Florida Probe was introduced to increase accuracy in detecting the cementoenamel junction (CEJ), and to improve consistency when recording periodontal attachment levels (Preshaw et al. 1999, Karpinia et al. 2002). Collectively, traditional clinical periodontal diagnostic procedures (inflammation, bleeding upon probing (BOP), probing depths, attachment levels) provide useful information related to periodontal status (Goodson et al. 1982, Grbic & Lamster 1992, Haffajee et al. 1983). Disease evaluation, performed at one point in time, cannot reliably identify sites with ongoing periodontal destruction. The ''gold standard'' for measuring change in periodontal status remains longitudinal measurement of clinical attachment level (CAL) from the CEJ, or relative attachment level from a fixed reference point (Clark et al. 1992, American Academy Periodontology 1996).

A modification of the Florida Probe was developed to increase accuracy in detecting the CEJ. The CEJ Probe was initially tested by Preshaw et al. (1999). His results indicated that the CEJ Probe had reproducibility and reliability in detecting the CEJ and measuring CAL in humans. The CEJ Probe has a modified sleeve, which includes a 0.125 mm prominent edge to facilitate a ''catch'' of the CEJ (Fig. 1). The width of this edge was considered small enough not to interfere with probing depth measurements, offering clinicians measurement of CAL and probing depth concurrently.

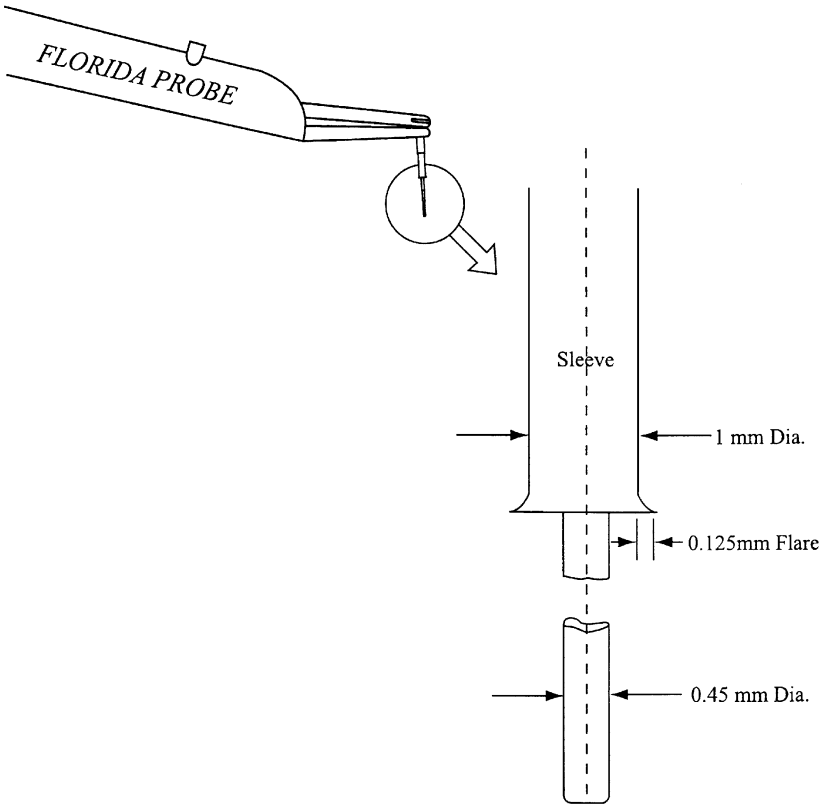

Fig 1. Diagram of the new cementoenamel junction (CEJ) Probe demonstrating a 0.125 mm flare on the lower portion of its sleeve.

The aim of the present study was to evaluate the performance of the newly introduced CEJ Probe in detecting CAL using the CEJ as a fixed reference point, and to compare the CEJ Probe with the Florida Disk Probe, as well as with a standard Manual Probe (North Carolina Probe).

Material and Methods

Twelve subjects diagnosed with chronic periodontitis and three healthy control subjects were included in the study. The experimental design attempted to examine intra- and inter-examiner probing consistency between the newly introduced CEJ Probe, the Florida Disk Probe and the North Carolina Probe, where consistency is measured by the difference in absolute value between the two visits at the same site. If sites are measured by the same examiner, it is called intra-examiner consistency, and if by two different examiners, it is called inter-examiner consistency. Two probing appointments were scheduled, with a 4-week healing time between visits. Three examiners, with variable clinical skills, recorded probing measurements using the new CEJ Probe, which measured attachment level and probing depth simultaneously, the Florida Disk Probe (Florida Probe Corporation, Gainsville, FL, USA) and/or the North Carolina Probe (Manual Probe). Each subject was probed two times at each appointment. Six measurements per tooth were recorded (mesiofacial, midfacial, distofacial, distolingual, midlingual and mesiolingual). The probing order was randomized. While the examiner may have varied, the same site during the same round, per visit, was always evaluated by the identical probe. Maxillary and mandibular arches may have been evaluated using different probes. Data analysis utilized the PROC MIXED of SAS.

Results

Intra-examiner comparisons

Table 1 shows the main output from PROC MIXED analysis comparing intra-examiner consistency. There was a strong examiner–probe interaction, that is, the consistency of a probe could not be determined by the probe alone. The skill of the examiner was an important additional contributor.

Tables 2 and 3 illustrate detailed comparison of probes and examiners. When comparing the CEJ Probe with the Disk and Manual Probe, the CEJ Probe performed better than the Disk Probe (Table 2). Apparently, the performance of the CEJ Probe is comparable to that of the Manual Probe. The CEJ Probe has the potential to perform more accurately for intra-examiner consistency (Table 3).

Inter-examiner comparisons

Tables 4–6 illustrate the outputs from PROC MIXED for inter-examiner consistency. There is a strong examiner–probe interaction. The CEJ Probe is most consistent as the examiner changed during visits (Table 4).

The inter-examiner results indicated a strong examiner–probe interaction. The

Table 1. SAS PROC MIXED outputs from intra-examiner consistency

Source	NDF	DDF	Type III *F*	Pr > *F*
examiner	2	1415	19.72	0.0001
probe	2	2761	10.52	0.0001
interaction	4	1052	9.35	0.0001

NDF = numerator degrees of freedom, DDF = denominator degrees of freedom.
Type III *F* = The *F*-test based on the source after all other sources have been considered (the most conservative test).

Table 2. Intra-examiner consistency by probe and examiner

Examiner/probe	CEJ	Disk	Manual
#l	0.683 (0.040)	0.971 (0.040)	0.614 (0.050)
#2	0.558 (0.039)	0.439 (0.050)	0.606 (0.052)
#3	0.568 (0.040)	0.760 (0.053)	0.514 (0.049)

The values in the parentheses are the standard error of the mean estimation.
CEJ = cementoenamel junction.

Table 3. Comparison of intra-examiner consistency using two probes

Probe	Examiner	Difference	*p*-value
CEJ versus disk	#1	− 0.289	0.0001
CEJ versus disk	#2	0.118	0.021
CEJ versus disk	#3	− 0.191	0.0003
CEJ versus manual	#1	0.068	0.200
CEJ versus manual	#2	− 0.048	0.350
CEJ versus manual	#3	0.054	0.289

Difference = mean CEJ error – other probe error.
Negative difference means CEJ had a small mean error.
CEJ = cementoenamel junction.

Table 4. SAS PROC MIXED outputs from inter-examiner consistency

Source	NDF	DDF	Type III *F*	Pr > *F*
examiner	2	1180	5.91	0.0028
probe	2	1831	14.80	0.0001
interaction	4	979	10.06	0.0001

NDF = numerator degrees of freedom, DDF = denominator degrees of freedom.
Type III *F* = The *F*-test based on the source after all other sources have been considered (the most conservative test).

Table 5. Mean inter-examiner consistency between probes and examiners

Examiner/probe	CEJ	Disk	Manual
#1–#2	0.593 (0.055)	0.824 (0.068)	0.686 (0.071)
#1–#3	0.815 (0.061)	0.692 (0.068)	0.813 (0.071)
#2–#3	0.583 (0.055)	0.942 (0.071)	1.020 (0.069)

The values in the parentheses are the standard error of the mean estimation
CEJ = cementoenamel junction.

Table 6. Comparison of inter-examiner using two probes

Probe	Examiner	Difference	*p*-value
CEJ versus disk	#1– #2	− 0.231	0.0004
CEJversus disk	#1– #3	0.123	0.0879
CEJ versus disk	#2– #3	− 0.340	0.0001
CEJ versus manual	#1– #2	− 0.092	0.1660
CEJ versus manual	#1– #3	0.002	0.9759
CEJ versus manual	#2– #3	− 0.438	0.0001

Difference = mean CEJ error – other probe error.
Negative difference means CEJ had a small mean error.
CEJ = cementoenamel junction.

CEJ Probe appeared to be the most consistent probe among examiners between visits (Table 5). The CEJ Probe had the best potential for consistency between examiners and visits. It had the potential to be better than the Disk Probe and the Manual Probe (Table 6).

Discussion

New technology and high-tech computers are becoming the rule rather than the exception during patient treatment. Computer applications and new devices are being developed and marketed to improve diagnosis, enhance therapy and monitor treatment outcomes. Additionally, computerization offers the entire dental team ideal potential to achieve examiner standardization, such that future comparison of health/disease becomes simpler, more precise and remains cost effective.

Traditional clinical periodontal diagnostic procedures (visual signs of inflammation, BOP, probing depths, attachment levels), considered collectively, have provided useful information related to periodontal pathology (American Academy of Periodontology 1996). Conversely, absence of the aforementioned clinical signs has been related to the presence of a stable, healthy periodontium. Disease evaluation, performed at one point in time, attempts to identify and quantify current clinical signs of inflammation as well as historical evidence of damage. It cannot reliably identify sites with ongoing periodontal destruction. Loss of clinical attachment, determined by physical assessment using a periodontal probe, measures damage resulting from past episodes of periodontal disease. Currently, the gold standard for recording changes in periodontal status is longitudinal measurement of CAL from the CEJ, or relative attachment level from a fixed reference point (Magnusson et al. 1988, Clark et al. 1992, American Academy of Periodontology 1996). The CEJ Probe has been developed to improve detection of the CEJ allowing assessment of accurate attachment level changes over time.

Measuring attachment levels is inherently difficult. The CEJ Probe was designed to provide an instrument that could be used both for recording of attachment level and pocket depth during longitudinal data measurements. Although no clinical studies have been performed to evaluate the consistency of probing pocket depth with the CEJ Probe, it is the investigators' clinical experience and opinion that the CEJ Probe performs as well as the original Florida Probe. Periodontal therapy, or lack thereof, is often based upon information regarding longitudinal attachment level data. Accurate, reliable measurement of attachment level is an important aspect of periodontal diagnosis and recommended treatment. If practitioners could more accurately determine where real change in attachment level has occurred, they may ultimately improve the diagnosis and treatment of periodontitis.

In this study, the CEJ Probe appeared to possess the greatest potential for consistency in attachment level and probing depth measurements within (intra-) and between (inter-) the three examiners. The difference in intra-examiner consistency between the CEJ Probe, Florida Probe and Manual Probe was small. Data demonstrated that the CEJ and Manual Probes were more consistent statistically. However, due to a large, unavoidable examiner–probe interaction, a clear-cut ranking of

individual probe performance was not possible from the limited information gained during this study. The results from the present study are consistent with those presented by Preshaw et al. (1999). Further evaluation, employing larger numbers of subjects and examiners, is indicated.

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Address:
K. Karpinia
Periodontal Disease Research Center
Department of Periodontology
University of Florida
P.O. Box 100434
Gainesville, FL 32610
USA
E-mail: kkarpinia@dental.ufl.edu