Is change in probing depth a reliable predictor of change in clinical attachment loss?

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Clinicians are challenged daily to monitor their patients' periodontal status reliably and efficiently. Periodontitis manifests as clinical attachment loss (CAL), which clinicians assess by using manual or automated probes. Whereas probing depth (PD) is measured from the gingival margin (GM), which can change across time, CAL relies on a fixed reference point, typically the cementoenamel junction (CEJ). CAL is not measured directly but rather is computed from two measures: PD and the distance from the CEJ to the GM. When the GM is coronal to the CEJ, CAL is equal to the PD minus the distance from the CEJ to the GM. When the GM is apical to the CEJ, CAL is equal to the PD plus the distance from the CEJ to the GM.

PD leads to underestimation of CAL when there is gingival recession. Conversely, PD leads to overestimation of CAL when the gingiva is enlarged because of, for example, inflammation or use of certain medications. CAL changes can occur with or without a concomitant change in PD, and vice versa. Pro-

ABSTRACT

Background. Clinicians and researchers need a measure for monitoring the periodontal condition of their patients or study participants. The authors explored the utility of change in probing depth (PD) for predicting change in clinical attachment loss (CAL).

Methods. The authors used clinical trial data from 363 participants who had received nonsurgical treatment to describe associations between PD and CAL changes. They computed the association between PD and CAL changes—correlation, sensitivity, specificity, and positive and negative predictive values—according to tooth type, tooth site and initial PD.

Results. Depending on the subset of tooth sites, sensitivity of PD change to predict CAL change ranged from 18 to 74 percent; the highest sensitivity was at initially deep sites. Specificity and negative predictive value were higher than sensitivity and positive predictive value. Correlations between person-level mean PD and CAL changes ranged from 0.60 to 0.79 and were highest at initially deep sites.

Conclusions. Except at initially deep sites, PD change did not reliably predict CAL change. Clinicians and researchers who measure only PD may fail to identify teeth that lose or gain attachment.

Clinical Implications. Clinicians should consider monitoring CAL to detect changes in periodontal status more reliably. It is unknown if these findings apply to patients treated surgically or to prediction of tooth loss.

Key Words. Periodontal disease; clinical trials; diagnosis.
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gressive CAL without PD deepening occurs when both the soft-tissue attachment and GM are displaced apically along the tooth surface as a result of traumatic oral hygiene habits, mechanical trauma associated with treatment, or inflammation. This scenario may be more likely when the supporting tissues (that is, the "biotype") are thin.

Full-mouth assessment of CAL is time consuming and technically demanding. For a patient with 28 teeth, more than 300 measurements are required to monitor CAL at six sites on each tooth. Thus, clinicians frequently use PD alone to identify teeth or tooth sites that have improved or deteriorated across time. This approach, however, is based on the assumption that changes in a patient's periodontal condition are detectable without direct measurement of CAL. Although clinicians also use radiographs to detect changes in periodontal support, they typically assess patients less frequently with radiographic than with clinical methods, and clinical changes typically precede radiographic ones.[1] Numerous investigators (as described by Pilgram and colleagues[2]) have examined associations between CAL and radiographic changes. Except in sites treated with guided tissue regeneration,[3] correlations between changes in CAL and bone height are low.[2,4,5]

The need to monitor change in disease status also has implications for research. In clinical trials, a primary outcome is selected to evaluate the effectiveness of a diagnostic, preventive or therapeutic intervention. The primary outcome or endpoint is the principal measure by which two or more treatments are compared. In 1994, the Task Force on Design and Analysis in Dental and Oral Research (now the Task Force on Design and Analysis in Oral Health Research) recommended that CAL or alveolar bone support be used as a primary outcome in nonsurgical interventional trials of periodontitis.[6] This group advocated using CAL as an a priori secondary outcome in trials in which bone loss was the primary outcome.

Historically, researchers have compared preventive or therapeutic regimens by using CAL as the primary outcome. More recently, however, investigators have reported PD but not CAL change in studies of locally delivered antimicrobial agents,[7] photodynamic therapy[8] and lasers.[9] Two professional products, locally delivered chlorhexidine and minocycline, received approval from the U.S. Food and Drug Administration as adjuncts to scaling and root planing for reduction of PD—not CAL—in patients with chronic periodontitis.[10,11] Although some might argue that PD change is the most practical and relevant outcome given that few practitioners monitor CAL, the distinction between a treatment's respective effects on CAL and PD may be blurred in marketing efforts and in the practitioner's perception of its effectiveness. Thus, the need to assess whether PD change is a good surrogate for CAL change is not a minor concern and has a variety of implications, including regulatory implications.

Few investigators have examined the association between PD and CAL changes.[12-14] These studies have included relatively few participants (16 to 49), and their focus was on progressing (worsening) tooth sites. Badersten and colleagues[12] followed up patients after scaling and root planing and found that fewer than 20 percent of sites with progressive CAL had a PD increase of a similar magnitude, whereas about three-fourths of sites with a PD increase also had a measurable increase in CAL. In a similar study, Claffey and Egelberg[14] followed up fewer patients but for a longer period. Relatively few facial or lingual sites with progressive CAL experienced an increase in PD, whereas about one-half of initially deep sites (PD ≥ 7 mm) with progressive CAL also showed an increase in PD. These results suggest that monitoring PD alone will lead to missing most sites with progressive CAL, although sites with increases in PD usually had CAL progression as well, particularly at initially deep sites.

Given the relative paucity of published data, we explored the association between change in PD and change in CAL in patients with chronic periodontitis. We used data from a variety of clinical trials, all of which included mechanical debridement. Although the trials included various adjunctive therapies, our goal was to explore associations between changes in physical measures of periodontitis, which we believed would be consistent across the various types of nonsurgical therapy provided.

METHODS

We used all deidentified data sets in our computer archives from clinical trials of nonsurgical periodontal therapy that included at least 12 months of clinical follow-up. Data were available from five such trials; four of the trials[15,16] were published and the other is an unpublished thesis (P. Shevitz, DDS, MS, unpublished

ABBREVIATION KEY. CAL: Clinical attachment loss. **CEJ:** Cementoenamel junction. **GM:** Gingival margin. **NPV:** Negative predictive value. **PD:** Probing depth. **PPV:** Positive predictive value.