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Comparisons of clinical and radiographic measurements of inter-proximal vertical defects before and 1 year after surgical treatments

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Abstract
Background: Radiographic measurements are often used as a substitute for direct clinical measurements requiring re-entry surgery for follow-up outcome studies.
Aims: (1) To assess the reliability of clinical and radiographic measurements of periodontal defects as compared to direct bone measurements during surgical procedures, and (2) to assess the associations between selected clinical and radiographic measurements of periodontal inter-proximal defects.
Methods: 57 inter-proximal periodontal defects were measured at baseline and at 12 months after surgical treatment. Direct measurements during surgery of the distance between the CEJ to the bottom of defects (ABL) were compared with probing to bone (PB), probing attachment level (PAL), and radiographic measurements.
Results: Probing to bone is an accurate measure to assess inter-proximal bone level as compared to ABL (mean difference: 0.1 mm) and that intra-oral standardized radiographs underestimate bone level and defect depth by approximately 1.4 mm. The interpretation of periodontal changes between baseline and 12 months after treatment by probing to bone, or PAL measurements, or from radiographic images yield almost identical results (mean difference$\leqslant$0.2 mm). For the assessments of changes over time using PB change as the standard, intra-class correlation (ICC) coefficients varied between 0.52 to 0.90. The best ICC coefficient was found for relative attachment level change assessed by the Florida probe (0.90), and with an ICC value of 0.61 for changes assessed from intra-oral radiographs. Two-way analysis of variance failed to demonstrate differences between sets of comparisons.
Conclusions: Both radiographic interpretations of changes over time, and measurements of attachment level changes are reliable in assessing the treatment outcome of inter-proximal intra-bony defects when compared to probing to bone changes as the standard method.

Key words: probing bone; probing attachment level, radiographic bone level

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The aim of periodontal diagnostic procedures is to provide the clinician with unbiased information regarding the type, the severity and the location of periodontal disease. Based on the findings, the clinician is then able to formulate a treatment plan and thereafter assess and monitor the efficacy of the treatment rendered. Currently, the most widely used tools for the clinical diagnosis of periodontal diseases and monitoring of outcome of care are the periodontal probe and intra-oral radiographs.

Periodontal probes are used to evaluate the severity of soft tissue inflammation (bleeding on probing and suppuration), presence of plaque or calculus, pocket depths and clinical attachment levels. The latter two are commonly used as primary outcome measures in clinical trials and for routine clinical assessment of periodontal therapies. However, current probing methods are also subject to a multitude of errors. Numerous studies have indicated that these errors are due to variations in probing force, probe design (tine shape, diameter and shape of tip, probe flexibility and probe thickness) and to the degree of tissue inflammation (Van der Velden 1979, 1982, Jeffcoat et al. 1986, Persson 1991, Bulthius et al. 1998). Even technologies aimed at limiting the effects of these variables, such as the use of controlled force probes, have failed to show significant advantages over manual probes. In consequence of their inherent inaccuracy, it is clear that measurements of probing depths only represent an approximation of the actual depth of periodontal pockets and clinical attachment levels. Probing to bone under local anaesthetics, however, has been identified as a method useful to identify the alveolar bone margin (Renvert et al. 1985).

Radiographic methods provide information about hard tissue changes. Radiographic images are unable to reveal soft tissue changes including changes in periodontal attachment levels. Radiographic images compared over time indicate possible cumulative changes over a period of time while probing values may reflect temporal changes in levels of soft tissue inflammation. Radiographs have the advantage that they can be stored and can be reassessed at any time. Radiographic assessments, however, are also subject to multiple sources of error. These include variations in projection geometry, exposure and processing errors as well as masking of osseous structures by various anatomic structures and examiner skills in defining landmarks. Early studies on dry skulls have suggested that radiographs underestimate the level of bone support of teeth, and that substantial bone loss must occur before being visible on radiographs. Newer technologies such as subtraction radiography and computer-assisted densitometric image analysis have been employed to extract additional information from radiographs that cannot otherwise not be visualized (Hausmann et al. 1996, Jeffcoat 1996, Byrd et al. 1998, Jensen et al.1998). This may yield additional information of changes over time but require highly standardized radiographic exposure methods.

Despite the known limitations of periodontal probing and radiographic evaluation, the question of the validity of these measurements as compared to the actual bone level has not been well studied. The objectives of the present analysis were (1) to assess the reliability of clinical and radiographic measurements of periodontal defects as compared to direct bone measurements during surgical procedures, (2) to assess the associations between selected clinical and radiographic measurements of periodontal inter-proximal defects, and (3) to assess if changes identified from probing to bone measurements could reliably be assessed by other clinical and radiographic methods.

Material and Methods

A total of 57 inter-proximal intra-bony defects which were treatment planned for surgical periodontal therapy were selected from 29 subjects who had signed consent approved by the IRB (Internal Review Board) at the University of Washington Seattle. The surgical treatments consisted of either an open flap debridement procedure, or a guided tissue regeneration (GTR) procedure using either resorbable barriers (Guidor AB. Gothenburg Sweden) or e-PTFE membranes (Gore Tex Periodontal Material, W.L Gore & Associates Flagstaff, AZ).

Clinical measurements

Immediately prior to the surgical procedures, the following clinical measurements were made using the CP 15 UNC periodontal probe and measured to the nearest mm: (i) probing depth, *PD*, to identify the deepest inter-proximal defect site; (ii) probing attachment level, *PAL,* at the deepest site (from CEJ or other fixed reference point); (iii) relative attachment level, *RAL*, using the Florida Disc Probe (Florida probe® Florida Probe Corp. Gainesville FL) at a standard probe force of 0.25 N; identified occlusal landmarks served as references for RAL measurements; measurements were made to the nearest 0.1 mm. Data were recorded on computer file directly and consequently the clinical examiner was blinded to the results; (iv) probing to bone, *PB*, at the deepest site (from CEJ or other fixed reference point after local anaesthesia); the probe was inserted into the defect at the deepest site and measurements were made when the examiner could feel that the probe could not be forced further;

Table 1A. Mean differences (mm) between clinical measurements of ABL (CEJ or other reference point to bottom of defect) and other variables at baseline when all defects were studied ($n=57$)

Pairs of variables compared	Mean difference (mm)	Standard deviation	95% confidence interval of the difference		*t*-value	Significance
			lower	upper		
ABL-PB	0.1	1.5	−0.3	0.5	0.3	N.S.
ABL-ABLX	1.4	2.8	0.7	2.2	3.9	$p<0.0001$
ABL-PAL	1.3	2.8	0.7	2.2	4.7	$p<0.0001$
PB-PAL	1.2	1.2	−1.5	−0.9	7.3	$p<0.001$
ABLX-PAL	−0.2	3.0	−1.0	0.6	0.5	N.S.
IBD-IBDX	1.5	2.5	0.8	2.1	4.4	$p<0.0001$

Table 1B. Intraclass correlation coefficients (ICC) and confidence intervals between clinical measurement of ABL and other baseline variables at the time of surgery

Pairs of variables compared	Intra-class correlation coefficient (ICC)	95% confidence interval
ABL-PB	0.87	0.78 to 0.92
ABL-ABLX	0.63	0.38 to 0.78
ABL-PAL	0.76	0.59 to 0.86
PB-PAL	0.54	0.22 to 0.73
ABLX-PAL	0.91	0.85 to 0.95
IBD-IBDX	0.45	0.45 to 0.68

(v) PAL, RAL and PB measurements were repeated at twelve month after surgery.

Following administration of local anaesthesia, flap elevation, defect and root surface debridement surgical measurements were made to the nearest 1 mm using the same the CP 15 UNC periodontal probe that was used prior to surgery: (i) alveolar bone level, *ABL,* the distance from CEJ or other fixed reference point to the bottom of the intra-bony defect; (ii) intrabony defect depth, *IBD*, the distance from the interproximal bone crest to the bottom of the intra-bony defect.

Radiographic measurements

At baseline (before surgical treatment) and at 12 months after surgery, standardized intra-oral peri-apical radiographs were taken using a cephalostat (Gx Ceph model 100500G1, Gendex Corp. Des Plains IL) for standardization of radiographic exposures. Kodak Ektaspeed plus films were used and exposed films were processed with a machine processor (DentX 810 Basic). Radiographs were studied and measured on computer digitized images assisted by a computer software program (Periopro 3.0, Jeffcoat, Birmingham AL).

The following distances were measured: (a) CEJ or another fixed reference point to the bottom of the defect, *ABLX*; (b) bone crest to the bottom of the defect, *IBDX*.

For the analysis of the radiographs, linear measurements were made on computer digitized images of the radiographs using the digital X-ray pro-

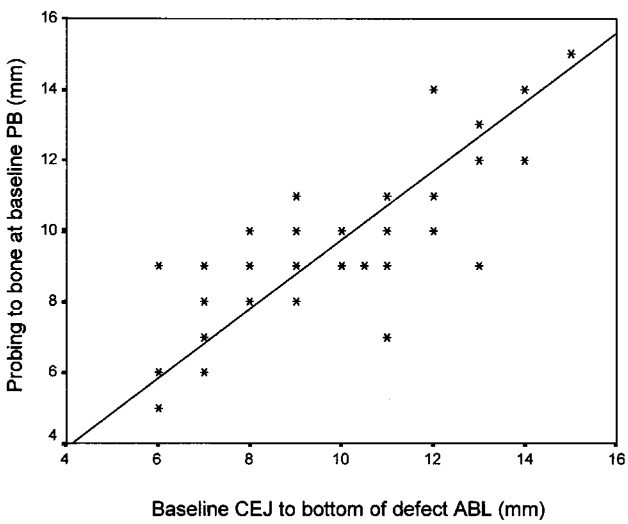

Fig. 1. Scatterplot diagram with best fit line for the association between the distance between probing to bone (PB) before surgery (*x*-axis) and measurements during surgery of the distance between CEJ to the bottom of inter-proximal vertical defects (each * may represent more than one set of measurements).

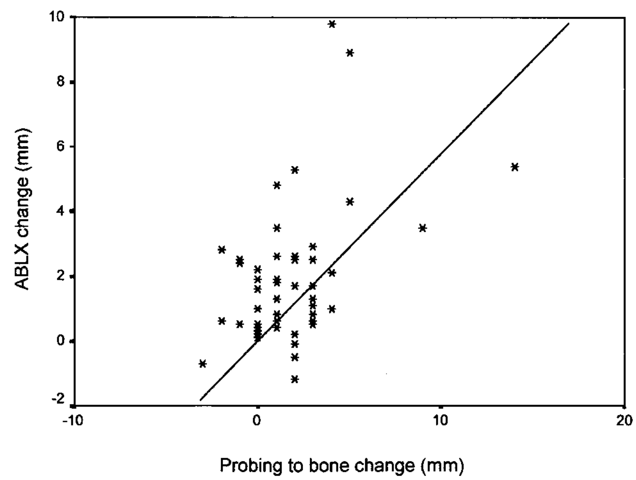

Fig. 3. Scatterplot diagram with best fit line for the association between the change in distance for probing to bone between baseline and 12 month (PB) (*x*-axis) and radiographic interpretation of change in bone height (distance CEJ to bottom of defect) between baseline and 12 month (*y*-axis) (each * may represent more than one set of measurements).

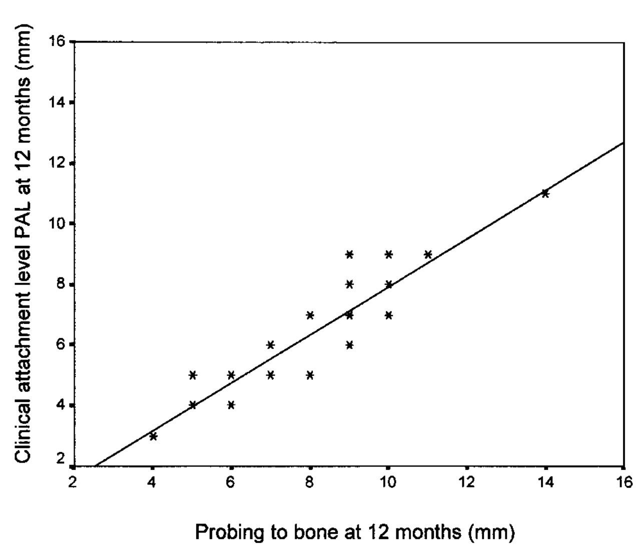

Fig. 2. Scatterplot diagram with best fit line for the association between the distance between probing to bone (PB) at 12 months after treatment (*x*-axis) and probing attachment level (PAL) (*y*-axis) (each * may represent more than one set of measurements).

cessing and analysis method described by Jeffcoat et al. (1984), Tonetti et al (1993) and Falk et al. (1997). The analysis was performed at the Regional Clinical Dental Research Center Imaging Laboratory at the School of Dentistry. The obtained results from the linear measurements were expressed in mm. Subtracting ABL values obtained at the follow-up radiographs from the baseline values assessed the amount of bone fill of the intra-bony defects. Defect resolution was obtained by comparing the two IBDx scores.

One of the investigators (MZ) made the clinical measurements. A second investigator (GRP) calibrated to read the radiographs (Falk et al. 1997) analyzed all the radiographs and was at the time of assessments unaware of any clinical study results.

Statistical methods:

Paired *t*-tests were used to compare pairs of data from different measurement procedures Intra-Class Corelation (ICC) coefficients and 95% confidence intervals were studied and two way analysis of variance for different sets of measurements was performed. The SPSS v 8.0 statistical software program for PC was used for data analysis (Chicago IL). The data set was tested for normal distribution characteristics.

Results

Agreements between direct measurements of ABL and IBD at baseline (gold standard) and other assessment methods of periodontal defects (Tables 1A, B)

The mean distance between CEJ to the bottom of the defect as measured during the surgical procedures, (ABL), was 9.5 mm (S.D.±2.4, median 9.0 mm, range: 6.0−15.0 mm). Mean differences, standard deviation of the mean differences, 95% confidence intervals, and *p*-values between ABL as reference gold standard and PB, PAL, and ABLX at baseline are given in Table 1A. Mean differences, standard deviations of the mean differences, 95% confidence intervals, and p-values are also given for comparisons of PB and PAL and for comparisons of IBD and IBDX (Table 1A). No significant statistical differences were found between ABL and PB measures while measurement comparisons between ABL-ABLX, ABL-PAL, PB-PAL, and IBD-IBDX were statistically different ($p<0.001$).

The ICC and 95% confidence intervals between ABL and other variables at baseline are presented in Table 1B. ICC coefficients were >0.60 for all comparisons except for IBD-IBDX comparisons. Intra-surgical ABL and PB measurements agreed within 1 mm (±0.5 mm) in 39% of cases. PB underestimated the ABL distance in 28% cases and over-estimated the distance in 33% cases. The association between PB and ABL is also illustrated in a scatterplot diagram with best fit linear regression line ($r^2=0.94$, $p<0.001$), (Fig. 1). Intra-surgical ABL and radiographic ABLX measures agreed within 1 mm (±0.5 mm) in 22 % of cases. ABLX under-estimated the ABL distance in 56% and over-estimated it in 22% of cases.

Because it may be more difficult to define the apical portion of a vertical defect in a three wall defect from a radiograph an analysis of the more ideal situation from a radiographic aspect was chosen. Thus when only known two- and one- wall defects for the comparisons of measurements were studied the best match was found between ABL and ABLX with a mean difference of 0.1 mm (Table 2A). Although the mean difference between ABL and ABLX, was smaller than the mean difference between ABL and PB the standard deviation of the mean difference between ABL and ABLX was approximately four times larger than the standard deviation of the mean difference for ABL-PB.

The ICC coefficients and 95% confidence intervals between ABL and other variables are presented in Table 2B. The ICC coefficients were >0.60 for all sets of comparisons but IBD-IBDX, and PB-PAL comparisons. However, two-way analysis of variance failed to demonstrate significant differences between sets of measurements

Agreements between probing to bone at twelve month (PB12 substitute gold standard) and other assessment methods of periodontal defects (Tables 3A, B)

Because re-entry surgical procedures were not performed, ABL data for month twelve were not available. However, once the appreciable agreement between ABL and PB at baseline was found, PB was used as a reasonable substitute measure. The mean PB value at 12 months (PB12) was 8.0 mm (S.D.±1.9, median; 8.0 mm, range; 4.0−14.0 mm). Mean differences, standard deviations, 95% confidence intervals, and correlation coefficient values between PB12, and other clinical measurements and radiographic measurements are presented in Tables 3A and 3B. At twelve month the mean difference between PB and ABLX was 1.6 mm while the mean difference between PB and PAL was 1.7 mm ($p<0.0001$). The twelve month ICC coefficient

Table 2A. Mean differences (mm) between clinical measurements of ABL and other baseline variables when only two- and one- wall intra-bony defects were studied ($n=28$)

Pairs of variables compared	Mean difference (mm)	Standard deviation	95% confidence interval of the difference		*t*-value	Significance
			lower	upper		
ABL- PB	0.3	0.9	−0.2	0.9	1.3	N.S
ABL- ABLX	0.1	3.2	−1.9	2.1	0.1	N.S.
ABL-PAL	1.3	1.8	0.3	2.4	2.7	$p<0.05$
PB-PAL	1.0	1.1	0.3	1.7	3.3	$p<0.01$
ABLX – PAL	1.2	3.4	−0.9	3.4	1.3	N.S.
IBD-IBDX	0.4	2.9	−2.2	1.5	−0.4	N.S.

Table 2B. Intra-class correlation coefficients (ICC) and confidence intervals between clinical measurements of ABL and other baseline variables at the time of surgery when only 2- and 1-wall intra-bony defects were studied ($n=28$)

Pairs of variables compared	Intra-class correlation coefficient (ICC)	95% confidence interval
ABL- PB	0.85	0.72 to 0.83
ABL- ABLX	0.72	0.42 to 0.87
ABL – PAL	0.66	0.56 to 0.91
PB – PAL	0.80	0.62 to 0.91
ABLX -PAL	0.43	0.07 to 0.95
IBD-IBDX	−0.47	−2.18 to 0.32

Table 3A. Mean differences between clinical measurements of PB at twelve month (PB12) and radiographic ABL at twelve month (ABLX12) and PAL at twelve month (PAL12), (n=57)

Pairs of variables compared	Mean difference (mm)	Standard deviation	95% confidence interval of the difference		*t*-value	Significance
			lower	upper		
PB12-ABLX12	1.7	2.5	−2.3	1.0	5.0	$p<0.0001$
PB12-PAL12	1.7	0.8	−1.9	1.4	14.8	$p<0.0001$

Table 3B. Intra-class correlation coefficient (ICC) and 95% confidence intervals between clinical measurements of Probing to bone at 12 month (PB12) and radiographic (ABLX12), and clinical attachment level readings at 12 month (PAL12) (n=57)

Pairs of variables compared	Intra-class correlation coefficient (ICC)	95% confidence interval
PB12-ABLX12	0.42	−0.13 to 0.67
PB12-PAL12	0.95	0.90 to 0.97

Table 4A. Mean differences (mm) between baseline to 12 month changes for PB and other variables, (n=57)

Pairs of variables compared	Mean difference (mm)	Standard deviation	95% confidence interval of the difference		*t*-value	Significance
			lower	upper		
PB-ABLX changes	0.2	2.5	−0.5	0.9	0.7	N.S.
PB-PAL changes	0.2	2.2	−0.5	0.8	0.5	N.S.
PB-RAL changes	0.1	1.6	0.2	0.3	−0.5	N.S.
ABLX-PAL changes	−0.2	2.5	−0.8	0.5	−0.5	N.S.
ABLX-RAL changes	0.2	2.8	−0.6	0.9	0.4	N.S.

Table 4B. Intra-class correlation coefficients (ICC) and 95% confidence intervals between baseline to 12 month changes for PB and other variables, (n=57)

Pairs of variables compared	Intra-class correlation coefficient (ICC)	95% confidence interval
PB-ABLX changes	0.61	0.32 to 0.77
PB-PAL changes	0.67	0.42 to 0.81
PB-RAL changes	0.90	0.83 to 0.94
ABLX-PAL changes	0.52	0.18 to 0.72
ABLX-RAL changes	0.62	0.35 to 0.77

values and 95% confidence intervals between PB versus ABLX and PAL are presented in Table 3B. Two-way analysis of variance failed to demonstrate significant differences between sets of measurements. The associations between PB and PAL twelve month values are also presented in Fig. 2 as a scatter-plot diagram with a best fit linear regression line (r^2=0.98, $p<0.001$).

Agreements between changes in probing to bone between baseline and 12 months and other clinical measures of differences over time (Tables 4A, B)

The mean change in PB between baseline and month twelve was 1.7 mm (S.D.±2.7, median 1.0, range: −3.0 to 14.0 mm). The mean differences, standard deviations of the difference, 95% confidence interval and significance between changes in PB and other variables are presented in Table 4A. The mean differences between variables were small and not statistically significant. The ICC coefficients and 95% confidence intervals are presented in Table 4B. Two analysis by variance failed to show differences between sets of measurements.

The association between baseline to twelve month changes for probing to bone, PB, (substitute gold standard), and ABLX is presented in a scatter-plot diagram with best fit linear regression line; r^2 =0.41, $p<0.01$ (Fig. 3). Radiographic measures of ABL changes (ABLX changes) agreed within 1 mm (±0.5 mm) with probing to bone changes in 26% of the cases, over-estimated the changes in 51%, and under-estimated the changes in 23% of the cases. The mean differences and correlation coefficients between measurements of changes were similar when only two- and one- wall defects were included.

Discussion

In periodontal therapy, clinical and radiographic measurements are commonly used to assess treatment outcomes. The importance of accurate measurements is obvious and especially needed in clinical studies attempting at defining differences in efficacy between procedures and to correctly assess outcome of care when surgical re-entry treatment is not an appropriate option. In the present study one calibrated investigator performed the clinical measurements (MZ) and a second calibrated investigator read the radiographs (GRP). This procedure was used in part to control for examiner bias. The generalization of the study results should be considered based on the fact that the measurements were made by examiners were trained and calibrated to perform the measurements Although the present data set and the results are restricted to assessments made by this pair of investigators both types of measurements have independently been used by numerous investigators. Both the clinical and the radiographic procedures have limitations to the accuracy of what they describe and to the precision of measurements. Nevertheless clinical and the radiographic measurements studied here are common procedures in clinical periodontal practice and research. Therefore, we believe that the reliability and associations between clinical and radiographic results reported have general applicability.

Studies of intra-oral radiographs in assessing linear distances between a reference point such as the CEJ and alveolar bone crest or the apical border of a vertical defect and the cement-enamel junction are common. Either direct measurements have been made from enlarged intra-oral radiographs (Papapanou & Wennstrom 1990, Persson et al. 1998 a, b), or computer digitized images (Jeffcoat et al. 1996, Falk et al. 1997, Persson et al. in press) have been studied. In principle there should be no differences in outcomes when measurements are made from enlarged images or from digitized images. The computer software program used in the present study allowed measurements with an accuracy of 0.1 mm. However the images and reference points studied on computer screens are restricted by the computer screen resolution but also direct measurements from enlarged or non-enlarged radiographs have limitations in defining reference points. We believe that the primary problems are (1) quality of the radiographic images and resolution of images studied, (2) anatomical landmarks, and (3) examiner skills.

In the present study, the mean difference between the ABL and the PB baseline measurements was very small (0.1 mm). It is possible that in 2- and 1-wall defects the probe tip penetrates more easily to the true bottom of the defect due to the anatomy of such lesions. Nevertheless, the 95% confidence interval of the difference between the ABL and PB baseline was within 0.8 mm. Thus, PB measurements constitute an accurate method of assessing bone level and can be reliably used to e.g. assess bone level changes after treatment making re-entry procedures in clinical trials unnecessary. Identification of the apical margin of one and two wall defect on a radiographic image may be easier than finding the apical margin of a three wall defect.

Bone measurements exerted as ABL or PB measurements exceeded PAL measurements by 1.2 mm (S.D.$\pm$1.2) mm prior to therapy (Table 1A) and by 1.7 (S.D.$\pm$0.8) mm 12 month after therapy (Table 3A). This difference may be explained by a certain amount of "biological width" between bone level and the bottom of the periodontal pocket that may be wider were healthy after treatment as compared to before treatment. Differences in changes between PB and PAL/RAL were almost identical (Table 4A). This is consistent with the findings of Cortellini et al. (1993a, b). These authors evaluated GTR treatment of intra-bony defects twelve month after surgery by PAL measurements using the Florida probe and re-entry bone measurements and received almost identical measures of changes; 4.1$\pm$2.5 mm in PAL gain and 4.3$\pm$2.5 mm for bone fill. Such similarities have been found in several studies following various treatment modalities of intra-bony defects (for review, see Laurell et al. (1998)). Changes in PAL/RAL can therefore serve as reliable substitute measures for bone changes.

PB and PAL/RAL recordings represent similar methods of assessment whereas information from radiographic images is quite different. Similar to PB and PAL/RAL measurements (Gibbs et al. 1988, Persson 1991) the radiographic image has limitation in the representation of three-dimensional conditions. The radiographic image can only depict a 2-dimensional perspective, whereas probing provides an opportunity to manipulate the instrument to a desired position. While probing measures therefore can be easily biased, interpretation of radiographic images can be made under standardized and non-biased conditions. An error introduced by projection differences can be managed by different standardization procedures during film placement and exposure. However, also probing measurements can be affected by the healing of the defects in that the angulation of the probe to reach the apex of the defect may change as a result of new anatomical relationships.

When only the 1- and 2-wall lesions were studied, the ICC coefficient between direct measure of the distance between CEJ to the bottom of the defect (ABL) improved from 0.62 to 0.72. However, the ICC for the direct defect depth (IBD) and by radiographic assessment (IBDX) did not change much. This suggests that three wall defect assessments are more difficult to make by studies of intra-oral radiographs. On the other hand the differences in ICC coefficients between all defects and the combination of one and two defects only versus probing attachment level measurements indicated better reliability for PAL studies of three wall defects than for the combined one and two wall defects by PAL. This difference was also reflected by the poor reliability between PAL and ABLX for the combined one and two wall defects. Interestingly enough the reliability between direct clinical measurements during surgery and probing to bone for one and two wall defects combined versus did not seem to changes as indicated by ICC coefficients.

In the present study, both at baseline and twelve months, ABLX values underestimated ABL and PB measures. This difference between direct clinic measures of ABL, or by PB and radiographic interpretation of the distance between CEJ and the bottom of the defect (ABL) has been demonstrated by other investigators, (Cortellini et al. 1993b, Tonetti et al. 1993, Falk et al. 1997, Eickholz et al. 1998). One reason for this discrepancy is that radiographs do not allow identification of the most apical component of vertical defects, and especially not in three wall defects. This is supported by the fact that radiographs also underestimated the depth of the intra-bony defect (IBD) as compared to measurements during surgery.

The average bone change, assessed from bone probing (PB) between baseline and month twelve and from radiographic assessments was very similar with a mean difference of only 0.2 mm. This finding suggests that standardized radiographs reliably and permanently describe hard tissue changes and thus can serve as substitute for probing to bone or re-entry measurements of bone changes. Analysis of the ICC coefficients revealed excellent reliability to changes identified by probing to bone for the Florida computer-supported relative attachment with a very high ICC coefficient (ICC=0.90). The reliability by radiographic changes was good (ICC coefficient=0.61). In conclusion, the present study showed that: (1) probing to bone is an accurate measure to assess inter-proximal bone level; (2) radiographs underestimate bone level and defect depth by approximately 1.4 mm; (3) interpretation of bone changes by probing to bone, or probing attachment level measurements, or from radiographic images yield reliable and similar results.

Zusammenfassung

Vergleich der klinischen und röntgenologischen Messung von approximalen vertikalen Defekten vor und ein Jahr nach der chirurgischen Behandlung

Der Zweck der vorliegenden Studie war es: 1. Die Zuverlässigkeit von klinischen und röntgenologischen Messungen parodontaler Defekte im Vergleich mit der direkten Knochenvermessung während chirurgischer Maßnahmen zu bestimmen und 2. Die Assoziationen zwischen ausgewählten klinischen und röntgenologischen Messungen von approximalen parodontalen Defekten zu bestimmen. 57 approximale parodontale Defekte wurden bei der Eingangsuntersuchung und 12 Monate nach der Chirurgie gemessen. Die direkte Messung der Entfernung zwischen der Schmelzzementgrenze (CEJ) und dem Boden des Defektes (ABL) während der Chirurgie wurde mit der Knochensondierung (PB), dem klinischen Attachmentniveau (PAL) und röntgenologischen Messungen verglichen. Die Analyse zeigte, dass die Knochensondierung im Vergleich mit dem ABL eine genaue Maßnahme zur Bestimmung des approximalen Knochenniveaus ist, (durchschnittlicher Unterschied 0.1 mm) und dass intraorale standardisierte Rötgenbilder das Knochenniveau sowie die Defekttiefe um etwa 1.4 mm unterschätzen. Die interpretation der parodontalen Veränderungen zwischen der Ausgangssituation und 12 Monate nach der Chirurgie durch Knochensondierung oder Messung des klinischen Attachmentniveaus oder durch Rötgenbilder erzielte fast identische Ergebnisse (durchschnittlicher Unterschied ≤0.2 mm). Für die Beurteilung von Veränderung im Laufe der Zeit mit der Verwendung des Knochensondierens als Standard ergibt sich ein intra-Klassenkorrelations-Koeffizient (ICC) zweischen 0.52 und 0.90. Der beste ICC wurde für die relativen Attachmentniveau-Veränderungen, die mit der Florida-Probe bestimmt wurden, gefunden (0.90). Für Veränderungen, die mit intraoralen Röntgenbildern bestimmt wurden, ergab sich ein ICC-Wert von 0.61. Die Zwei-Wege-Varianz-Analyse konnte keine Unterschiede zwischen den Vergleichsgruppen aufzeigen. Die Schlussfolgerung ist, dass bei Vergleich mit Veränderungen der Knochensondierung als Standard sowohl die röntgenologische Interpretation von Veränderungen im Laufe der Zeit als auch die Messung der Veränderung des klinischen Attachmentniveaus zuverlässig das Behandlungsergebnis von approximalen Knochendefekten bestimmen können.

Résumé

Comparaisons de mesures cliniques et radiographiques des lésions verticales interproximales avant et un an après traitement chirurgical
Les buts de cette étude ont été: (1) d'évaluer la précision des mesures cliniques et radiographiques de lésions parodontales comparées aux mesures osseuses directes durant l'opération; (2) d'analyser les relations entre les mesures cliniques sélectionnées et radiologiques dans les lésions interproximales parodontales. 57 lésions parodontales interproximales ont été mesurées lors de l'examen initial ainsi que 12 mois après le traitement chirurgical. Les mesures directes de la distance entre la CEJ et la base des lésions (ABL), lues durant la chirurgie, ont été comparées avec la profondeur au sondage du contact osseux (PB), le niveau d'attache au sondage (PAL) et les mesures radiographiques. L'analyse des résultats a montré que le sondage osseux était une mesure précise pour calculer le niveau osseux interproximal comparé à ABL (différence moyenne de 0.1 mm) et que les radiographies standardisées intrabuccales sous-estimèrent le niveau osseux et la profondeur de la lésion d'environ 1.4 mm. L'interprétation des différences entre l'examen initial et celui fait 12 mois après le traitement pour le sondage osseux ou les mesures cliniques de niveau d'attache au sondage ou pour les radiographies présentaient des résultats presque identiques (différence moyenne ≤0.2 mm). Pour les estimations des variations au cours du temps, les variations du sondage osseux étant pris comme standard, les coefficients de corrélation intra-classe (ICC) varièrent de 0.52 à 0.90. Le meilleur coefficient ICC a été trouvé pour la variation du niveau d'attache relative par la sonde Florida (0.90), avec une valeur ICC de 0.61 pour les variations des mesures lues sur les radiographies intrabuccales. L'analyse de variance à deux voies ne montra aucune différence entre les groupes de comparaison. En conclusion, tant l'interprétation radiographique des variations au cours du temps que les mesures de variation des niveaux d'attache sont adéquates pour estimer l'issue du traitement des lésions intraosseuses interproximales lorsqu'elles sont comparées aux variations par sondage osseux comme méthode standard.

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