KEY WORDS
Periodontal probing, Dental plaque, Bleeding on probing, Gingival recession, Case series, Randomised controlled trial

CAN PERIODONTAL PROBING IMPROVE CLINICAL VARIABLES IN UNTREATED PERIODONTAL PATIENTS? A CASE SERIES

MICHELE NIERI, DDS, PhD
Department of Experimental and Clinical Medicine, University of Florence, Italy

SARA CIANCARELLI
Dental hygienist, Private practice, Florence, Italy

UMBERTO PAGLIARO, MD, DDS
Department of Experimental and Clinical Medicine, University of Florence, Italy

LORENZO FRANCHI, DDS, PhD
Department of Experimental and Clinical Medicine, University of Florence, Italy

ANTONELLA LABRIOLA, DDS
Private practice, Taranto, Italy

Correspondence to:
Michele Nieri
Department of Experimental and Clinical Medicine, University of Florence - Via del Ponte di Mezzo 46-48 - 50127, Florence, Italy
E-mail: michelenieri@gmail.com

PURPOSE. To evaluate any variations in periodontal indices (dental plaque, bleeding on probing, gingival recession, pocket depths) after periodontal probing in untreated subjects suffering from periodontal disease.

MATERIALS AND METHODS. This is a single centre case series. Fifteen participants in need of periodontal therapy were consecutively recruited. At baseline (T0), patients were assessed on a periodontal chart by an experienced periodontist. The following variables were evaluated: presence of plaque (PI), pocket depth (PD), bleeding on probing (BoP), and gingival recession depth (Rec). The variables were recorded at both patient and tooth site level. After that, the patients waited for one hour in the waiting room, and then the same variables were recorded again (T1) by the same periodontist. The patients were discharged with no dental care instructions, motivation or therapy. After two weeks, the patients were recalled, and the same variables were recorded again (T2). Multilevel models were applied for inferential analysis at site level.

RESULTS. All 15 patients completed the study. The difference between T0 and T1 was not significant for the variables PD (difference 0.00 mm; 95% CI from -0.02 to 0.02; P = 0.97) or Rec (difference -0.01 mm; 95% CI from -0.02 to 0.01; P = 0.39). However, the number of sites with presence of plaque decreased from T0 to T1 (OR = 0.59; 95% CI from 0.51 to 0.68; P<0.0001), while the number of sites with BoP increased from T0 to T1 (OR = 1.71; 95% CI from 1.45 to 1.96; P<0.0001). The difference in PD between T0 and T2 was significant (difference -0.15 mm; 95% CI from -0.18 to -0.12; P<0.0001), as was the difference in Rec (T0–T2 difference 0.03 mm; 95% CI from 0.01 to 0.05; P = 0.0006). The number of sites with plaque present did not change from T0 to T2 (OR = 1.00; 95% CI from 0.87 to 1.14; P = 0.98), but the number of sites with BoP decreased from T0 to T2 (OR = 0.68; 95% CI from 0.60 to 0.77; P<0.0001).

CONCLUSIONS. Dental plaque, bleeding on probing, pocket depth, and gingival recession can change over time without any therapy. In particular, merely recording these variables (T0) can increase bleeding on probing and reduce plaque after one hour (T1). After two weeks (T2), a decrease in inflammation was noted, characterized by reduced bleeding on probing, a slight decrease in probing depth, and a slight increase in gingival recession.

CONFLICT OF INTEREST STATEMENT. The authors declare that they completely self-funded the study, and that there are no conflicts of interest.

Doi: 10.36130/CTD.05.2020.05

INTRODUCTION

Periodontal probing has been and continues to be one of the more useful diagnostic tools to determine the presence and severity of periodontal lesions[1,2]. Periodontal probing is generally also used for classification and screening purposes, or to evaluate periodontal changes throughout the treatment process[3,4]. Other clinical factors may contribute to giving an indication of the extent and severity of periodontal disease. These include gingival recession, plaque accumulation, bleeding on probing, clinical attachment level, furcation involvement, and tooth mobility and migration. For a comprehensive assessment of a patient's periodontal status, a six-point periodontal chart may be used to record pocket depth, bleeding on probing, mobility, furcation, etc.[3]

Normally, the periodontal probing procedure is believed to have no effect on periodontal tissues. Numerous studies have reported on repetition of the periodontal probing procedure usually to verify the intra- or inter-rater agreement of assessors or examiner calibration in clinical trials[5-8]. Generally, periodontal probing is repeated (at baseline and at follow-up of the same sites) to verify the effect of a therapy in the short or long term. This assumes that the diagnostic procedure itself is not able to change the clinical course.

However, the probing procedure is a potentially invasive process and could theoretically modify the detection of plaque, bleeding, gingival recession, and the periodontal probing itself after a certain period of time[6]. To our knowledge, no studies have been carried out to investigate the change in periodontal variables that may occur as a result of periodontal probing without any therapy being administered. Hence, the aim of this study was to evaluate any variations in periodontal indices (plaque, bleeding, recession, and probing depths) after periodontal probing in untreated subjects suffering from periodontal disease.

MATERIALS AND METHODS

Trial design

This was a single-centre case series conducted at the University of Florence Department of Periodontology (Italy) in 2006.

Participants

Fifteen volunteers in need of periodontal therapy were consecutively recruited for the study at the University of Florence, Italy.

The inclusion criteria used for selection were:

- Age >18 years;
- Presence of at least 20 teeth;
- Absence of professional instruction regarding home oral hygiene;
- Need for periodontal therapy.

The exclusion criteria were:

- Pregnancy or lactation;
- Disabling syndromes or pathologies;
- Antibiotic therapy.

Clinical procedures

At baseline (T0), patients were assessed on a periodontal chart by an expert periodontist (AL). The following variables were evaluated at six sites on each tooth using a PCP-UNC 15 periodontal probe:

- Presence or absence of plaque (PI)[9];
- Periodontal probing (pocket depth, PD) in mm;
- Presence or absence of bleeding on probing (BoP)[10];
- Gingival recession (Rec) in mm.

After that, patients waited one hour in the waiting room, and then the same variables were measured again (T1). Patients were discharged without any dental care instruction or motivation, and were then recalled after two weeks, when the same variables were reassessed (T2). Subsequently patients were started on cause-related periodontal therapy. All measurements were carried out by the same examiner.

Sample size

A sample of fifteen patients was collected to highlight differences between baseline and follow-up (matched pair) of at least one effect size using $\alpha = 0.05$, a power of 80% and 30% dropout.

Statistical methods

Descriptive statistics were calculated using mean and standard deviation for quantitative data, and frequency and percentage for qualitative data. Data for both tooth site and patient levels is presented.

For inferential analysis at site level, multilevel models were applied. In the models, three levels were used: patient, site, and occasion. For the outcome variables PD and Rec, two linear models were constructed. In the first model the values at T0 and T1 were considered, and the difference between T0 and T1 was tested. In the second model the values at T0 and T2 were considered, and the difference between T0 and T2 was tested. For the outcome variables PI and BoP, two similar logistic models were constructed. In the first model the values at T0 and T1 were considered, and the odds ratio (OR) between T0 and T1 was tested. In the second model the values at T0 and T2 were considered and the odds ratio between T0 and T2 was tested.

As a sensitive inferential analysis at patient level, the differences between T0 and T1 and between T0 and T2 were tested for mean PD, mean Rec, full-mouth plaque score (FMPS) and full-mouth bleeding score (FMBS) using the paired t-test. The analysis at patient level was undertaken because, even though it is less powerful with respect to multilevel analysis, it is more frequently used in the dentistry literature.

RESULTS

A total of 15 subjects (12 females) were enrolled in the study. The number of teeth examined was 412, and a total of 2472 sites were assessed. The mean age was 46.5 years (standard deviation 11.5) [minimum 27; maximum 68]. No subjects were smokers. There were no dropouts.

Statistical differences at tooth site level between T0 and T1 are presented in **TABLE 1**. The difference between T0 and T1 was not significant for PD (difference 0.00 mm; 95% CI from -0.02 to 0.02; P = 0.97) or Rec (difference -0.01 mm; 95% CI from -0.02 to 0.01; P = 0.39). However, the number of sites with plaque present decreased from T0 to T1, and the odds ratio (OR) for PI was significant (OR = 0.59; 95% CI from 0.51 to 0.68; P<0.0001). The number of sites with bleeding on probing (BoP) increased from T0 to T1, and the OR for BoP was significant (OR = 1.71; 95% CI from 1.45 to 1.96; P<0.0001).

Statistical differences at tooth site level between T0 and T2 are presented in **TABLE 2**. The difference in PD between T0 and T2 was significant (difference -0.15 mm; 95% CI from -0.18 to

TABLE 1 STATISTICS AT SITE LEVEL BETWEEN T0 AND T1

	T0	T1	Estimate*	95% CI	P-value
PD mm (sd)	2.75 (1.17)	2.75 (1.15)	0.00	-0.02; 0.02	0.97
Rec mm (sd)	0.36 (0.83)	0.35 (0.82)	-0.01	-0.02; 0.01	0.39
Number of sites with PI (%)	1387 (56.1%)	1176 (47.6%)	0.59	0.51; 0.68	<0.0001
Number of sites with BoP (%)	1475 (59.7%)	1686 (68.2%)	1.71	1.45; 1.96	<0.0001

**Difference for PD and Rec; odds ratio for PI and BoP*
Number of total sites 2472
T0: Baseline; T1: One hour after baseline

TABLE 2 STATISTICS AT SITE LEVEL BETWEEN T0 AND T2

	T0	T2	Estimate*	95% CI	P-value
PD mm (sd)	2.75 (1.17)	2.60 (1.10)	-0.15	-0.18; -0.12	<0.0001
Rec mm (sd)	0.36 (0.83)	0.39 (0.86)	0.03	0.01; 0.05	0.0006
Number of sites with PI (%)	1387 (56.1%)	1386 (56.1%)	1.00	0.87; 1.14	0.98
Number of sites with BoP (%)	1475 (59.7%)	1304 (52.7%)	0.68	0.60; 0.77	<0.0001

**Difference for PD and Rec; odds ratio for PI and BoP*
Number of total sites 2472
T0: Baseline; T2: Two weeks after baseline

-0.12; P<0.0001), as was the difference in Rec (T0-T2 difference 0.03 mm; 95% CI from 0.01 to 0.05; P = 0.0006). The number of sites with plaque present did not change from T0 to T2, and the OR for PI was not significant (OR = 1.00; 95% CI from 0.87 to 1.14; P = 0.98). The number of sites with bleeding on probing (BoP) decreased from T0 to T2, and the OR for BoP was significant (OR = 0.68; 95% CI from 0.60 to 0.77; P<0.0001).

The sensitivity analyses at patient level are presented in **TABLES 3** and **4**, and statistical differences at patient level between T0 and T1 are presented in **TABLE 3**. The difference between T0 and T1 was not significant for either mean PD (difference 0.00 mm; 95% CI from -0.04 to 0.04; P = 0.95) or mean Rec (T0-T1 difference -0.01 mm; 95% CI from -0.02 to 0.01; P = 0.42). However, FMPS decreased significantly from T0 to T1 (difference = -8.1; 95% CI from -12.8 to -3.5; P = 0.002), while FMBS increased significantly from T0 to T1 (difference = 8.5; 95% CI from 4.8 to 12.2; P = 0.0002).

Statistical differences at patient level between T0 and T2 are presented in **TABLE 4**. The difference in mean PD between T0 and T2 was significant (difference 0.16 mm; 95% CI from -0.25 to -0.06; P = 0.003), whereas the difference in mean Rec between T0 and T2 was not significant (difference 0.04 mm; 95% CI from -0.03 to 0.10; P = 0.22). FMPS did not change from T0 to T2 (difference = 0.3; 95% CI from -6.2 to 6.8; P = 0.92), but FMBS decreased significantly from T0 to T2 (difference = -7.2; 95% CI from -11.8 to -2.5; P = 0.005).

DISCUSSION

The objective of this study was to verify the effect of the diagnostic procedures in periodontology, that is to evaluate whether the classical diagnostic procedures (dental plaque, blee-

TABLE 3 STATISTICS AT PATIENT LEVEL BETWEEN T0 AND T1

	T0	T1	Estimate	95% CI	P-value
Mean PD mm (sd)	2.77 (0.44)	2.77 (0.45)	0.00	-0.04; 0.04	0.95
Mean Rec mm (sd)	0.39 (0.41)	0.38 (0.42)	-0.01	-0.02; 0.01	0.42
FMPS (sd)	56.8 (23.4)	48.7 (24.3)	-8.1	-12,8; -3,5	0.002
FMBS (sd)	59.9 (18.6)	68.4 (16.3)	8.5	4.8; 12.2	0.0002

T0: Baseline; T1: One hour after baseline

TABLE 4 STATISTICS AT PATIENT LEVEL BETWEEN T0 AND T2

	T0	T2	Estimate	95% CI	P-value
Mean PD mm (sd)	2.77 (0.44)	2.61 (0.40)	-0.16	-0.25; -0.16	0.003
Mean Rec mm (sd)	0.39 (0.41)	0.43 (0.48)	0.04	-0.03; 0.10	0.22
FMPS (sd)	56.8 (23.4)	57.1 (20.6)	0.3	-6.2; 6.8	0.92
FMBS (sd)	59.9 (18.6)	52.8 (20.5)	-7.2	-11.8; -2.5	0.005

T0: Baseline; T2: Two weeks after baseline

ding on probing, gingival recession, periodontal probing assessment) can induce changes in the same variables during short-term follow-up.

Fifteen patients needing periodontal therapy were included in this study. No instruction or motivation to oral hygiene or periodontal therapy were performed until the end of the study. Although no therapy was carried out, numerous changes in the measured variables were observed. In particular, one hour after the first measurement, the plaque decreased and bleeding on probing increased. After two weeks, the pocket depth decreased, the gingival recession increased, and the bleeding on probing decreased. Sensitivity analysis at patient level confirmed all these results at site level, with the exception of gingival recession after two weeks.

Plaque increased after one hour but had returned to baseline at two weeks. Probably, tooth surface and soft tissue manipulation using the periodontal probe can disturb the structure of the bacterial biofilm and eliminate a certain amount of plaque. In fact, after one hour, the FMPS had decreased by 8.1%. In addition, in one hour there is not enough time for the formation of new plaque. It is important to underline that in studies of intra- or inter-rater agreement, the study of plaque must be independent from the study of agreement on other variables that require probing. This is because, as we showed, the periodontal probing procedure itself could lead to a decrease in bacterial plaque and a worsening of the agreement indices (kappa statistics or intraclass correlation coefficient)[6]. Indeed, after two weeks, the FMPS was substantially the same as at baseline. For this reason, a Hawthorne effect was not observed in this study. The patients knew that they were included in a trial; this could be expected to induce patients to improve their oral care, but this did not happen, at least two weeks after baseline.

Bleeding on probing increased after one hour and decreased after two weeks. Probing the

same site one hour apart is likely to cause greater trauma to the periodontal epithelial-connective tissue and could explain the greater tendency to bleeding. Provocation of bleeding is a potentially invasive process, and it is therefore unsuitable for repeated assessments within short time periods, as pointed out in the dental literature[6]. After two weeks the FMBS decreased by 7.2% with respect to baseline. This is noteworthy, and could denote a marked reduction in inflammation after two weeks, because the first manipulations (at T0 and T1) using the periodontal probe might have disturbed the structure of the bacterial biofilm and eliminated a certain amount of plaque.

Pocket depth resulted unmodified after one hour, but decreased after two weeks. This reduction was by about 0.15 mm. Although 0.15 mm at a single site seems clinically negligible, overall it is not a finding to be underestimated. In fact, taking into consideration the entire mouth of a patient, the reduction in probing depth was about 25 mm per patient on average. The extent of this decrease in probing suggests a decrease in gingival oedema due to inflammation, and could be attributable to a decrease in inflammation, as observed for bleeding on probing.

Gingival recession was unmodified after one hour but increased after two weeks. This increase was not confirmed by the patient level analysis, probably because the analysis was underpowered for this variable. Nonetheless, the reduction was about 0.03 mm, a clinically negligible value. It could be due to a decrease in gingival oedema because of a reduction in inflammation, as observed for bleeding on probing and probing depth. The reduction in probing depth and bleeding on probing and the slight increase in gingival recession indicated a decrease in inflammation after two weeks.

The reduced inflammation could be due to several causes. Primarily, a Hawthorne effect may have occurred in the first few days following the initial measurements; due to the presence of observers, participants may have brushed their teeth more during the first few days following the first appointment, and then returned to regular brushing. Indeed, plaque returned to its initial level at two weeks. Moreover, the cyclical nature of gingivitis associated with periodontitis must be considered. Patients may have sought periodontal therapy during a natural gingivitis peak with a high level of FMBS that naturally decreased over time. It is also not inconceivable that the examiner may have introduced bias by probing patients with less force at two weeks. Given the high reliability and experience of the examiner, however, this would seem unlikely. In addition, the examiner did not know the true purpose of the study, having been told that this was an intra-rater agreement study. Finally, the probing procedure (repeated twice, one hour apart) may have disturbed the architecture of the bacterial biofilm, and this may have been sufficient to lead to a reduction in inflammation after two weeks.

Regardless of the phenomenon that generated the differences between T0 and T2, it is in any case clear that it was not attributable to any therapy, given that no treatment was administered. This effect is not even attributable to a placebo effect, which occurs when the patients or the operators or the examiners imagine that a treatment has in any case been delivered. It is, however, important to note that if therapy had been carried out, for example in a case series, we would have erroneously attributed the effect to that therapy. From these observations we can assume that, to establish the efficacy of a therapy that includes probing depth and other periodontal indices as outcome variables, it is necessary to use a control group, possibly in a randomised controlled study. Only in this way, by comparing the difference in efficacy between two or more therapies, we can have results unburdened by the measurement error, Hawthorne effect, placebo effect and, as we have seen, the effect due to the probing itself. Indeed, these effects are produced in the same way in different arms of a

randomised controlled trial, and are eliminated by considering the outcome differences between the arms.

The principal limitation of this study is that it was not itself a randomised controlled trial. Unfortunately, it is very difficult to design an RCT on this subject because the probing was the "therapy" under investigation, and the resulting measures are the outcome variables. For this reason, if in one arm we did not perform probing, it would not be possible to determine whether pocket depth is changed in a subsequent measure.

It is also important to note that in this study untreated periodontal patients with high levels of FMPS and FMBS were included. The observed effects may not occur in treated periodontal patients or patients with good oral health.

CONCLUSIONS

Ordinary periodontal variables such as dental plaque, bleeding on probing, pocket depth, and gingival recession can change over time without performing therapy. In particular, merely recording these variables can increase bleeding on probing and reduce plaque after one hour. After two weeks, a decrease in inflammation was noted, characterized by reduced bleeding on probing and probing depth, and a slight increase in gingival recession.

REFERENCES

1. Listgarten MA. Periodontal probing: what does it mean? J Clin Periodontol 1980;7(3):165-76.
2. Armitage GC. Manual periodontal probing in supportive periodontal treatment. Periodontol 2000 1996;12:33-9.
3. Al Shayeb KN, Turner W, Gillam DG. Periodontal probing: a review. Prim Dent J 2014;3(3):25-9.
4. Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: framework and proposal of a new classification and case definition. J Clin Periodontol 2018;45(Suppl 20):S149-61.
5. Fleiss JL, Mann J, Paik M, Goultchin J, Chilton NW. A study of inter- and intra-examiner reliability of pocket depth and attachment level. J Periodontal Res 1991;26(2):122-8.
6. Hefti AF, Preshaw PM. Examiner alignment and assessment in clinical periodontal research. Periodontol 2000 2012;59(1):41-60.
7. Corraini P, Baelum V, Lopez R. Reliability of direct and indirect clinical attachment level measurements. J Clin Periodontol 2013;40(9):896-905.
8. Merli M, Bernardelli F, Giulianelli E, Toselli I, Moscatelli M, Pagliaro U, Nieri M. Inter-rater agreement in the diagnosis of mucositis and peri-implantitis. J Clin Periodontol 2014;41(9):927-33.
9. O'Leary T. The periodontal screening examination. J Periodontol 1967;38:617-24.
10. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. Int Dent J 1975 ;25(4):229-35.