Loma Linda University

TheScholarsRepository@LLU: Digital Archive of Research, Scholarship & Creative Works

Loma Linda University Electronic Theses, Dissertations & Projects

12-1981

Histologic Probe Position in Treated and Untreated Human Periodontal Tissues

Clifford Fowler

Follow this and additional works at: <https://scholarsrepository.llu.edu/etd>

Part of the [Periodontics and Periodontology Commons](#)

Recommended Citation

Fowler, Clifford, "Histologic Probe Position in Treated and Untreated Human Periodontal Tissues" (1981).
Loma Linda University Electronic Theses, Dissertations & Projects. 1177.
<https://scholarsrepository.llu.edu/etd/1177>

This Thesis is brought to you for free and open access by TheScholarsRepository@LLU: Digital Archive of Research, Scholarship & Creative Works. It has been accepted for inclusion in Loma Linda University Electronic Theses, Dissertations & Projects by an authorized administrator of TheScholarsRepository@LLU: Digital Archive of Research, Scholarship & Creative Works. For more information, please contact scholarsrepository@llu.edu.

Abstract

HISTOLOGIC PROBE POSITION IN TREATED AND UNTREATED HUMAN PERIODONTAL TISSUES

by

Clifford Fowler, Steve Garrett,

Max Crigger and Jan Egelberg

This study was designed to histologically determine the relationship of the periodontal probe tip to the periodontal tissues during probing of untreated periodontal pockets and periodontal pockets treated with oral hygiene and root planing. Human, condemned, single rooted teeth with buccal probing pocket depth at least 6 mm were used. Two groups of specimens were included: 12 untreated teeth from 6 patients and 15 treated teeth from 10 patients.

In the treated group, the effects of therapy were monitored clinically every two weeks until maximum improvement had taken place. A periodontal probe tip was then inserted on the buccal aspect of the tooth using 0.50 N pressure, and block section biopsies were taken. The histologic examination of the untreated teeth showed that the probe tip penetrated beyond the apical termination of the junctional epithelium and into the subjacent connective tissue by a mean of $0.45\pm$

0.34 mm, whereas in the treated specimens the probe stopped coronal to this landmark by a mean of 0.73 ± 0.80 mm.

This study demonstrated that the probe tip most often does not reach the base of the junctional epithelium in pockets treated by plaque control and root planing, and that clinical measurements of attachment levels are not reliable in determining the true histologic level of connective tissue attachment.

LOMA LINDA UNIVERSITY

Graduate School

HISTOLOGIC PROBE POSITION IN TREATED
AND UNTREATED HUMAN PERIODONTAL TISSUES

by

Clifford Fowler, Steve Garrett,

Max Crigger and Jan Egelberg

A Manuscript Submitted by Clifford Fowler
in Partial Fulfillment of the Requirements for the Degree
Master of Science in Periodontology

December 1981

Each person whose signature appears below certifies that this manuscript in his opinion is adequate, in scope and quality, in lieu of a thesis for the degree Master of Science.

Chairman
Jan Egelberg, L.D.S., Odont. Dr.

Steven Garrett, D.D.S., M.S.

Max Crigger, D.D.S., M.S.

ACKNOWLEDGEMENTS

Appreciation is extended to the Department of Periodontics, namely, Jan Egelberg, L.D.S., Max Crigger, D.D.S. and Steve Garrett, D.D.S. for their indispensable guidance and stimulation. Appreciation is also extended to Julie Cranfill for her secretarial assistance.

INTRODUCTION

Periodontal probing is used to clinically determine the results of periodontal therapy based on the variation in penetration of the probe tip into the gingival tissue. Recent studies have demonstrated that the depth of probe penetration is not only dependent on the level of connective tissue attachment to the tooth but also on such factors as the dimension of the probe tip, the probing force and the degree of inflammation of the gingival tissue (see reviews by Listgarten 1980, and Robinson & Vitek 1980).

Further studies are needed to clarify the interpretation of probe penetration following periodontal therapy. This study was designed to histologically determine the relationship of the probe tip to the periodontal tissue in untreated periodontal pockets and periodontal pockets treated with oral hygiene and root planing.

MATERIALS AND METHODS

Subjects

Patients having at least one single rooted tooth condemned for extraction were screened for this study. Twenty-seven teeth demonstrating a periodontal pocket 6 mm or deeper with at least 6 mm of attachment loss on the buccal aspect were selected from 16 subjects. Twelve teeth from six subjects were selected to remain untreated, and 15 teeth from ten subjects were selected to be treated.

Clinical parameters

Gingival fluid measurements were made only in the treated group to supplement the probings to evaluate the effect of treatment. Filter paper strips were placed at the orifice of the crevice for three minutes as described by Löe and Holm-Pederson (1965). The strips were dried, saturated with ninhydrin and the stained area determined by microscopic grid square analysis with a 10 X 10 ocular grid at 100X magnification.

Probing records were taken in the untreated and the treated group using a Michigan #1 periodontal probe* with a

* Marquis Dental Manufacturing Company, Denver, CO, U.S.A.

terminal diameter of 0.40 mm and machined to 1 mm increments. An electronic pressure sensitive device* enabled application of a standardized probing pressure of 0.50 N. The probing measurements were performed by inserting the probe tip into the buccal sulcus parallel to the long axis of the tooth. A gentle but increasing force was applied until 0.50 N was reached as indicated by an audible beep from the pre-set pressure device. The amount of penetration, i.e. probing pocket depth, was then recorded to the nearest 0.5 mm. The distance from the cemento-enamel junction to the gingival margin was also recorded with the same probe enabling calculation of probing attachment level and gingival recession. This initial probe placement dictated the orientation of a reference groove which was cut into the dentin to serve as a positioning guide for all subsequent probing measurements.

After removal of the probe, the gingival margin was examined, and the presence or absence of bleeding was recorded.

Treatment

After initial clinical measurements, the subjects in the treated group were given mechanical plaque control instruc-

* Electronic Periodontal Probe, Model 200, Vine Valley Research, Middlesex, NY, U.S.A.

tion using toothbrush and dental floss. The teeth were then carefully root planed until the surfaces were smooth and free of detectable deposits, using Gracey 5-6 and 11-12 curettes*. All instrumentation was accomplished in one visit by the same investigator.

The subjects were seen every two weeks for reinforcement of plaque control and for recordings of the clinical parameters. The measurements were taken until healing and stabilization was reached. This was determined by three consecutive recordings showing no further improvement. This took from 10 to 23 weeks with the teeth under study. The experimental procedures are outlined in Fig. 1.

Histology

After the initial recording of the untreated teeth and the final recording of the treated teeth, the probe tip was withdrawn and detached from the pressure sensitive probe handle. It was immediately reinserted by hand to the pre-recorded depth. The tip was securely fixed to the tooth crown with acid etch composite material. The buccal portion of all treated and untreated teeth, their adjacent periodontal tissues, and the probe were removed in block section.

* Hu-Friedy Manufacturing Company, Chicago, ILL, U.S.A.

The sections were fixed in 10% neutral buffered formalin and demineralized in 5% formic acid. Following demineralization, the probe tip was carefully removed.

The specimens were prepared for routine paraffin embedding. Serial bucco-lingual sections 7 μ thick were made and stained with hematoxylin and eosin for histologic examination. The section demonstrating the most apical penetration of the probe tip in relation to the apical termination of the junctional epithelium was selected for histometric analysis using a 10 X 10 ocular grid at 100X magnification.

The distances from the probe tip to (1) the gingival margin, (2) the base of the junctional epithelium, (3) the nearest alveolar bone, and (4) the alveolar bone crest were recorded to the nearest 0.05 mm.

A connective tissue inflammatory index was taken by positioning the grid at the probe tip and parallel to the probe surface. The number of grid squares lying over connective tissue exhibiting clusters of five or more inflammatory cells were recorded. The grid was moved coronally and the recording process repeated. The combined ratio of the number of inflamed grid areas over the total number of possible grid areas was calculated. The histometric methods are diagrammed in Fig. 2.

RESULTS

Clinical Measurements

Untreated specimens (Table 1). The probing pocket depth prior to biopsy ranged from 6.0 to 7.0 mm with a mean depth of 6.1 mm. All sites bled upon probing.

Treated specimens (Table 2). The pretreatment probing pocket depth ranged from 6.0 to 8.5 mm with a mean depth of 6.5 mm. Bleeding upon probing was encountered in 13 of the 15 sites. These clinical measurements from the pretreatment group compared well with those of the untreated group. The gingival fluid measurements showed a mean of 2.6 mm^2 .

All of the clinical parameters were significantly changed following the treatment phase. Probing pocket depth was reduced by 2.2 mm. This was explained by 0.8 mm gingival recession and 1.4 mm gain of probing attachment level. Bleeding on probing was absent in 14 of the 15 sites. The gingival fluid was reduced to 0.7 mm^2 .

Histologic Measurements

Untreated specimens (Table 3, Fig. 3). The probe tip reached beyond the base of the junctional epithelium in 11 of 12 specimens by a mean penetration of 0.45 mm. Also, the probe tip was found apical to the alveolar bone crest in 7 of the 12 specimens. The mean distance between the probe

tip and the nearest alveolar bone was 0.52 mm. The connective tissue inflammatory index ranged from 52 to 93 percent, with a mean of 67 percent.

Treated specimens (Table 4, Figs. 4, 5 and 6). The probe tip was found coronal to the base of the junctional epithelium in 13 of the 15 specimens and stopped on the average 0.73 mm short of this landmark. The distance from the probe tip to the alveolar bone crest varied from 3.5 mm apical to the bone crest to 2.2 mm coronal to the crest. The mean distance between the probe tip and the nearest alveolar bone was 1.25 mm. The connective tissue inflammatory index ranged from 5 to 69 percent, with a mean of 34 percent.

The results of statistical comparisons between the untreated and the treated specimens using Student's t-test for unpaired samples are presented in Table 5.

DISCUSSION

Success or failure of periodontal treatment is generally determined by clinical measurements, relying particularly on the increase or decrease in probing attachment levels recorded by periodontal probing (i.e. Ramfjord et al. 1975, Rosling et al. 1976). Human and animal studies have not provided histologic evidence of new connective tissue attachment on previously diseased root surfaces following conventional periodontal treatment methods (Listgarten & Rosenberg 1979, Caton & Zander 1979, Caton & Nyman 1980, Caton et al. 1980, Steiner et al. 1981). From these studies it appears that improved probing attachment levels following therapy may not be due to new connective tissue attachment but may be explained by improved epithelial adhesion and improved connective tissue tonus preventing the probe from penetrating to pretreatment levels.

Previous studies on the penetration of the periodontal probe have established that various factors modify the position of the probe, i.e. the probing force, probe dimension, inflammatory status of the tissue, position of the alveolar bone, sulcus or pocket depth, and length of the junctional epithelium (van der Velden 1979, 1980, Listgarten 1980, Robinson & Vitek 1980, van der Velden & Jansen 1980, 1981).

The present study used condemned human teeth with advanced periodontitis and buccal pocket depth at least 6 mm. A pressure sensitive probe described by Polson et al. (1980) were used. A probing force of 0.50 N and probe tip diameter of 0.40 mm were selected. The effects of treatment were monitored every two weeks and the teeth were removed in block section when the optimal effect of treatment was obtained as determined by stabilization of clinical recordings.

The biopsy procedure involved removing a portion of the tooth in block with the probe fixed in place with adjacent soft and bony tissues intact. This allowed histologic evaluation of the relation of the probe to the base of the junctional epithelium. It also permitted a study of the relationship between penetration of the probe and adjacent alveolar connective tissue.

The results of the study demonstrated that in the untreated specimens the probe tip generally penetrated apical to the base of the junctional epithelium (mean -0.45 mm). These findings are in accordance with several previous studies (Saglie et al. 1975, Listgarten et al. 1976, Sivertson & Burgett 1976, Armitage et al. 1977, Spray et al. 1978, Robinson & Vitek 1979, Magnusson & Listgarten 1980, Jansen et al. 1981). In the majority of the treated specimens the probe tip stopped coronal to the base of the junctional

epithelium (mean 0.73 mm). Thus, the difference of probe penetration between untreated and treated specimens was approximately 1.2 mm. This difference approximates the 1.4 mm gain of probing attachment level seen in the clinical recordings of the treated specimens.

The observed difference in the probe tip penetration in the treated and untreated specimens is in agreement with the findings by Magnusson & Listgarten (1980). The results of the present study showed that this difference seems to be related to the level of connective tissue inflammation. The available data does not allow the determination of a cause and effect relationship, but it seems reasonable that reduced inflammatory infiltrate levels would allow for greater resistance to probe penetration.

In attempts to evaluate the effect of the location of alveolar bone on the penetration of the probe, the analyses were somewhat inconclusive. In some treated as well as some untreated specimens the probe tip went apical to the bone crest into intrabony defects. Evaluating the distance of the probe tip to the nearest bone, the probe stopped nearer the bone in untreated specimens than in treated specimens. This indicates that in a diseased state the bone may be more responsible for stopping the probe than in a more healthy condition.

There are some limitations to the present study. Teeth that are scheduled for extraction may provide special situations which may influence the results. In addition, with the exception of one patient, the untreated and treated teeth were obtained from separate individuals. Therefore, comparisons between the two groups of specimens should be made with caution. However, the fact that there was similar clinical characterization of the untreated teeth and the pretreatment status of the treated teeth was helpful.

Since block biopsies of buccal sites could be done without creating residual defects of the alveolar ridge, only buccal surfaces were evaluated in this study. Results for buccal surfaces may not necessarily be valid for other aspects of the teeth. A final concern involves the placement of the probe tip prior to biopsy. The probe was first positioned with the use of the electronic pressure sensitive device. The probe was then removed and reinserted to the prerecorded depth and fixed to the crown surface. There is a possibility of error in the replacement insertion.

In conclusion, and with the above limitations in mind, this study demonstrated that the probe tip most often does not reach the base of the junctional epithelium in pockets treated by plaque control and root planing. Also, the study confirmed that clinical measurements of attachment levels

are not reliable in determining the true histologic level of connective tissue attachment. It seems essential to develop additional methods of evaluating the effects of periodontal therapy.

Table 1. Untreated specimens. Clinical measurements of probing pocket depth and bleeding on probing.

Subject N=6	Tooth Number N=12	Bleeding on Probing	Probing Pocket Depth	
			Specimen Data	Patient Mean
1	12	+	6.0	6.0
11	35	+	6.5	
11	45	+	6.0	6.3
12	12	+	6.0	6.0
13	13	+	6.0	
13	11	+	6.0	6.0
14	23	+	6.0	
14	15	+	7.0	
14	13	+	6.0	6.3
15	13	+	6.0	
15	11	+	6.0	
15	43	+	6.0	6.0
Mean		12/12	6.1	6.1
+S.D.			0.3	0.2

Table 2. Treated specimens. Pre- and posttreatment clinical measurements. Gingival fluid in mm², presence (+) or absence (-) of bleeding upon probing, pretreatment probing pocket depth, post-treatment probing pocket depth, reduction of probing pocket depth, gain of probing attachment level and gingival recession in mm.

Subject	Tooth Number	Gingival Fluid		Bleeding on Probing		Probing Pocket Depth				Gain of Probing Attachment Level				Gingival Recession	
		Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Specimen Data	Patient Mean	Specimen Data	Patient Mean	Specimen Data	Patient Mean	Specimen Data	Patient Mean	Specimen Data	Patient Mean
N=10	1	21	3.2	0	-	7.0		4.0		3.0		2.0		1.0	
	1	22	0.8	0	+	6.0		4.0		2.0		2.5		1.0	
	2	21	1.6	0.1	+	6.5		3.0		3.5		2.5		1.0	
	2	23	2.2	0.1	+	6.0		3.5		2.5		2.5		0	
	2	35	2.8	1.1	+	6.0		5.0		1.0		1.0		0	
	3	34	7.0	0.3	+	6.0		4.0		2.0		2.3		0	
	4	11	0.2	0	+	6.0		5.0		1.0		1.0		1.5	
	5	21	1.8	0	+	6.0		3.5		2.5		2.5		1.0	
	6	41	5.2	4.2	+	7.5		5.5		2.0		2.0		1.0	
	7	11	0.6	0	-	6.0		4.0		1.5		0.5		1.0	
N=15	7	21	0.2	0	+	6.5		5.5		1.0		1.3		0	
	8	14	1.1	0.9	+	6.0		4.5		1.5		1.5		1.0	
	9	41	2.0	1.7	+	7.0		4.5		2.5		2.0		0.5	
	9	42	2.0	1.4	+	8.5		5.5		3.0		2.8		0.5	
	10	33	8.8	0.2	+	7.0		3.0		4.0		4.0		1.0	
	Mean		2.6	0.7	13/15	6.5		4.3		2.2		2.2		1.4	
	±S.D.		2.5	1.1		0.7		0.9		0.9		0.9		0.5	

Table 3. Untreated specimens. Histometric analysis. Distances from probe tip (PT) to base of junctional epithelium (BJE), from probe tip to alveolar bone crest (BC), from probe tip to nearest alveolar bone (NB) in mm and connective tissue inflammatory index (CTI) in percent.

Sub- ject	Tooth Num- ber	Probe Tip (PT) to the Base of Junctional Epithelium (BJE)		Probe Tip (PT) to the Alveolar Bone Crest (BC)		Probe Tip (PT) to the Nearest Alveo- lar Bone (NB)		Connective Tissue Inflammatory Index (CTI)	
		Specimen Data	Patient Mean	Specimen Data	Patient Mean	Specimen Data	Patient Mean	Specimen Data	Patient Mean
N=6	N=12								
1	12	-0.2*	-0.2	-0.1	-0.1	0.3	0.3	63	63
11	35	0.1		---	*	---	*	59	
11	45	-0.2	-0.1	-0.1	-0.1	0.8	0.8	68	64
12	12	-0.5	-0.5	0.3	0.3	0.6	0.6	93	93
13	13	-0.6		-0.3		0.4		78	
13	11	-0.4	-0.5	-0.7	-0.5	0.4	0.4	79	79
14	23	-0.6	-0.8	---	**	0.4	0.6	52	57
14	15	-1.3		-1.3		0.5		64	
14	13	-0.4		0.8	-0.3	0.9		56	
15	13	-0.3		-0.7		0.8		57	
15	11	-0.6		-1.0		0.5		70	
15	43	-0.4	-0.4	0.0	-0.6	0.1	0.5	63	63
Mean		-0.45	-0.42	-0.31	-0.27	0.52	0.53	67	70
+S.D.		0.34	0.25	0.63	0.35	0.26	0.19	12	14

* (-) minus = probe tip is apical to the histologic landmark

** No alveolar bone observed in biopsy

Table 4. Treated specimens. Histometric analysis. Distance from probe tip (PT) to base of junctional epithelium (BJE), from probe tip to alveolar bone crest (BC), from probe tip to nearest alveolar bone (NB) in mm and connective tissue inflammatory index (CTI) in percent.

Sub- ject	Tooth Num- ber	N=10		N=15		N=10		N=15		N=10		N=15	
		Probe Tip (PT) to Base of Junctional Epithelium (BJE)	Specimen Mean	Probe Tip (PT) to Alveolar Bone Crest (BC)	Specimen Mean	Probe Tip (PT) to Nearest Alveolar Bone (NB)	Specimen Mean	Connective Tissue Inflammatory Index (CTI)	Specimen Mean	Probe Tip (PT) to Base of Junctional Epithelium (BJE)	Specimen Mean	Probe Tip (PT) to Alveolar Bone Crest (BC)	Specimen Mean
1	21	1.4		-0.3		1.4		69		1.4		1.7	
1	22	1.1		1.4		1.6		21		1.6		1.7	
2	21	2.7		2.2		2.4		5		2.4		2.4	
2	24	0.8		-0.4		1.0		12		1.0		1.0	
2	35	0.0		1.2		1.5		49		1.5		1.1	
3	34	-0.4*		-0.4		0.6		48		0.6		0.6	
4	11	0.8		0.8		1.3		19		1.3		1.3	
5	21	0.4		0.4		1.0		28		1.0		1.0	
6	42	-0.1		0.4		0.4		41		0.4		0.4	
7	11	0.8		1.7		1.8		19		1.8		1.8	
7	21	0.4		0.8		1.0		23		1.4		1.0	
8	14	0.4		0.4		---		38		---		---	
9	41	1.8		1.8		1.8		51		1.8		1.8	
9	43	0.0		0.9		1.3		---		1.3		0.7	
10	33	0.8		0.8		1.3		50		1.3		1.3	
Mean		0.73		0.59		1.25		34		1.16		0.54	
+S.D.		0.80		0.54		0.91		18		0.41		0.54	

* (-) minus= probe tip is apical to the histologic landmark
 ** No alveolar bone observed in the biopsy
 *** Insufficient connective tissue available in the biopsy

Table 5. Results of statistical comparison of histologic parameters between untreated and treated specimens. Means, standard deviations and levels of statistical significance.

	Specimen Data		Patient Data	
	Untreated	Treated	Untreated	Treated
Probe Tip (PT) to Base of Junctional Epithelium (BJE)	-0.45±0.34	0.73±0.80	-0.42±0.25	0.59±0.54
	p < 0.001		p < 0.001	
Probe Tip (PT) to Alveolar Bone Crest (BC)	-0.31±0.63	0.16±1.54	-0.27±0.35	0.13±0.91
	N.S.		N.S.	
Probe Tip (PT) to Nearest Alveolar Bone (NB)	0.52±0.26	1.25±0.54	0.53±0.19	1.16±0.41
	p < 0.001		p < 0.01	
Connective Tissue Inflammation Index (CTI)	67±12	34±18	70±14	36±13
	p < 0.001		p < 0.001	

REFERENCES

- Armitage, G.C., Svanberg, G.K. & Löe, H. (1977) Microscopic evaluation of clinical measurements of connective tissue attachment levels. Journal of Clinical Periodontology 4, 173-190.
- Caton, J.G. & Zander, H.A. (1979) The attachment between tooth and gingival tissue after periodic root planing and soft tissue curettage. Journal of Periodontology 50, 462-466.
- Caton, J. & Nyman, S. (1980) Histometric evaluation of periodontal surgery I. The modified Widman flap procedure. Journal of Clinical Periodontology 7, 212-223.
- Caton, J., Nyman, S. & Zander, H. (1980) Histometric evaluation of periodontal surgery II. Connective tissue attachment levels after four regenerative procedures. Journal of Clinical Periodontology 7, 224-231.
- Jansen, J., Pilot, R. & Corba, N. (1981) Histologic evaluation of probe penetration during clinical assessment of periodontal attachment levels. Journal of Clinical Periodontology 8, 98-106.
- Listgarten, M.A., Mao, R. & Robinson, P.J. (1976) Periodontal probing and the relationship of the probe tip to periodontal tissues. Journal of Periodontology 47, 510-513.
- Listgarten, M.A. & Rosenberg, M.M. (1979) Histological study of repair following new attachment procedures in human periodontal lesions. Journal of Periodontology 50, 333-344.
- Listgarten, M.A. (1980) Periodontal probing: What does it mean? Journal of Clinical Periodontology 7, 165-176.
- Löe, H. & Holm-Pedersen, P. (1965) Absence and presence of fluid from normal and inflamed gingivae. Periodontics 3, 171-177.

- Magnusson, I. & Listgarten, M.A. (1980) Histologic evaluation of probing depth following periodontal treatment. Journal of Clinical Periodontology 7, 26-31.
- Polson, A.M., Caton, J.G., Yeaple, R.N. & Zander, H.A. (1980) Histological determination of probe tip penetration into gingival sulcus of humans using an electronic pressure-sensitive probe. Journal of Clinical Periodontology 7, 479-488.
- Ramfjord, S.P., Knowles, J.W., Nissle, R.R., Burgett, F.G. & Shick, R.A. (1975) Results following three modalities of periodontal therapy. Journal of Periodontology 46, 522-526.
- Robinson, P.J. & Vitek, R.M. (1979) The relationship between gingival inflammation and resistance to probe penetration. Journal of Periodontal Research 14, 239-243.
- Robinson, P.J. & Vitek, R.M. (1980) Periodontal examination. Dental Clinics of North America 24, 597-612.
- Rosling, B., Nyman, S., Lindhe, J. & Jern, B. (1976) The healing potential of the periodontal tissues following different techniques of periodontal surgery in plaque-free dentitions. A 2-year study. Journal of Clinical Periodontology 3, 233-250.
- Saglie, R., Johansen, J.R. & Flotra, L. (1975) The zone of completely and partially destructed periodontal fibers in pathological pockets. Journal of Clinical Periodontology 2, 198-202.
- Sivertson, J.F. & Burgett, F.G. (1976) Probing of pockets related to the attachment level. Journal of Periodontology 47, 281-286.
- Spray, J.R., Garnick, J.J., Doles, L.R. & Klawitter, J.J. (1978) Microscopic demonstration of the position of periodontal probes. Journal of Periodontology 49, 148-152.

- Steiner, S.S., Crigger, M. & Egelberg, J. (1981) Connective tissue regeneration to periodontally diseased teeth. II. Histologic observations of cases following replaced flap surgery. Journal of Periodontal Research 16, 109-116.
- van der Velden, U. (1979) Probing force and the relationship of the probe tip to the periodontal tissues. Journal of Clinical Periodontology 6, 106-114.
- van der Velden, U. (1980) Influence of periodontal health on probing depth and bleeding tendency. Journal of Clinical Periodontology 7, 129-139.
- van der Velden, U. & Janse, J. (1980) Probing force in relation to probe penetration into the periodontal tissues in dogs. A microscopic evaluation. Journal of Clinical Periodontology 7, 325-327.
- van der Velden, U. & Jansen, J. (1981) Microscopic evaluation of pocket depth measurements performed with six different probing forces in dogs. Journal of Clinical Periodontology 8, 107-116.

LEGENDS

- FIGURE 1. Summary of experimental procedures.
- FIGURE 2. Schematic illustration of histometric parameters. GM = gingival margin, PT = probing tip, BJE = base of junctional epithelium, BC = bone crest, NB = nearest alveolar bone to the probe tip, CTI₁ and CTI₂ = grids for counts of connective tissue inflammatory index.
- FIGURE 3. Untreated specimen with probe tip (PT) 0.5 mm apical to the base of the junctional epithelium (BJE). Dense inflammatory infiltrate in the connective tissue. Subject number 12, tooth number 12.
- FIGURE 4. Treated specimen with the probe tip (PT) 0.8 mm coronal to the base of the junctional epithelium (BJE). Relative absence of inflammatory cell infiltrate. Seemingly, the contour of the root directed the probe away from the tooth surface. A thin layer of junctional epithelium surrounds the probe tip. Subject number 7, tooth number 11.
- FIGURE 5. Treated specimen demonstrating the furthest (0.4 mm) penetration of the probe tip (PT) beyond the junctional epithelium (BJE). A thin layer of junctional epithelium surround the probe tip. The root planing of this specimen created a bevel in the surface of the root. This feature was typical of most of the treated specimens. Subject number 3, tooth number 34.
- FIGURE 6. Treated specimen with the probe tip (PT) 1.4 mm coronal to the base of the junctional epithelium (BJE). The probe tip penetrated beyond the alveolar bone crest (BC). The probe tip approximated the root planing bevel in this and another two of the 15 treated specimens. Subject number 1, tooth number 21.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.