

# Probe penetration in relation to the connective tissue attachment level: influence of tine shape and probing force

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**Abstract.** Previous research has shown that probing force and probe tine shape influence the clinically assessed probing depth. The purpose of the present study was to investigate the effect of tine shape and probing force on probe penetration, in relation to the microscopically assessed attachment level in untreated periodontal disease. In 22 patients, scheduled for partial or full mouth tooth extraction and no history of periodontal treatment, 135 teeth were selected. At mesial and distal sites of the teeth reference marks were cut. Three probe tines, mounted in a modified Florida Probe® handpiece, were tested: a tapered, a parallel and a ball-ended; tip-diameter 0.5 mm. The three tines were distributed at random over the sites. At each site increasing probing forces of 0.10 N, 0.15 N, 0.20 N, 0.25 N were used. After extraction, the teeth were cleaned and stained for connective tissue fiber attachment. The distance between the reference mark and the attachment level was determined using a stereomicroscope. The results showed that the parallel and ball-ended tine measured significantly beyond the microscopically assessed attachment level at all force levels; with increasing forces, the parallel tine measured 0.96 to 1.38 mm and the ball-ended tine 0.73 to 1.06 mm deeper. The tapered tine did not deviate significantly from the microscopic values at the forces of 0.15, 0.20 and 0.25 N. It can be concluded that for the optimal assessment of the attachment level in inflamed periodontal conditions, a tapered probe with a tip diameter of 0.5 mm and exerting a probing force of 0.25 N may be most suitable.

**Key words:** periodontal probing; probe tine shape; probing forces; inflamed periodontium; attachment level

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The most widely used tool for the clinical diagnosis of periodontitis is the periodontal probe. In general, three characteristics are evaluated, i.e., pocket depth, bleeding on probing and attachment level. The latter is by far the most important parameter, but also the most difficult to evaluate. The cemento-enamel junction may be difficult to locate, due to caries, restorations and abrasions. A solution which is often chosen to overcome the problems associated with the assessment of the cemento-enamel junction is the use of a splint as a reference point. Fur-

thermore, the location of the attachment level is difficult to assess due to inflammation of the periodontal tissues at the bottom of the pocket and the accessibility of that area to the probe. During recent decades, several studies have investigated the relationship between inflammation and periodontal probing. In general the results suggest that when the periodontal tissues are healthy, the probe tip remains coronal to the attachment level. In contrast, when inflammation is present at the bottom of the pocket, the probe tip is located apically to the

attachment level (Listgarten et al. 1976, Armitage et al. 1977, Garnick et al. 1980, Hancock & Wirthlin, 1981, Fowler et al. 1982).

In order to improve the assessment of the location of the attachment level, research has focused on factors such as probing force and the flexibility and shape of the probe tine. With regard to probing force, it was shown that with increasing forces the probing depth increases as well (Robinson & Vitek 1978, Van der Velden & De Vries, 1978, Barendregt et al. 1996). This implies that with increasing forces the location of

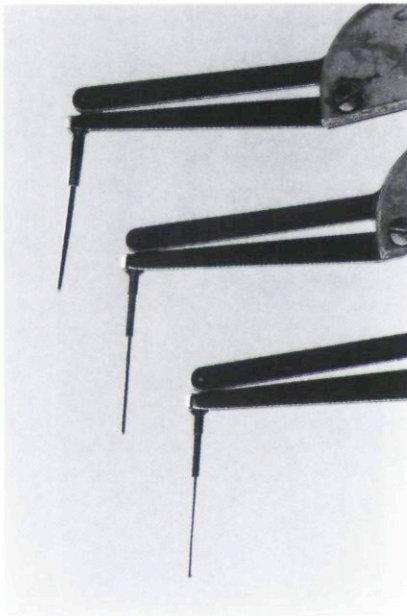


Fig. 1. Florida Probe® handles mounted with three custom made probe tines: upper: tapered tine; middle: parallel tine; lower: ball-ended tine.

the probe tip may change from a coronal to an apical position relative to the true attachment level. Concerning the flexibility of the probe tine, Schmid (1967) introduced a plastic periodontal probe, the Plasto-probe. However, no additional advantages over a normal metal probe were found (Sanderink et al. 1983).

The influence of the shape of the probe tine was studied by Atassi et al. (1991) and Barendregt et al. (1996). The first study suggested deeper probing measurements using the parallel tine, compared to the tapered tine. The latter paper reported significantly deeper recordings of probing depths with the WHO (ball-ended) tine compared to the parallel and tapered sided tines. However, in these two above mentioned studies, the probing depth was evaluated in (relatively) healthy sites. Furthermore, no attempt was made to evaluate the relationship between the location of the probe tip and the true attachment level in the inflamed situation.

Therefore, the purpose of the present study was to investigate in untreated periodontitis, the influence of tine shape and probing force on probe penetration in relation to the attachment level as determined microscopically.

## Material and Methods

### Subjects

A total of 22 patients (16 male and 6 female; mean age 54.5 years) volunteered to participate in this study. The selected patients had teeth which were scheduled for extraction in order to provide an immediate (complete) denture. The criteria for patient selection: untreated severe periodontitis characterised by moderate to deep pocketing in conjunction with severe attachment loss in at least one of the teeth to be extracted.

### Probe tines and forces

Three, custom made, probe tines (Sparnaay, Amsterdam, The Netherlands) were used: (1) a tapered tine, increasing in diameter from 0.5 mm at the tip to 0.7 mm at the 7 mm marking and 0.8 mm at the 10 mm marking; (2) a parallel tine of 0.5 mm diameter; (3) a ball-ended tine, ball diameter 0.5 mm, with a parallel shaft of 0.3 mm (Fig. 1). The probe tines were mounted in a Florida Probe® handpiece (Florida Probe Company, Gainesville, Florida, USA) which was modified (Sparnaay), so that the exerting force could be adjusted to either 0.10 N, 0.15 N, 0.20 N or 0.25 N probing force (probing pressure: 51 N/cm<sup>2</sup>, 76 N/cm<sup>2</sup>, 102 N/cm<sup>2</sup>, 127 N/cm<sup>2</sup>, respectively). In ad-

dition a manual conventional probe (Williams, Hu-Friedy, USA) was used. This is a tapered probe with the same probe tip dimensions as mentioned above for the tapered probe tine.

### Clinical procedures

After local infiltration anesthesia in the buccal and lingual fold, reference marks, parallel to the long axis of the experimental teeth were cut with a cylindrical burr (Fg 112 010, Horico®, Berlin, Germany). The burr had the same diameter as the sleeve of the Florida Probe® handpiece, so that the reference marks facilitated reproducible placement of the handpiece and thus optimal measurements. The marks were made mesial and distal of each tooth, in the majority of teeth both from the buccal and the lingual aspect, so that the most apical point of the reference mark was located at the gingival margin (Fig. 2).

Probe penetration measurements (PPM) were recorded through the hardware and software of the Florida Probe® system to 0.1 mm precision. During this procedure, the edge of the sleeve of the probe was located at the bottom of the reference marks. At each probing site increasing forces of 0.10 N, 0.15 N, 0.20 N and 0.25 N were used. The sites were randomly allocated for each probe tine. Each site was probed with only one

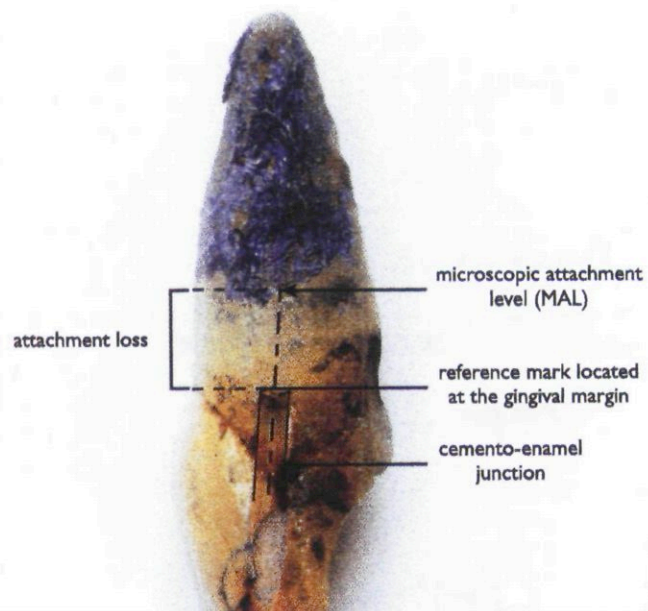


Fig. 2. Example of the measurements on one of the extracted experimental teeth. Indicated in the figure is the reference mark and the microscopic attachment level. The distance between these two landmarks was measured to determine microscopic attachment loss.

probe tine. During the probing, the examiner (HMB) was blind for all the recorded measurements due to direct collection of the data into the computer.

After all force controlled measurements were completed, the probe penetration was assessed again at the reference marks, using a Williams probe. These assessments were recorded to the nearest whole mm. Following the manual probing procedure, an estimation of the amount of force was made by repeating the probing procedure on an electronic balance with digital readout.

Finally, the experimental teeth were extracted for further analysis.

### Microscopic assessments

Immediately after extraction, the teeth were rinsed with running tap water and cleaned with an electric toothbrush (Braun/Oral B, Plak Control®), in order to remove blood, plaque and epithelial cell remnants. After cleaning, the teeth were stained with mercury bromophenol blue (Mazia et al. 1953). The location of the most coronal connective tissue fibers was determined by using a stereomicroscope at  $\times 80$  magnification. Microscopic attachment level measurements (MAL) were made up to 0.1 mm precision with the parallel tine mounted in a Florida Probe® handpiece. During this procedure the edge of the sleeve of the probe was located at the bottom of the reference mark, whereas the tip of the tine was fixed at the microscopic attachment level. The measurements were again made through the software of the Florida Probe® system. In addition, the amount of recession was established by determining the distance between the cemento-enamel junction and the bottom of the reference mark, using the Florida Probe®, up to 0.1 mm.

### Data analysis

The differences between the probe penetration measurements (PPM) of each probe tine at each force level and the microscopic attachment level measurements (MAL) were calculated. A mixed models analysis (BMDP 3V) was carried out to determine disturbing influences of between-patient differences. Adjusted means and 95% CFI of differences between PPM and MAL were computed using covariance matrices of this analysis. To determine differences between probe tines, post

testing was performed using a Student *t*-test for 2 independent samples. *p*-values  $<0.05$  were accepted as statistically significant.

### Results

The material consisted of 128 extracted teeth with a total of 429 evaluable sites. The mean distance from the cemento-enamel junction to the bottom of the reference mark, i.e. gingival recession, amounted to 1.92 mm (sd=1.61). The attachment level as assessed microscopically was 3.22 mm (sd=1.70) apical from the reference mark. When using the Williams probe, the mean value of the probe penetration was 4.00 mm (sd=1.86). The exerted manual probing force amounted to, on average, 0.45 N (probing pressure: 229 N/cm<sup>2</sup>).

### Comparisons clinical force controlled measurements and microscopic assessments

#### Tapered probe tine

The results showed that the mean value of the microscopically assessed attach-

ment level (MAL) for the sites measured with the tapered probe tine was 3.24 mm (Table 1). The mean values of the clinical force controlled probe penetration measurements (PPM) varied from 2.80 mm at the 0.15 N force level, to 3.14 mm at the 0.25 N force level (Table 1). At all force levels, the probe tip was, on the average, located coronally to the microscopically assessed attachment level: mean difference between PPM and MAL increased from -0.43 mm at 0.10 N to -0.10 mm at 0.25 N (Table 2). The mean values of the measurements carried out with the Williams probe, at the same sites was 4.04 mm (Table 1). This means that the probe tip was located 0.81 mm apically from the microscopic attachment level (Table 2).

In Table 3, the statistically determined adjusted means and the confidence intervals of the differences between PPM and MAL, corrected for the patient effect, are presented. These data show that at the force level of 0.10 N the tapered probe tine was significantly different (more coronal) from the MAL, while at force levels of 0.15, 0.20 and 0.25 N the tapered tine measure-

Table 1. Mean values, mm±standard deviations, of probe penetration measurements (PPM) and the microscopically assessed attachment level (MAL) in 3 groups of randomly assigned sites evaluated with a tapered, parallel and ball-ended probe

	Tapered probe sites	Parallel probe sites	Ball-ended probe sites
microscopic assessment (MAL)	(n=135) 3.24±1.71	(n=145) 3.10±1.55	(n=149) 3.31±1.82
Williams probe (PPM)	4.04±1.96	3.96±1.71	4.01±1.93
Force controlled probe (PPM):	Tapered probe tine	Parallel probe tine	Ball-ended probe tine
0.10 N	2.80±1.88	4.06±1.81	4.04±2.00
0.15 N	2.83±1.81	4.27±1.76	4.06±2.01
0.20 N	3.11±2.00	4.41±1.79	4.26±2.05
0.25 N	3.14±2.02	4.48±1.80	4.37±1.99

Table 2. Mean differences, mm±standard deviations, between the clinical probe penetration measurements (PPM) and the microscopically assessed attachment level (MAL); a negative value indicates that with the clinical measurement, the tip of the probe is located coronally to the microscopically assessed attachment level

	Mean differences (PPM-MAL)		
	Tapered probe sites	Parallel probe sites	Ball-ended probe sites
	(n=135)	(n=145)	(n=149)
Williams probe	0.81±1.21	0.86±1.39	0.74±1.86
Force controlled probe:	Tapered probe tine	Parallel probe tine	Ball probe tine
0.10 N	-0.43±1.56	0.96±1.46	0.73±1.44
0.15 N	-0.40±1.39	1.17±1.50	0.75±1.37
0.20 N	-0.12±1.40	1.31±1.50	0.95±1.36
0.25 N	-0.10±1.44	1.38±1.49	1.06±1.25

Table 3. Means and 95% confidence intervals of differences between the probe penetration measurements (PPM) and the microscopically assessed attachment level (MAL), adjusted for patients effects; a negative value indicates that with the clinical measurement, the tip of the probe is located coronally to the microscopically assessed attachment level

	Adjusted means (PPM-MAL)		
	Tapered probe sites (n=135)	Parallel probe sites (n=145)	Ball-ended probe sites (n=149)
Force controlled probe:	Tapered probe tine	Parallel probe tine	Ball probe tine
0.10 N	-0.363 (-0.706, -0.020) <sup>a,b,c</sup>	0.719 (0.376, 1.062) <sup>a</sup>	1.045 (0.693, 1.397) <sup>a</sup>
0.15 N	-0.256 (-0.597, 0.085) <sup>b,c</sup>	0.842 (0.499, 1.185) <sup>a</sup>	1.085 (0.731, 1.439) <sup>a</sup>
0.20 N	0.136 (-0.203, 0.475) <sup>b,c</sup>	1.404 (1.063, 1.754) <sup>a,d</sup>	0.704 (0.388, 1.092) <sup>a</sup>
0.25 N	0.262 (-0.077, 0.601) <sup>b,c</sup>	1.402 (1.061, 1.743) <sup>a,d</sup>	0.817 (0.465, 1.169) <sup>a</sup>

<sup>a</sup>PPM significantly different from MAL ( $p < 0.05$ ).

<sup>b</sup>Tapered probe tine significantly different from parallel probe tine ( $p < 0.05$ ).

<sup>c</sup>Tapered probe tine significantly different from ball probe tine ( $p < 0.05$ ).

<sup>d</sup>Tapered probe tine significantly different from ball probe tine ( $p < 0.05$ ).

ments did not deviate from the microscopic assessments. This indicates that clinical probe penetration measurements obtained with 0.15, 0.20 and 0.25 N force represent best the true attachment level.

#### Parallel probe tine

The mean value of the microscopically assessed attachment level for the sites measured with the parallel probe tine was 3.10 mm. The mean values of the force controlled measurements varied from 4.06 mm at 0.10 N to 4.48 mm at 0.25 N (Table 1). At all force levels the probe tip was located apically to the microscopically assessed attachment level; the mean difference (PPM-MAL) increased from 0.96 mm at 0.10 N to 1.38 mm at 0.25 N (Table 2). The mean value of the measurements obtained with the Williams probe at the same sites was 3.96 mm (Table 1). Comparison with the microscopic measurements showed that on the average the probe tip was located 0.86 mm apical to the attachment level (Table 2).

Adjusted means and 95% confidence intervals for the differences between PPM and MAL for the parallel probe tine also showed that the probe tine tip, at all forces, was located apically to the MAL (Table 3).

#### Ball-ended probe tine

The mean value of the microscopically assessed attachment level for the sites measured with the ball-ended probe tine was 3.31 mm (Table 1). The values of the measurements increased from 4.04 mm at 0.10 N to 4.37 mm at 0.25 N. At all force levels, the probe tip was located apically to the microscopically assessed attachment level; mean difference (PPM-MAL) increased from 0.73

mm to 1.06 mm (Table 2). The mean value of the measurements carried out with the Williams probe at the same sites, was 4.01 mm (Table 1). This implies that with manual probing, the probe tip was located 0.74 mm apically to the microscopically assessed attachment level (Table 2).

The mixed model analysis showed that all measurements performed were significantly different from the microscopically assessed attachment level (Table 3), the tip of the ball-ended probe tine ended at all force levels beyond the MAL.

#### Comparison between probes

The statistical analysis (Table 3) indicate that at each force level, the differences between the tapered probe tine and the parallel probe tine as well as between the tapered- and ball-ended probe tine were significant. In other words, the parallel probe tine measured always deeper than the tapered tine at all force levels. Similarly, the ball-ended tine measured deeper than the tapered tine. The differences between the parallel- and ball-ended probe tine were significant at the force levels of 0.20 and 0.25 N.

#### Discussion

To investigate the influence of tine shape on probing depth measurements, 3 tines were compared: (1) a tapered tine, which is the most widely used tine, (2) a parallel tine, which was used for the first time by Van der Velden (1979) and (3) a ball-ended tine with a parallel shaft. This latter tine is a modification by Jeffcoat et al. (1986) from the original WHO probe introduced by Emslie

(1980). All tines compared in the present study had the same diameter at the tip (0.5 mm). The data analysis showed that the mean manual probe penetration measured from the reference mark, was 4.00 mm and the mean recession amounted to 1.92 mm. This average value of almost 6 mm of loss of connective tissue attachment as determined clinically by means of manual probing, illustrates the extent of disease in the present study population. Below follows a discussion of results separately per tine.

#### Tapered probe tine

The majority of studies evaluate the importance of probing based on data obtained with tapered probes. Frequently studied parameters are probing force, bleeding on probing and pocket depth. It has been shown that the probing force may vary greatly between examiners (0.20 N to 1.30 N; Hassel et al. 1973). Therefore, the results of manual probing, with a tapered probe without force control, show vast differences between examiners. For example, Listgarten et al. (1976) found that a tapered probe tends to measure the apical extent of the junctional epithelium, whereas Sivertson and Burgett (1976) showed that with routine clinical probing of untreated periodontal pockets, the probe tip may penetrate the coronal level of the connective tissue. In the present study, the use of a tapered manual probe without force control, resulted in a probe tip position of on average 0.8 mm apical to the true attachment level. This is in contrast to the force controlled results where the tapered probe tip was located coronally to the true attachment level. Most likely the higher probing force is responsible

for this difference: manual probing resulted in, on average, 0.45 N force (229 N/cm<sup>2</sup> probing pressure), while the force controlled probing varied from 0.10–0.25 N (probing pressure from 51 N/cm<sup>2</sup> to 127 N/cm<sup>2</sup>). The influence of probing force on the location of tapered probe tips has been the subject of a number of studies in animals and humans. In general, the animal studies included extremely shallow pockets, possibly due to the experimental procedures (Armitage et al. 1977, Hancock & Wirthlin 1981, Van der Velden & Jansen 1981, Jansen et al. 1981, Andersen et al. 1991). The results of these studies seem to suggest that in "severe periodontitis", the probe tip will be located apical to the attachment level.

In studies in man, including deep pockets, Fowler et al. (1982) showed that in untreated teeth the tapered probe tip is located 0.45 mm apical and in treated teeth 0.73 mm coronal to the true attachment level, when using a probing force of 0.50 N (398 N/cm<sup>2</sup> probing pressure). Comparable results were found by Robinson and Vitek (1979). In contrast, Garnick et al. (1980) found no differences on probe tip location between treated and untreated teeth; when using 0.20 N probing force (286 N/cm<sup>2</sup> probing pressure), the tapered probe tip was, in both conditions, on the average located at the true attachment level. The results of the present study support the concept that when using tapered probes, the probing pressure applied is an important variable. The pressures in the present study are considerably lower than those in the studies cited above. This may explain why in our experiments the tapered probe tip stopped coronally to or at the attachment level.

#### Parallel probe tine

A few studies evaluated the effect of a parallel instead of a tapered probe tine on the assessment of the true attachment level. In only two animal studies parallel probes were used (Van der Velden & Jansen 1981, Garnick et al. 1989). Both studies used a range of probing forces from light,  $\leq 0.17$  N (48 N/cm<sup>2</sup> probing pressure), to high,  $\geq 0.75$  N (256 N/cm<sup>2</sup> probing pressure), and both found that the probe displacement from the gingival margin increased with inflammation. However, this result was not statistically significant in the study of Garnick et al. (1989). Furthermore, both studies

showed that the force required to reach the attachment level amounted to over 0.45 N (160 N/cm<sup>2</sup> probing pressure). Unfortunately, as in the animal studies on tapered probes, the material included only shallow pockets. Therefore, the results of these studies are difficult to compare to the present results in patients with deep pocketing. In studies in man, the probing force required to reach the attachment level varied between 0.30 N (126 N/cm<sup>2</sup> probing pressure) (Aguero et al. 1995) and 0.75 N (240 N/cm<sup>2</sup> probing pressure) (Van der Velden, 1979). These values are in contrast to the present data, showing that already with a probing force of 0.10 N (51 N/cm<sup>2</sup> pressure) the parallel probe tip was located apically to the attachment level. Most likely a difference in the degree of inflammation of the periodontal tissues is responsible for the discrepancies. In the present study only patients with untreated periodontitis were included, whereas in the study of Van der Velden (1979) the teeth were extracted after initial periodontal therapy. Furthermore, in a subsequent analysis of the same material (Van der Velden 1982), it was found that in bleeding pockets the tip of the probe was located apically to the attachment level, whereas in non-bleeding sites the probe ended at the attachment level. Aguero et al. (1995) identified 3 groups with different degrees of inflammation. Their data suggest that in deep inflamed pockets, the probe tip is located apically to the attachment level. However, due to the small sample size this trend failed to reach the level of statistical significance. The assumption that the degree of inflammation is an important factor in relation to the location of the probe tip, was recently again confirmed by Ahmed et al. (1996). When using a parallel probe with a probing force of 0.20 N (160 N/cm<sup>2</sup> probing pressure) at molar sites, the tip of the probe was positioned 0.45 mm apically to the true attachment level. In non-molar sites the probe tip was located at the attachment level. Most likely this discrepancy was caused by a difference in degree of inflammation.

#### Ball-ended probe tine

As far as we know, no previous studies have been carried out which evaluated the influence of probing force on the assessment of the true attachment level when using a ball-ended probe, either with a parallel shaft or a tapered shaft (WHO probe).

#### Probe tine, probing force and pocket depth

In the present study 3 probe tines and 4 levels of probing force were used. It can be argued that the probe penetration values are not only the result of the employed tine shape and the exerted force, but are also influenced by the repeated probing procedure. Repeated probing in relation to force can be carried out in 3 different ways: (i) a high force followed by a lighter force; (ii) the same force consecutively; (iii) a light force followed by a higher force. It has been shown that repeated probing with the same amount of force may lead to a slight increase in probing depth e.g. 0.1 mm in some of the cases in the study of Barendregt et al. (1996). In the present study all 4 probe penetration measurements had to be carried out consecutively before extraction. Increasing forces were used assuming that the tissues apically to the first/previous probing are not disturbed. Nevertheless, a slight influence of this way of repeated probing may have occurred. Therefore, the results of the present study must be viewed in this perspective.

The results in relation to probe tine indicate that the shape of the probe tine is an important factor in periodontal probing. Two other papers reported on the effect of tine shape on probing depth (Atassi et al. 1992, Barendregt et al. 1996). Atassi et al. (1992) used a tapered and a parallel tine. No significant differences were found in their overall material, but when a difference occurred, the parallel tine recorded the deeper measurement, as in the present data. In general, the results of the study of Barendregt et al. (1996) indicated that the ball-ended WHO tine, and the parallel tine recorded significantly deeper pocket depths compared to the tapered tine. However, these two latter studies did not evaluate true attachment levels. Therefore, the deeper probe readings of Barendregt et al. (1996) with the parallel and ball-ended WHO probe tines, might have been probe readings beyond the true attachment level.

#### Probing and treatment

As stated by Chamberlain et al. (1985), it is imperative to know and standardise the probing force for evaluating the results following periodontal therapy. However, the results of the present study show another important aspect of probing. When using the manual probe

in untreated periodontitis the probe tip was located on average 0.8 mm apically to the true attachment level. Therefore, if this measurement is used to determine the depth to which a diseased pocket should be curetted, this will lead to the removal of an amount of intact connective tissue attachment. This aspect becomes even more important when one realises that the mean value of 0.8 mm is the result of measurements which vary from 3.8 mm coronal to and 6.4 mm apical to the true attachment level. In the latter case, 6.4 mm of connective tissue attachment will be removed due to curetting to the "bottom" of the pocket. It seems likely that this may occur especially in more acute inflammatory conditions during exacerbations of the disease process.

The present data, obtained from deep inflamed periodontal pockets, showed that with the tapered probe, at the force levels of 0.15, 0.20 and 0.25 N (probing pressure: 76 N/cm<sup>2</sup>, 102 N/cm<sup>2</sup> and 127 N/cm<sup>2</sup>, respectively), the tip of the probe was located at the true attachment level. In order to evaluate the result of the periodontal treatment it is important to use the same amount of probing force/pressure before and after therapy, since the level of healing cannot be predicted. However after treatment the tonus of the gingiva increases and therefore the gingiva will fit more tightly around the teeth (Beardmore 1963). As a consequence, when using the same amount of probing forces/pressures, shallower probing depths will be recorded after treatment (Van der Velden 1980, Fowler et al. 1982, Chamberlain et al. 1985). If too gentle probing forces/pressures are applied one may run the risk that the probe tip will not enter the orifice of the pocket. Therefore based on the results of the present study, the tapered probe with 0.25 N force (127 N/cm<sup>2</sup> probing pressure), i.e., the highest force/pressure level at which the tapered probe tip was located at the true attachment level, seems most suitable for the evaluation of the periodontal condition. However, one has to bear in mind that in a number of cases, an over- or under-estimation of the true attachment level will still occur.

#### Acknowledgements

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#### Zusammenfassung

*Eindringtiefe der Parodontalsonde in Relation zum Niveau des bindegewebigen Attachments: Einfluß der Sondenform und der Sondierungskraft*

Frühere Untersuchungen zeigten, daß die Sondierungskraft und die Sondenform die klinische Messung der Sondierungstiefe beeinflussen. Der Zweck der vorliegenden Studie war es, die Wirkung der Sondenform und der Sondierungskraft auf die Eindringtiefe der Parodontalsonde zu untersuchen und mit dem zum mikroskopisch gemessenen Attachmentniveau bei unbehandelter Parodontalerkrankung zu vergleichen. Bei 22 Patienten, die für eine teilweise oder vollständige Extraktion aller Zähne vorgesehen waren und bei denen früher keine Parodontalbehandlung durchgeführt worden war, wurden 135 Zähne ausgewählt. An der Mesial- und Distalfläche der Zähne wurden Referenzmarkierungen angebracht. Es wurden drei Sondenformen, die an einem modifizierten Florida Probe<sup>®</sup>-Handstück angebracht wurden, getestet: eine konische, eine parallele und eine mit einer kugelförmigen Spitze mit jeweils 0.5 mm Durchmesser der Spitze. Die drei Formen wurden randomisiert auf die Zahnflächen verteilt. An jeder Fläche wurden ansteigende Kräfte von 0.10 N, 0.15 N, 0.20 N und 0.25 N verwendet. Nach der Extraktion wurden die Zähne gereinigt und für die Bestimmung des bindegewebigen Attachments angefarbt. Der Unterschied zwischen der Referenzmarkierung und dem Attachmentniveau wurde mittels Stereomikroskop bestimmt. Die Ergebnisse zeigten, daß die parallele und die Sonde mit kugelförmiger Spitze bei allen Sondierungskräften signifikant über das mikroskopisch gemessene Attachmentniveau hinaus maßen; mit ansteigenden Kräften maß die parallele Sonde 0.96 bis 1.38 mm und die Sonde mit kugelförmiger Spitze 0.73 bis 1.06 mm tiefer. Die Sonde mit konischer Form wich bei Kräften von 0.15 N, 0.20 N und 0.25 N nicht signifikant von den mikroskopischen Werten ab. Es kann die Schlußfolgerung gezogen werden, daß für die optimale Messung des Attachmentniveaus bei entzündetem Parodont, eine Sonde mit konischer Form und einem Durchmesser der Spitze von 0.5 mm sowie eine Sondierungskraft von 0.25 N am besten geeignet wäre.

#### Résumé

*Pénétration de la sonde par rapport au niveau de l'attache de tissu conjonctif: influence de la forme de la pointe et de la force de sondage*  
Des recherches antérieures ont montré que la force de sondage et la forme de la pointe de la sonde avaient une influence sur la mesure clinique de la profondeur de sondage. Le but du présent travail était d'étudier l'effet de la forme de la pointe et de la force de sondage sur la pénétration de la sonde, par rapport au niveau de l'attache mesuré par microscopie, dans la maladie parodontale non traitée.

Chez 22 patients convoqués pour extractions dentaires, partielles ou totales, et chez qui aucun traitement parodontal n'avait été pratiqué, 135 dents ont été sélectionnées. Des entailles repères ont été faites sur les dents dans des sites mésiaux et distaux. L'essai a porté sur 3 pointes de sondes, montées dans un manche de sonde Florida Probe<sup>®</sup> modifiée: l'une conique, l'autre de forme parallèle, la troisième à extrémité en forme de boule; le diamètre de l'extrémité était 0.5 mm. Les 3 pointes ont été réparties au hasard entre les sites. Dans chacun des sites, on utilisait des forces de sondage croissantes, de 0.10 N, 0.15 N, 0.20 N, 0.25 N. Après l'extraction, les dents ont été nettoyées et colorées pour mettre en évidence l'attache des fibres de tissu conjonctif. La distance entre les entailles repères et le niveau de l'attache a été déterminée en utilisant un stéréomicroscope. Les résultats ont montré que la pointe parallèle et la pointe à extrémité en forme de boule donnaient à tous les niveaux de force utilisés des mesures allant significativement au delà du niveau de l'attache déterminé par microscopie; à mesure que les forces augmentaient, l'augmentation de la profondeur donnée par la pointe parallèle était de 0.96 à 1.38 mm, et par la pointe à extrémité en forme de boule, de 0.73 à 1.06 mm. A des forces de 0.15, 0.20 et 0.25 N, la pointe conique ne déviait pas significativement des valeurs obtenues par microscopie. En conclusion, pour obtenir une mesure optimale du niveau de l'attache dans l'inflammation parodontale, une sonde conique dont la pointe a un diamètre de 0.5 mm et exerce une force de sondage de 0.25 N peut être le mieux appropriée.

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