

"Critical probing depths" in periodontal therapy

J. LINDHE, S. S. SOCRANSKY*, S. NYMAN, A. HAJFAJEE* AND E. WESTFELT

Department of Periodontology, Faculty of Odontology, University of Gothenburg, Gothenburg, Sweden and

*Forsyth Dental Center, Boston, MA, USA

Abstract. The present investigation was carried out on 15 individuals who were referred for treatment of moderately advanced periodontal disease. All patients were first subjected to a *Baseline examination* comprising assessment of oral hygiene and gingival conditions, probing depths and attachment levels. Following case presentation and instructions in oral hygiene measures, the patients were given periodontal treatment utilizing a split mouth design. In one side of the jaw scaling and root planing were performed in conjunction with a modified Widman flap procedure while in the contralateral jaw quadrants the treatment was restricted to scaling and root planing only. The period from initial treatment to 6 months after treatment was considered to be the *healing phase* and from 6-24 months after treatment the *maintenance phase*. During the healing phase the patients were recalled for professional tooth cleaning once every 2 weeks. During the maintenance phase the interval between the recall appointments was extended to 3 months. Reexaminations were carried out 6, 12 and 24 months after the completion of active treatment.

The results revealed that treatment resulted in loss of clinical attachment in sites with initially shallow pockets, while sites with initially deep pockets gained clinical attachment. With the use of regression analysis "critical probing depths" were calculated for the two methods of treatment used. It was found that the critical probing depth value for scaling and root planing was significantly smaller than the corresponding value for scaling and root planing used in combination with modified Widman flap surgery (2.9 vs 4.2 mm). In addition, the surgical modality of therapy resulted in more attachment loss than the non-surgical approach when used in sites with initially shallow pockets. On the other hand, in sites with initial probing depths above the critical probing depth value more gain of clinical attachment occurred following Widman flap surgery than following scaling and root planing.

The data obtained from the reexaminations 12 and 24 months after active treatment demonstrated that the probing depths and the attachment levels obtained following active therapy and healing were maintained more or less unchanged during a maintenance care period which involved careful prophylaxis once every 3 months. However, the data also disclosed that the level of oral hygiene maintained by the patients during healing and maintenance was more critical for the resulting probing depths and attachment levels than the mode of initial therapy used. Thus, sites which during the maintenance period were found to be free from supragingival plaque were associated with shallow pockets and maintained attachment levels. In contrast, sites which harboured plaque exhibited increasing probing depths and further attachment loss.

The effect of treatment of periodontal disease has been described in long-term studies by e.g. Knowles (1973), Ramfjord et al. (1973, 1975, 1980), Lindhe & Nyman (1975), Nyman et al. (1975, 1977), Rosling et al. (1976a, b), Knowles et al. (1979, 1980), Nyman & Lindhe (1979),

Badersten et al. (1981), Pihlstrom et al. (1981). Frequently the results have been reported in terms of alterations from the pretreatment status regarding e.g. oral hygiene, gingival inflammation, probing depths, attachment levels and alveolar bone height. The parameters

studied have been expressed as mean values representing the individual, different groups of teeth or tooth surfaces. The findings reported unequivocally demonstrate that different modalities of periodontal therapy may be successful in patients who following active therapy are incorporated in a carefully designed maintenance care program.

Recently Morrison et al. (1980), Badersten et al. (1981), Pihlstrom et al. (1981) and Lindhe et al. (1982) observed that reduction in probing depths and gain of clinical attachment can be obtained by oral hygiene instruction and scaling and root planing. It was suggested (Morrison et al. 1980, Lindhe et al. 1982) that the improvements of periodontal health previously attributed to surgical methods of therapy could be obtained by non-surgical methods. This means that the effect of a surgical procedure *per se* can be evaluated only in trials in which a control group subjected to scaling and root planing alone has been incorporated.

The effect of periodontal therapy on clinical attachment levels has been examined and related to initial probing depths (e.g. Knowles et al. 1979, Pihlstrom et al. 1981, Lindhe et al. 1982). It was demonstrated that loss of attachment occurred following periodontal treatment at sites with initially shallow probing depths while sites with deep pockets gained considerable amounts of clinical attachment. Furthermore, Lindhe et al. (1982) showed that the degree of loss of attachment in initially shallow pockets and gain in deeper pockets was more pronounced following a surgical than a non-surgical mode of therapy. The findings imply that a critical initial probing depth for gain/loss of clinical attachment may exist and that this critical probing depth may vary not only from one group of teeth to another but also with the type of therapy employed. The first aim of the present study was to calculate the critical probing depth values for one surgical and one non-surgical method of periodontal therapy.

Walker & Ash (1976) reported that microscopic amounts of calculus can be observed on a

root surface even after extensive instrumentation. Waerhaug (1978) examined extracted teeth previously exposed to subgingival scaling and root planing and suggested that it was difficult or impossible to eliminate properly the subgingival plaque in pockets deeper than 4-5 mm. Similar findings have been reported by Rabbani et al. (1981) and Tabita et al. (1981). In contrast, Listgarten et al. (1978) in a comparative clinical, microbiological and histopathological study found that subgingival scaling and root planing in periodontal sites with probing depths >5 mm was an effective means of reducing gingival inflammation and probing depths. This controversy led to the second aim of the present study which was to monitor, during an 18-month period of maintenance care, sites which following active therapy were associated with probing depths of >4 mm with respect to gingival inflammation and attachment level alterations.

Recently it was suggested (Ramfjord et al. 1981) that the degree of plaque control maintained by the patient after active therapy was of less importance than a professionally performed prophylaxis once every 3 months for the maintenance of shallow pockets and attachment levels. A third aim of the present study was to evaluate the effect of the oral hygiene status on probing depths and attachment levels during the maintenance care period in patients who following active therapy were recalled for prophylaxis every 3 months.

Material and Methods

The present investigation was carried out on 15 subjects, 32-57 years of age, who were referred for treatment of moderately advanced periodontal disease to the Department of Periodontology, University of Gothenburg. The patients were first subjected to a *Baseline examination* which included assessment of *oral hygiene status* (Plaque Index; Silness & L oe 1964), *gingival conditions* (Gingival Index; L oe & Silness 1963), *probing depths* and *attachment levels*. The ex-

amination included all teeth present. (For details regarding the examination procedure see Lindhe et al. (1982)). Following the *Baseline examination* all patients were given a description of their periodontal problems and detailed instructions in oral hygiene measures. Subsequently they were subjected to periodontal treatment utilizing a split mouth design. In the right or left side of the jaw (by random selection) debridement was performed in conjunction with a modified Widman flap procedure (Ramfjord & Nissle 1974 - *MWF-group*) while in the contralateral jaw quadrants the treatment was restricted to scaling and root planing (*RPL-group*).

The period from initial treatment to 6 months was considered to be the healing phase and from 6-24 months the maintenance phase. During the healing phase the patients were recalled for professional tooth cleaning (Axelsson & Lindhe 1974) once every 2 weeks. During the maintenance phase the interval between the recall appointments was 3 months. All patients were reexamined regarding oral hygiene, gingival conditions, probing depths and attachment levels 6, 12 and 24 months after the completion of active treatment. All recordings were confined to the same surfaces and location points which had been examined at the *Baseline examination*. For details regarding the examinations and treatment procedures the reader is referred to the publication by Lindhe et al. (1982).

Statistical analysis

The mean, standard deviation and 95% confidence intervals as well as the determination of significance of difference of means using the t-test were performed according to standard methods. Regression analysis was carried out using initial probing depth as the independent (X-axis) variable. The slope and X intercept values as well as the 95% confidence intervals were computed. The X intercept was considered to be the critical probing depth (CPD). The significance of differences of slope and X intercepts was calculated.

Results

Attachment level alterations during the phase of healing

Fig. 1 shows the regression lines for initial probing depths and attachment level alterations as well as the critical probing depth (CPD) for all sites treated with scaling and root planing only (RPL), and sites subjected to Widman flap surgery (MWF) as well. The CPD for sites subjected to scaling and root planing was $2.9 \text{ mm} \pm 0.4$ while the corresponding figure for the MWF group was $4.2 \text{ mm} \pm 0.2$. This difference between the two modalities of therapy is statistically significant ($P < 0.01$). The CPD-value of 2.9 for sites treated with scaling and root planing only implies that sites with an initial probing depth of less than 2.9 mm are likely to show attachment loss as a consequence of root instrumentation even in patients maintained at an optimal plaque control level. On the other hand, the same treatment of sites with initial probing depths > 2.9 mm are likely to show gain of clinical attachment. The same argument is applicable to a treatment procedure which involves root debridement in conjunction with Widman flap surgery, with the difference that the CPD-value for this treatment modality is significantly higher. Consequently sites with initial probing depths of up to a value of 4.2 mm are likely to suffer attachment loss.

The slopes (Table 1, Fig. 1) of the two regression lines ($\text{RPL} = 0.2 \pm 0.04$; $\text{MWF} = 0.42 \pm 0.04$) indicate that in sites with initially deeper pockets (≥ 7 mm) the resulting attachment gain following therapy was more pronounced following surgical than non-surgical treatment. Sites with initially shallow pockets (< 3 mm) consequently suffered more attachment loss following surgery than after non-surgical therapy.

Fig. 2 and Table 1 describe corresponding regression lines and CPD-values for the two modes of treatment (RPL and MWF) of different groups of teeth (incisors, premolars and molars) and Fig. 3 and Table 1 of different tooth

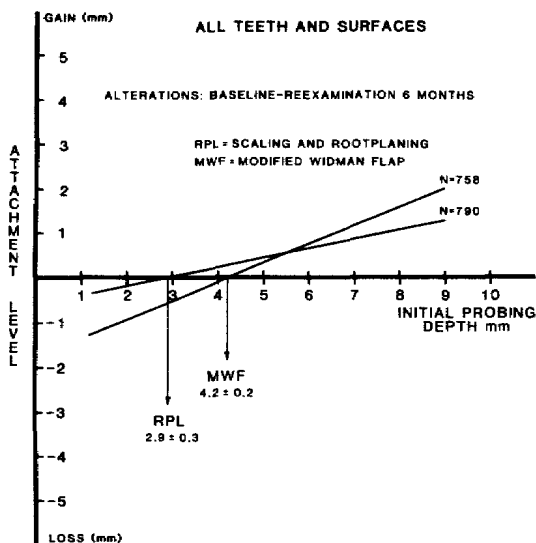


Fig. 1. Diagram illustrating alterations of the attachment level (gain and loss) between the Baseline examination and the reexamination after 6 months. The initial probing depth values are described on the X-axis. The regression lines illustrating the effect of scaling and root planing (RPL) and periodontal surgery (MWF) intersect the X-axis at points representing initial probing depths (PD) of 2.9 ± 0.3 (RPL) and 4.2 ± 0.2 (MWF).

Das Diagramm zeigt die Veränderungen des Attachmentniveaus (Gewinn und Verlust) zwischen der Ausgangsuntersuchung und der Nachuntersuchung nach 6 Monaten. Die ursprünglichen Sondierungstiefen sind auf der Abzisse (X-Achse) abgesetzt. Die Regressionslinien, die den klinischen Effekt der Zahnsteinentfernung und Wurzelglättung (RPL) und der Parodontalchirurgie (MWF) zeigen, kreuzen die X-Achse an den Punkten, die die ursprünglichen Sondierungstiefen von 2.9 ± 0.3 (RPL) und 4.2 ± 0.2 (MWF) bezeichnen.

Diagramme illustrant les changements du niveau de l'attache (attachment level) - perte (loss) ou gain - entre l'Examen Initial (Baseline) et l'examen de contrôle de 6 mois. Les valeurs initiales de la profondeur de sondage sont marquées sur l'axe des X. Les droites de régression illustrant l'effet du détartrage et polissage des surfaces radiculaires (RPL) et celui du traitement chirurgical (MWF) coupent l'axe des X à des points représentant des profondeurs initiales de sondage de 2.9 ± 0.3 mm (RPL) et 4.2 ± 0.2 mm (MWF).

surfaces (buccal, interproximal, lingual). It is obvious that for each category of teeth and tooth surfaces the non-surgical mode of therapy yielded lower CPD-values than a treatment procedure that also included the use of modified Widman flaps. The values describing the slope of the regression lines (Table 1) were consistently higher for sites in the MWF-group than in the RPL-group.

Effect of plaque on attachment levels during the healing phase

The CPD-values for sites with Plaque Index 0 at the 6-month examination were $2.7 \text{ mm} \pm 0.3$ (RPL) and $4.2 \text{ mm} \pm 0.2$ (MWF). The corresponding values for sites which at the 6-month examination received a Plaque Index score >0 were $4.3 \text{ mm} \pm 0.6$ (RPL) and $4.9 \text{ mm} \pm 0.4$ (MWF). Finally, sites with Plaque Index score 2 and 3 at the 6-month examination received CPD-values of $5.1 \text{ mm} \pm 1.3$ and $7.3 \text{ mm} \pm 2.6$ for the two modes of therapy respectively. It is

obvious that for each modality of active therapy the CPD-value increases with increasing plaque scores. In other terms, if the plaque score assessed at the 6-month examination is representative of the oral hygiene conditions during the phase of healing, the CPD-value obtained for a given site is dependent not only on the initial probing depth but also on presence or absence of plaque during healing.

Table 1. Slope and critical probing depths (CPD) of regression lines calculated using initial probing depth as the independent variable and change in attachment level during the healing phase as the dependent variable
Neigung der Regressionslinien und kritische Sondierungstiefen (CPD), bei deren Errechnung die Sondierungstiefe als unabhängige Variable und die Veränderung des Attachmentniveaus während der Heilungsphase als abhängige Variable diente

Profondeurs de sondage critiques (CPD) et pente (slope) des droites de régression calculées en utilisant la profondeur de sondage initiale comme variable indépendante et le changement de niveau de l'attache pendant la phase de guérison comme variable liée

| Treatment | Teeth | Sites | Slope | CPD | r |
|-----------|-----------|----------|------------|----------|------|
| MWF | All | All | 0.42±0.04* | 4.2±0.2* | 0.59 |
| RPL | All | All | 0.20±0.04 | 2.9±0.4 | 0.34 |
| MWF | Incisors | All | 0.41±0.07 | 4.1±0.3 | 0.56 |
| RPL | Incisors | All | 0.26±0.07 | 2.7±0.5 | 0.42 |
| MWF | Premolars | All | 0.36±0.08 | 4.7±0.4 | 0.56 |
| RPL | Premolars | All | 0.18±0.07 | 2.5±0.9 | 0.35 |
| MWF | Molars | All | 0.46±0.07 | 4.1±0.3 | 0.63 |
| RPL | Molars | All | 0.19±0.06 | 3.5±0.8 | 0.31 |
| MWF | All | Buccal | 0.46±0.09 | 4.1±0.4 | 0.60 |
| RPL | All | Buccal | 0.35±0.08 | 2.8±0.4 | 0.53 |
| MWF | All | Interpr. | 0.35±0.09 | 4.2±0.5 | 0.49 |
| RPL | All | Interpr. | 0.16±0.10 | 2.5±1.9 | 0.25 |
| MWF | All | Lingual | 0.54±0.15 | 4.2±0.6 | 0.74 |
| RPL | All | Lingual | 0.28±0.15 | 3.1±1.5 | 0.49 |

* Slope or critical probing depth (CPD)±95% confidence interval

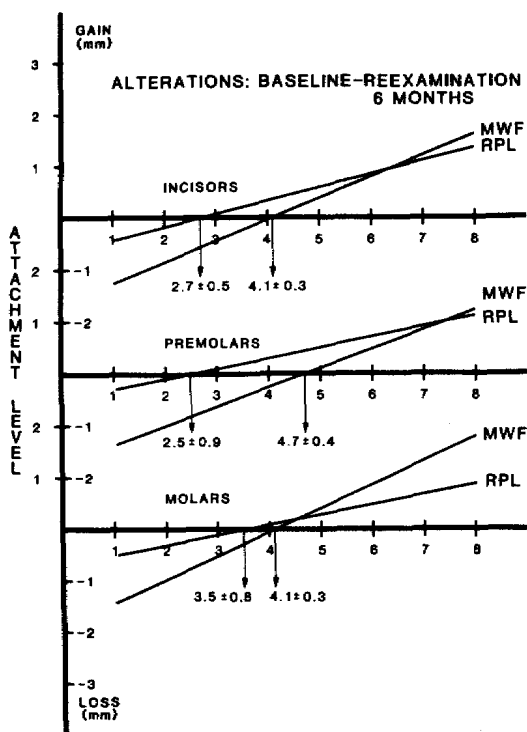
Treatment (*Behandlung, traitement*), teeth (*Zähne, dents*), sites (*Regionen, localisations*), slope (*Neigung, pente*).

Probing depth and attachment level alterations during the maintenance phase

Table 2 presents sites within the MFW- and RPL-groups which at the 6-month reexamination had a probing depth <4 mm (i.e. PD<4 mm at 6 months=100%). At the *Baseline examination* 54% (MWF) and 58% (RPL) were already in this probing depth category while 37% (MWF) and 39% (RPL) were in the category of 4–6 mm of probing depth. The corresponding figures for probing depths >6 mm were 8% (MWF) and 3% (RPL). During the maintenance phase around 90% of the sites treated by either modality remained in the probing depth category of <4 mm, while around 10% became deeper. The attachment level change for these sites during the mainte-

nance phase was insignificant for both modalities of initial therapy (MWF=−0.26 mm±0.2, RPL=−0.29 mm±0.15).

Table 3 describes the sites which at the 6-month reexamination had a probing depth between 4 and 6 mm (PD=4–6 mm at 6 months=100%). 63% of these sites were already in this category of probing depths at the initial examination while between 37% (MWF) and 35% (RPL) of the sites were initially deeper. During the maintenance phase, around 60–70% of these sites remained within the 4–6 mm category of probing depths while around 30% entered into the <4 mm category. Only between 1–4% of the sites developed into deeper pockets. Also in this category of initial probing depths, the attachment level change during the



maintenance phase was insignificant for both modalities of therapy (MWF = $-0.08 \text{ mm} \pm 0.2$, RPL = $+0.05 \text{ mm} \pm 0.15$).

Table 4 shows the sites within the MWF- and RPL-groups which at the end of the healing phase, i.e. at the 6-month reexamination, had a probing depth $>6 \text{ mm}$ (PD $>6 \text{ mm}$ at 6 months = 100%). At the Baseline examination, 20% (MWF) and 32% (RPL) of these sites were in the 4–6 mm category while 80% (MWF) and 68% (RPL) belonged to the $>6 \text{ mm}$ class of probing depths. During the maintenance phase, 27–60% of this group entered into the 4–6 mm or $<4 \text{ mm}$ category of pockets while around 40–50% remained unchanged. In sites which were in the $>6 \text{ mm}$ category at the 6-month reexamination there was a significant gain of

Fig. 2. Diagram illustrating the gain and loss of attachment (Y-axis) in incisors, premolars and molars calculated from measurements made at the Baseline examination and the reexamination after 6 months. RPL = scaling and root planing, MWF = modified Widman flap surgery. The initial probing depth values are presented on the X-axis. The non-surgical approach of therapy (RPL) consistently yielded lower critical probing depth (CPD) values than the surgical approach (MWF) of therapy.

Das Diagramm zeigt den Gewinn und den Verlust des Attachments (Ordinate = Y-Achse) bei Inzisivien, Prämolaren und Molaren nach 6 Monaten, errechnet aus den Werten der Ausgangsuntersuchung und der Nachuntersuchung. RPL = Zahnsteinentfernung und Wurzelglättung, MWF = modifizierte Lappenchirurgie nach Widman. Die ursprünglichen Sondierungstiefen sind auf der Abszisse (X-Achse) abgesetzt. Bei der nicht-chirurgischen Therapievariante (RPL) lagen immer geringere Werte für die Sondierungstiefen vor als bei der chirurgischen (MWF) Behandlungsform.

Diagramme illustrant le gain et la perte de l'attache (axe des Y) des incisives, prémolaires et molaires, calculés d'après les mesures faites à l'examen Initial et à l'examen de contrôle 6 mois après. RPL = détartrage et polissage des surfaces radiculaires, MWF = opération à lambeau de Widman modifiée. Les valeurs de la profondeur initiale de sondage sont présentées sur l'axe des X. Les valeurs critiques de la profondeur de sondage trouvées pour la méthode non chirurgicale (RPL) étaient régulièrement inférieures aux valeurs critiques trouvées pour la méthode chirurgicale (MWF).

attachment during the maintenance period which varied between $1.6 \text{ mm} \pm 0.8$ (MWF) and $1.2 \text{ mm} \pm 0.7$ (RPL).

Tables 2, 3 and 4 indicate that shallow pockets tended to lose, while deeper sites tended to gain attachment during the maintenance phase.

Fig. 3. Diagram illustrating gain or loss of attachment between the Baseline examination and the reexamination after 6 months following surgical (MWF) and non-surgical (RPL) mode of therapy. The critical probing depth values for buccal (B), interproximal (I) and lingual (L) surfaces varied between 4.1 and 4.2 mm (MWF) and 2.5–3.1 mm (RPL).

Das Diagramm veranschaulicht Gewinn oder Verlust von Attachment zwischen der Ausgangsuntersuchung und der Nachuntersuchung nach 6 Monaten bei chirurgischer (MWF) und nicht-chirurgischer Therapieform. Die Werte der kritischen Sondierungstiefe für bukkale (B), approximale (I) und linguale (L) Zahnoberflächen variierte zwischen 4.1 und 4.2 mm (MWF) und 2.5–3.1 mm (RPL).

Diagramme illustrant le gain ou la perte d'attache prenant place entre l'Examen Initial et l'examen de contrôle 6 mois après le traitement par méthode chirurgicale (MWF) et par méthode non chirurgicale (RPL). Les valeurs critiques de la profondeur de sondage pour les faces vestibulaires (B), interproximales (I) et linguales (L) variaient entre 4.1 et 4.2 mm (MWF) et entre 2.5–3.1 mm (RPL).

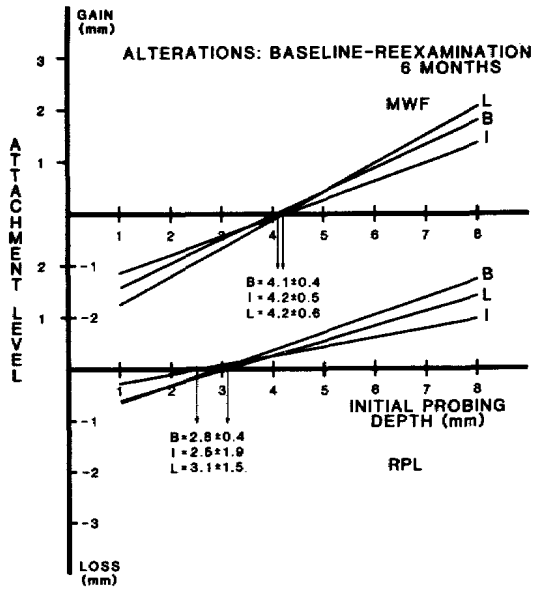


Table 2. Distribution of sites at the Baseline examination and during maintenance which had a probing depth of <4 mm at the 6-month reexamination. Around 75–83% (RPL and MWF) of all sites examined had a probing depth of <4 mm at the 6-month reexamination

Die Vorkommenshäufigkeit von Regionen (Ausgangsuntersuchung und Nachsorge), bei denen anlässlich der Nachuntersuchung nach 6 Monaten eine Sondierungstiefe von <4 mm registriert wurde. Etwa 75–83% (RPL und MWF) aller untersuchter Regionen hatten bei der Nachuntersuchung nach 6 Monaten eine Sondierungstiefe von <4 mm Distribution, à l'Examen Initial (Baseline) et pendant la phase de maintien, des localisations ayant une profondeur de sondage <4 mm à l'examen de contrôle de 6 mois. Environ 75–83% (RPL et MWF) de toutes les localisations examinées avaient à l'examen de 6 mois une profondeur de sondage <4 mm

| | <4 mm | MWF 4–6 mm | >6 mm | <4 mm | RPL 4–6 mm | >6 mm |
|--|-------|----------------|-------|-------|-----------------|-------|
| Baseline | 54% | 37% | 8% | 58% | 39% | 3% |
| 6 months | 100% | - | - | 100% | - | - |
| 12 months | 93% | 7% | - | 91% | 8% | - |
| 24 months | 90% | 9% | - | 91% | 10% | - |
| Attachment level change 6–24 months | | -0.26 mm ± 0.2 | N.S. | | -0.29 mm ± 0.15 | |

Attachment level change (Änderung des Attachmentniveaus, changement du niveau de l'attache).

Table 3. Distribution of sites at the Baseline examination and during maintenance which had a probing depth of 4–6 mm at the 6-month reexamination. Around 18–25% (MWF and RPL) of all sites examined had a probing depth of 4–6 mm at the 6-month reexamination

Die Vorkommenshäufigkeit von Regionen (Ausgangsuntersuchung und Nachsorge), bei denen anlässlich der Nachuntersuchung nach 6 Monaten eine Sondierungstiefe von 4–6 mm registriert wurde. Bei etwa 18–25% (MWF und RPL) aller untersuchter Regionen wurde bei der Nachuntersuchung nach 6 Monaten eine Sondierungstiefe von 4–6 mm gemessen

Distribution, à l'Examen Initial et pendant la phase de maintien, des localisations ayant une profondeur de sondage de 4–6 mm à l'examen de contrôle de 6 mois. Environ 18–25% (MWF et RPL) de toutes les localisations examinées avaient à l'examen de 6 mois une profondeur de sondage de 4–6 mm

| | MWF | | | RPL | | |
|--|-------|----------------|-------|-------|-----------------|-------|
| | <4 mm | 4–6 mm | >6 mm | <4 mm | 4–6 mm | >6 mm |
| Baseline | – | 63% | 37% | 2% | 63% | 35% |
| 6 months | – | 100% | – | – | 100% | – |
| 12 months | 28% | 71% | 1% | 27% | 70% | 3% |
| 24 months | 29% | 69% | 2% | 32% | 64% | 4% |
| Attachment level change 6–24 months | | –0.08 mm ± 0.2 | N.S. | | +0.05 mm ± 0.15 | |

Attachment level change (*Änderung des Attachmentniveaus, changement du niveau de l'attache*).

The mode of therapy used during active treatment did not significantly influence the alteration of the attachment level during the maintenance phase.

Effect of plaque on probing depths and attachment levels during the maintenance phase

Tables 5 and 6 describe the percentage distribution of sites with probing depths of <4 mm, 4–6

mm, and >6 mm for the two modalities of initial therapy (MWF and RPL) as assessed by clinical examinations at 6, 12 and 24 months.

Table 5 reports alterations of probing depths and attachment levels at sites which at the 6-, 12- and 24-month reexaminations received a PII score of 0 while Table 6 reports corresponding alterations at sites with PII scores >0. Towards the end of the period of healing, i.e. at the 6-

Table 4. Distribution of sites at the Baseline examination and during maintenance which had a probing depth of >6 mm at the 6-month reexamination. It should be observed that only 1–2% of all sites examined at 6 months had probing depths >6 mm

Die Vorkommenshäufigkeit von Regionen (Anfangsuntersuchung und Nachsorge), bei denen anlässlich der Nachuntersuchung nach 6 Monaten eine Sondierungstiefe von >6 mm registriert wurde. Beachten Sie, dass nur bei 1–2% aller untersuchter Regionen nach 6 Monaten Sondierungstiefen von >6 mm gemessen wurden

Distribution, à l'Examen Initial et pendant la phase de maintien, des localisations ayant une profondeur de sondage >6 mm à l'examen de contrôle de 6 mois. Il convient de remarquer que 1–2% seulement de toutes les localisations examinées avaient à l'examen de 6 mois des profondeurs de sondage >6 mm

| | MWF | | | RPL | | |
|--|-------|---------------|-------|-------|---------------|-------|
| | <4 mm | 4–6 mm | >6 mm | <4 mm | 4–6 mm | >6 mm |
| Baseline | – | 20% | 80% | – | 32% | 68% |
| 6 months | – | – | 100% | – | – | 100% |
| 12 months | – | 40% | 60% | – | 27% | 73% |
| 24 months | – | 60% | 40% | 5% | 48% | 48% |
| Attachment level change 6–24 months | | +1.6 mm ± 0.8 | N.S. | | +1.2 mm ± 0.7 | |

Attachment level change (*Änderung des Attachmentniveaus, changement du niveau de l'attache*).

Table 5. Distribution of sites with probing depths of <4 mm, 4-6 mm, >6 mm which at the 6-, 12- and 24-month reexaminations had a Plaque Index score of 0

Die Vorkommenshäufigkeit von Regionen mit Sondierungstiefen von <4 mm, 4-6 mm, >6 mm, bei denen anlässlich der Nachuntersuchungen nach 6, 12 und 24 Monaten die Plaqueindex Beurteilungseinheit (score) von 0 registriert wurde

Distribution des localisations qui avaient un score de 0 pour l'Indice de Plaque aux examens de contrôle de 6, 12 et 24 mois, suivant la profondeur de sondage: <4 mm, 4-6 mm, >6 mm

| | MWF | | | RPL | | |
|--|-----------------|--------|-------|-----------------|--------|-------|
| | <4 mm | 4-6 mm | >6 mm | <4 mm | 4-6 mm | >6 mm |
| 6 months | 93% | 7% | - | 82% | 17% | - |
| 12 months | 94% | 6% | - | 85% | 13% | 1% |
| 24 months | 91% | 9% | - | 84% | 14% | 1% |
| Attachment level change 6-24 months | -0.16 mm ± 0.12 | | N.S. | -0.18 mm ± 0.14 | | |

Attachment level change (Änderung des Attachmentniveaus, changement du niveau de l'attache).

month reexamination, 93% (MWF) and 82% (RPL) of plaque free sites had a probing depth of <4 mm, while 7% (MWF) and 17% (RPL) of the sites were in the 4-6 mm category. These figures demonstrate that surgical therapy was somewhat more effective than scaling and root planing alone in establishing sites with probing depths of <4 mm. During the maintenance period there was in both groups almost no change in the percentage of sites with probing depths <4 mm. Sites in either the MWF-group or the RPL-group showed no significant change in the attachment levels between the 6- and 24-month reexaminations. Table 6 shows that sites

which at the 6-, 12- and 24-month reexamination harboured plaque were associated with deeper probing depths than the corresponding plaque free sites (Table 5). Thus, while around 45-60% of the sites which had Plaque Index scores >0 belonged to the 4-6 or >6 mm categories, only 6-15% of the plaque free sites (Table 5) belonged to this category of pockets. Furthermore, sites with plaque scores >0 at the 6-, 12- and 24-month reexaminations lost attachment during the maintenance period. The degree of clinical attachment loss varied between -0.72 mm ± 0.2 (MWF) and -0.55 mm ± 0.15 (RPL). The difference in attachment

Table 6. Distribution of sites with probing depths of <4 mm, 4-6 mm, >6 mm which at the 6-, 12- and 24-month reexaminations had a Plaque Index score >0

Die Vorkommenshäufigkeit von Regionen mit Sondierungstiefen von <4 mm, 4-6 mm, >6 mm, bei denen anlässlich der Nachuntersuchungen nach 6, 12 und 24 Monaten eine Plaqueindex Beurteilungseinheit (score) von >0 registriert wurde

Distribution des localisations qui avaient un score >0 pour l'Indice de Plaque aux examens de contrôle de 6, 12 et 24 mois, suivant la profondeur de sondage: <4 mm, 4-6 mm, >6 mm

| | MWF | | | RPL | | |
|--|----------------|--------|-------|-----------------|--------|-------|
| | <4 mm | 4-6 mm | >6 mm | <4 mm | 4-6 mm | >6 mm |
| 6 months | 55% | 45% | - | 41% | 53% | 7% |
| 12 months | 37% | 61% | 2% | 44% | 43% | 13% |
| 24 months | 51% | 46% | 3% | 44% | 47% | 9% |
| Attachment level change 6-24 months | -0.72 mm ± 0.2 | | N.S. | -0.55 mm ± 0.15 | | |

Attachment level change (Änderung des Attachmentniveaus, changement du niveau de l'attache).

level alterations between plaque free and plaque harbouring sites was statistically significant ($P < 0.05$).

Discussion

Previous investigations describing the effect of therapy on patients with periodontal disease have shown that while sites with initially deep pockets tend to gain clinical attachment, sites with initially shallow pockets tend to lose attachment (Ramfjord et al. 1973, 1975, 1980, Knowles et al. 1979, 1980, Pihlstrom et al. 1981, Lindhe et al. 1982). In the present study regression analysis was used to identify so-called critical probing depths, i.e. initial probing depths of sites from different groups of teeth and tooth surfaces below which loss of clinical attachment is likely to occur and above which attachment gain often results. By this analysis it was found that the critical probing depth value (CPD) for scaling and root planing used alone was significantly smaller than the corresponding value for scaling and root planing used in combination with the modified Widman flap technique of surgery. The slopes of the regression lines for the two modalities of therapy described in Fig. 1 also indicate, however, that in sites with initial probing depths above the CPD-value more gain of clinical attachment can be expected to occur following Widman flap surgery than following the non-surgical modality of therapy. On the other hand, the surgical approach may result in more attachment loss than scaling and root planing alone when used in sites with initially shallow pockets. Thus, these findings indicate that in patients with a large number of periodontal sites with shallow probing depths a non-surgical approach of therapy may be preferable, while in patients with a large number of deep pockets surgical treatment may result in more gain of clinical attachment. Findings reported by Knowles et al. (1979) and Pihlstrom et al. (1981) support this view.

In the present patient sample treatment in-

cluding the modified Widman flap technique gave a CPD-value of $4.2 \text{ mm} \pm 0.2$. It is interesting to observe that Knowles et al. (1979) and Pihlstrom et al. (1981) using the same treatment technique reported that attachment loss tended to occur in sites with initial probing depths < 4 mm, while attachment gain occurred in sites with deeper initial probing depths. In addition, Knowles et al. (1979) found that more attachment gain was encountered in initially deep (7–12 mm) than in initially moderately deep (4–6 mm) pockets.

The critical probing depth values and the slopes of the corresponding regression lines for the two modalities of therapy used have been described for different groups of teeth and for different tooth surfaces (Figs. 2 and 3; Table 1). The data reported make it possible, prior to therapy, to estimate the expected net gain or loss of attachment for a given tooth and mode of therapy in patients maintained on a proper plaque control program. For example, at the initial examination, a premolar tooth may display the following probing depths: 1 mm (buccal), 6 mm (mesial), 2 mm (lingual) and 5 mm (distal). If this tooth is subjected to a therapy which involves scaling and root planing in combination with Widman flap surgery, the following attachment level alterations might be expected to occur: buccal -1.4 mm, mesial $+0.7$ mm, lingual -1.2 mm, distal $+0.2$ mm, i.e. a net total loss of attachment of 1.7 mm. If the same tooth is subjected to scaling and root planing only, a net total attachment gain amounting to $+0.1$ mm might be expected. While the above example may not be valid for a given tooth in a given patient it suggests that the regression analysis approach may be used as a guide to the overall effect on the clinical attachment level of certain treatment procedures. Clinical trials are presently being performed on patients with advanced periodontal disease in an attempt to identify critical probing depths and regression lines for different modalities of periodontal surgery.

The data presented in Tables 2, 3 and 4 clearly

demonstrate that the probing depths obtained following active therapy and healing (i.e. at 6 months in the present study) can be maintained unchanged or reduced further during a maintenance care period involving careful prophylaxis once every 3 months. Obviously, the non-surgical mode of therapy (RPL) was not as effective as root planing combined with Widman flap surgery in establishing sites after healing with probing depths <4 mm (Lindhe et al. 1982). However, the attachment level alterations during the maintenance phase were more or less the same in the two treatment groups and evidently unrelated to the method of treatment used during active therapy. These findings are in agreement with the results presented by Lövdal et al. (1961), Alexander (1969), Hughes & Caffesse (1978), Helldén et al. (1979), Torfason et al. (1979), Morrison et al. (1980), Badersten et al. (1981) and Pihlstrom et al. (1981), showing that scaling and root planing combined with oral hygiene measures have the potential to reduce inflammation and probing depths. Badersten et al. (1981) studied the effect of non-surgical therapy on moderately advanced periodontitis and concluded that non-surgical therapy can be successful even in sites with 4–7 mm pockets. The findings reported from the present study are, however, in variance with results by Walker & Ash (1976), Waerhaug (1978), Rabbani et al. (1981) and Tabita et al. (1981) who claimed that root surfaces of sites with probing depths of >3 mm even after extensive scaling and root planing contained microscopic amounts of plaque and calculus. Waerhaug (1978) stated: "if the pocket ranges from 3–5 mm the chances of failure are greater than the chances of success, and if the pocket depth surpasses 5 mm, the chances of failure dominate". In the present study as in the trials reported by Ramfjord and coworkers (for review see Knowles et al. 1979) and by Lindhe & Nyman (1975) no attempts were made except by clinical probing to assess the presence of calculus or subgingival plaque at various treated sites during the maintenance period. Findings

reported by Listgarten et al. (1978) make it reasonable to assume, however, that periodontal sites with probing depths >3 mm following therapy may harbour a subgingival microbiota dominated by coccoid cells and non-motile short rods. If this was the microbiota detected on the root surface of extracted teeth, it may be compatible with gingival health and maintained attachment levels (Listgarten et al. 1978). Hence, it must be questioned if the mere presence of microorganisms on a treated root surface should be used as a measure indicative of failure of therapy.

The present study indicates that the level of oral hygiene established during healing and maintenance is more critical for the resulting probing depths and attachment levels than the mode of initial therapy used. Thus, sites which during the maintenance period were found to be devoid of clinically detectable supragingival plaque (Table 5) were associated with probing depths of <4 mm. In contrast only 30–50% of sites which harboured plaque belonged to the <4 mm category (Table 6). Furthermore, while plaque free sites showed no or little attachment loss, plaque infected sites lost on the average between 0.72 and 0.55 mm of attachment during the 18 months of maintenance. These findings are in close agreement with Rosling et al. (1976) and Nyman et al. (1975, 1977) and illustrate anew that the quality of the maintenance care is of critical importance for the long-term result of treatment of periodontal disease.

Zusammenfassung

"Kritische Sondierungstiefen" bei parodontaler Therapie

Die hier vorliegende Untersuchung wurde an 15 Probanden durchgeführt, die zur Behandlung fortgeschrittener parodontaler Krankheit überwiesen worden waren. An allen Patienten wurde zuerst einmal eine *Ausgangsuntersuchung* vorgenommen, die eine Beurteilung der oralen Hygiene und des gingivalen Status, sowie Messungen der Sondierungstiefen und der Attachmentniveaus beinhaltete. Danach wurden die Patienten über ihren oralen Status unterrichtet, in oralen Hygienemaßnahmen unterwiesen

und dann nach einem "split mouth" Behandlungsmodell (unterschiedlicher therapeutischer Einsatz an "halben Zahnbögen") parodontal behandelt. An der einen Kieferseite wurden, bei gleichzeitiger modifizierter Widman Lappenoperation, der Zahnstein entfernt und dann die Wurzeln geglättet. An den kontralateralen Kieferquadranten beschränkte sich der therapeutische Einsatz ausschließlich auf Zahnsteinentfernung und Wurzelglättung. Die Zeitspanne von der Initialbehandlung bis 6 Monate nach dieser Behandlung wurde als *Heilungsphase* und die Periode vom 6. bis zum 24. postoperativen Monat als die das Heilungsergebnis *aufrechterhaltende Phase* bezeichnet. Während der Heilungsphase wurden die Patienten jede 2. Woche zu professioneller Zahnreinigung einbestellt. Während der aufrechterhaltenden Phase betrug die Intervalle zwischen den Einbestellungen zur Nachsorge 3 Monate, 6, 12 und 24 Monate nach Abschluss der aktiven Behandlung wurden Nachuntersuchungen vorgenommen.

Die Resultate zeigten, dass die Behandlung in Regionen mit eingangs flachen Taschen zu Verlust an klinischem Attachment führte, während Regionen mit ursprünglich tiefen Taschen klinisches Attachment gewannen. Mit Hilfe einer Regressionsanalyse wurden für die beiden hier angewendeten Behandlungsmethoden "kritische Sondierungstiefen" ermittelt. Es zeigte sich, dass der kritische Sondierungswert für Zahnsteinentfernung und Wurzelplanung signifikant geringer war als der entsprechende Wert für Zahnsteinentfernung und Wurzelglättung bei gleichzeitiger modifizierter Widman'scher Lappenoperation (2,9 gegenüber 4,2 mm). Weiterhin hatte, bei eingangs flachen Zahnfleischtaschen, die chirurgische Therapievariante mehr Attachmentverlust zur Folge als die nicht-chirurgische Behandlung. Andererseits stellte sich - bei Sondierungstiefen über dem kritischen Sondierungswert - nach Widman'scher Lappenoperation ein höherer Attachmentgewinn ein als nach nicht-chirurgischer Behandlung durch Zahnsteinentfernung und Wurzelglättung.

Die Daten der Nachuntersuchungen, 12 und 24 Monate nach der aktiven Behandlung zeigen, dass die nach aktiver Therapie vorgefundenen Sondierungstiefen und Höhen der Attachmentniveaus während der aufrechterhaltenden Behandlungsphase (Nachsorgeperiode), mit sorgfältigen Prophylaxebehandlungen in 3-monatlichen Intervallen, sogut wie unverändert blieben. Die Daten zeigen jedoch gleichfalls, dass das Niveau eigener oraler Hygiene während der Heilungs- und aufrechterhaltenden Phase mehr für die sondierbaren Taschentiefen und Attachmentniveaus bedeutete, als die initial angewendete Therapievariante. So wurde an Regionen mit supragingivaler Plaquefreiheit während der Nachsorgeuntersuchungen, flache Taschen und unveränderte Attachmentniveaus gefunden. Im Gegensatz dazu wurde in Regionen mit Plaqueabsetzungen, sich erhöhende

Werte für Sondierungstiefen und weitergehender Attachmentverlust konstatiert.

Résumé

"Profondeurs de sondage critiques" dans les traitements parodontaux

La présente étude a porté sur 15 sujets qui nous avaient été adressés pour traitement de parodontopathies à un degré avancé. Tous les patients ont d'abord subi un *Examen Initial* comportant l'enregistrement de l'état des gencives et du niveau de l'hygiène bucco-dentaire, et la mesure de la profondeur des culs-de-sac lors du sondage et des niveaux de l'attache. Après avoir reçu des informations détaillées sur leur cas et des instructions sur les mesures d'hygiène bucco-dentaire, les patients ont reçu un traitement parodontal suivant une technique de bouche divisée. D'un côté de la mâchoire, on a effectué détartrage et polissage des surfaces radiculaires au cours d'une opération à lambeau suivant la technique de Widman modifiée, tandis que, dans les quadrants contralatéraux, le traitement se bornait à faire détartrage et polissage des surfaces radiculaires. La période allant du traitement initial à 6 mois après le traitement était considérée comme *phase de guérison*, et la période allant de 6 à 24 mois après le traitement était considérée comme *phase de maintien*. Pendant la phase de guérison, les patients étaient convoqués pour un nettoyage professionnel des dents tous les quinze jours. Pendant la phase de maintien, l'intervalle entre les rappels était porté à 3 mois. Des examens de contrôle étaient pratiqués 6, 12 et 24 mois après la fin du traitement actif.

Les résultats ont montré que le traitement déterminait une perte d'attache clinique dans les localisations où les poches étaient peu profondes à l'origine, tandis que, au niveau des localisations où les poches étaient profondes à l'origine, l'attache clinique s'était améliorée. Au moyen d'une analyse de régression, on a calculé les "profondeurs de sondage critiques" pour les deux méthodes de traitement utilisées. La profondeur de sondage critique trouvée pour le traitement par détartrage et polissage des surfaces radiculaires était significativement moins grande que la valeur correspondante trouvée pour le traitement où détartrage et polissage avaient lieu au cours de l'opération à lambeau selon la méthode de Widman modifiée (2,9 VS 4,2 mm). De plus, le traitement avec intervention chirurgicale donnait une perte d'attache plus importante que la méthode non chirurgicale lorsqu'on l'utilisait dans les localisations présentant à l'origine des poches peu profondes. Cependant on constatait, dans les localisations au niveau desquelles la profondeur de sondage initiale dépassait la valeur de la profondeur de sondage critique, un gain plus important d'attache clinique après l'opération à lam-

beau de Widman modifiée qu'après détartrage et polissage des racines.

Les données obtenues lors des examens de contrôle 12 et 24 mois après le traitement actif montraient que les profondeurs de sondage et les niveaux d'attache obtenus après le traitement actif et la phase de guérison restaient plus ou moins inchangés pendant la durée du traitement de maintien comportant des séances de nettoyage minutieux tous les 3 mois. Cependant, il ressortait aussi des données que le niveau de l'hygiène bucco-dentaire maintenu par les patients eux-mêmes pendant la phase de guérison et pendant la phase de maintien était d'une importance plus critique pour la profondeur de sondage et le niveau de l'attache que la méthode de traitement utilisée au début. Ainsi, les localisations au niveau desquelles on constatait l'absence de plaque supra-gingivale pendant la phase de maintien présentaient des poches peu profondes et maintenaient le niveau de l'attache. Par contre, les localisations au niveau desquelles la plaque s'était accumulée présentaient une augmentation de la profondeur des poches et de la perte d'attache.

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Address:

Department of Periodontology
Faculty of Odontology
University of Gothenburg
Box 33070
S-400 33 Gothenburg
Sweden

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