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# Effect of a combination of amine/stannous fluoride dentifrice and mouthrinse in periodontal maintenance patients

**S. Paraskevas, M. M. Danser, M. F. Timmerman, U. Van der Velden and G. A. Van der Weijden**

Department of Periodontology, ACTA Academic Centre for Dentistry, Louwesweg 1, 1006 EA Amsterdam, The Netherlands

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***Abstract***

**Aim:** The purpose of the present study was to evaluate the beneficial effect of using a dentifrice and mouthrinse containing amine fluoride (AmF) and stannous fluoride ($SnF_2$) in a group of periodontal maintenance patients. Efficacy parameters were plaque, gingival inflammation, pocket depth and attachment loss. An additional parameter was development of stain.

**Material and Methods:** In total, 80 patients who had been treated for moderate-to-severe periodontitis agreed to participate in this study. Subjects received supportive periodontal therapy at regular intervals of 3–4 months for at least a period of 1 year. The patients were randomly divided into two groups: (1) the test group used an AmF/$SnF_2$ dentifrice and mouthrinse and (2) the control group used a sodium fluoride (NaF)-containing dentifrice and mouthrinse. Clinical assessments were performed at baseline, 3, 6, 12, 18 and 24 months.

**Results:** The mean plaque index score after 3 months in the test group (0.24) was significantly lower than that in control group (0.34) ($p \leqslant 0.05$), a difference that was maintained throughout the remainder of the study. In terms of bleeding on probing, at no point in time were significant differences between test and control group found. No significant differences were noted between the two groups, nor were there any significant changes in comparison with baseline values with respect to pocket depth and attachment level. At baseline, the mean percentage of sites with no staining was 98% for both the test and control groups. At all further assessments, the staining in both groups was elevated as compared with baseline. Smoking did not affect the outcome of the study.

**Conclusion:** The combined use of an AmF/$SnF_2$ dentifrice and mouthrinse did not affect the parameters of inflammation (bleeding upon marginal probing and probing pocket depth), but it has shown to be more effective in terms of plaque reduction when compared with the use of an NaF dentifrice and mouthrinse in a group of periodontal patients placed under regular maintenance care.

Key words: attachment loss; bleeding; mouthrinse; periodontitis; plaque; pocket depth; supportive therapy; stain

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Daily mechanical removal of plaque by brushing commonly fails to maintain low levels of plaque and good gingival health (Johansson et al. 1984, Wilson 1987). Therefore, additional plaque control by chemical antimicrobial agents has been proposed (Mandel 1988). The development of mouthrinses is an approach aimed at delivering broadly the same functional benefits as dentifrices.

The use of fluoride in oral hygiene products is one of the cornerstones of prevention, since fluoride exerts anticariogenic activity through the process of remineralization. Additionally, there is ample evidence that fluoride has effects against many oral bacteria (Hamilton 1990, Van Loveren 2001). However, whether the antibacterial effects of fluoride contribute to caries prevention is still debatable. Yet, inhibition of bacterial metabolism at low pH ($pH < 5.5$) could occur in dental plaque, if bound fluoride becomes sufficiently available (Van

Loveren 2001). This antimicrobial activity of fluoride appears to be increased when it is combined with cations such as $Sn^{2+}$ or amine (Van Loveren 2001).

Stannous salts have been widely used in dentifrices for more than 20 years, predominantly in the form of stannous fluoride ($SnF_2$) for the control of dental caries (Van Loveren 1990, 2001, Miller et al. 1994). The potential of zinc ion as a plaque inhibitor has already been described (Harrap et al. 1983). However, stability problems impaired its use as the sole factor in dentifrice or mouthrinse formulations (White 1995).

Amine fluoride (AmF) is a fluoride compound well known for its caries-inhibiting and antimicrobial activity (Kay & Wilson 1988, Shani et al. 1996, 2000).

By combining AmF with $SnF_2$, it is possible to overcome the problem of stability of fluoride stannous salts in aqueous solutions. In this combination, the antibacterial properties of the two fluorides are synergistically strengthened (Brecx et al. 1990, 1993, Zimmerman et al. 1993). In short-term mouthrinsing experiments, this combination showed a much better inhibition of plaque accumulation than these two substances alone and a favorable effect on oral hygiene and gingivitis was reported in several clinical trials (Brecx et al. 1990, 1993, Zimmerman et al. 1993).

In patients with periodontitis, treatment in the form of supra- and subgingival debridement only temporarily reduces the amount of plaque on the tooth surfaces (Mousques et al. 1980, Magnusson et al. 1984). The degree of success of this therapy is very much dependent on the extent to which prevention of supra- and subgingival plaque formation is achieved. Therefore, the maintenance of periodontal health requires a considerable effort from the patient through careful oral hygiene measures. The purpose of the present study was to evaluate the effect of a dentifrice and mouthrinse combination containing AmF and $SnF_2$ in a group of periodontal maintenance patients. The efficacy parameters were plaque, gingival inflammation, pocket depth and attachment loss. An additional parameter was development of stain.

## Material and Methods

In total, 80 patients who had been treated for moderate-to-severe periodontitis agreed to participate in this study. All patients received periodontal treatment at the Department of Periodontology at ACTA (Academic Centre for Dentistry, Amsterdam). Patients were healthy individuals, 30–65 years of age, who had completed the active periodontal treatment more than 1 year prior to entering the study. Subjects received supportive periodontal therapy at regular intervals of 3–4 months, had not received antibiotic therapy for any reason within 3 months prior to the start of the study, were not hypersensitive to $SnF_2$, sodium fluoride (NaF) or AmF, had no systemic disorders and used no medication that may affect periodontal tissues. In every quadrant, a minimum of at least three natural teeth had to be present. All participants were explained the outline, purpose and duration of the study and all signed an ''informed consent'' form. The study protocol was approved by the Medical Ethical Committee (MEC) of the Academic Medical Center (AMC), Amsterdam.

At baseline, the patients were randomly divided into two groups: (1) a test group used a dentifrice (Meridol®, GABA International AG, Münchenstein, Switzerland (1400 p.p.m. $F^-$: 350 p.p.m. deriving from AmF and 1050 p.p.m. deriving from $SnF_2$)) and mouthrinse (Meridol®, GABA INT (alcohol-free version of Meridol® – 250 p.p.m. $SnF_2$/AmF)) combination containing AmF/$SnF_2$ and (2) the control group used a dentifrice and mouthrinse combination containing NaF (Dentifrice: 1400 p.p.m. $F^-$ and mouthrinse: 250 p.p.m. $F^-$) (of the same formulation and fluoride content). Both were packed in identical white bottles and tubes so that during the study, neither the examiner nor the patients were aware of the group assignment. Normal oral hygiene, including both brushing and interdental cleaning, was allowed. During the 2-year study, the use of mouthrinses or dentifrices other than the products under investigation was not permitted. Every 6 months, each patient received sufficient amount of ''test'' or ''control'' products.

Clinical assessments were performed at baseline, 3, 6, 12, 18 and 24 months. At baseline, 6, 12 and 24 months, the following parameters were scored: plaque index (PI; according to Silness & Löe 1964), bleeding upon marginal probing (BOMP; Van der Weijden et al. 1994a, b), probing pocket depth (PPD; using the Brodontic® (Ash/Dentsply, Addlestone, UK) pressure-sensitive probe), attachment loss (measured as the distance from the gingival margin to the cemento-enamel junction and subtracted from the PPD) and stain (Gründemann et al. 2000). The clinical parameters were scored at four sites per tooth: mesio-vestibular, mid-vestibular, disto-vestibular and lingual. Stain was recorded only at the labial surface of each tooth (the mesial, distal, gingival and incisal aspect of the labial surface). At all appointments, the oral cavity was screened at each examination for adverse reactions. At 3 and 18 months, assessments were restricted to the parameters PI, BOMP and stain.

At the 1-year examination, participants were asked to fill out a questionnaire. Questions addressing oral hygiene habits (duration and frequency of brushing) were asked. Smoking, as an important factor in relation to staining, was also evaluated (history of smoking, duration and number of cigarettes). Furthermore, questions about consumption of red wine, coffee and tea were included. In addition, subjects were asked to mark their appreciation of the taste of the dentifrice and mouthrinse on a visual analogue scale.

All examination procedures were performed by the same investigator (M. M. D.), to whom records of earlier examinations were not available. Patients were instructed to brush their teeth approximately 3 h before, but not within 1 h prior to each examination appointment to avoid an increase of the bleeding tendency due to oral hygiene measures (Abbas et al. 1990). All subjects were requested to return their used products and surplus at the 6 months appointment in order to obtain an indication of their compliance.

The patients continued to be scheduled for supportive periodontal therapy at regular intervals at the Department of Periodontology, ACTA. During these appointments, subjects were provided with professional prophylaxis and supra- and subgingival debridement where necessary. The dental hygienist responsible for this treatment was blinded to the group assignment. This appointment for supportive care in all instances followed appointments made for the assessments of the study.

### Statistical analysis

The primary efficacy variables were plaque and gingival bleeding. Secondary variables were pocket depth and attachment level. Stain was assessed as a side effect of the treatment. Analyses were performed at each measurement period.

*Table 1.* Mean plaque scores (PI) and mean percentage of bleeding on marginal probing (BOMP) at the different evaluation moments in the test group and control group

| | Base | 3 months | 6 months | 12 months | 18 months | 24 months |
|---|---|---|---|---|---|---|
| Total sites | | | | | | |
| test | 97.1 | 97.1 | 97.1 | 96.7 | 96.8 | 96.5 |
| control | 97.9 | 97.9 | 97.7 | 97.6 | 97.5 | 97.5 |
| **Mean PI** | | | | | | |
| test | 0.43 (0.27) | 0.24 (0.21)$^{\ddagger}$ # | 0.28 (0.18)$^{\dagger}$ ¶ | 0.27 (0.20)$^{\dagger}$ # | 0.30 (0.19)$^{\dagger}$ # | 0.31 (0.20) # |
| control | 0.40 (0.29) | 0.34 (0.24) | 0.44 (0.28) | 0.40 (0.28) | 0.43 (0.27) | 0.43 (0.25) |
| **% BOMP** | | | | | | |
| test | 9 (7) | 10 (7) | 10 (9) | 9 (8) | 13 (9)$^{\dagger}$ | 15 (10)$^{\ddagger}$ |
| control | 9 (8) | 9 (7) | 11 (7) | 9 (6) | 12 (10)$^{\dagger}$ | 14 (9)$^{\dagger}$ |

Standard deviations in parentheses.
Significant change compared with baseline.
$^{\ddagger}p \leqslant 0.001$, $^{\dagger}p \leqslant 0.01$, $^{*}p \leqslant 0.05$.
Significant differences between groups:
$^{\P}p \leqslant 0.01$, $^{\#}p \leqslant 0.05$.

All data were analyzed on both site and patient level. In addition to mean values, the presence and absence of plaque and bleeding was analyzed, in order to obtain percentages. The main effect on plaque reduction was analyzed by using a Repeated Measures Analysis with baseline values as covariate. Normality of residuals was assessed to be able to accept *p*-values as computed with this analysis. For each patient, data concerning PPD and AL at baseline and follow-up were pooled at a site level. Using a difference of $\leqslant 2$ mm, a site was accepted showing changes in pocket depth or attachment level as was suggested by Haffajee et al. (1983a, b) and Lindhe et al. (1983). *p*-Values $< 0.05$ were accepted as statistically significant.

## Results

In total 71 subjects completed the study. The test group consisted of 25 females and eight males, with a mean age of 48 years, of which 10 were smokers. The control group consisted of 25 females and 13 males, with a mean age of 50 years, of which also 10 subjects were smokers. Since nine patients did not finish the study protocol they were excluded from the analysis. These drop-outs were due to the following reasons: periodontal surgery ($n = 1$, test group); long-term illness and hospitalization ($n = 3$, test group); unacceptable heavy staining ($n = 2$, one in test group, one in control group); unacceptable taste of the mouthrinse ($n = 1$, test group); pregnancy ($n = 2$, one in test group, one in control group).

The mean PI scores are shown in Table 1. At baseline, the mean PI scores of the two groups were 0.43 and 0.40 for the test group and the control group, respectively. The mean PI score after 3 months in the test group (0.24) was significantly lower than that in the control group (0.34) ($p \leqslant 0.05$), a difference that was maintained throughout the remainder of the study.

Table 1 shows that the percentage of BOMP at baseline was comparable for the test and control group (9%, for both groups). During the first year of the study, no significant differences were noted from the baseline values. At 18 and 24 months, an increase of BOMP was found in both groups in comparison with baseline (from 9% to 15% for the test group and from 9% to 14% for the control group, respectively). However, at no point in time were there significant differences between the test and control group.

Each of the two groups contained 10 patients who were smokers. Further analysis was performed in order to explore the effect of smoking on the treatment outcomes. Repeated measure analysis of variance revealed that for both groups, smokers harbored constantly less plaque ($p = 0.04$) and exhibited less bleeding ($p = 0.008$) in comparison with the non-smokers. However, smoking appeared to have no effect on the outcome of the study with respect to the efficacy of the mouthrinses (Table 2).

Table 3 shows the mean values of PPD and AL as well as the percentage of sites that remained unchanged throughout the entire study and the percentage of pockets with PPD $\geqslant 5$ mm. The mean PPD ranged from 2.3 to 2.5 mm and the mean AL ranged from 3.4 to 3.5 mm throughout the study period. No significant differences were noted between the two groups nor were there any significant changes in comparison with baseline values with respect to PPD and AL. Analysis for both PPD and AL revealed that the majority of the sites showed no change ($\leqslant 2$ mm) during the experimental period irrespective of the group. During the study period, the percentage of pockets $\geqslant 5$ mm decreased for both groups in comparison with the baseline values. At 1-year evaluation, this difference became statistically significant for the control group, and remained unchanged until the end of the experimental period. For the test group, this difference became significant at 24 months. No differences were noted between groups at any evaluation point.

Table 4 presents the mean percentages of the staining index. At baseline, the mean percentage of sites with a score ''0'' was 98% for both the test and control groups. At all further assessments, the staining in both groups was elevated as compared with baseline. During the first year of the study, significantly more staining was found in the test than in the control group. At 24 months, the mean percentage staining index was 23% in the test group and 19% for the control group. This difference was not statistically significant.

The results of the questionnaire are shown in Table 5. No significant differences were observed between the test and control group, except for the participants' perception of staining. On a scale of 0–2, the mean staining perception in the test group was 0.9 and in the control group 0.3 (0 = no difference, 1 = slight discoloration, 2 = heavy discoloration) ($p = 0.0003$). In total, 20 subjects were

*Table 2*. Mean plaque scores (PI) and percentage of bleeding on marginal probing (BOMP) for smokers and non-smokers at the different evaluation moments in the test group and control group

| | Base | 12 months | 24 months |
|---|---|---|---|
| **Mean PI** | | | |
| Test | | | |
| smokers ($N = 10$) | 0.39 (0.24) | 0.21 (0.12) | 0.28 (0.19) |
| non-smokers ($N = 23$) | 0.45 (0.28) | 0.29 (0.22) | 0.33 (0.20) |
| Control | | | |
| smokers ($N = 10$) | 0.26 (0.13) | 0.31 (0.20) | 0.32 (0.17) |
| non-smokers ($N = 28$) | 0.45 (0.31) | 0.43 (0.30) | 0.47 (0.27) |
| **% BOMP** | | | |
| Test | | | |
| smokers ($N = 10$) | 7 (8) | 6 (4) | 9 (7) |
| non-smokers ($N = 23$) | 10 (6) | 11 (9) | 18 (10) |
| Control | | | |
| smokers ($N = 10$) | 6 (2) | 5 (5) | 9 (8) |
| non-smokers ($N = 28$) | 10 (9) | 10 (7) | 15 (9) |

Standard deviations in parentheses.
Effect of smoking (ANOVA with repeated measures): PI ($p = 0.04$), BOMP ($p = 0.009$).
Effect of smoking habits (ANOVA with repeated measures) on the treatment outcome: PI ($p = 0.99$), BOMP ($p = 0.75$).

*Table 3*. Mean probing pocket depth (PPD) in millimeters, mean attachment loss (AL) in millimeters and percentage of sites showing no change ($\leqslant 2$ mm) in PPD and in AL at the different evaluation moments in the test group and control group

| | Base | 6 months | 12 months | 24 months |
|---|---|---|---|---|
| **Mean PPD** | | | | |
| test | 2.5 (0.4) | 2.4 (0.3) | 2.4 (0.3) | 2.3 (0.3) |
| control | 2.4 (0.4) | 2.3 (0.3) | 2.3 (0.3) | 2.3 (0.3) |
| **Mean AL** | | | | |
| test | 3.4 (0.9) | 3.5 (0.8) | 3.5 (0.9) | 3.4 (0.9) |
| control | 3.4 (1.1) | 3.4 (1.0) | 3.4 (1.0) | 3.4 (1.0) |
| **No change in PPD** | | | | |
| test | | 88 (14) | 88 (13) | 87 (13) |
| control | | 91 (12) | 91 (11) | 91 (12) |
| **No change in AL** | | | | |
| test | | 80 (12) | 80 (11) | 79 (11) |
| control | | 82 (11) | 81 (9) | 81 (11) |
| **% PPD $\geqslant$ 5 mm** | | | | |
| test | 6 (7) | 4 (4) | 4 (5) | 4 (4)* |
| control | 5 (6) | 4 (5) | 3 (4)* | 4 (5)* |

Standard deviations in parentheses.
Significant change compared to baseline
*$p \leqslant 0.05$.

smokers and these were equally divided between the two groups. The mean number of cigarettes per day in the test group was 15.8 and in the control group 14.5. The consumption of tea, coffee and red wine was evaluated and no differences between the groups were found in relation to amounts. These parameters did not appear to affect the presence of staining. It was the brushing event in the evening at which the subjects brushed most thoroughly. The test group spent on average 8.3 min cleaning their teeth with toothbrush, interdental brushes, wooden sticks and floss, whereas for the control group this was 10 min. On a scale of 1–10, the subjects in the test group valued the taste of the mouthrinse with a mean of 5.2 and the dentifrice with a 6.1. In the control group this was 6.2 and 6.7, respectively.

In the course of the study, 13 subjects in the test and 16 in the control group were prescribed antibiotics for various reasons by their physician. Analysis revealed that these patients did not behave differently when compared with the patients not receiving antibiotics.

## Discussion

Daily plaque removal represents one of the basic concepts for establishing a stable periodontal situation. Claffey et al. (1990) showed that a higher percentage of sites harboring plaque at several consequent examinations over a 24-month period lost attachment when compared with sites that at the same examination moments did not harbor any plaque. No substantial evidence has thus far been brought up to identify a level of plaque compatible with maintenance of periodontal health (Lang 1997). However, the importance of self-performed plaque control has long been demonstrated by Lindhe et al. (1984).

Plaque that has accumulated for long periods of time along the gingival margin may affect the stability of periodontal condition. Despite the availability of products for mechanical oral hygiene, evidence suggests that plaque removal is not complete in the majority of individuals. Motivation, skills and dexterity required for effective oral hygiene might be beyond the ability of some patients (Lindhe & Koch 1967). Therefore, an alternative method of reducing the plaque levels would be desirable. In the present study, the mean plaque scores in the test group showed a significant decrease. This decrease was significantly larger than in the control group. This difference between the test and control group remained throughout the duration of the study. This indicates that the combination of AmF/$SnF_2$ dentifrice and mouthrinse has a beneficial effect on plaque reduction as measured after 3 months and lasting for 2 years. This finding is in agreement with the findings of other studies (Brecx et al. 1990, 1993, Zimmerman et al. 1993, Netuschil et al. 1995).

The control group in the present study brushed and rinsed with products containing NaF. In this respect, the controls were also using active ingredients. For ethical reasons, the longitudinal design of the study did not allow for a non-fluoridated dentifrice. It was therefore decided to use NaF in both mouthrinse and dentifrice. These could be considered as the standard fluoridated products. The anti-caries activity of NaF has been well established (Volpe et al. 1995, Brambilla 2001).

The mean percentages of bleeding at baseline in both groups were low (9% for both the test and control group). During the first year no differences were found in the bleeding scores; however, after 18 and 24 months a slight increase was found in both groups. The reason for this is not clear. Abbas et al. (1990) have observed increased bleeding on

*Table 4*. Mean percentage of sites showing staining scores 0–3 at the different evaluation moments in the test group and control group

| % | Base | 3 months | 6 months | 12 months | 18 months | 24 months |
|---|---|---|---|---|---|---|
| Score 0 | | | | | | |
| test | 98 (5) | 73 (24)* | 68 (18)* | 71(16)* | 70 (17) | 77 (12) |
| control | 99 (4) | 83 (21) | 79 (21) | 80 (20) | 78 (20) | 81 (16) |
| Score 1 | | | | | | |
| test | 1 (3) | 21 (19) | 23 (13)* | 16 (8)* | 19 (8)* | 8 (7) |
| control | 1 (3) | 13 (17) | 17 (17) | 11 (11) | 14 (9) | 8 (8) |
| Score 2 | | | | | | |
| test | 1 (2) | 7 (7)* | 9 (8) | 11 (11) | 10 (10) | 12 (8)* |
| control | 0 (1) | 3 (8) | 4 (6) | 7 (10) | 6 (9) | 8 (8) |
| Score 3 | | | | | | |
| test | 0 (1) | 0 (1) | 0 (1) | 2 (6) | 1 (2) | 3 (6) |
| control | 0 (0) | 0 (0) | 1 (2) | 2 (6) | 2 (6) | 2 (7) |
| Overall† | | | | | | |
| test | 2 (5) | 27 (24)* | 32 (18)* | 30 (16)* | 30 (17) | 23 (12) |
| control | 1 (4) | 17 (21) | 21 (21) | 20 (20) | 22 (20) | 19 (16) |

Standard deviations in parentheses.
Significant differences between groups.
*$p \leqslant 0.05$.
†Overall = percentage of sites with scores > 0.

*Table 5*. Mean result of the questionnaire at 1 year for the test and control group

| | Test | Range | | Control | Range | |
|---|---|---|---|---|---|---|
| taste of mouthrinse (scale: 0–10) | 5.2 (2.8) | 0.3–10 | | 6.2 (2.3) | 0.4–9.6 | |
| taste of toothpaste (scale: 0–10) | 6.1 (2.5) | 1.2–10 | | 6.7 (2.0) | 0.3–9.2 | |
| brushing frequency (number of times/day) | 2.3 (0.5) | 2–4 | | 2.2 (0.7) | 1–5 | |
| brushing time morning (min) | 4.4 (2.7) | 1–10 | ($N = 33$) | 4.1 (4.3) | 2–25 | ($N = 35$) |
| brushing time lunch (min) | 2.3 (0.7) | 2–4 | ($N = 8$) | 3.3 (1.7) | 2–6 | ($N = 7$) |
| brushing time night (min) | 8.3 (4.2) | 1–20 | ($N = 33$) | 10.0 (9.6) | 3–60 | ($N = 37$) |
| number of cigarettes/day | 15.8 (6.4) | 8–25 | ($N = 10$) | 14.5 (12.4) | 5–45 | ($N = 10$) |
| red wine (glasses/week) | 9.4 (8.8) | 1–35 | ($N = 19$) | 8.8 (7.2) | 0–28 | ($N = 26$) |
| coffee (cups/week) | 34.3 (17.7) | 3–70 | ($N = 32$) | 30.7 (21.5) | 7–94 | ($N = 38$) |
| tea (cups/week) | 22.9 (19.4) | 1–70 | ($N = 33$) | 21.2 (17.7) | 1–70 | ($N = 38$) |

Standard deviations in parentheses.

probing scores shortly after mechanical oral hygiene procedures. One explanation could be that during the study, the patients became less compliant to their written instruction not to brush at least 1 h prior to the appointment. Still it can be stated that a mean bleeding score of 14–15% is low and compares favorably with bleeding scores reported in other studies (Badersten et al. 1984, 1990, Claffey et al. 1990, Kaldahl et al. 1996).

Explorative analysis showed no effect of smoking on the treatment outcome. It was, however, found that smokers exhibited less bleeding than non-smoking patients. A lower bleeding tendency in smokers has been reported by many studies (for a review, see Newbrun 1996), although this is not generally accepted (Haber et al. 1993, Fung & Corbet 1995, Van der Weijden et al. 2001). The decreased bleeding tendency has been explained as being due to the local effects of the nicotine on the gingival tissues (vasoconstriction) (Clarke & Carey 1985). Smokers are also associated with deeper periodontal pockets and AL (Van der Weijden et al. 2001) when compared with non-smokers. Some authors try to explain this by reporting that smokers are frequently associated with high plaque levels in comparison with non-smokers (Sheiham 1971, Macgregor 1984). Other studies, however, have questioned this concept (Preber & Bergström 1986, Bergström & Eliasson 1987). An interesting finding of the present study was that smokers presented less plaque at any evaluation moment in comparison with non-smokers. The present study population consisted of patients undergoing supportive periodontal care. An explanation for the lower plaque scores of these periodontally treated smokers has not been found; however, it does explain the lower bleeding scores of these recall patients.

The mean staining % overall at baseline was 2 in the test group and 1% in the control group, respectively. A significant increase was seen at all evaluation times for both groups. At 3, 6 and 12 months significantly more staining was found in the test group than in the control group. At the end of the experimental period, however, the difference between the two groups was not statistically significant. As assessed by the staining index, however, patient perception assessed by the questionnaire at 1 year showed that the test products were considered to cause more staining of the teeth. Since polishing of the teeth was provided at every recall appointment, the staining score represents the incidence of staining, which developed within 3–4 months. The amount of staining seen in the test group was expected, since a yellowish golden stain caused by $SnF_2$ has already been reported by several authors when it is used in mouthrinses or dentifrices (Leverett et al. 1986, Wolff et al. 1989, Brecx et al. 1993, Boyd 1994, Conforti et al. 2000). The staining was most pronounced when mouthrinses (without toothbrushing) are used for extended periods of time. This stain can easily be removed by pumicing, but not fully by toothbrushing (Rølla & Ellingsen 1994). Surprisingly also in the control group using NaF a significant increase of staining was found. Observations from the questionnaire could not explain this finding. The relative dentin abrasivity (RDA) of both AmF/$SnF_2$ and NaF dentifrices used in this study was the same (RDA = 75). This suggests that the difference in staining could not be attributed to a different degree of abrasiveness of the used dentifrices.

The population in the present study was a group of subjects who received supportive periodontal care after having been treated for periodontal disease in the past. If one regards the control group, using fluoridated products, the mean AL was 3.4 mm at baseline and remained the same until the end of the experimental period. Analysis revealed that 82% of the sites remained stable. Comparable results were observed for pocket depth where 91% of the sites remained stable throughout the entire study, whereas a small percentage showed deepening or shallowing of $\geqslant 2$ mm (2% and 4%, respectively). These results appear to be in line with the longitudinal studies (Lindhe et al. 1984, Ramfjord et al. 1987). In the

Lindhe et al. (1984) study, subjects came in for maintenance every 4–6 months. It was found that 85% of the sites remained stable, whereas 10–12% of the sites showed AL of $\geqslant$2 mm. Ramfjord et al. (1987), also in a 5-year follow-up of a 3-month recall treatment, observed that 67.5% of the sites showed no change in pocket depth. Axelsson & Lindhe (1981) provided maintenance therapy at a higher frequency of 2–3 months throughout a period of 6 years. In this study, 10% of the sites lost $\geqslant$1 mm of attachment whereas the remaining 90% either remained stable or gained clinical attachment (17%). All these studies compare favorably with the results of the present study and underline the importance of recall appointments in maintaining the periodontal health. Without such professional assistance, periodontal disease will possibly reoccur (Suomi 1971, Axelsson & Lindhe 1981).

In conclusion, the combined use of an AmF/$SnF_2$ dentifrice and mouthrinse did not affect the parameters of inflammation (BOMP and PPD), but it has shown to be more effective in terms of plaque reduction when compared with the use of an NaF dentifrice and mouthrinse in a group of periodontal patients placed under regular maintenance care.

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Address:
*S . Paraskevas*
*Department of Periodontology*
*Academic Center for Dentistry Amsterdam, ACTA*
*Louwesweg 1*
*1006 EA Amsterdam*
*The Netherlands*
Fax: +31 20 5188512
E-mail: s.paraskevas@acta.nl