Effect of different frequencies of preventive maintenance treatment on dental caries: five-year observations in general dentistry patients

Birgitta Rosén, Göran Olavi, Dowen Birkhed, Stig Edvardsson and Jan Egelberg

Dental Services, County of Skåne, Sweden; Faculty of Odontology, Sahlgrenska Academy at Göteborg, Sweden; Faculty of Odontology, Malmö University, Sweden

Rosén B, Olavi G, Birkhed D, Edvardsson S, Egelberg, J. Effect of different frequencies of preventive maintenance treatment on dental caries: five-year observations in general dentistry patients. Acta Odontol Scand 2004;62:282–288. Oslo. ISSN 0001-6357.

A long-term study in adults at a public dental clinic in Sweden was initiated to evaluate the relative effectiveness of prophylactic treatments on the progression of dental caries and periodontal disease. With treatments scheduled every 3rd, 6th, 12th or 18th month, this report presents results on caries for the 3-month, 6-month and 18-month groups, and evaluates the impact of various caries-related risk factors. Caries increment over approximately 5 years was determined by adding clinical and radiographic findings of manifest primary and secondary caries during the study. Overall caries activity among all 105 participating individuals was low to moderate. No significant differences for caries on any of the various tooth surfaces or for total caries were observed among the three groups. Multiple regression analysis with 5-year caries increment as dependent variable showed that the following factors had a statistically significant association with caries increment: percentage filled surfaces at baseline examination, dietary score, plaque score, and number of mutans streptococci and lactobacilli in saliva. Non-significant factors included number of preventive treatments provided during the 5-year interval. The results of this long-term trial suggest that preventive treatments as often as every 3–6 months may not be justified in the case of patients with low to moderate caries activity. ☐ *Dental caries; long-term; maintenance treatment; prevention*

Dowen Birkhed, Department of Cariology, Faculty of Odontology, P.O. Box 450, SE-405 30 Göteborg, Sweden. Tel. +46 31 773 32 01, fax. +46 31 41 05 70, e-mail. birkhed@odontologi.gu.se

There are studies documenting that the progression of dental caries and periodontal disease in adults can be effectively reduced by preventive treatment programs provided every 2–3 months, including professional tooth cleaning, fluoride application, and oral hygiene reinforcement (1–3). In order to gather more information on the value of these programs, a long-term longitudinal study in adults was initiated to evaluate the relative effectiveness of prophylactic treatments, scheduled every 3rd, 6th, 12th or 18th month, on the progression of caries and periodontal disease. The results on periodontal disease have been published previously (4). This report presents the results on dental caries, and includes an evaluation of the relative impact of various caries-related risk factors.

Materials and methods

Overall study design

The study was conducted during the period 1983 to 1990 at a public dental clinic in the municipality of Kävlinge, Sweden. Following the recruitment of subjects, an initial examination was performed. Thereafter, all subjects were given necessary preventive, periodontal, and restorative treatment. The baseline examination was carried out approximately 3 months after completion of this initial treatment.

During the subsequent observation period, the protocol called for preventive treatment at recall intervals of 3, 6, 12, and 18 months, respectively. Four study groups were therefore formed. Examinations for data collection were scheduled to take place at 3 consecutive 18-month intervals for the 3-, 6-, and 18-month recall groups, and at 4 consecutive 12-month intervals for the 12-month recall group.

Subjects

The majority of the subjects for the study were recruited among recall patients at the study clinic. In addition, new patients seeking treatment at the clinic were included (about 20%), and a total of 391 patients were initially examined. For various reasons, 68 patients did not complete the initial treatment, and 64 others dropped out during the 5-year study. Thus, 323 individuals were examined at baseline and 259 patients completed the entire study. An analysis after completion of the study, however, showed that adherence to the intended protocol had often failed, affecting both recall intervals and time of final examination. It proved necessary to limit the analyses of the data to individuals who had a final examination after at least 54 months but no more than 66 months. This reduced the total number to 153.

Following initial examination, the original 391 subjects were divided into 4 experimental groups. First, 3 age groups were formed: 21–34 years, 35–49 years, and $\geq$50 years. Within each of these age groups, equal numbers of individuals were matched and allocated into the four

Taylor&Francis healthsciences

DOI 10.1080/00016350410001757

experimental groups, based on the following additional characteristics and with decreasing priority: number of remaining teeth, number of decayed tooth surfaces, number of filled tooth surfaces, full mouth dental plaque score, and mean probing depth. However, some of the effects of this initial matching were lost owing to the high loss of subjects, and this had to be taken into consideration during the data analyses.

Recordings

Clinical dental caries, radiographic dental caries, plaque scores, and numbers of remaining teeth, tooth surfaces, and filled surfaces were recorded by one and the same examiner throughout the study (author B.R.). The examiner had previously participated in a study on the reproducibility of caries recordings and found an intra-individual intraclass coefficient of correlation for manifest caries on a patient level amounting to 0.92 (5).

Clinical dental caries. Prior to recording, the teeth were cleaned with a rubber cup and pumice and dried with compressed air. Primary and secondary lesions located on crowns and roots were recorded when the tooth structure had disintegrated, forming cavities (manifest caries).

Radiographic coronal dental caries was recorded in conjunction with the clinical examination. Full mouth periapical radiographs (14 films) and 4 bitewing radiographs were taken at the initial and final examinations. At the intermediate examinations, only four bitewing radiographs were taken. Caries was scored when the lesion had reached the dentin.

Total dental caries for each individual was calculated by adding clinical and radiographic findings, which included primary and secondary lesions on crowns and roots. Caries recordings were not performed at baseline, since all lesions observed at initial examination had been restored prior to baseline. Caries lesions developing after baseline and detected at the intermediary and final examinations were added for each individual (5-year caries increment) and expressed as number of decayed surfaces and as a percentage relative to the number of available tooth surfaces.

Dental plaque was scored following use of a disclosing dye (Diaplac Rondell, Astra, Sweden). Stained plaque along the gingival margin that could be dislodged with a probe was recorded. Six sites of each tooth were scored: mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual. Plaque score for each individual was calculated as a percentage of examined sites. An average plaque score from baseline, intermediary, and final examinations was used for data analyses.

Bleeding on probing was recorded interchangeably by one of two dental hygienists providing the maintenance treatment (to facilitate scheduling; see below). An electronic, pressure-sensitive probe (tip diameter 0.5 mm) with a standardized probing force of 0.5 N was used for the same sites as for the plaque scores (Electronic Periodontal Probe, Model 200, Vine Valley Research, Middlesex, N.Y., USA). The probing was done to probing depth. The percentage of sites with bleeding was calculated and an average bleeding score from the baseline, intermediary, and final examinations was used for data analyses.

Dietary score. The frequency of intake of sugar-containing, between-meal snacks (e.g. candy, cakes, cookies, and soft drinks) was estimated from interviews using a standardized questionnaire (6). Interviews were conducted at baseline, intermediary, and final examinations. Intake frequency was given one of the following scores: 1 = never or seldom; 2 = every week; 3 = every day; 4 = 2–3 times/day; and 5 = >3 times/day. A median score from the examinations throughout the study was calculated for each patient.

Medication affecting salivary flow. At each examination, patients were asked about use of any medication, and those who reported taking drugs known to reduce salivary flow at one or more of the four examinations throughout the study were recorded.

Salivary and microbiological examination. Secretion rate of paraffin-stimulated whole saliva was expressed in mL/min (7) and buffer capacity as final pH (8). Numbers of mutans streptococci and lactobacilli in saliva were determined using selective agar media and expressed as colony forming units (CFU) per mL saliva (9). Average readings from the four examinations throughout the study were calculated.

Age, sex, and level of education. Education was determined using a questionnaire that included 4 levels (level 1: minimum education requirement at the time of the patient's schooling; level 4: university education).

Maintenance treatment

Recall treatment during the observation period was generally provided during visits of 0.5–1.0 h duration. The following preventive procedures were included: dental health information, oral hygiene instruction, dietary counseling, supra- and subgingival scaling, tooth polishing, and topical fluoride treatment with fluoride varnish (Duraphat, 2.23% F; Colgate, Piscataway, N.J., USA). Recommended personal oral hygiene aids included fluoridated toothpaste, soft toothbrushes, interdental brushes, triangular toothpicks, and dental floss. Home care fluoride rinses were not recommended.

The study clinic was staffed with seven dentists, two dental hygienists, and two dental assistants trained in preventive procedures. Most patients had all their preventive treatment provided by the dental hygienists. Some, however, were treated by the specially trained dental assistants and a dentist in combination, and in these situations the dentist primarily carried out the supra- and subgingival scaling. This variation in clinical routine was related to the staffing conditions at the clinic. Caries lesions found by the examiner during the study period were restored by the dentist assigned to the individual patient.

Table 1. Baseline characteristics of the 3-, 6-, and 18-month study groups with respect to caries-related risk factors (mean ± standard deviation; proportions of subjects)

Variable	3-month group ($n = 34$)	6-month group ($n = 33$)	18-month group ($n = 38$)	Comparisons between groups (level of significance)
Age	40.6 ± 13.4	40.8 ± 12.6	39.9 ± 11.9	NS
Sex (males/females)	20/14	17/16	17/21	NS
Level of education (1+2/3+4)	28/6	24/9	28/10	NS
Dietary score (1+2+3/4+5)	30/4	30/3	35/3	NS
Medication (yes/no)	5/29	8/25	10/28	NS
Missing surface at baseline (%)	17.1 ± 24.3	14.9 ± 17.5	15.1 ± 19.3	NS
Filled surface at baseline (%)	45.6 ± 17.8	46.6 ± 17.6	44.4 ± 19.7	NS
Salivary secretion rate (mL/min)	1.4 ± 0.6	1.3 ± 0.5	1.3 ± 0.6	NS
Salivary buffer capacity (pH)	5.1 ± 1.5	5.4 ± 1.5	5.6 ± 1.5	NS
Mutans streptococci (log CFU/mL)	6.8 ± 0.8	6.5 ± 1.0	6.5 ± 0.9	NS
Lactobacilli (log CFU/mL)	6.2 ± 0.6	6.0 ± 0.1	6.0 ± 0.3	NS
Plaque score (%)	36.0 ± 20.0	35.4 ± 19.3	36.1 ± 18.1	NS
Bleeding on probing score (%)	31.5 ± 18.8	34.0 ± 17-9	35.3 ± 20.1	NS

Data analyses

As mentioned above, intermediary examinations were scheduled every 18 months during the study for the 3-, 6-, and 18-month recall groups, and every 12 months for the 12-month recall group (2 and 3 intermediary examinations, respectively). This meant that caries increment during the total study interval was based on added lesions from 3 examinations for the 3-, 6-, and 18-month recall groups and from 4 examinations for the 12-month recall group (including final examinations). In a previous study, we found that some caries lesions are overlooked during examinations and may be detected at a subsequent recording (5). Comparatively more lesions might therefore be discovered during the total study interval for the 12-month group than for the other 3 groups. It was therefore decided to omit the 12-month group. This reduced the total number of patients with complete caries records to 105.

Because of the high attrition of subjects from the study, it was important to compare the final 105 subjects to those of the original 391 subjects who, for various reasons, were not included in the data analysis. Thus, scores from initial examination for each of 14 available caries-related risk factors were compared between the final 105 subjects and the 286 'drop-outs' using Student's unpaired *t* tests (age, missing surfaces, filled surfaces, decayed surfaces, plaque scores, bleeding on probing scores, salivary secretion rate, salivary buffer capacity, numbers of mutans streptococci and lactobacilli); Mann-Whitney tests (level of education, dietary score, and medication) and chi-square test (sex). No significant differences between the 2 groups were found for any of the 14 variables.

The 3-, 6-, and 18-month study groups were first compared with respect to all available caries-related risk factors at baseline examination using analyses of variance, Kruskal-Wallis, and chi-square tests for the various factors. No significant differences between the groups were observed for any of the variables (Tables 1 and 2). The analyses were therefore continued, comparing the 5-year caries increment among the study groups employing analyses of variance.

Step-wise, multiple regression analysis with the 5-year caries increment (% surfaces) as dependent variable was used for the combined 105 subjects in order to evaluate the degree of relationship between the exposure to caries and the various factors which were recorded. The recall frequency was entered as the actual number of preventive treatments each patient had experienced over the total observation interval. Recordings for level of education, medication, and dietary scores were dichotomized according to the most favorable dichotomization as established from repeated analyses.

Additional analyses of factors associated with exposure to caries were performed by comparing the 18 subjects who showed no caries lesions during the 5-year observa-

Table 2. Baseline DMFT and DMFS (means ± standard deviation) for the 3-, 6-, and 18-month groups by different age subgroups

	3-month group* ($n = 34$)			6-month group* ($n = 33$)			18-month group* ($n = 38$)		
	20—34 years ($n = 11$)	35–49 years ($n = 16$)	≥50 years ($n = 7$)	20–34 years ($n = 11$)	35–49 years ($n = 15$)	≥50 years ($n = 7$)	20–34 years ($n = 15$)	35–49 years ($n = 14$)	≥50 years ($n = 9$)
DMFT	17.2 ± 4.5	21.0 ± 6.0	24.4 ± 3.3	18.5 ± 4.1	20.4 ± 5.1	24.6 ± 4.0	19.1 ± 5.5	21.1 ± 4.9	22.4 ± 3.8
DMFS	43.7 ± 17.9	64.9 ± 29.8	90.3 ± 25.9	46.0 ± 15.0	65.8 ± 20.8	83.1 ± 24.6	49.1 ± 24.0	63.6 ± 18.6	79.0 ± 25.3

* No statistically significant difference between groups for DMFT and DMFS (Kruskal-Wallis test).

Table 3. Five-year caries increment for various tooth surfaces and for total caries score of the 3-, 6-, and 18-month groups (mean ± standard deviation; median and range within parentheses)

	No. of decayed surfaces			% decayed surfaces		
Surface	3-month group* ($n = 34$)	6-month group* ($n = 33$)	18-month group* ($n = 38$)	3-month group* ($n = 34$)	6-month group* ($n = 33$)	18-month group* ($n = 38$)
Occlusal	0.03 ± 0.2	0.3 ± 0.7	0.2 ± 0.4	0.2 ± 1.2	1.9 ± 4.6	1.4 ± 2.9
Buccal	1.5 ± 1.5	1.0 ± 1.4	1.1 ± 1.8	4.7 ± 5.1	3.0 ± 4.7	3.0 ± 4.7
Lingual	0.6 ± 1.0	0.4 ± 0.8	0.5 ± 1.1	3.1 ± 5.6	1.6 ± 3.2	2.2 ± 4.6
Approximal	2.3 ± 2.6	2.3 ± 3.1	3.1 ± 3.7	5.4 ± 6.7	5.1 ± 7.2	6.3 ± 8.9
Total	4.4 ± 4.2	4.0 ± 4.6	4.9 ± 5.3	4.9 ± 6.4	3.8 ± 4.9	4.4 ± 5.3
	(3.0)	(3.0)	(3.5)	(2.7)	(3.1)	(3.2)
	(0–20)	(0–21)	(0–23)	(0–35)	(0–24)	(0–27)

* No statistically significant differences among the 3 groups, neither for caries at any of the various tooth surfaces, nor for total caries score (analyses of variance).

tion interval with the 18 individuals who showed the highest 5-year caries increment among the final 105 subjects. Statistical comparisons between these two extreme groups were performed with Mann-Whitney tests (age, level of education, dietary score, medication, filled surfaces at initial examination, number of preventive treatments, salivary secretion rate, salivary buffer capacity, numbers of mutans streptococci and lactobacilli, plaque and bleeding on probing scores) and chi-square test (sex).

Throughout the statistical analyses, $P < 0.05$ was used for level of statistical significance.

Results

The baseline characteristics of the three study groups with respect to the caries-related risk factors are presented in Tables 1 and 2. As mentioned above, no significant differences between the groups were observed for any of the variables.

The average length of the observation period was 61 months for the 3-month group, 61 months for the 6-month group, and 58 months for the 18-month group. The mean number of preventive treatments during the observation interval was 16 for the 3-month group (range 11–20), 9 for the 6-month group (range 7–10), and 3 for all individuals of the 18-month group.

At baseline, following initial treatment, the mean numbers of remaining teeth (± standard deviation) were 24.5 ± 5.1, 25.0 ± 3.6, and 24.9 ± 4.0, respectively, for the 3-, 6-, and 18-month groups. Tooth loss from baseline to final examination was low for all 3 groups: in the 3-month group, 1 patient lost 1 tooth; in the 6-month group, 4 patients lost 1 tooth and 1 patient lost 2 teeth; and in the 18-month group 2 patients lost 1 tooth and 1 patient lost 2 teeth.

The 5-year caries increments for subjects of the 3-, 6-, and 18-month groups are presented in Table 3. No significant differences were observed among the three groups for caries at any of the various tooth surfaces or for total caries score.

The occurrence of root caries at any of the examinations during the study was also similar between the 3 groups, and was found in 24%, 18%, and 26% of individuals in the 3-, 6-, and 18-month groups, respectively (NS, chi-square test).

The results of step-wise multiple regression analysis with 5-year caries increment as the dependent variable are presented in Table 4. Factors having statistically significant association with the caries increment and remaining in the equation were: percentage filled tooth surfaces at baseline examination, dietary score, plaque score, and numbers of mutans streptococci and lactobacilli. These factors accounted for 41% of the variation. Non-significant factors eliminated in the analyses included number of preventive treatments during the 5-year observation interval.

The frequencies of different levels for the 5-year caries increment among all 105 subjects are presented in Table 5 and show that 18 subjects developed no caries lesions at

Table 4. Results of step-wise multiple regression analysis using 5-year caries increment (% tooth surfaces) as dependent variable

	Level of significance
Variables showing statistical significance	
Filled surfaces at baseline examination (%)	<0.001
Dietary score (scores 1+2+3 versus score 4+5)	<0.05
Plaque score (%)	<0.01
Mutans streptococci (log CFU/mL)	<0.05
Lactobacilli (log CFU/mL)	<0.05
Variables not showing statistical significance	
Age	NS
Sex	NS
Level of education (1+2 versus 3+4)	NS
Medication (use of drugs affecting salivary flow versus no such drugs)	NS
Preventive treatments during the 5-year observation interval (number)	NS
Salivary secretion rate (mL/min)	NS
Salivary buffer capacity (pH)	NS
Bleeding on probing score (%)	NS

Table 5. Frequencies (number and %) of different levels for the 5-year caries increment among all 105 subjects under analysis

No. of caries lesions	No. of subjects	% subjects
0	18	17
1–3	36	34
4–6	30	29
7–9	8	8
10–12	6	6
13–15	2	2
16–18	2	2
19–21	2	2
22–23	1	1
Total	105	100

all; 36 developed 1–3 lesions and 3 developed 19–23 lesions.

Comparisons between the 18 subjects who showed no caries lesions during the 5-year observation interval and the 18 that showed the highest 5-year caries increment among the final 105 subjects are presented in Table 6. Statistically significant differences between the two extreme groups were observed with respect to percentage filled surfaces at initial examination, salivary secretion rate and buffer capacity, numbers of mutans streptococci and lactobacilli, and plaque and bleeding on probing scores. For each of these variables, however, the values for the two groups showed a marked overlap. Variables that did not show differences between the two groups included number of preventive treatments.

Discussion

This study was performed in order to evaluate the long-term effects of different frequencies of preventive maintenance treatments on caries activity in adults. Few studies of this nature have been published over the years. The present trial, which included an evaluation of effects on periodontal disease (4), was conducted and built within the routines of a public dental clinic. Although this clinical environment may have been advantageous as far as extrapolation of the findings to corresponding clinical situations was concerned, some compromise had to be made in the experimental design due to practical circumstances. Preventive care was therefore provided by different therapists and may therefore have varied to some extent. Following completion of the study, it was found that regularity of the recall intervals for the different groups had not been strictly adhered to. Cancellations by the patients and sick-leave by the staff had not been sufficiently supervised to prevent such irregularities. This called for a limitation of the data analyses to participating individuals of the various study groups with acceptable adherence to the initial protocol.

Because of the high attrition of subjects from the study,

Table 6. Comparison between the 18 subjects who showed no caries lesions during the 5-year observation interval and the 18 who showed the highest 5-year caries increment among the final 105 subjects (mean ± standard deviation and range within parentheses; proportions of subjects)

Variable	No caries experience ($n = 18$)	Highest caries increment ($n = 18$)	Comparison between groups (level of significance)
5-year caries increment (No. of lesions)	0	12.8 ± 4.8 (7–23)	
5-year caries increment (% lesions)	0	13.7 ± 7.6 (7–35)	
Age	36.0 ± 10.5 (24–59)	42.9 ± 13.0 (23–75)	NS
Sex (males/females)	10/8	8/10	NS
Level of education (1+2/3+4)	13/5	16/2	NS
Dietary score (1+2+3/4+5)	16/2	16/2	NS
Medication (yes/no)	3/15	5/13	NS
Filled surface at baseline examination (%)	30.9 ± 16.3 (5–61)	52.5 ± 19.1 (20–88)	<0.01
Preventive treatments (No.)	6.8 ± 4.9 (2–15)	7.6 ± 5.6 (2–16)	NS
Salivary secretion rate (mL/min)	1.7 ± 0.6 (0.8–3.0)	1.2 ± 0.4 (0.6–1.9)	<0.05
Salivary buffer capacity (pH)	5.4 ± 1.4 (3.5–7.7)	4.5 ± 1.0 (3.2–7.4)	<0.05
Mutans streptococci (log CFU/mL)	5.2 ± 0.6 (3.3–6.4)	6.0 ± 0.5 (5.2–6.7)	<0.001
Lactobacilli (log CFU/mL)	4.2 ± 0.8 (3.3–5.7)	5.3 ± 0.7 (3.9–6.5)	<0.001
Plaque score (%)	30.5 ± 13.9 (6.4–49.8)	42.4 ± 18.5 (11.5–85.4)	<0.05
Bleeding on probing score (%)	27.6 ± 10.4 (4.4–48.0)	43.3 ± 15.9 (9.4–63.7)	<0.01

it was also important to compare the subjects included in the final data analyses to the 'drop-outs' with respect to initial characteristics of potential importance for the development of caries. These analyses did not discover any significant differences between the two groups for any of the available parameters. This included the factor found most related to the 5-year caries increment, namely percentage filled surfaces at initial examination. The lack of differences at initial examination does not, of course, eliminate the suspicion that the subjects used for the final data analyses generally had been more motivated to comply with the study protocol.

The study by Axelsson & Lindhe (1, 2) seems to be the only previous, long-term prospective trial in adults evaluating the effects of professional preventive treatment on dental caries in adults. This study compared the caries increment in 310 test patients to that of 146 control patients of 3 different age groups over a 6-year period. Test subjects received preventive treatments once every 2nd month during the first 2 years and once every 3rd month during the following 4 years. The control patients were examined by a dentist and were provided with restorations at yearly intervals, but received no professional preventive procedures and no emphasis on oral home care. The results revealed mean 6-year caries increments for the controls amounting to 11.9–15.1 lesions as compared to the test subjects with an average of only 0.2–0.3 lesions. The mean 5-year caries increments for the 3 study groups in the present study amounted to 4.0–4.9 lesions. These values suggest that: 1) caries activity in Sweden at the time of the Axelsson & Lindhe study was high in individuals not provided with any preventive treatment; 2) the preventive treatment given in the Axelsson & Lindhe study was extremely efficient; and 3) the preventive treatments supplied in the present study did not measure up to the effectiveness observed in the Axelsson & Lindhe study.

During the period of the present study, the Medical Board of the Swedish Government presented guidelines to the public dental health clinics with respect to caries and caries prevention in adults. A patient who presented with 1–3 caries lesions per year was defined as 'caries active', while a patient with $\geq$4 lesions per year was considered to have 'high caries activity'. These definitions suggest that the subjects in the present study generally showed low to moderate caries activity. In fact, 18 of the 105 showed no activity at all. The majority of subjects showed a caries rate corresponding to less than a single lesion per year, and only a couple of patients could be considered to have 'high caries activity' (Table 5).

The results of the present study failed to demonstrate any dissimilarity in 5-year caries increment between subjects provided preventive maintenance care every 3rd, every 6th, or every 18th month. The lack of differences may, at least in part, be due to the overall low caries activity of the participating individuals. At the time of the study, most of the available dentifrices in Sweden were fluoridated. Regular use of such toothpastes may decrease the need for professional preventive maintenance treatments. Yet, the effectiveness of the preventive treatments provided every 3rd month in the present study was inferior to that achieved in the study by Axelsson & Lindhe (2). This leads to the issue of the quality of the preventive treatments, both with respect to manual procedures and patient motivation skills. Using average plaque scores during the observation intervals for the two studies as an indicator of success of patient motivation, a difference can be observed. Axelsson & Lindhe (2) achieved overall mean plaque scores amounting to 15–20%, while the corresponding scores in the present study averaged 35%.

The present study also evaluated the impact of various caries-related risk factors for caries development in the participating subjects. Regression analyses of all 105 subjects showed a significant impact of the following variables: percentage filled surfaces at baseline examination, dietary score, plaque score, and numbers of mutans streptococci and lactobacilli. The analyses comparing the 18 subjects who had no caries lesions with the 18 who showed the highest caries increment during the 5-years observation interval showed the significant influence of 3 additional variables, namely salivary secretion rate, salivary buffer capacity, and bleeding on probing score. Thus, the present study confirms the influence of previously well-known caries risk factors (10–12). These findings would seem to give credence to the validity of the present study, indirectly adding support to the negative outcome with respect to lack of influence of the frequency of maintenance treatment.

In conclusion, within the limitations of this study as discussed above, namely the limited number of participants and the great age span in the study groups, no difference in 5-year caries increment was observed among subjects provided preventive treatments every 3rd, 6th, or 18th month. Previous analyses of the periodontal conditions (including the group receiving preventive treatment every 12th month) showed some limited evidence of disadvantage to the 18-month group compared to the 3-, 6-, and 12-month groups, but no differences between these latter 3 groups (4). This may be interpreted as suggesting that preventive treatments as often as every 3–6 months may not be justified in the case of recall patients with limited susceptibility to caries and/or periodontal disease. It has to be emphasized, however, that disease activities may vary over time and that in determining the extent of preventive treatment of the individual patient current signs of disease activity have to be taken into consideration.

The data for this study were collected a considerable number of years ago (between 1983 and 1990). Hugoson et al. (13) demonstrated an improvement of caries prevalence for 20 to 50-year-olds in Sweden from 1973 to 1993, but there seem to be no epidemiological data for young Swedish populations after 1993. However, there is reason to believe that the situation has continued to improve and thus the above recommendation that preventive treatments as often as every 3–6 months may

not be justified in patients with low to moderate caries activity has been strengthened.

Acknowledgements.—We express our gratitude to: Lena Hindeman, RDH, Karin Nilsson, LDS, and Gull-Britt Strömblad, RDH, for clinical examinations throughout the study; Marika Hansson for study coordination; Jan Lanke, Professor of statistics, for statistical guidance and support. We thank the following colleagues for help in different ways: Anita Badersten, Karin Bengtsson, Jim Bergsäng, Anna-Lisa Björn, Runo Cronström, Thomas Forss, Kersti Franke, Hans-Erik Hansson, Kerstin Holst, Hans Ingemar Jeppsson, Kjell Mårtensson, Anders Rönström, Christer Sjöberg, and Göran Söderholm. In addition, we are greatly indebted to all members of staff at the Public Dental Clinic of Kävlinge, Sweden, for their loyal participation in providing dental services for the study subjects. Financial support for the study was received from the Division of Dental Services, County Council of Skåne, Sweden, and from the Crafoord Foundation, Sweden.

References

1. Axelsson P, Lindhe J. Effect of controlled oral hygiene procedures on caries and periodontal disease in adults. J Clin Periodontol 1978;5:133–51.
2. Axelsson P, Lindhe J. Effect of controlled oral hygiene procedures on caries and periodontal disease in adults. Results after 6 years. J Clin Periodontol 1981;8:239–48.
3. Söderholm G. Effect of a dental care program on dental health conditions. A study of employees of a Swedish shipyard [Thesis]. Department of Periodontology, Faculty of Odontology, University of Lund, Malmö, Sweden; 1979.
4. Rosén B, Olavi G, Badersten A, Rönström A, Söderholm G, Egelberg J. Effect of different frequencies of preventive maintenance treatment on periodontal conditions. 5-year observations in general dentistry patients. J Clin Periodontol 1999;26:225–33.
5. Rosén B, Birkhed D, Nilsson K, Olavi G, Egelberg J. Reproducibility of clinical caries diagnoses on coronal and root surfaces. Caries Res 1996;30:1–7.
6. Söderholm G, Birkhed D. Caries predicting factors in adult patients participating in a dental health program. Community Dent Oral Epidemiol 1988;16:374–77.
7. Heintze U, Birkhed D, Björn H. Secretion rate and buffer effect of resting and stimulated whole saliva as a function of age and sex. Swedish Dent J 1983;7:227–38.
8. Ericsson Y. Clinical investigations of the salivary buffering action. Acta Odontol Scand 1959;17:131–65.
9. Klock B, Krasse B. Microbial and salivary conditions in 9- to 12-year-old children. Scand J Dent Res 1977;85:56–63.
10. Block AH. Caries prediction: implications for individual patient care. In: Johnson NW, editor. Risk markers for oral diseases. Vol. 1. Dental caries. Cambridge: Cambridge University Press; 1991. p. 424–44.
11. Powell LW. Caries prediction: a review of the literature. Community Dent Oral Epidemiol 1998;26:361–71.
12. Reich E, Lussi A, Newbrun E. Caries-risk assessment. Int Dent J 1999;;49:15–26.
13. Hugoson A, Koch G, Slotte C, Bergendal T, Thorstensson B. Caries prevalence and distribution in 20–80-year-olds in Jönköping, Sweden, in 1973, 1983, and 1993. Community Dent Oral Epidemiol 2000;28:90–6.

Received for publication 4 June 2004
Accepted 19 October 2004