J Clin Periodontol 2007; 34: 1068–1073 doi: 10.1111/j.1600-051X.2007.01150.x

Journal of Clinical Periodontology

Plaque and gingivitis in the elderly: a randomized, single-blind clinical trial on the outcome of intensified mechanical or antibacterial oral hygiene measures

Ulrich Schiffner, Mathias Bahr and Susanne Effenberger

Department of Operative and Preventive Dentistry, University of Hamburg, Hamburg, Germany

Schiffner U, Bahr M, Effenberger S. Plaque and gingivitis in the elderly: a randomized, single-blind clinical trial on the outcome of intensified mechanical or antibacterial oral hygiene measures. J Clin Periodontol 2007; 34: 1068–1073. doi: 10.1111/j.1600-051X.2007.01150.x

Abstract

Objectives: To study the outcome of intensified mechanical oral hygiene compared with the effect of an adjunctive antibacterial mouth rinse on plaque and gingivitis in elderly people.

Material and Methods: In a randomized, single-blind, 6-month controlled clinical study, 106 subjects, 55 years or older, were divided into four groups: (I) Participants were instructed on improved mechanical oral hygiene, including interdental hygiene; (II) subjects used an antibacterial mouth rinse containing amine and stannous fluoride in addition to their usual oral hygiene practices; (III) both intensive mechanical and antibacterial measures were combined; and (IV) a control group with no specific regimen. Gingivitis and plaque were examined.

Results: After 6 months, both plaque and gingivitis scores were significantly lower than at baseline in all groups. Reductions in gingivitis differed significantly between the control group and all other groups but not between the three intervention groups. Only groups with improved mechanical oral hygiene showed significant improvements in plaque scores compared with control.

Conclusions: Intensive mechanical oral hygiene resulted in greater plaque reduction than the combination of an antibacterial rinse and usual oral hygiene procedures. Gingivitis was reduced by both intensive oral hygiene and use of the amine/stannous fluoride rinse. Combining intensive mechanical oral hygiene with the antibacterial rinse did not result in further gingivitis reduction.

Key words: amine/stannous fluoride; elderly people; gingivitis; interdental hygiene; mouth rinse; plaque

Accepted for publication 21 August 2007

Conflict of interest and source of funding statement

The authors declare that they have no conflict of interests.

The study was self-supported, but TePe Comp., Malmö (Sweden), provided free toothbrushes and inter-dental brushes, and Gaba Comp., Lörrach (Germany), provided free Meridol® mouth rinse used in this study. The study protocol was prepared by the chief investigator.

Several studies investigating oral health and preventive regimens in children, adolescents or younger adults have been published. In contrast, studies concerning the oral health of senior citizens are uncommon (Davies 2003). Preventive recommendations are usually extrapolated from studies of children and

adolescents (Davies 2004). Other studies in seniors mainly deal with general aspects of their oral health (de Baat 1993, Frenkel et al. 2001, Hamalainen et al. 2004) or with special groups like institutionalized elderly (Meurman et al. 2001, Peltola 2004). It has been shown that oral health in elderly patients is improved by adequate oral hygiene measures (Kundert & Palla 1988, Murtomaa & Meurman 1992). However, reports comparing the effectiveness of different individual preventive measures in this age group are inconclusive (Axelsson et al. 2004, Verma & Bhat 2004).

In industrialized countries, the life expectancy is rising steadily, and the number of elderly people is growing (Nitschke 2001). As a consequence of improved dental awareness and dental care, more and more older people retain their own teeth (de Baat 1993, Jones 1995). In Germany, the oral health of adults and senior citizens was examined in a nationwide representative randomized sample (Micheelis & Schiffner 2006). Senior citizens exhibited higher scores for plaque and gingivitis than younger adults. However, in comparison with earlier examinations, the average number of missing teeth had declined. The higher number of retained teeth predisposes these patients to a higher prevalence of root caries and severe periodontitis (Micheelis & Schiffner 2006). Thus, more attention to preventive regimens in senior citizens is required to reduce plaque and gingivitis (de Baat 1993, Jones 1995, Nitschke 2001).

In general, elderly people can benefit from the same preventive regimens as younger people. However, the performance of adequate oral hygiene is reduced by factors such as reduced manual and cognitive skills, reduced sight, but also by systemic diseases or social isolation. These factors might imply that the prevention of oral diseases might be improved by the institution of measures other than mechanical hygiene, such as chemical plaque control or professional tooth cleaning (Davies 2004).

Different agents are available for chemical plaque control. Comparative studies have shown repeatedly that chlorhexidine rinses exhibit the strongest effect (Lang & Brecx 1986, Altenhofen et al. 1989, Brecx et al. 1992). Their side effects limit their long-term use, especially at higher concentrations (Schiffner 2000). In contrast, rinsing solutions with a combination of amine fluoride and stannous fluoride can be a suitable choice for long-term preventive use (Zimmermann et al. 1993). Studies have shown the positive effect of this combination on plaque and gingivitis reduction (Bànòczy et al. 1989, Netuschil et al. 1995, Mengel et al. 1996). An additional benefit to the plaque reduction by the stannous ions is the remineralizing effect of the fluoride. This can be of particular importance for the prevention of root caries (Bànòczy et al. 1989, Jones 1995). Thus, there are many possible positive effects of the use of these agents in combination that could be of special importance for senior citizens.

Until now, there have been no direct comparisons of the plaque and gingivitis-reducing effects by improved mechanical measures or of adjunctive antibacterial plaque-inhibiting regimens in seniors. The aim of the present study is to compare both preventive strategies in subjects 55 years and older. The hypothesis tested in the study was that senior citizens obtain a greater benefit in the reduction of plaque and gingivitis from performing both intensified mechanical oral hygiene as well as the use of an adjunctive daily mouth rinse.

Material and Methods

Participants

The investigation was carried out as a randomized, single-blinded prospective 6-month clinical study. Volunteers older than 54 years were recruited by distributing handouts to senior housing estates, senior meeting places and senior sport groups. The inclusion criteria specified persons of a minimum age of 55 years, and not a dental professional, with at least 12 natural teeth, a salivary flow rate of at least 0.7 ml/min., good general health, on no permanent medication and no medications that might affect bleeding tendency or salivary secretion.

The sample size was calculated assuming a statistical power of 80%. Based on representative data on gingival health in German senior citizens (Micheelis & Reich 1997), who exhibited a papillary bleeding index (PBI) of 1.3 (standard deviation 1.1), and on previous studies investigating oral hygiene, showing a PBI reduction of 50% under improved oral hygiene measures, the sample was set on 24 subjects per study group plus another five participants to cover drop outs. One hundred and sixteen participants were assigned to one of four groups in a randomized stratified sampling procedure. The stratifying criterion was the social class affiliation, which was evaluated by their former profession. Subsets of participants of low, medium or high socioeconomic status were formed. The participants were assigned to their groups by the chief investigator, who was not the examiner. The examiner was blinded for group assignment, and the participants were not. The subjects were informed about the objectives of the study, and informed consent was obtained.

Study groups

Group 1 (mechanical plaque control)

Subjects in this group were informed, motivated and individually instructed with an intensified oral hygiene. Areas of inadequate plaque removal were disclosed using a two-color revelator (Mira-2-Ton, Hager&Werken, Duisburg, Germany). Tooth brushing was demonstrated, and brushing was practiced using a rotation method. The subjects were provided with a short-head multi-tufted toothbrush (TePe, Malmö, Sweden) and instructed to use it twice a day. Special attention was paid to inter-dental hygiene. All subjects were provided with inter-dental brushes (TePe) of adequate size and in sufficient numbers. They were instructed to perform inter-dental hygiene once a day.

Group 2 (chemical plaque control)

Subjects of group 2 were instructed to use an antibacterial mouth rinse once daily for 30 s. For this purpose, an amine/stannous fluoride rinsing solution with 250 ppm fluoride (Meridol®, Gaba-GmbH, Lörrach, Germany) was used. The subjects were provided with sufficient rinsing solution. They continued their usual oral hygiene practices.

Group 3 (mechanical plus chemical plaque control)

Subjects of group 3 performed both the measures of mechanical plaque control as described for group 1 and the measures of chemical plaque control that were applied in group 2.

Group 4 (control)

Like all participants, the subjects of group 4 received a professional tooth cleaning at the beginning of the study period and were examined three times for plaque and gingivitis during the entire study period as well. There were no further preventive interventions.

Oral investigations

The examination took place at the Center of Dental and Oral Medicine of the University Medical Center Hamburg-Eppendorf. All investigations were performed by one examiner. There was a baseline investigation, an intermediate investigation after 3 weeks and a final check after 6 months. At baseline, pocket depths and the caries experience in terms of prevalence of decayed, missing or filled teeth (DMFT, World Health Organization (WHO) 1997) as well as the root caries index (RCI, Katz et al. 1982], which relates the number of decayed or filled root surfaces to the number of exposed root surfaces, were determined in order to check the comparability of the groups.

Plaque and gingivitis scores, which were the target variables in this study, were determined for all teeth including third molars. For quantitative plaque recording, the Quigley/Hein index (QHI, Quigley & Hein 1962) was used after disclosing plaque with a revelator (Mira-2-tone, Hager&Werken, Duisburg, Germany). Plaque was scored in the first and third quadrant at the vestibular tooth surfaces and in the second and fourth quadrant at the oral surfaces. Gingivitis was determined using the PBI (Saxer & Mühlemann 1975) and was measured in the second and fourth quadrant at all vestibular papillae and in the first and third quadrant at all oral papillae.

Following the baseline examination, each subject received a professional prophylaxis. Debris, plaque, and supragingival calculus were removed with hand and ultrasonic instruments. Easily accessible subgingival calculus was removed too. The tooth surfaces were polished with pumice and a rubber cup.

After 3 weeks, the plaque and gingivitis indices were determined again. On this occasion, the appropriate use of the mechanical or chemical devices was checked, and participants' questions about their preventive regimens were answered if necessary.

The final examination was carried out after 6 months. Plaque and gingivitis were examined again. In addition, the subjects had to fill in a questionnaire to evaluate whether the subjects had followed the recommendations of their specific study group.

For statistical analysis, non-parametric test routines were used (χ^2, Wilcoxon' test, Kruskal–Wallis test, and Mann–Whitney test; SPSS program). To minimize possible unknown bias due to subject dropout, an intent-to-treat analysis was used in which the last observation was carried forward for randomized subjects who did not complete all study visits.

Results

One hundred and six subjects (73 women, 33 men) participated up to the end of the study. Two persons were excluded due to a low number of own teeth, and two subjects were excluded due to reduced salivary flow. Six persons discontinued their participation in the study for different reasons: two of them complained about discoloration following the use of the rinsing solution, while the remaining four persons discontinued without giving any reason. The questionnaire filled in at the end of the study revealed a high degree of compliance, as all subjects stated that they had followed the oral hygiene recommendations of their specific study group.

The mean age of the participants was 62.6 (± 6.2) years, with a range from 55 to 84 years. Similarly, the social and oral health characteristics of the four participant groups did not differ with respect to age, periodontal pocket depth, DMFT or RCI (Table 1). Neither were there any differences with respect to gender ($p = 0.278$) or social class distribution in the groups ($p = 0.882$; χ^2 test).

Tables 2 and 3 show the development of the plaque and gingivitis scores during the 6-month study interval. At baseline, the scores did not differ between

Table 1. Age and oral parameters of the participants in the different study groups

Study group*	Age	Number of teeth	Mean pocket depth (mm)	DMFT	RCI (%)
Group 1	63.5 ± 6.7	24.0 ± 3.4	3.6 ± 0.8	19.2 ± 3.5	27.4 ± 17.8
Group 2	63.4 ± 6.2	24.5 ± 4.2	3.6 ± 0.7	18.2 ± 4.7	29.6 ± 30.6
Group 3	61.3 ± 5.1	24.8 ± 4.1	3.9 ± 1.0	18.6 ± 4.3	26.8 ± 24.9
Control	62.4 ± 6.8	24.8 ± 3.7	3.7 ± 0.8	18.7 ± 4.7	25.7 ± 27.7
p-value†	0.48	0.73	0.74	0.87	0.82

*Group 1, intensive mechanical oral hygiene; group 2, use of an amine/stannous fluoride mouth rinse in addition to routine mechanical oral hygiene; group 3, intensive mechanical oral hygiene plus amine/stannous fluoride mouth rinse.
†Kruskal–Wallis test.
RCI, root caries index; DMFT, decayed, missing or filled teeth.

Table 2. Plaque index (QHI, mean and SD) in the different study groups

Study group*	Plaque index (QHI)			
	baseline examination	3 weeks	6 months	mean reduction at 6 months from baseline (95% CI)
Group 1	1.2 ± 0.5	0.5 ± 0.4†	0.5 ± 0.4†	0.8 ± 0.6 (0.5–1.0)
Group 2	1.4 ± 0.6	0.9 ± 0.4†	0.8 ± 0.5†	0.5 ± 0.5 (0.3–0.7)
Group 3	1.5 ± 0.6	0.7 ± 0.5†	0.7 ± 0.4†	0.7 ± 0.5 (0.5–0.9)
Control	1.2 ± 0.5	0.7 ± 0.4†	0.9 ± 0.5†,‡	0.3 ± 0.4 (0.2–0.5)
p-value§	0.52	0.01	0.006	0.003

*Group 1, intensive mechanical oral hygiene; group 2, use of an amine/stannous fluoride mouth rinse in addition to routine mechanical oral hygiene; group 3, intensive mechanical oral hygiene plus amine/stannous fluoride mouth rinse.
†Significantly different from baseline (Wilcoxon's test).
‡Significantly different from intermediate examination (Wilcoxon's test).
§Kruskal–Wallis test.

Table 3. Papillary-bleeding index (PBI, mean and SD) in the different study groups

Study group*	Gingivitis (PBI)			
	baseline examination	3 weeks	6 months	mean reduction at 6 months from baseline (95% CI)
Group 1	1.1 ± 0.5	0.4 ± 0.5†	0.4 ± 0.4†	0.7 ± 0.5 (0.5–0.9)
Group 2	1.1 ± 0.5	0.4 ± 0.3†	0.5 ± 0.4†	0.7 ± 0.5 (0.5–0.9)
Group 3	1.2 ± 0.6	0.4 ± 0.4†	0.5 ± 0.3†	0.7 ± 0.5 (0.5–0.9)
Control	1.1 ± 0.7	0.5 ± 0.4†	0.8 ± 0.6†,‡	0.4 ± 0.3 (0.3–0.5)
p-value§	0.97	0.56	0.02	0.03

*Group 1, intensive mechanical oral hygiene; group 2, use of an amine/stannous fluoride mouth rinse in addition to routine mechanical oral hygiene; group 3, intensive mechanical oral hygiene plus amine/stannous fluoride mouth rinse.
†Significantly different from baseline (Wilcoxon's test).
‡Significantly different from intermediate examination (Wilcoxon's test).
§Kruskal–Wallis test.

Table 4. Summary of pairwise comparisons (*p*-values) of the reductions between baseline and final examination of each two study groups with respect to plaque (upper right half) and gingivitis (lower left half) (Mann–Whitney test)

	Group 1	Group 2	Group 3	Control
Group 1		0.06	0.56	0.001
Group 2	0.66		0.11	0.20
Group 3	0.83	0.88		0.003
Control	0.01	0.03	0.02	

Group 1, intensive mechanical oral hygiene; group 2, use of an amine/stannous fluoride mouth rinse in addition to routine mechanical oral hygiene; group 3, intensive mechanical oral hygiene plus amine/stannous fluoride mouth rinse.

the four groups. After 3 weeks, both plaque and gingivitis were reduced significantly in all groups. At the end of the study, all scores were still significantly improved compared with baseline. However, while both scores in groups 1–3 remained nearly stable from the intermediate to the final examination, there was a significant rebound in the control group after the intermediate examination.

The differences between baseline and final examinations in all groups are shown in Tables 2–4. It is evident that the improvements in all intervention groups (1–3) were more distinct than those in the control group. With respect to gingivitis, the reductions in all intervention groups were significantly different from the control but not from each other (Table 4). The plaque reduction in groups 1–3 did not differ statistically. However, compared with the control, only groups 1 and 3 differed significantly, while the improvements in group 2, whose members performed measures of chemical plaque control without intensified mechanical measures, did not differ significantly from the changes in the control group (Table 4).

Discussion

This study compared the effect of improved mechanical oral hygiene with antibacterial plaque control using an amine/stannous fluoride solution in senior citizens older than 54 years during a 6-month period. Subjects in the groups with intensified mechanical hygiene were instructed to brush each tooth properly and to conduct inter-dental hygiene. The use of dental floss was not recommended as the use of inter-dental brushes results in better plaque and gingivitis control (Jackson et al. 2006).

In adults and senior citizens, the positive outcome of improved mechanical oral hygiene on plaque level and gingivitis is well known (Murtomaa & Meurman 1992, Benz et al. 1997, Powell et al. 1999). Similarly, for different antibacterial mouth rinses, the positive outcome has been proven (Brecx et al. 1992, Damen et al. 2002, Clavero et al. 2003). This also applies for the amine/stannous fluoride rinse Meridol®, which has been shown to also reduce plaque and gingivitis (Bànòczy et al. 1989, Brecx et al. 1990, Brecx et al. 1993, Zimmermann et al. 1993, Mengel et al. 1996). However, there are no studies comparing the outcome of mechanical against antibacterial measures in seniors.

An inclusion criterion for entery into the study was to have at least 12 own teeth in order to assure a sufficient number of sites to determine the QHI and the PBI. On average, senior citizens in Germany exhibit 14 of their own teeth (Micheelis & Schiffner 2006). However, the volunteers who participated had a mean number of 24 remaining teeth. This has to be considered when interpreting the results as it points to the conclusion that the study results were obtained in a group with clearly above average oral hygiene.

Oral health, as well as oral awareness, are unequally distributed in society, with people with low socioeconomic status exhibiting less awareness and more diseases than people from higher social levels (Micheelis & Schiffner 2006). For this reason, the study panel was stratified with respect to socioeconomic status. Furthermore, there were no differences between the study groups with regard to the number of remaining teeth. The same applies for the caries experience expressed as DMFT or RCI, for the salivary flow rate or the average pocket depths. Thus, the findings can reliably be related to the different regimens in the study groups.

Compliance was considered to be good for all subjects; those who completed the study responded in the questionnaire that they followed their assigned oral hygiene regimens. The study revealed that both plaque and gingivitis scores improved in all groups. In the intervention groups, this improvement was stable up to the final examination after 6 months. In contrast, the scores in the control group deteriorated after the intermediate 3-week examination.

It is striking that even in the control group, significant improvements of oral health were observed even after 6 months. One explanation could be the professional tooth cleaning, which all participants received at baseline to ensure and standardize the study conditions. Removing supragingival and accessible subgingival calculus might have had a long-lasting positive effect. Furthermore, it cannot be excluded that the participation in the study with three thorough dental examinations during the 6 months motivated the control participants to improve their efforts too.

With respect to gingivitis, mechanical or adjunctive chemical measures gave the same results. The main focus in the groups with improved mechanical

measures (groups 1 and 3) was to teach adequate interdental brushing. The positive outcome of interdental hygiene on gingivitis is known (Bergenholtz & Olsson 1984) and was confirmed by this study. Interestingly, additionally applied antibacterial measures did not result in further improvements, as shown by comparison of groups 1 and 3. This might be interpreted in terms of mechanical measures being the best choice for motivated healthy senior citizens that cannot be enhanced by chemical approaches, even at sites accessible for rinsing solutions.

The gingivitis reduction in the subjects who used the antibacterial solution (group 2) is comparable to the improvement in the group with intensified mechanical measures (group 1). It has to be considered that the participants in group 2 continued with their usual mechanical oral hygiene measures. The study thus confirms earlier results showing that an amine/stannous fluoride rinse, combined with habitual self-performed oral hygiene, improves plaque and gingivitis scores (Brecx et al. 1992). Compared with the baseline scores of habitual mechanical oral hygiene, both intensified mechanical and additional chemical plaque control measures obviously exhibit the same improvement of gingival health. A corresponding finding can be demonstrated when comparing the changes between the 3-week examination and the final examination.

The results with respect to the plaque scores are in many aspects similar to the results for gingivitis. There were distinct plaque reductions in all intervention groups. The improvements during the study period were most pronounced in the group with the mechanical approach only and in the group with both the mechanical and the chemical approach. This means that under intensified mechanical measures, there is no additional benefit from an antimicrobial rinse on plaque scores, which also applies for the plaque score alterations between the intermediate and the final examination.

In the group using the solution as the only intervention, the improvement is also statistically significant, but the plaque reduction from baseline to final examination is lower than in the groups with mechanical intervention. Furthermore, this improvement does not differ statistically from the improvements in the control group. Thus, it can be concluded that plaque is reduced to a greater extent by mechanical rather than by chemical measures.

In contrast to the study hypothesis, adding antibacterial measures to improved mechanical regimens did not result in a further reduction in plaque or gingivitis. However, it should be recognized that the study sample consisted of subjects with apparently above average oral health awareness.

Although reducing plaque to a different degree, both regimens had the same effect on a reduction in gingivitis. This might be caused by the fact that the applied solution not only reduced plaque to a certain amount, but in particular, reduced gingivitis-associated oral flora (Mengel et al. 1996, Meurman et al. 2001). This might imply that senior citizens who are not able to improve their manual oral hygiene can achieve the same effect on gingivitis reduction with an antibacterial mouth rinse. Studies in subjects with poor oral conditions and oral awareness should be conducted to support this implication.

In conclusion, in healthy individuals older than 54 years, both intensified mechanical oral hygiene with special emphasis on interdental brushing and the use of an amine/stannous fluoride mouth rinse resulted in significantly improved plaque and gingivitis findings over 6 months. Comparing the magnitude of the improvements, both mechanical and chemical measures as well as the combination of both yielded similar reductions in papillary bleeding. With respect to plaque, the most pronounced improvements were obtained under intensified mechanical measures. Combined mechanical and antibacterial measures did not result in an additional reduction in plaque or gingivitis.

Acknowledgements

The authors thank Dr K. Wegscheider (Department of Medical Biometry and Epidemiology, University Medical Center Hamburg-Eppendorf) for statistical advice.

References

Altenhofen, E., Lutz, F. & Guggenheim, B. (1989) Microbiologic in vitro comparison of plaque-inhibiting mouthwashes. *Schweizer Monatsschrift fur Zahnmedizin* **99**, 13–18.

Axelsson, S., Soder, B., Nordenram, G., Petersson, L. G., Dahlgren, H., Norlund, A., Kallestal, C., Mejare, I., Lingstrom, P., Lagerlof, F., Holm, A. K. & Twetman, S. (2004) Effect of combined caries-preventive methods: a systematic review of controlled clinical trials. *Acta Odontologica Scandinavica* **62**, 163–169.

Bànòczy, J., Szoke, J., Kertèsz, P., Toth, Z., Zimmermann, P. & Gintner, Z. (1989) Effect of amine fluoride/stannous fluoride-containing toothpaste and mouthrinsings on dental plaque, gingivitis, plaque and enamel F-accumulation. *Caries Research* **23**, 284–288.

Benz, C., Engelmann, A., Benz, B. & Hickel, R. (1997) Oral hygiene in the elderly population – can it be improved? (In German). *Deutsche Zahnarztliche Zeitschrift* **51**, 698–700.

Bergenholtz, A. & Olsson, A. (1984) Efficacy of plaque-removal using interdental brushes and waxed dental floss. *Scandinavian Journal of Dental Research* **92**, 198–203.

Brecx, M., Brownstone, E., MacDonald, L., Gelskey, S. & Cheang, M. (1992) Efficacy of Listerine, Meridol and chlorhexidine mouthrinses as supplements to regular tooth cleaning measures. *Journal of Clinical Periodontology* **19**, 202–207.

Brecx, M., Macdonald, L. L., Legary, K., Cheang, M. & Forgay, M. G. (1993) Long-term effects of Meridol and chlorhexidine mouthrinses on plaque, gingivitis, staining, and bacterial vitality. *Journal of Dental Research* **72**, 1194–1197.

Brecx, M., Netuschil, L., Reichert, B. & Schreil, G. (1990) Efficacy of listerine, Meridol and chlorhexidine mouthrinses on plaque, gingivitis and plaque bacteria vitality. *Journal of Clinical Periodontology* **17**, 292–297.

Clavero, J., Baca, P., Junco, P. & Gonzalez, M. P. (2003) Effects of 0.2% chlorhexidine spray applied once or twice daily on plaque accumulation and gingival inflammation in a geriatric population. *Journal of Clinical Periodontology* **30**, 773–777.

Damen, J. J., Buijs, M. J. & ten Cate, J. M. (2002) Acidogenicity of buccal plaque after a single rinse with amine fluoride–stannous fluoride mouthrinse solution. *Caries Research* **36**, 53–57.

Davies, R. M. (2003) The prevention of dental caries and periodontal diseases from the cradle to the grave: what is the best available evidence? *Dental Update* **30**, 170–179.

Davies, R. M. (2004) The rational use of oral care products in the elderly. *Clinical Oral Investigation* **8**, 2–5.

de Baat, C. (1993) The effectiveness of oral hygiene programmes for elderly people – a review. *Gerodontology* **10**, 109–113.

Frenkel, H., Harvey, I. & Newcombe, R. G. (2001) Improving oral health in institutionalised elderly people by educating caregivers: a randomised controlled trial. **29**, 289–297.

Hamalainen, P., Meurman, J. H., Keskinen, M. & Heikkinen, E. (2004) Changes in dental status over 10 years in 80-year-old people: a prospective cohort study. **32**, 374–384.

Jackson, M. A., Kellett, M., Worthington, H. V. & Clerehugh, V. (2006) Comparison

of interdental cleaning methods: a randomized controlled trial. *Journal of Periodontology* **77**, 1421–1429.

Jones, J. (1995) Root caries: prevention and chemotherapy. *American Journal of Dentistry* **8**, 352–357.

Katz, R. V., Hazen, S. P., Chilton, N. W. & Mumma, R. D. (1982) Prevalence and intraoral distribution of root caries in an adult population. *Caries Research* **16**, 265–271.

Kundert, E. & Palla, S. (1988) Oral hygiene in older patients. Psychological and practical aspects of oral hygiene in gerodontology. *Schweizer Monatsschrift fur Zahnmedizin* **98**, 654–662.

Lang, N. P. & Brecx, M. C. (1986) Chlorhexidine digluconate – an agent for chemical plaque control and prevention of gingival inflammation. *Journal of Periodontal Research* **21**, 74–78.

Mengel, R., Wissing, E., Schmitz-Habben, A. & Flores-de-Jacoby, L. (1996) Comparative study of plaque and gingivitis prevention by AmF/SnF2 and NaF. A clinical and microbiological 9-month study. *Journal of Clinical Periodontology* **23**, 372–378.

Meurman, J. H., Kari, K., Aikas, A. & Kallio, P. (2001) One-year compliance and effects of amine and stannous fluoride on some salivary biochemical constituents and oral microbes in institutionalized elderly. *Special Care in Dentististry* **21**, 32–36.

Micheelis, W. & Reich, E. (1997) *Third German Oral Health Study (Dritte Deutsche Mundgesundheitsstudie DMS III)*. Cologne: Deutscher Ärzte-Verlag.

Micheelis, W. & Schiffner, U. (2006) *Forth German Oral Health Study (Vierte Deutsche Mundgesundheitsstudie DMS III)*. Cologne: Deutscher Ärzte-Verlag.

Murtomaa, H. & Meurman, J. H. (1992) Mechanical aids in the prevention of dental diseases in the elderly. *International Dental Journal* **42**, 365–372.

Netuschil, L., Weiger, R., Preisler, R. & Brecx, M. (1995) Plaque bacteria counts and vitality during chlorhexidine, meridol and listerine mouthrinses. *European Journal of Oral Sciences* **103**, 355–361.

Nitschke, I. (2001) Geriatric oral health issues in Germany. *International Dental Journal* **51**, 235–246.

Peltola, P. (2004) Oral health and treatment needs of the long-term hospitalised elderly. *Gerodontology* **21**, 93–99.

Powell, L. V., Persson, R. E., Kiyak, H. A. & Hujoel, P. P. (1999) Caries prevention in a community-dwelling older population. *Caries Research* **33**, 333–339.

Quigley, G. A. & Hein, J. W. (1962) Comparative cleansing efficiency of manual and power brushing. *The Journal of the American Dental Associations* **65**, 26–29.

Saxer, U. P. & Mühlemann, H. R. (1975) Motivation and education. *Schweizer Monatsschrift fur Zahnmedizin* **85**, 905–919.

Schiffner, U. (2000) Chemical plaque control: which antimicrobial additives in dentifrices and rinsing solutions can be recommended? (In German). *Deutsche Zahnarztliche Zeitschrift* **55**, 160–167.

Verma, S. & Bhat, K. M. (2004) Acceptability of powered toothbrushes for elderly individuals. **64**, 115–117.

World Health Organization. WHO (1997) *Oral Health Surveys. Basic Methods*, 4th edition. Geneve: World Health Organization.

Zimmermann, A., Flores-de-Jacoby, L., Pan, P. & Pan, P. (1993) Gingivitis, plaque accumulation and plaque composition under long-term use of Meridol. *Journal of Clinical Periodontology* **20**, 346–351.

Address:
Prof. Dr. Ulrich Schiffner
Department of Operative and Preventive
Center of Dental and Oral Medicine
University Medical Center Hamburg-Eppendorf
Dentistry
Martinistrasse 52
D–20246 Hamburg
Germany
E-mail: schiffner@uke.uni-hamburg.de

Clinical Relevance

Scientific rationale for the study: There is an increasing aged population who are retaining their own teeth, many of them exhibiting gingival or periodontal alterations. This requires special strategies for oral prevention such as improved mechanical oral hygiene or adjunctive antibacterial measures. This study compared the outcome of these both strategies on plaque and gingivitis in the elderly.

Principal findings: Gingivitis was reduced by both intensive mechanical oral hygiene and use of an amine/stannous fluoride mouth rinse while only intensive mechanical oral hygiene resulted in plaque reduction. Use of an amine/stannous fluoride mouth rinse in addition to routine mechanical oral hygiene did not reduce plaque. Combining both strategies yielded no further reduction of gingivitis.

Practical implications: The study indicates that preventive recommendations for elderly patients should focus on improved mechanical hygiene measures. Patients who are limited in their ability to physically clean their teeth and also suffer from gingivitis would benefit similarly from the use of antibacterial measures.