

Professional Domiciliary Oral Care for Elderly in Nursing Homes—A Randomized Controlled Pilot Trial

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Abstract

Domiciliary dental care (DDC) makes regular dental visits possible for people with different functional limitations who otherwise would not be able to access a dental clinic. DDC also facilitates cooperation with nursing staff. To our knowledge, the effect of DDC on oral health among elderly people in nursing homes has not been studied. As part of a project to establish recommendations for DDC, the aim of this randomized, controlled, single-blind, pilot trial with three parallel arms was to study the effect of professionally conducted oral care intervention, in domiciliary setting, on gingival bleeding on probing, dental plaque and oral mucosa. For three months, the participants were given either A) monthly professional DDC with oral care intervention, B) monthly individual oral care instructions, or C) oral care as usual. A total of 102 (n = 107) individuals completed the study. After three months, gingival bleeding on probing was significantly reduced among more participants in groups A and B compared with group C (p < 0.0004). Dental plaque scores changed significantly over three months for group B compared with group C (p < 0.04). Mucosal-plaque scores were significantly reduced in group A compared with both group B and C (p < 0.0001). All other intergroup differences were statistically non-significant. Compared with care as usual, professional DDC has the most favourable effect on gingival bleeding, whereas individual oral care instructions result in the highest reduction of dental plaque. Both professional oral care interventions and individual oral-hygiene instructions should be included in a domiciliary oral-care programme.

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Keywords

Geriatrics, Aged, Domiciliary Care, Oral Health, Oral Hygiene

1. Introduction

An increasing number of research publications point to the association between oral and general health, and even mortality [1]-[3]. It is important to develop oral care strategies that effectively prevent oral diseases, especially in frail risk groups, such as very old and care dependent individuals, and it is also important to help these vulnerable groups gain access to professional oral health care.

Professional oral care has been considered an effective method to prevent dental diseases, such as caries and periodontal problems in elderly people. The national guidelines for dentistry in Sweden state that there is no scientific evidence for the effect of professional oral care in addition to daily self-performed oral care tasks in adults [4]. This statement, however, cannot be transferred to frail, elderly people who are dependent on help from their caregivers to perform their daily oral hygiene tasks. In addition, nursing staff in general have been found to have poor knowledge in oral care and lack of motivation to perform the oral care tasks [5] [6], with the risk of daily oral care tasks being handled by elderly individuals themselves [7].

Domiciliary dental care (DDC) makes regular dental visits possible for people with different functional limitations, who otherwise would not be able to transport themselves to a dental clinic. It is also a way to establish cooperation with overburdened nursing staff [8] who express extended dental contacts as a way to improve the oral care for their care takers [5] [9].

To our knowledge, the effect of DDC for elderly people in nursing homes has not been studied previously. High-quality DDC including preventive oral care can be performed with rather simple equipment, while more advanced DDC requires more advanced equipment [10]. However, the Swedish dental system's subsidies for dental care for elderly and/or care-dependent individuals have been increasingly restricted year by year in terms of the number of preventive, oral care procedures covered [11]. The levels of restrictions vary between different county councils and regions, and the rationale is probably economic and political.

2. Aim

As a part of a project to establish relevant recommendations for DDC, the aim of this randomized, controlled, single-blind pilot trial with three parallel arms, over three months, was to study the effect of domiciliary delivered oral care intervention on gingival bleeding on probing, dental plaque and oral mucosa. The participants were given either A) monthly DDC with professional oral care intervention, B) monthly individual oral care instructions, or C) oral care as usual.

3. Methods

3.1. Participants and Eligibility

During 2015, 125 individuals were assessed for eligibility to participate in the study. Participants were required to live in a nursing home, age ≥ 65 years, to have at least ten natural teeth and/or dental implants, and to be able to cooperate during the interventions and registrations. Exclusion criteria were: edentulism, two complete dentures, cognitive impairment that would prevent cooperation, extreme hyposalivation (assessed by friction test with the back of a dental mirror) [12], malignancy, coagulation defect or haematological disorder.

3.2. Ethics

The study was approved by the Regional Ethical Review Board (Stockholm, Sweden 2014/672-31/4), and all participants provided written informed consent to participate in the study. The study design and criteria were not changed after the trial was initiated. The primary investigator (author IW) monitored for adverse events reported during the trial.

3.3. Study Design

A randomized, controlled, single-blind trial with a total of 107 individuals in three parallel groups, see **Figure 1**. The randomization was done by an independent study coordinator and the code was concealed from the study personnel who provided the interventions and analysed the data. Randomisation was done at nursing home level, with a 1:1:1 allocation ratio, including six different nursing homes in Stockholm, Sweden.

Two weeks before the baseline registration all chlorhexidine gluconate products were discontinued. At baseline registration, all participants received professional dental cleaning and debridement. The nursing home personnel were given a 20-to-30-minute lecture in oral hygiene. On a monthly basis during three months, the study participants were visited in their rooms at the nursing homes and received different oral care interventions as follows: Participants in group A received monthly professional dental cleaning, cleaning with interdental brushes and necessary supra-gingival scaling as well as individual oral care instructions, group B received monthly individual verbal and written oral care instructions (but no cleaning), while group C participants were not visited at all by dental personnel during the study period and continued with their personal oral care as usual. In all three study groups, the participants were given both verbal and written recommendations to brush their teeth with 1000 - 1450 ppm fluoride tooth paste and to do interdental cleaning daily, as usual. After three months, a final registration was made, and the study ended.

3.4. Outcomes

The primary outcome was bleeding on probing (BoP) according to Modified Sulcus Bleeding Index [13], in the buccal gingival crevice on Ramfjord's index teeth (16, 12, 24, 36, 32, 44) or, when missing, the closest tooth [14]. Secondary outcomes were the plaque index score and mucosal score, combined to a mucosal-plaque score

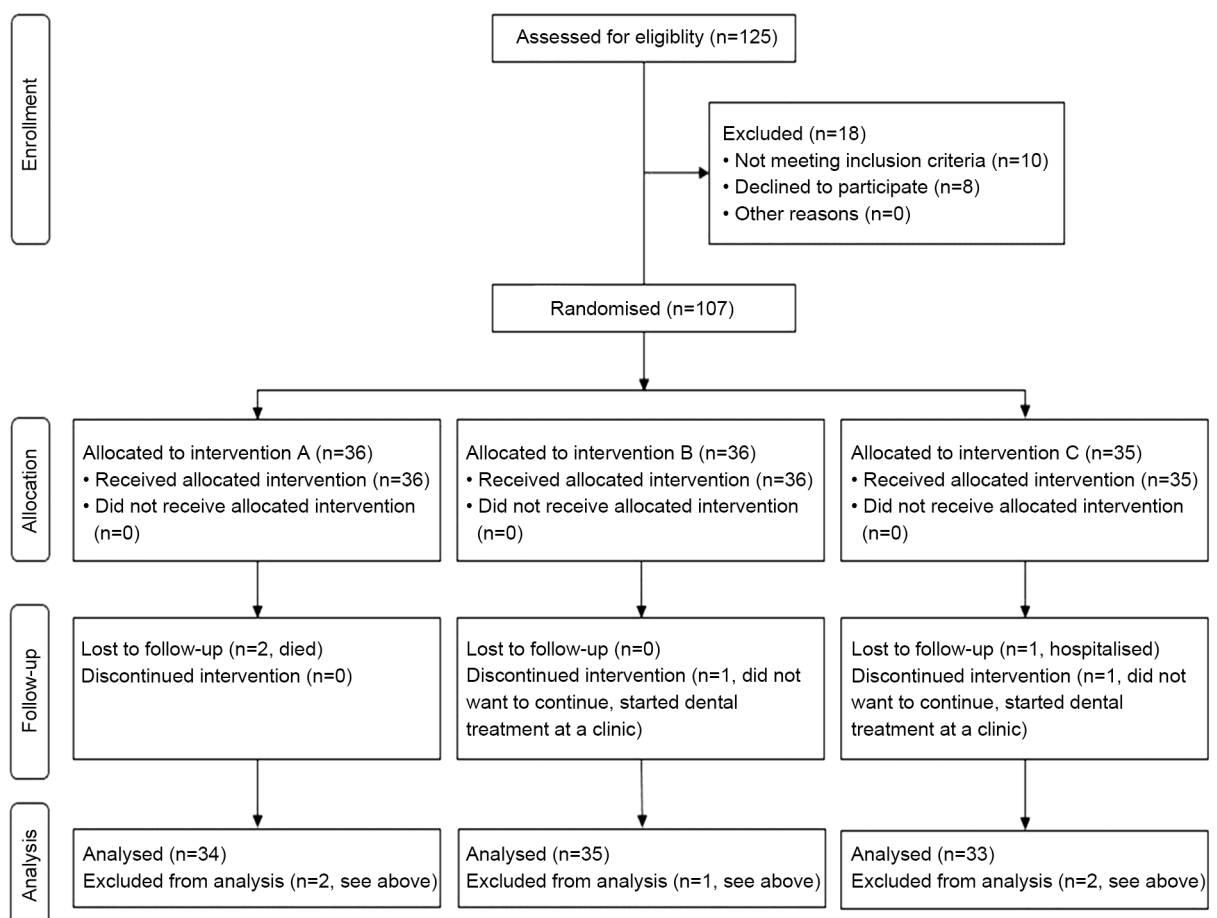


Figure 1. Consort diagram of the participant flow during the trial.

(MPS) [15]. Xerostomia at baseline was assessed by asking the participant about subjective impressions of mouth dryness and by mirror-sliding friction test inside of the buccal mucosa [12]. Recordings were also made for oral care products used during the study, new oral care products bought during the study, use of saliva-stimulating or saliva-substituting substances, as well as the number of prescribed drugs at study start.

Before start, all three data collecting dental personnel were calibrated. Bleeding on probing was registered from 0 - 3, with 0 no bleeding, 1 slight bleeding on probing on certain crevices, 2 slight, general bleeding on probing, 3 heavy, visible bleeding on probing.

The MPS [15] was used both for individuals with and without natural teeth and prostheses. The MPS index was originally designed to evaluate oral health and oral hygiene in groups of elderly individuals in hospitals and at other institutions [15], and comprises two measurements; first, mucosal disorders (MS), using the criteria 1) normal gingiva and mucosa 2) mild inflammation 3) moderate inflammation and 4) severe inflammation; and second plaque score (PS), using the criteria 1) no easily visible plaque 2) small amounts of plaque 3) moderate amounts of plaque and 4) abundant amounts of confluent plaque. The scores are then added to a single index measuring a person's oral hygiene. The purpose of the scores is not to make a diagnosis [15].

3.5. Statistical Analyses

Baseline characteristics were presented as mean numbers with standard deviations (SD), or as proportions, and compared between study groups with Fischer's exact test. The limit for statistical significance was set to $p < 0.05$.

The clinical outcomes were analysed as improvement in health status (positive values), no change (zero), or deterioration (negative values), in frequency tables, and as mean changes from baseline to three months' follow-up.

For the subsequently planned full-scale trial, a sample size of 175 individuals per group was calculated in order to detect 7% difference in BoP ($\alpha = 0.05$ och $\beta = 0.20$); thus this pilot study was intentionally underpowered.

4. Results

4.1. Withdrawals and Dropouts

The participant flow through the study is shown in **Figure 1**. In group A, two participants died during the study period. In groups B and C, one participant in each group discontinued treatment since they became motivated to start treatment at a dental clinic; and in group C, one participant was lost to follow-up due to hospitalisation, leaving a total of 102 participants for final analyses at three months' follow-up.

4.2. Baseline Characteristics

Baseline characteristics are shown in **Table 1**. The mean age of the participants was 86.8 (SD 7.8) years, with 61% women. The mean number of natural teeth was 20.9 (SD 5.2), and 23% received help with their daily tooth brushing. During the last year, 79% had regular dental appointments and 2% had an emergency dental visit. The participants had a mean number of 9.2 (SD 6.0) prescribed drugs and 28% had xerostomia.

4.3. Bleeding on Probing

At three months, the highest bleeding-on-probing category (score 3) was significantly improved (*i.e.* reduced) among more participants in groups A and B compared with group C ($p < 0.0004$), whereas no significant differences were found between the groups regarding the lower bleeding-on-probing categories (scores 0 - 2) (**Table 2**).

4.4. Plaque Score

Measured by "improvement", "no change" or "deterioration" for the individual plaque scores among the participants, the amount of biofilm changed significantly over three months in favour for group B (improved $n = 11$) compared with group C (improved $n = 7$, $p = 0.0399$) (**Table 3**). The mean plaque scores were reduced in groups A (-0.25 , SD 0.50) and B (-0.28 , SD 0.51), but not in group C (0.03, SD 0.66, $p = 0.0493$ A vs. C, and $p = 0.0327$ B vs. C) (**Table 4**).

Table 1. Baseline characteristics.

	Group A (n = 36)	Group B (n = 36)	Group C (n = 35)	Total (n = 107)
Age, mean (SD)	89.8 (7.2) ¹	87.6 (6.6) ²	82.9 (8.1) ^{1,2}	86.8 (7.8)
Men, number (%)	11 (31)	13 (36)	18 (51)	42 (39)
Natural teeth, mean (SD)	20.9 (4.8)	21.8 (3.6)	20.0 (6.8)	20.9 (5.2)
Help with tooth brushing, number (%)	9 (25)	7 (19)	9 (26)	25 (23)
Uses fluoride toothpaste, number (%)	36 (100)	36 (100)	34 (97)	106 (99)
Uses other oral care products, number (%)	16 (44)	16 (44)	13 (37)	45 (42)
Tooth brushing frequency per day, mean (SD)	2.0 (0.7)	2.1 (0.6)	1.9 (0.7)	2.0 (0.7)
Removable denture on implants, number (%)	0 (0)	2 (5.6)	2 (5.7)	4 (3.7)
Removable partial denture, number (%)	1 (2.8)	1 (2.8)	1 (2.9)	3 (2.8)
Removable complete denture, number (%)	3 (8.3)	1 (2.8)	1 (2.9)	5 (4.7)
Regular dental appointments, number (%)	25 (6.9)	31 (8.6)	28 (0.8)	84 (79)
Emergency dental appointments, number (%)	1 (2.8)	0 (0)	1 (2.9)	2 (1.9)
Number of drugs, mean (SD)	9.3 (5.1)	9.5 (6.8)	8.8 (6.0)	9.2 (6.0)
Xerostomia ³ , number (%)	10 (28)	9 (25)	11 (31)	30 (28)
Strained food, number (%)	2 (5.6)	1 (2.8)	1 (2.9)	4 (13)
Nutritional drinks intake, number (%)	3 (8.3)	4 (11)	7 (20)	14 (13)

¹Statistically significant difference between group A and C ($p = 0.0003$); ²Statistically significant difference between group B and C ($p = 0.009$). All other intergroup differences were n.s.; ³Assessed by asking the participant and by mirror sliding friction test inside of the buccal mucosa.

Table 2. Changes in bleeding-on-probing scores over three months (positive values indicate clinical improvement whereas negative values indicate deterioration).

	Mean (SD)			p-value
	Group A (n = 34)	Group B (n = 35)	Group C (n = 33)	
BoP score 0	-0.38 (1.54)	0.34 (2.31)	-0.12 (2.43)	0.2453
BoP score 1	-0.09 (1.44)	-0.49 (2.57)	-0.42 (2.02)	0.9980
BoP score 2	0.35 (0.81)	0.74 (3.35)	0.39 (2.40)	0.3297
BoP score 3	0.12 (0.41)	0.00 (0.00)	-0.18 (0.46)	<0.0004 ¹

¹p-value for difference between group A versus C, and B versus C.

4.5. Mucosal Score

There were no significant differences in mucosal health over three months, as measured by “improvement”, “unchanged”, or “deterioration” for individual mucosal scores among the participants (**Table 3**). The mean mucosal scores were numerically, but not significantly, reduced in group A (-0.03, SD 0.51), but not in group B (0.06, SD 0.41, n.s.) or group C (0.11, SD 0.47, n.s) (**Table 4**).

4.6. Mucosal-Plaque Score

Measured as the number of individuals with “improved”, “unchanged”, or “deteriorated” mucosal-plaque scores, the amount of biofilm and mucosal health combined changed significantly in favour of group A (improved $n = 16$) compared with group B (improved $n = 1$, $p < 0.0001$), and with group C (improved $n = 2$) ($p < 0.0001$) (**Table 3**). The mean mucosal-plaque scores were reduced in group A (-0.75, SD 1.13) but not in group B (0.56, SD 0.97, $p = 0.0001$ A vs B), or in group C (1.00, SD 1.46, $p = 0.0001$ A vs C) (**Table 4**).

Table 3. Frequency table for change over three months in plaque score, mucosal score, and mucosal-plaque score (MPS) among the study participants.

	Change over 3 months, n (%)			
	Group A (n = 34)	Group B (n = 35)	Group C (n = 33)	Total (n = 102)
Plaque score¹				
Deterioration	1 (2.94)	1 (2.86)	8 (24.24)	10
Unchanged	23 (67.65)	23 (65.71)	18 (54.55)	64
Improvement	10 (29.41)	11 (31.43)	7 (21.21)	28
Mucosal score				
Deterioration	4 (11.76)	4 (11.43)	6 (18.18)	14
Unchanged	25 (73.53)	29 (82.86)	25 (75.76)	79
Improvement	5 (14.71)	2 (5.71)	2 (6.06)	9
MPS²				
Deterioration	1 (2.94)	12 (34.29)	16 (48.48)	29
Unchanged	17 (50.00)	22 (62.86)	15 (45.45)	54
Improvement	16 (47.06)	1 (2.86)	2 (6.06)	19

¹p = 0.0399 for difference between group B versus C; ²p < 0.0001 for difference between group A versus B, and A versus C.

Table 4. Plaque scores, mucosal scores and mucosal-plaque scores at baseline, after three months, and change over 3 months.

	Mean (SD)		
	Group A (n = 34)	Group B (n = 35)	Group C (n = 33)
Plaque scores			
Baseline	2.00 (0.83)	2.11 (0.62)	2.49 (0.70)
At 3 months	1.75 (0.77)	1.83 (0.70)	2.51 (0.61)
Change	-0.25 (0.50) ¹	-0.28 (0.51) ²	0.03 (0.66) ¹
Mucosal scores			
Baseline	1.61 (0.77)	1.86 (0.76)	2.06 (0.76)
At 3 months	1.58 (0.65)	1.92 (0.77)	2.17 (0.75)
Change	-0.03 (0.51)	0.06 (0.41)	0.11 (0.47)
Mucosal-plaque scores			
Baseline	1.94 (1.17)	1.28 (0.51)	1.57 (0.61)
At 3 months	1.19 (0.40)	1.83 (1.00)	2.57 (1.54)
Change	-0.75 (1.13) ^{3,4}	0.56 (0.97) ³	1.00 (1.46) ⁴

Plaque scores range from 1 to 4, where higher scores indicate more biofilm. Mucosal scores range from 1 to 4, where higher scores indicate more mucosal inflammation. Mucosal-Plaque Score is the sum of plaque- and mucosal scores ranging from 2 to 8; ¹p = 0.0493 for difference between group A and C; ²p = 0.0327 for difference between group B and C; ³p = 0.0001 for difference between group A and B; ⁴p < 0.0001 for difference between group A and C.

4.7. Adverse Events

No adverse events were reported during the trial.

5. Discussion

This study was the first in a comprehensive project with the aim to establish relevant recommendations for do-

miliary, preventive, professional oral care. In this randomized, controlled pilot trial, the participants were given either monthly professional domiciliary oral care, or monthly individual oral care instructions, compared with oral care as usual.

At three months' follow up, bleeding on probing on the highest level was significantly improved among more participants in both the professional, domiciliary oral care group, and in the monthly, individual oral care instructions group, compared with the care-as-usual group. In addition, dental plaque scores changed significantly over three months in favour of the instruction group compared with the control group, whereas mucosal-plaque scores were significantly reduced in the oral care group compared with both the instruction group and the care-as-usual group. A possible explanation for this result is that many elderly individuals do not immediately respond to dental plaque with development of gingivitis, which may reflect a decreased immune response [16]. However, there have been reports on the association between self-reported bleeding gums and cardiovascular diseases, while such a result may have implications for the general health [17].

Oral care instructions do not reach all nursing home staff at the same time. Staff attendance to instruction sessions varies with working schedules, but also because the oral care instructions are considered mandatory. Thus, during the study the least motivated staff, who would probably have gained most of the instructions, did not attend the instruction sessions. Further on, the need of regularly given oral care information seems to be relatively constant over time, given the high staff turnover and work load at nursing homes in large cities in Sweden. Furthermore, oral care tasks are nowadays difficult due to many natural teeth, and studies report that it seems easier to clean dentures [18]. Maybe oral care of today is so demanding that it is almost an impossible task for non-dental professionals alone to perform oral care properly for those who need help.

Another contributing reason may be that many of the care-dependent elderly themselves do not consider it natural that oral care tasks are assisted by nursing staff. They recognise oral care as a responsibility for dental professionals. Several research reports have dealt with the problem of non-cooperating nursing-home residents in the oral care situation (5,7).

Generally, oral care protocols are designed like care bundles with a variety of interventions and activities, making it difficult to distinguish which part of the effect is derived from each of the given interventions, or whether the observed effect is a result of the combination of interventions. For example, the mere presence of dental staff at a nursing home may contribute to unexpected effects on oral care routines, especially if information about oral care is simultaneously disseminated. Therefore, in order to separate the effect of instructions given from the effect of hands-on oral care work, the pilot study was designed with two different intervention groups and a control group. We also wanted to avoid contamination between the study groups due to transfer of information between the nursing staff members. Thus the study groups were clustered in six different nursing homes, two per study group.

So far, most of the studied oral care intervention programs have been evaluated with non-clinical outcomes, such as nursing staff knowledge and attitudes. These outcomes are important, but it is uncertain whether improved knowledge and attitudes lead to improved oral care. Thus, patient-related, oral-health measurements need to be measured and related to subsequent clinical outcomes.

6. Conclusion

In conclusion, compared with care as usual, the current trial showed that professional domiciliary oral care resulted in the highest reduction in gingival bleeding, but a significant reduction was also found in the instruction group, in which the highest reduction of dental plaque was found, too. Thus, it seems that both professional oral care and individual instructions need to be combined in a domiciliary oral care intervention programme. Consequently, in an upcoming randomized controlled trial, the effect of the combined intervention will be compared with a control group that receives oral care as usual. In the full-scale trial, we will also follow caries development, general health markers (e.g. pneumonia), oral-health-related quality of life, and nursing-staff knowledge and attitudes. The study material will be collected both at nursing homes and in private homes. The private homes constitute the most challenging context of oral care among care-dependent elderly.

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Conflict of Interests

The authors declare that they have no competing interests.

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