ORIGINAL ARTICLE

T Sato T Abe M Ichikawa Y Fukushima N Nakamoto N Koshikiya A Kobayashi T Yoda

Authors' affiliations:

T. Sato, T. Abe, M. Ichikawa, Y. Fukushima, N. Nakamoto, N. Koshikiya, A. Kobayashi, T. Yoda, Department of Oral and Maxillofacial Surgery, Saitama Medical University, Saitama, Japan

Correspondence to:

Tsuyashi Sato Department of Oral and Maxillofacial Surgery Saitama Medical University 38 Moro-hongou Moroyama-machi Iruma-gun Saitama 350-0495 Japan Tel. & Fax: +81 49 276 1859 E-mail: tsato@saitama-med.ac.jp

Dates:

Accepted 14 September 2007

To cite this article:

Int J Dent Hygiene 6, 2008; 63–67 Sato T, Abe T, Ichikawa M, Fukushima Y, Nakamoto N, Koshikiya N, Kobayashi A, Yoda T. A randomized controlled trial assessing the effectiveness of professional oral care by dental hygienists.

© 2008 The Authors. Journal compilation © 2008 Blackwell Munksgaard A randomized controlled trial assessing the effectiveness of professional oral care by dental hygienists

Abstract: Objectives: This study was designed to compare professional oral care (POC) by a dental hygienist with tooth brushing and mouth rinsing by patients themselves according to the instructions of a nurse (control). Methods: Forty patients were randomly assigned to either the POC group (n = 20) or control group (n = 20). The presence of plaque and bacteria was assessed clinically. Results: One patient in the POC group and three patients in the control group dropped out because of exacerbation of underlying disease or death. Plaque control record scores were significantly lower in the POC group than in the control group on the fifth hospital day and the day of discharge. There was no significant difference between the groups in the detection rate of Candida species; and nosocomial pathogens on either day. Conclusions: Professional oral care by a dental hygienist is more effective than tooth brushing and mouth rinsing by patients themselves according to the instructions of a nurse.

Key words: dental hygienist; mouth rinsing; plaque control record; professional oral care; randomized controlled trial; tooth brushing

Introduction

Oral bacterial pathogens can cause not only dental diseases, but also serious systemic diseases (1). Aspiration pneumonia is a common condition in the elderly that can lead to death from nosocomial infections (2, 3). Clinical evidence suggests that oral care, i.e. use of the proper technique for cleansing the oral cavity, may prevent aspiration pneumonia as well as nosocomial infections (4, 5). El-Solh *et al.* (6) have reported an association of respiratory infections with the colonization of dental plaques as assessed by molecular genotyping in institutionalized patients. Such complications can be prevented by proper oral care, leading to early discharge. Oral care may thus have important implications for healthcare costs (7).

Many studies of oral care have been performed by dentists, dental hygienists, nurses, and caregivers in nursing homes or hospitals (8–11). In Japan, nurses are responsible for the oral care of patients at most hospitals. Nurses brush the teeth of activities of daily living (ADL)-dependent patients and instruct ADL-independent patients on how to brush their teeth or rinse their mouth by themselves. However, inability of ADL-independent patients to care for their own oral hygiene might exacerbate underlying disease and increase the risks of complications and nosocomial infections. Professional oral care thus seems warranted from the viewpoint of preventive medicine.

To our knowledge, however, no study has compared professional oral care (POC) by a dental hygienist with tooth brushing or mouth rinsing by patients themselves in accordance with the instructions of a nurse. We carried out a randomized controlled trial to clarify which of these two methods is more effective.

Methods

The subjects were inpatients at the Departments of Respiratory Medicine or Oral and Maxillofacial Surgery at Saitama Medical University Hospital. All patients had a score of 100 on the Barthel index. We excluded patients who were hospitalized for 5 days or less and those who had intraoral diseases. Patients were enrolled from July 2005 to December 2005.

The subjects were divided into two groups: the POC group, in which a dental hygienist participated in oral care, and a control group, in which a dental hygienist was not involved. On the basis of our clinical experience, we estimated that 40 patients (20 per group) were required to reject the null hypothesis at a power of 80% and a significance level of P < 0.05. The study was performed in accordance with the Declaration of Helsinki and approved by the Institutional Review Board at Saitama Medical University. The dentist in charge provided all patients or their guardians with an explanation of the study. Patients were free to withdraw from the study at their own free will at any time. Informed consent was obtained from all subjects and recorded in their case report forms.

The subjects were randomly assigned by the envelope method to either the POC group or control group. Outcome data were not analysed on an intention-to-treat (ITT) basis. Patients who died or did not participate in this study because of exacerbation of underlying disease were excluded.

Procedures

In both groups, all patients brushed their teeth and rinsed their mouth with povidone iodine in the morning and evening everyday, according to the instructions of a nurse. In the POC group, a dental hygienist provided 15 min of instructions on mouth cleaning and on Bass tooth brushing method. Instructions were first provided on the second hospital day and were then given at 2- or 3-day intervals.

Clinical evaluations

We used the O'Leary Plaque Control Record (PCR) for clinical evaluation (12). Bacterial examination of the tongue was conducted as follows: samples were collected by swabbing the tongue with a sterile cotton pad and placed in a sterile tube. The samples were submitted to the Department of Laboratory Medicine at our hospital to assess the presence or absence of *Candida* species; and nosocomial pathogens. They were plated onto sheep blood agar, chocolate blood agar and McConkey's agar plates and streaked. It was then incubated in 5% carbon dioxide at 35–37°C for 18–24 h. The items on the PCR were evaluated on the second hospital day, the fifth hospital day, and the day of discharge. Bacterial examinations were performed on the second hospital day and the day of discharge.

Questionnaire

A questionnaire before this study (yes/no format) was used to determine whether the subjects were concerned about their oral hygiene. The questionnaire was performed on the second hospital day and comprised the following five questions:

Q1. Do you brush your teeth <3 times per day? (yes/no)

Q2. Do you use dental floss or inter-dental brushes? (yes/no)

Q3. Do you brush your teeth for <2 min per time? (yes/no)

Q4. Are you interested in tooth brushing instructions? (yes/no)

Q5. Is there sometimes bleeding when you brush your teeth? (yes/no)

Table 1. Baseline characteristics of the patients

	POC group	Control group	
	(n = 19)	(n = 17)	P-value
Men (% of patients)	52.6	70.6	0.177
Age (years, mean ± SD)	61.1 ± 13.1	62.9 ± 13.0	0.676
Duration of admission (days, mean ± SD)	34.5 ± 28.9	42.2 ± 19.0	0.345
Number of teeth (mean \pm SD)	18.1 ± 9.2	17.4 ± 10.0	0.816
Questionnaire (% of patients)			
Q1. Tooth brushing <3 times per day	84.2	70.6	0.434
Q2. No use of floss or inter-dental brushes	84.2	64.7	0.463
Q3. Tooth brushing <2 min per time	73.7	36.8	0.090
Q4. Indifferent to tooth brushing instructions	57.9	36.8	0.505
Q5. Bleeding on tooth brushing	52.6	64.7	0.516

A questionnaire after this study (yes/no format) was used to know the view of oral hygiene. The questionnaire was performed on the day of discharge and comprised the following three questions:

Q1. Did you feel fine at the inside of the mouth? (yes/no)

Q2. Do you think that tooth brushing is necessary every day? (yes/no)

Q3. Do you want to have you check your mouth? (yes/no)

Statistical analyses

Baseline variables were compared between the two groups with the use of the Welch *t*-test and Fisher's exact test. PCR scores were evaluated by the Welch *t*-test. Positive detection rates of *Candida* species were evaluated by Fisher's exact test. All analyses were performed with spss 14.0J statistical software (SPSS Inc., Chicago, IL, USA) for Windows (Microsoft Corp.). In all analyses, P < 0.05 was considered to indicate statistical significance.

Results

Baseline characteristics and dropouts

Twenty-five men and 15 women were studied. Twenty patients were assigned to each group. The youngest patient was 35 years old, and the oldest was 83 years old. No patient was found to be ineligible after group assignment. One patient in the POC group and three patients in the control group dropped out because of exacerbation of underlying disease or death. Baseline characteristics, including sex, age, duration of admission, number of teeth and the responses to the questionnaire, did not differ significantly between the groups (Table 1).

Table 2 shows the underlying diseases in the groups. In the POC group, one patient had pulmonary fungal aspergillosis. No patient had pulmonary aspergillosis in the control group.

Clinical outcomes

In the control group, PCR scores on the fifth hospital day and the day of discharge were both approximately 66.0%. In the POC group, however, the PCR score was 46.5% on the fifth hospital day and 30.2% on the day of discharge. The PCR scores differed significantly between the groups on the fifth hospital day as well as the day of discharge (Table 3A).

In the control group, *Candida* species (*Candida glabrata*, *Candida albicans* or *Candida tropicalis*) were detected in one patient (5.9%) on the second hospital day and three patients (17.6%) on the day of discharge. In the POC group, *Candida* species were detected in one patient (5.3%) on the second hospital day and none (0%) on the day of discharge. The difference between the groups was not significant on either day (Table 3B).

On the other hand, in the control group, nosocomial pathogens (*Haemophilus influenza*, *Serratia marcescens*, *Psuedomonas aeruginosa* or *Klebsiella oxytoca*) were detected in one patient (5.9%) on the second hospital day and five patients (29.4%) on the day of discharge. In the POC group, nosocomial pathogens were detected in three patients (15.8%) on the second hospital

Table 2. L	Jnderlying	diseases	according) to g	grou	ρ
------------	------------	----------	-----------	--------	------	---

	POC group (<i>n</i> = 19)	Control group $(n = 17)$	Total (<i>n</i> = 36)
Lung cancer (including suspicion)	9	11	20
Pneumonia	3	1	4
Asthma	0	1	1
Lung cancer and pneumonia*	2	2	4
Asthma and pneumonia*	1	0	1
Lung tuberculosis	0	1	1
Bronchiectasis	1	0	1
Pulmonary aspergillosis	1	0	1
Pleural fluid retention	0	1	1
Thyroglossal duct cyst	2	0	2

*Patients who had two underlying diseases.

rabie of i eri deeled, peerine deteering te gre	Table 3. P	CR scores,	positive detection	rate of Candida s	species and that o	f nosocomial path	ogens according	g to gro	up
---	------------	------------	--------------------	-------------------	--------------------	-------------------	-----------------	----------	----

	POC group $(n = 19)$	Control group $(n = 17)$	P-value
A. PCR scores			
PCR score on the second hospital day (%, mean \pm SD)	73.2 ± 19.0	61.9 ± 20.7	0.097
PCR score on the fifth hospital day (%, mean \pm SD)	46.5 ± 15.9	67.2 ± 17.7	0.001
PCR score on the day of discharge (%, mean \pm SD)	30.2 ± 17.6	65.9 ± 19.7	0.000*
B. Positive detection rate of <i>Candida</i> species			
Positive detection rate of <i>Candida</i> spp. on the second hospital day (% of patients)	5.3	5.9	1.000
Positive rate of <i>Candida</i> spp. detection on the day of discharge (% of patients)	0	17.6	0.095
C. Positive detection rate of nosocomial pathogens			
Positive detection rate of nosocomial pathogens on the second hospital day (% of patients)	15.8	5.9	0.605
Positive rate of nosocomial pathogens detection on the day of discharge (% of patients)	5.3	29.4	0.081

*P = 0.000002.

day and one (5.3%) on the day of discharge. The difference between the groups was not significant on either day (Table 3C). There were no patients who developed aspiration pneumonia in both groups.

According to the questionnaire after this study, the results were significantly different between both groups: about Q1, 18 patients (94.7%) in the POC group and four patients (23.5%) in the control group; about Q2, 16 patients (84.2%) in the POC group and eight patients (47.1%) in the control group; about Q3, 16 patients (84.2%) in the POC group and six patients (35.3%) in the control group (Table 4).

Discussion

To our knowledge, this is the first randomized controlled trial to show that POC by a dental hygienist is more effective than tooth brushing and mouth rinsing by patients themselves. The PCR score is an index of the adhesion rate of dental plaque; therefore, a decline in the PCR score indicates a decrease in oral bacteria.

In this study, a dental hygienist explained the method for mouth cleaning and performed tooth brushing. As ADL-inde-

Table 4. A questionnaire about view of oral hygiene after this study

	POC group (<i>n</i> = 19)	Control group (<i>n</i> = 17)	<i>P</i> -value
Questionnaire (% of patients)			
Q1. Feeling fine at the inside of the mouth	94.7	23.5	0.000*
Q2. Tooth brushing is necessary	84.2	47.1	0.033
Q3. To have you check the mouth	84.2	35.3	0.005

*P = 0.00002.

pendent patients can understand such explanations, they may be motivated to practice good oral hygiene. This apparently resulted in the lower PCR score in the POC group. Understanding the explanations provided by the dental hygienist is more important than having their teeth brushed. This is in contrast to ADL-dependent patients because many of them cannot perform on proper oral hygiene.

The number of patients with *Candida* species and nosocomial pathogens increased in the control group, but decreased in the POC group. This finding suggests that POC has an important role in reducing *Candida* species and nosocomial pathogens. Unfortunately, the differences between the groups were not statistically significant. Demonstration of a significant difference may require a larger study group. The view of oral hygiene was significantly different between both groups. In the POC group, the concern about oral hygiene was remarkably high because they were motivated by the dental hygienist. This also helps improvement of the quality of life.

The incidence of ventilator-associated pneumonia (VAP), the most common nosocomial infection in intensive care units (ICU), ranges from 9% to 40% (13). VAP thus remains an important problem in ICU (14). Several studies have pointed out the importance of oral care in ICU (15–17). Mori *et al.* (18) reported that POC by a dentist reduced incidence of VAP in ICU, suggesting that POC plays an important part in preventing VAP. After this study, within 3 months, the number of patient exacerbated underlying diseases was two patients (11.3%) in the control group and three patients (15.7%) in the POC group. This indicated that ceasing proper oral care may cause the exacerbation of underlying diseases. From the viewpoint of preventive medicine, proper oral care may be important. Our study shows that POC by a dental hygienist is effective. Further studies are needed to confirm whether POC by a dental hygienist is beneficial for ADL-dependent patients. Assessment of PCR scores is difficult in this subgroup of patients, and the oral hygiene index proposed by Abe *et al.* (19) may be better suited for clinical evaluation. Further randomized controlled trials are needed to confirm our results and to assess optimal techniques for evaluation, particularly in ADL-dependent patients.

Conclusion

Professional oral care by a dental hygienist is more effective than tooth brushing and mouth rinsing by patients themselves in accordance with the instructions of a nurse.

References

- 1 Marsh PD, Percival RS. The oral microflora friend or foe? Can we decide? *Int Dent J* 2006; **56**: 233–239.
- 2 Johanson WG Jr, Pierce AK, Sanford JP, Thomas GD. Nosocomial respiratory infections with gram-negative bacilli. The significance of colonization of the respiratory tract. *Ann Intern Med* 1972; 77: 701–706.
- 3 Niederman MS. Nosocomial pneumonia in the elderly patient. Chronic care facility and hospital considerations. *Clin Chest Med* 1993; **14**: 479–490.
- 4 Sasaki H, Sekizawa K, Yanai M, Arai H, Yamaya M, Ohrui T. New strategies for aspiration pneumonia. *Intern Med* 1997; 36: 851–855.
- 5 Yoneyama T, Yoshida M, Matsui T, Sasaki H. Oral care and pneumonia. *Lancet* 1999; **354**: 515.
- 6 El-Solh AA, Pietrantoni C, Bhat A *et al.* Colonization of dental plaques: a reservoir of respiratory pathogens for hospital-acquired pneumonia in institutionalized elders. *Chest* 2004; **126**: 1575–1582.

- 7 Jablonski RA, Munro CL, Grap MJ, Elswick RK. The role of biobehavioral, environmental, and social forces on oral health disparities in frail and functionally dependent nursing home elders. *Biol Res Nurs* 2005; 7: 75–82.
- 8 Yoshino A, Ebihara T, Ebihara S, Fuji H, Sasaki H. Daily oral care and risk factors for pneumonia among elderly nursing home patients. *JAMA* 2001; **286**: 2235–2236.
- 9 Frenkel H, Harvey I, Newcombe RG. Improving oral health in institutionalised elderly people by educating caregivers: a randomised controlled trial. *Community Dent Oral Epidemiol* 2001; 29: 289–297.
- 10 Adachi M, Ishihara K, Abe S, Okuda K, Ishikawa T. Effect of professional oral health care on the elderly living in nursing homes. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2002; 94: 191– 195.
- 11 Munro CL, Grap MJ. Oral health and care in the intensive care unit: state of the science. *Am J Crit Care* 2004; **13**: 25–33.
- 12 O'Leary T, Drake R, Naylor JE. The plaque control record. J Periodontol 1972; 43: 38–39.
- 13 Safdar N, Crnich CJ, Maki DG. The pathogenesis of ventilatorassociated pneumonia: its relevance to developing effective strategies for prevention. *Respir Care* 2005; **50**: 725–739.
- 14 Torres A, Aznar R, Gatell JM *et al.* Incidence, risk, and prognosis factors of nosocomial pneumonia in mechanically ventilated patients. *Am Rev Respir Dis* 1990; **142**: 523–528.
- 15 Fitch JA, Munro CL, Glass CA, Pellegrini JM. Oral care in the adult intensive care unit. Am J Crit Care 1999; 8: 314–318.
- 16 Binkley C, Furr LA, Carrico R, McCurren C. Survey of oral care practices in US intensive care units. Am J Infect Control 2004; 32: 161–169.
- 17 Abidia RF. Oral care in the intensive care unit: a review. J Contemp Dent Pract 2007; 8: 76–82.
- 18 Mori H, Hirasawa H, Oda S, Shiga H, Matsuda K, Nakamura M. Oral care reduces incidence of ventilator-associated pneumonia in ICU populations. *Intensive Care Med* 2006; **32:** 230–236.
- 19 Abe S, Ishihara K, Adachi M, Okuda K. Oral hygiene evaluation for effective oral care in preventing pneumonia in dentate elderly. *Arch Gerontol Geriatr* 2006; **43**: 53–64.

Copyright of International Journal of Dental Hygiene is the property of Blackwell Publishing Limited and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.