Effect of Oral Care Protocol on Dental and Gingival Plaque Index in Patients With Endotracheal Tube Admitted to the Intensive Care Unit

Ali Ghaempanah[1], Mitra Payami Bosari[2], Abolfazl Amini[3], Soqrat Faghihzadeh[4], Zahra Aghazadeh[5]

[1] *Department of Critical Care Nursing, School of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran*

[2] *Department of Community Health Nursing, School of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran*

[3] *Deprtment of Medical-Surgical Nursing, School of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran*

[4] *Department of Biostatistics and Social Medicine, Research Center for Social Factors, Zanjan University of Medical Sciences, Zanjan, Iran*

[5] *Department of Endodontic, School of Dentistry, Tabriz University of Medical Sciences, Tabriz, Iran*

Received: 14 Oct. 2020; Accepted: 21 May 2021

Abstract- Oral health is one of the most critical aspects of nursing care in critically ill patients. The study aimed to investigate the effect of oral health protocol on dental and gingival plaque index in patients with endotracheal tubes admitted into the ICU. This double-blind clinical trial was conducted on 70 patients admitted into ICU randomly by tossing a coin, and 35 patients were assigned to each of the experimental and control groups. Oral care was performed in the experimental group using the chlorhexidine (CHX) solution, toothpaste, and oral moisturizer protocol; in the control group, according to the routine method, 0.2% CHX was used twice a day. The data were collected at the time of inclusion and four days later, using the MGI and the O'Leary dental plaque index. The mean ages in the experimental and control groups were 38.4±14.4 and 41±14.5 years, respectively. In the experimental and control groups, 77% and 83% of the subjects were male, respectively. After the intervention, the mean gingival index in the experimental and control groups was 0.59±0.31 and 0.90±0.41, and the plaque index was 42.53±15.97 and 53.52±11.9, respectively. The differences before and after the intervention in each group and the difference between the two groups in both gingival and dental plaque indices were statistically significant (*P*=0.0001). The results showed that the oral health protocol was more effective in improving gingival and dental plaque indices than the routine (CHX) method.

Acta Med Iran 2021;59(6):351-356.

Keywords: Dental plaque; Gingivitis; Oral health; Protocol

Introduction

Oral hygiene is one of the most critical issues affecting the general health of patients admitted to intensive care units (1). Full compliance with health rules for oral and dental health requires precise knowledge in this regard (2). One of the responsibilities of ICU nurses in the provision of good oral hygiene for the patient. Oral hygiene has a pivotal role in general health; the accumulation of bacteria in the pharynx is associated with several systemic conditions, including cardiovascular disease, chronic obstructive pulmonary disease, endocarditis, and bacteremia (3).

A dental plaque is a compound environment that contains microorganisms and their products and salivary secretions and causes colonization of microorganisms. When the pathogenic bacteria in the dental plaque are aspirated into the lower airways, they can cause respiratory and ventilator-associated pneumonia (VAP) (4). It has been shown that the number of organisms in the oral cavity increases from day one to day four (5).

Gingivitis is the most common type of gingival disease, and more than 70% of people over 35 years of age suffer from it, which is due to non-observance of oral hygiene and the formation of microbial plaque (6,7). Epidemiologic studies show a high prevalence of this disease all over the world. The prevalence of gingivitis also increases with aging (8). According to

Corresponding Author: M. Payami Bosari
Department of Community Health Nursing, School of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran
Tel: +98 9122423357, Fax: +98 2433148319, E-mail address: Payami@zums.ac.ir

epidemiological studies, the prevalence of gingivitis in Brazil is between 74% and 100% (9). Gingivitis changes gingival color and causes swelling, bleeding, subgingival inflammation, and bone destruction (periodontitis) (10).

There are two ways to remove the dental plaque and its associated microorganisms: the mechanical method (including tooth brushing and mouthwash) and the chemical method (including antibiotics). Of course, ordinary oral care is impossible or difficult in critically ill patients. Therefore, the removal of plaque and microorganisms might be carried out inadequately (4,11).

Research has shown that nurses render oral care often based on commonly used methods. They have no specific technique for oral examination and do it with available mouthwash solutions, such as chlorhexidine, oxygenated water, normal saline that its frequency of use is approved by the hospitals (12,13). Despite widespread notification of the importance of oral hygiene in ICU patients, scientific evidence suggests limited protocols for oral hygiene practices in intubated patients (14). Adib *et al*., (2011), in a review study, examined the methods used for oral and dental care in hospitalized patients in the ICU and introduced a protocol for oral care (15). The protocol presented by Adib has advantages, such as simplicity for nurses, and the protocol is divided into three parts: the preparation, the methodology, and the completion of care. However, its application is practically associated with problems, such as the incorrect use of the Jenkins and BRUSHED oral examination tools. None of these tools have been evaluated and objectively validated and are not widely used. Therefore, there is a lack of sufficient information on the standard protocol in the respect and the frequency and equipment for oral care. Considering the importance of oral care and prevention of dental plaque in patients hospitalized in the ICU, this study aimed to determine the effect of oral hygiene protocol on dental plaque and gum index in these patients.

Materials and Methods

This double-blind, randomized clinical trial with a control group was undertaken after its protocol was approved by the Ethics Committee of Zanjan University of Medical Sciences under the code ZUMS.REC.1395.35, with the clinical trial registration number of IRCT201211189664N5. The convenient sampling and random allocation were implemented using the toss of a coin based on inclusion and exclusion criteria. Seventy patients with endotracheal trachea admitted into the intensive care unit of Mousavi Hospital in Zanjan from July to December 2016 were enrolled. The required descriptions of the research objectives and the confidentiality of the information were presented to the patients. Also, written informed consent was obtained from the patient's parents/guardians and their physicians. The sample size in this study was calculated at 35 in each group (β=0.10, α=0.05, d=0.8) according to similar studies (16).

The inclusion criteria consisted of the following: Female and male patients admitted into the ICU with an oral tracheal tube, an age range of 18-65 years, a maximum of 12 hours since admission into the ICU, no coagulation disorders, non-pregnancy, and having natural teeth. The following subjects were excluded: the removal of the tracheal tube, the patient's death or his/her transfer from the ICU before the fourth day (completion of the study), the reluctance to continue the study by the patient’s legal guardian or physician.

The tools used in the study consisted of a questionnaire and a three-part checklist. At the time of inclusion in the study, the demographic data, history of the disease, the cause of hospitalization, the level of consciousness, and the drugs used by each patient were recorded in the questionnaire. The checklist was used to assess the status of the tooth. At this stage, the number of teeth in the oral cavity was recorded. Before the intervention, the oral hygiene assessment was carried out using Beck Oral Assessment Scale (BOAS), and the results were recorded. Modified BOAS checklist, O’Leary index, and Silness and Loe index are standard tools for the evaluation of oral and dental plaque (17,18). The content validity method was used to determine the validity of the data collection form. The technique was evaluated by ten faculty members of the Nursing and Midwifery Faculty and nursing specialists in the ICU prior to using the content, and the necessary corrections were made. To determine the reliability of the tools, observer reliability was used. First, 20 patients were selected based on inclusion criteria, and two nurses separately completed the checklist. Pearson’s correlation coefficient was 82%. Concerning the gingival and plaque index reliability, 20 samples were examined by the researcher and an assistant, and the data were recorded in separate forms. The correlation coefficient was 94% for dental plaque and 77% for gingivitis. In the plaque index (PI) form, the O’Leary index was used. According to this index, each tooth is divided into four parts (mesiobuccal, mid-buccal, distobuccal, and lingual). A dental plaque disclosing agent was used to determine the frequency of the dental plaque. The presence of color at each level is considered as a positive score, and the plaque index for each tooth is obtained by dividing the total score of its

various levels by four. The total score is obtained from the teeth divided by the number of teeth to determine the plaque index. Silness and Loe modified tool known as 'modified gingival index' was used to measure the gingival index. Soft gingival tissue around the tooth was divided into four parts (distobuccal plaque, mesiobuccal plaque, the gingival margin on the buccal aspect, gingival margin on the lingual aspect), and then the inflamed areas were scored by direct observation. In the absence of inflammation, a score of 0 was assigned; mild to moderate inflammation that was not around all the dental surfaces were given a score of 1; moderate to severe inflammation around the dental surfaces was given a score of 2, and severe inflammation associated with ulcers and bleeding was given a score of 3. The overall score was determined by summing up the four scores obtained for each area and around the tooth and divided by four.

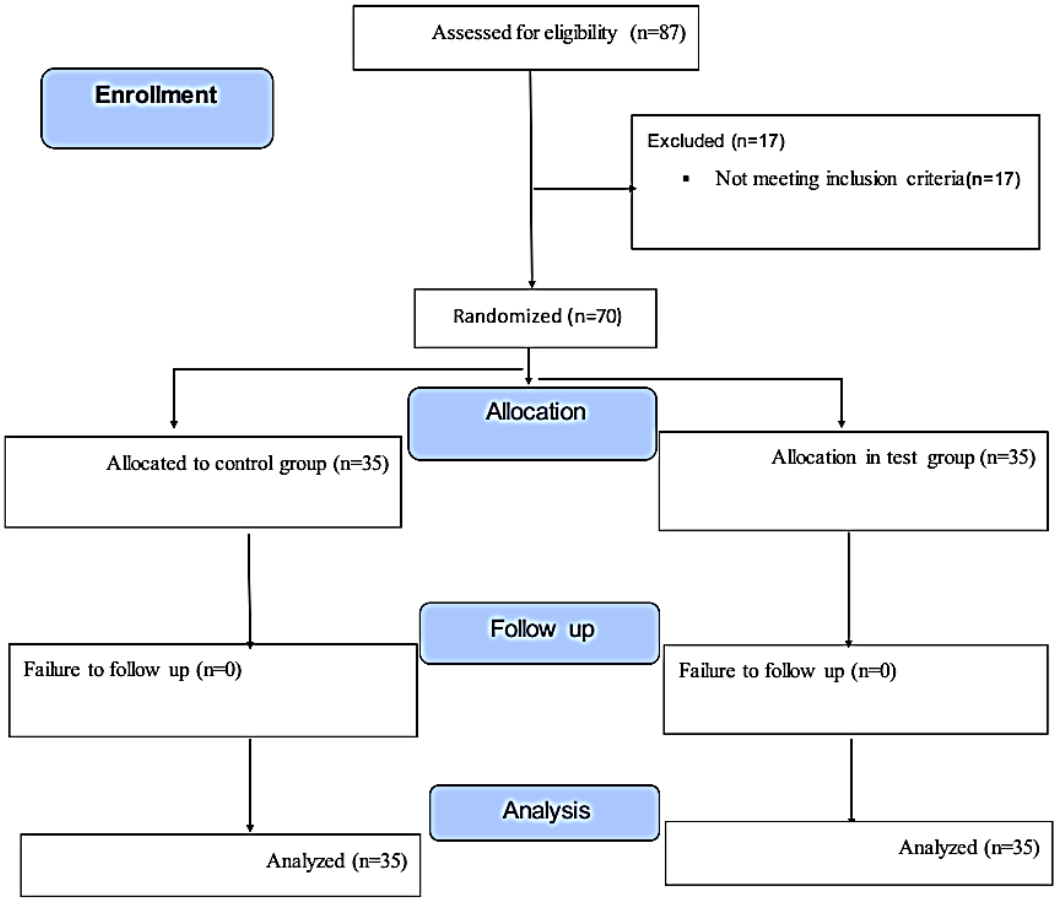

Figure 1. CONSORT diagram

In this study, 0.2% CHX mouthwash was used in the control group twice a day by the nurses in the ICU. The general protocol used for the test group was derived from a review study by Adib *et al*., (19), with some modifications, including the use of a modified Beck Oral Assessment Scale (BOAS). In the test group, based on the proposed protocol, in addition to the 0.2% CHX, a soft toothbrush plus toothpaste, a moisturizer of the oral mucosa, and an ointment were used to soften the lips. The frequency of care varied from two to 12 hours, depending on the oral evaluation results. To implement the protocol, two nurses working in the ICU were invited to collaborate in various shifts as research assistants. The care protocol was as follows: First, the nurses washed their hands, wore gloves, and put on masks and protective glasses. Prior to oral care, its pressure was adjusted using a special manometer (20-25 mmHg) to ensure proper cuff obstructive pressure. Then, every time before brushing, the deep-throat suction was used. A baby toothbrush and a small amount of antimicrobial toothpaste containing fluoride were used to brush all the external and internal surfaces of the teeth and gums with rotational

movements. After the teeth, all the surfaces of the tongue and palate were brushed with back-to-front movements. After brushing each part of the oral cavity, an alcohol-free CHX solution was poured into the same section with a special syringe and then aspirated with a suctioning machine. Using a sponge swab, a moisturizing gel was applied on the entire surfaces of the oral mucosa, and the patient's lips were also moistened with the ointment. The protocol was executed for four days. On the first and fourth days of hospitalization (two hours after the last mouthwash) (16), the gingival index, dental plaque index, and BOAS tool were determined and recorded for the patients. Paired t-test, independent t-test, Fisher's exact test, and chi-squared test were used for data analysis with SPSS 24. The groups were similar in terms of age (P=0.42), gender (P=0.55), number of teeth (P=0.1), underlying disease (P=0.41), type of anti-ulcer drug (P=0.59), level of consciousness (P=0.41), and oral health condition (P=0.3). The significance level was considered at P<0.05.

Results

The mean age in the test group was 38.4±14.4 years, with 41±14.5 in the control group. Gender distribution was as follows: 77% and 83% of the subjects in the test and control groups were male, respectively. The results of statistical tests showed no significant difference between the two groups in terms of age, gender, type of underlying disease, number of teeth, and oral hygiene status before the intervention (P>0.05). Sixteen out of 87 subjects included in the study were excluded due to tuberculosis extirpation before the fourth day of study, and one was excluded because of death in the ICU ward. Table 1 presents the demographic characteristics of the patients in the test and control groups.

A comparison of the means and standard deviations of plaque index between the test (62.33±14.75) and control (60.62±14.15) groups at the time of admission showed no significant difference between the two groups at the beginning of the study (P=0.62), and the two groups were in the same statistical condition before the intervention. The results showed that the means and standard deviations of plaque index before and after intervention in both the control and experimental groups decreased, and their differences were significant (P<0.0001). The mean and standard deviation of plaque index after intervention in patients in the experimental group were significantly lower than those in the control group (P<0.002) (Table 2).

A comparison of the means and standard deviations of the gingival index between the experimental (0.95±0.373) and control (0.41±0.44) groups at admission showed no significant difference between the two groups at the beginning of the study (P=0.35). A comparison of the means and standard deviations of the gingival index before and after intervention between the control and experimental groups showed a significant difference (P<0.0001). The mean and standard deviation of the gingival index after intervention in the experimental group was significantly lower than the control group (P<0.001) (Table 3).

Table 1. Frequency distribution of subjects based on demographic characteristics and pathology in terms of the studied groups

Demographic situation and pathology		Control	Test	*P*
		Number (percentage)	Number (percentage)	
Gender	**Female**	6 (17)	8 (23)	0.55
	Male	29 (83)	27 (77)	
History of the underlying disease	**HTN**	4 (11.4)	1 (2.9)	0.41
	COPD	2 (5.7)	2 (5.7)	
	BPH	1 (2.9)	0 (0)	
	Seizure	0 (0)	1 (2.9)	
	No underlying disease	28 (80)	31 (88.5)	
Taking anti-ulcer medications	**Ranitidine ampoule**	24 (58.68)	30 (72.85)	0.59
	Ranitidine Tablets	11 (41.32)	5 (27.15)	
Oral health condition	**Mild disorder (10-6)**	17 (48.6)	14 (40)	0.3
	Moderate disorder (15 - 11)	15 (42.9)	17 (48.6)	
	Severe disorder (20-16)	3 (8.5)	4 (11.4)	
Age (years)	**Mean±SD**	41±14.5	38.4±14.4	0.42
Number of teeth	**Mean±SD**	24.48±8.61	27.37±5.7	0.1

Table 2. Comparison of the plaque index on the first and fourth days of hospitalization in terms of the test and control groups

Group/ Plaque index	Control Mean ± SD	Test Mean ± SD	T-test *P*
First day of admission(before intervention)	60.62±14.15	62.32±14.75	0.62
Fourth day of admission (after intervention)	53.52±11.92	42.54±15.97	0.002
Paired-t test *P*	0.0001	0.0001	--

Table 3. Comparison of the gingival index on the first and fourth days of hospitalization between the test and control groups

Group/ Gingival index	Control Mean ± SD	Test Mean ± SD	Independent t-test *P*
First day of admission (before intervention)	1.04±0.44	00.95±0.373	0.35
Fourth day of admission (after intervention)	0.415±0.905	0.593±0.31	0.001
Paired-t test *P*	0.0001	0.0001	-

Discussion

The results of this study showed that the plaque and gingival indices after the intervention in patients undergoing treatment with the proposed protocol significantly decreased compared to patients undertaking the ward's routine methods. The difference was statistically significant ($P<0.001$). The results of a study by Jafari *et al*., (2007) on the effect of oral cleansing with 0.2% CHX mouthwash solution on dental plaque formation are consistent with those of the present study (20). Of course, the study by Jafari *et al*., compared the saline serum solution with CHX twice a day and showed no difference between the two methods. A systematic review showed that mechanical methods (toothbrushes) are superior to CHX in reducing plaque colonization, while drug interventions (such as oral solutions) are more effective on the colonization of oral and aerobic microorganisms associated with ventilation (21).

The results of this study showed a significant relationship between age and the prevalence of dental plaque and gingival inflammation. A study by Bayat *et al.*, suggested an increase in dental problems and gingival inflammation with aging (22). Also, the results of this study showed no significant relationship between gender and the prevalence of dental plaque and gingivitis. In a study by Corbet *et al*., (1989), there was a significant relationship between gender and periodontal plaque size in adults of Hong Kong, and men had a worse situation compared to women (23). The results of this study indicated that the average gingival index during admission in the ICU patients was not favorable. In other words, these patients suffered from gingival diseases during admission into the intensive care unit. This finding is consistent with the results of other studies (16). Similar studies have shown that gingival disease is a silent epidemic in society (24). It has also been reported that gingivitis is the most common periodontal disease that affects 90% of the population (25). According to epidemiological studies, the prevalence of gingivitis in Brazil 74-100% (9).

The results of this study showed that the use of the proposed protocol could affect oral and dental health conditions (dental plaque and gingivitis). Considering the importance of oral and dental health in intubated patients, it is recommended that a comprehensive protocol be used; it is also recommended that the proposed protocol be used in traumatic patients in ICUs of other hospitals in future studies.

Acknowledgments

Hereby, we would like to thank the Vice-Chancellor for Research and Technology of Zanjan University of Medical Sciences and the members of the Research Council of the Faculty of Nursing and Midwifery for supporting this research, as well as all the patients who participated in this project.

References

1. Jones DJ, Munro CL, Grap MJ. Natural history of dental

plaque accumulation in mechanically ventilated adults: a descriptive correlational study. Intensive Crit Care Nurs 2011;27:299-304.
2. Robinson E. A comparative evaluation of the Scrub and Bass Methods of toothbrushing with flossing as an adjunct (in fifth and sixth graders). Am J Public Health 1976;66:1078-81.
3. Scannapieco FA, Ho AW. Potential associations between chronic respiratory disease and periodontal disease: analysis of National Health and Nutrition Examination Survey III. J Periodontol 2001;72:50-6.
4. 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.
5. Hutchins K, Karras G, Erwin J, Sullivan KL. Ventilator-associated pneumonia and oral care: a successful quality improvement project. Am J Infect Control 2009;37:590-7.
6. Clerehugh V, Tugnait A. Periodontal diseases in children and adolescents: I. Aetiology and diagnosis. Dent Update 2001;28:222-30, 232.
7. Oh TJ, Eber R, Wang HL. Periodontal diseases in the child and adolescent. J Clin Periodontol 2002;29:400-10.
8. Carranca F, Newman M. Clinical periodontology. 8 ed. Philadelphia: WB Saunders Co, 1996.
9. Suresh L, Neiders ME. Definitive and differential diagnosis of desquamative gingivitis through direct immunofluorescence studies. J Periodontol 2012;83:1270-8.
10. Labeau S, Blot S. Research priorities in oral care for endotracheally-intubated patients. Annual update in intensive care and emergency medicine 2011: Springer; Springers2011:144-55.
11. Marron A, Carratala J, Gonzalez-Barca E, Fernandez-Sevilla A, Alcaide F, Gudiol F. Serious complications of bacteremia caused by Viridans streptococci in neutropenic patients with cancer. Clin Infect Dis 2000;31:1126-30.
12. Johnstone L, Spence D, Koziol-McClain J. Oral hygiene care in the pediatric intensive care unit: practice recommendations. Pediatr Nurs 2010;36:85-96.
13. Ganz FD, Fink NF, Raanan O, Asher M, Bruttin M, Nun MB, et al. ICU Nurses' Oral-Care Practices and the Current Best Evidence. J Nurs Scholarsh 2009;41:132-8.
14. Feider LL, Mitchell P, Bridges E. Oral care practices for orally intubated critically ill adults. Am J Crit Care 2010;19:175-83.
15. Adib-Hajbaghery M, Ansari A, Azizi-Fini E. Oral care in ICU patients: a review of research evidence. Journal of Kashan Univ Med Sci (FEYZ) 2011;15:280-93.
16. Rezaei S, Rezaei K. Comparison the effect of Miswak/Aloe Vera & chlorhexidine mouthwashes on gingival index in intubated patients. CMJA 2015;5:1155-66.
17. Lobene R, Weatherford T, Ross N, Lamm R, Menaker L. A modified gingival index for use in clinical trials. Clin Prev Dent 1986;8:3-6.
18. Ames NJ, Sulima P, Yates JM, McCullagh L, Gollins SL, Soeken K, et al. Effects of systematic oral care in critically ill patients: a multicenter study. Am J Crit Care 2011;20:e103-14.
19. Abidia RF. Oral care in the intensive care unit: a review. J Contemp Dent Pract 2007;8:76-82.
20. Jafari S, Ranjbar H, Kamrani F, Alavi-Majd H, Yaghmaei F. Effects of chlorhexidine and normal saline on dental plaque formation in ICU patients: a comparative study. J Shahid Beheshti Sch Nurs Midwifery 2007;17:40-9.
21. Halm MA, Armola R. Effect of oral care on bacterial colonization and ventilator-associated pneumonia. Am J Crit Care 2009;18:275-8.
22. Bayat M, Nikoo K, Mohsen S, Afshar Hezarkhani F. Prevalence of systemic diseasesin patients with dental infections. J Dent Med 2012;25:283-9.
23. Corbet E, Holmgren C, Lim L, Davies W. Sex differences in the periodontal status of Hong Kong adults aged 35-44 years. Community Dent Health 1989;6:23-30.
24. Pihlstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. Lancet 2005;366:1809-20.
25. Lo Russo L, Fierro G, Guiglia R, Compilato D, Testa NF, Lo Muzio L, et al. Epidemiology of desquamative gingivitis: evaluation of 125 patients and review of the literature. Int J Dermatol 2009;48:1049-52.