Original Article

Comparison of the Effects of Two Oral Care Methods: A Pilot Study

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Abstract

Background: Scrubbing with toothbrush and gargling with chlorhexidine has been shown to be effective in reducing bacteria and preventing ventilator-associated pneumonia (VAP) in patients in the intensive care unit (ICU). However, we still lack established evidence-based practice for oral care specific to ICUs. ***Objective:*** To evaluate effect of two oral care practices in two different ICUs as measured by the previously developed Intensive Care Oral Care Frequency Assessment Scale (ICOCFAS). ***Methods:*** This experimental pilot study was conducted with seven experiment group and seven control group of patients in the ICU setting. Data were collected using a patient information form, Richmond Sedation-Agitation Scale, Glasgow Coma Scale, pain score and ICOCFAS score. The research population consisted of inpatients in the ICU of a training and research hospital in Sakarya, Turkey. ***Results:*** After the application of two different oral care practices for seven days, there was no statistically significant difference between the groupsin before and after average total ICOCFAS scores, $F(0.214, 14.570) = 2.010$ ($p>0.05$). However, when the group effect was kept constant, there was a significant difference between the measurements taken at the end of the seventh day, $F(1.214, 14.570) = 5.520$ ($p<0.05$). ***Conclusion:*** Chlorhexidine combined with toothbrush scrubbing can reduce the incidence of ventilator-associated pneumonia (VAP). However, further studies are needed withlarger sample sizes and additional oral care plans for ICU patients on mechanical ventilation. ICU nurses should be continuously instructed on the importance of adequate dental biofilm removal, chlorhexidine solutions and toothbrush use. The ICOCFAS should be used to evaluate the oral care of patients in ICUs.

Keywords: Intensive care unit, patients on mechanical ventilation, nursing oral care, toothbrush, chlorhexidine

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Introduction

Intensive care units (ICUs) are units that are equipped with advancedtechnological devices and multidisciplinary health care providersperforming complicated care and treatment of critical patients. In these units, life-support treatments are frequently provided for patients, who require constant care. Interventions such as endotracheal intubation and tracheal aspiration during invasive mechanical ventilation increase the risk of deterioration of the oral mucosal membrane.[1,2] Poor oral hygiene history, maintenance of the mouth in an open position due to an endotracheal tube and its associated equipment (plaster, gauze, etc.), and the inability to take fluids and nutrients orally may lead to various oral problems,including the deterioration of the oral flora, dry mouth and chapped lips. Furthermore, the entry of bacteria into the respiratory tract can be caused by intraoral plaques and biofilm layers, increasing the risk of infection.[3-6] Inadequate oral hygiene increases the risk of mortality by causing fatal complications such as ventilator-associated pneumonia (VAP).[1-5]

Oral care is a basic nursing care application in the

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ICU, and evidence-based application guidelines have been established. However, in recent years, many studies have underlined the need to improve the frequency and quality of oral care.[3,7,8]To improve oral care application, it is critical to develop protocols with consideration for time, practicality, frequency, and tools and equipment. In addition, the best current application method determined by studies should be utilised in line with evidence-based practise.[8,9]

In the literature, it has been shown that the use of multiple oral care solutions increases the quality of nursing applications and significantly decreases the incidence of VAP.[8-10]However, there are not enough studies on the use of a suction toothbrush, which is often recommended for its ease of use, efficiency, and reliability. It has been reported in the literature that toothbrush scrubbing and gargling with chlorhexidine is effective in reducing bacteria and preventing VAP.[11,12] In a half-experimental study by Anggraeni et al. (2020) conducted with a single group, suction toothbrushes were assessed,though no positive results were found between pretest and post-test measurements.[5] In the study, it was stated that too many factors affected patientsin the ICU and further experimental and comparative studies were needed. In this direction, the current study was planned as a pilot study and conducted with the aim of comparing the effects of two different oral care methods on the frequency of oral care in two different ICUs, as testedby the previously developed Intensive Care Oral Care Frequency Assessment Scale (ICOCFAS).[3]

Methods

*Aims and Design:*This was an experimental pilot study with experiment and control groups and was conducted to compare the effects of two different oral care methods on the frequency of oral care in the ICU.

Hypothesis of the Research:

H0: The average ICOCFAS score of the patients who received oral care with a toothbrush and suction oral care kit will be higher than the patients who received oral care with a sponge oral care kit.

H1: The average ICOCFAS score of the patients who received oral care with a toothbrush and suction oral care kit will be lower than the patients who received oral care with a sponge oral care kit.

*SettingandSample:*The study was carried out between December 2018 and May 2019 at two third-degree, seven-bed adult ICUs in a training and research hospital affiliated with the Ministry of Health.In this research, the sample size calculation method was used to determine the sample size needed to assess the interaction of scale scores between groups, measurements, and group-measurements. With an effect size of 0.25,a mixed-measures analysis of variance was used to calculate the desired sample size. Other parameters needed to calculate the sample size are type I and type II errors; to achieve a 95% confidence for type I error and 80% confidence for type II error, α and β values were entered into the software as 0.5 and 0.20, respectively. Correlations between the measurements were calculated as 0.80. G*Power 3.1.9.4 software (Faul, Erdfelder, Lang and Buchner, 2007) was used for the calculations, and the necessary sample size was determined to beeight subjects.[13]

The sample of the study comprised patients under the age of 18 who were treated in the ICU, received invasive or non-invasive ventilator treatment and received oral care. The patients were included in the study after consent was received from conscious patients or the relatives of unconscious or sedated patients. Patients who did not agree to participate and patients who were not appropriate for oral care were excluded from the research. The study was completed with a total of 14 patients (sevenin the experimentgroup and sevenin the control group).

*Data Collection Tools:*Patient Information Form:This form consisted of questions on the sociodemographic characteristics of the patients, such as age, gender,smoking status, etc.

Acute Physiological and Chronic Health Evaluation II: The Acute Physiological and Chronic Health Evaluation II (APACHE II) evaluation system is commonly used in ICUs to assessdisease severity and evaluates 12 physiological measurements, age and previous health status. Age, chronic illness status and worst patient data (vital signs, blood gas analysis, laboratory results, etc.) during the first 24 hours following admission to the ICU were scored and mortality risk was identified based on the total score.[14]The Richmond Sedation-Agitation Scale (RASS) measurement tool developed by Cook and Palma (1989) and adapted to Turkish by Sessler (2002) evaluates the levels of both sedation and agitation. RASS scores range from +4 to −5. Positive RASS scores indicate agitated patients and negative RASS scores indicate sedated or comatose patients.[15] In this study, it was used to ensure the homogeneity between the experiment and control group patients.Glasgow Coma Scale was developed by Teasdale and Jennett in 1974, which is commonly used in emergency units and ICUs to evaluate level of consciousness. The scale consists of three components: eye, motor and verbal response. Total scores of this scale range from 3 to 15. Aconscious patient is assigned a score of 13–15, a precoma patient a score of 8–12 and a comatose patient a score of <8.[16] In this study, it was used to ensure homogeneity between the experiment and control group patients. The Numerical Rating Scale (NRS) and Behavioral Pain Scale (BPS) were used for pain evaluation. The NRS is scored on a 0–10 scale, and it is commonly used for measuring pain level,as it has been shown to be valid and reliable. In application, patients are asked to choose the number that best describes their level of pain. An NRS score of 0 indicates no pain and a score of 10 indicates the worst pain imaginable.[17] The BPS was developed in 1993 to evaluate the pain behaviours of children who cannot express themselves verbally. It evaluates the patient's "facial expression", "posture", "extremities" and "adaptation to ventilation". Validity and reliability studies of the BPS for adult ICU patients were performed by Payen et al.,[18] and it was adapted into Turkish by Vatansever.[19]In this study, pain evaluation scales were used to ensure homogeneity between the experiment and control group patient. Intensive Care Oral Care Frequency Assessment Scale (ICOCFAS) was developed by Doğu Kökcü and Terzi[3]and investigates nine parameters, including "age", "lips", "teeth", "tongue", "oral mucosa", "saliva", "cheeks", "nutrition support" and "ventilatory support". Each parameter is evaluated separately as 1 ("Normal"), 2 ("Mild"), 3 ("Moderate") and 4("Severe"), and the sum of the scores gives the total ICOCFAS score. The presence of broad-spectrum antibiotic and steroid treatment, diabetes mellitus diagnosis, low haemoglobin level and immunosuppressive drug use each add one extra point to the total score. The frequency of oral care increases as the total ICOCFAS score increases, and the scores are interpreted in the following manner: a score of 9 points indicates"oral care at least once in 12 hours";a score of 10–19 points indicates"oral care at least once in 8–12 hours";a score of 20–29 points indicates "oral care at least once in 6 hours"; anda score of 30 points and above indicates "oral care at least once in 4 hours".[3]Cronbach's alpha coefficient was 0.851 for the scale and as the study used a repeated-measures design, its reliability was checked by test-retest and a Cronbach's alpha of 0.85 was obtained.

Data Collection Process:

Data were collected by following the steps below:

In the study, the case-control designs of two different studies were used and tested for their efficiency. The study was carried out simultaneously in two seven-bed adult ICUs.Patients were included in the study after they were informed and consent from the patients or their relatives was obtained. Data collection forms were completed by the nurses who provided care for the included patients at their first encounter, and the frequency of oral care was determined using the ICOCFAS.Oral care application steps prepared by the researchers before the study were presented to the ICU nurses for their opinions. Necessary revisions were made based on the nurses' feedback and the document "Oral Care Application Steps" was placed in the ICU where nurses could easily refer to it.

Care plans were developed for the experiment and control groups according to the determined oral care frequency. Chlorhexidine gluconate and oral sponge swabs, considered routine care in the ICU, were used for the control group. Oral swabs were used on the upper right chin, upper left chin, lower right chin, lower left chin, left and right buccal mucosa, palatoglossal area and sublingual area. For the experiment group, oral care was provided with chlorhexidine gluconate and an oral care kit consisting of a toothbrush and suction. Teeth on the upper right chin, upper left chin, lower right chin and lower left chinwere brushed. Saliva and liquid accumulated in the mouth during brushing were suctioned. The soft sponge swabs used for the left and right buccal mucosa, hypoglossal area and sublingual area were sterilised in a chlorhexidine solution.Oral care lasted at least two minutes for both groups and the process were completed with the application of moisturizer to the patients' lips. Both groups had anICOCFAS evaluation every morning for seven days, and the obtained oral care frequency scores were recorded into the nursing care forms.

*Data Analysis:*Data were analysed using the Statistical Package for the Social Sciences (SPSS) for Windows Version 23.0. G*Power analysis

Table 1. Result of mixed measures ANOVA

Source of Variance	Sum of Squares	Degree of Freedom	Mean Square	F	p	Eta-square
Group	1989,887	13				
Group (Individual/Group)	1,724	1	1,724	,010	,920	,001
Error	1988,163	12	165,680			
Measurement	79,715	16,998				
Measurement (Pretest-Posttest)	22,531	1,214	18,556	5,520	,028	,315
Group*Measurement	**8,204**	**1,214**	**6,757**	**2,010**	**,177**	**,143**
Error	48,980	14,570	3,362			
Total	2038,867	29,998				

F: Mixed Measures ANOVA

was usedto calculate the sample size of the study. One-sample Wilcoxon signed-rank test was used to compare the scale scores between groups, and mixed-measures analysis of variance was used to analyse daily changes. Spearman'srank correlation coefficient was used to analyse the relationships between the average oral care score and numerical variables, and Mann–Whitney 'U' test was used to analyse the relationships between the average oral care score and categorical variables.

Results

The average total ICOCFAS scores of both groups were above 9 points, and a statistically significant difference in scores was present between the groups (median: experimental= 21.43, control=22.00, Z=2.366, p<0.018, wilcoxon).

Daily changes in the average total ICOCFAS scores of the individuals are given in Table 1 and Graph 1. After participants underwent two different oral care methods for seven days, no statistically significant difference was found between the before and after average ICOCFAS scores, F(1.214,14.570) =2.010, (p>0.05). When keeping the measurement effect constant, no difference was present in average ICOCFAS scores between the experiment and control groups F(1, 12) = 0.010, (p>0.05). In other words, the average total ICOCFAS scores were similar for the experiment and control groups when assuming that no repetitive measurements were performed. However, when keeping the group effect constant, a statistically significant difference was present between the measurements at the end of the seventh day, F(1.214, 14.570) = 5.520 (p<0.05).

There was a decrease in the average ICOCFAS scores of both groups. When examining the values between 19.50 and 21.50, although it appears that there is a difference, it was identified that the decrease in the scale scores was not caused by different groups and was not statistically significant (Table 1, Figure 1).Table 2 presents the investigation of relationships between the average total ICOCFAS scores and numerical variables such as age, APACHE II values and time in the ICU. A significant positive relationship was found between average total ICOCFAS score and age in the experiment group (r =0.893, p<0.05). A non-significant, positive, advanced relationship was present between average ICOCFAS score and time in the ICU in the experiment group (r = .750, p ≤ .05). For both groups, the relationships between average ICOCFAS total score and the other variables were low-level and statistically non-significant (p>0.05)(Table 2).When investigating the differences between average ICOCFAS total score and gender, smoking status, toothbrushing habits, presence of endotracheal intubation and

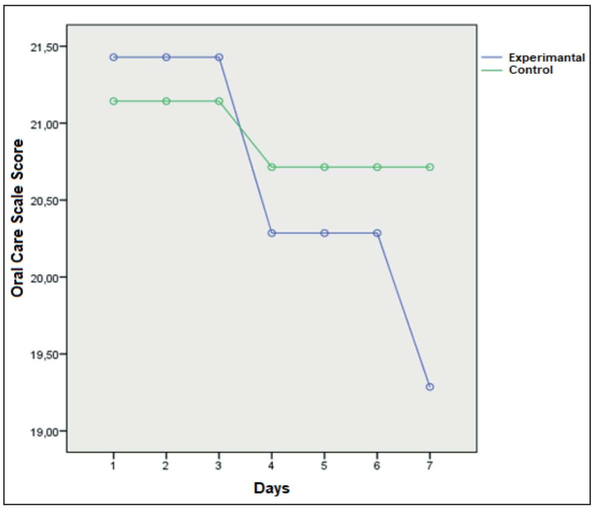

Figure 1. Change of the ICOCFAS mean score of the groups according to the days

tracheostomy tubes, enteral nutrition status and sedation protocols, average ICOCFAS scores of patients in the experiment group who had tracheostomy tubes were significantly higher than patients who did not ($p < .05$). No statistically significant difference was found between average total ICOCFAS scores and other variables for both the experiment and control groups ($p>0.05$) (Table 3).

Table 2. The relationship between the groups' age, APACHE II score, length of stay in the ICU and ICOCFAS mean scores

			ICOCFAS_Mean	
			Groups	
			Experimental	**Control**
Spearman's rho	Old	Correlation Coefficient	,893*	-,037
		Sig. (2-tailed)	,007	,937
		N	7	7
	APACHEII Score	Correlation Coefficient	,162	-,346
		Sig. (2-tailed)	,728	,448
		N	7	7
	Length of Stay in ICU	Correlation Coefficient	,750	,126
		Sig. (2-tailed)	,052	,788
		N	7	7
**. Correlation coefficient is significant at 0.001 level (2-tailed).				

Table 3. Categorical Variables and ICOCFAS Mean Scores Analysis Results

Variable			**N**	**Mean**	**Std. Deviation**	**Z**	**p**
Gender	Experimental	Women	4	22,4286	3,63842	-.707	.480
		Male	3	18,2381	5,67187		
	Control	Women	2	17,6429	7,57614	-.775	.439
		Male	5	22,2000	3,96232		
Smoking	Experimental	Drinks	1	21,0000	.	-.500	.617
		Notdrinking	6	20,5714	5,17687		
	Control	Drinks	4	21,0000	3,36650	-.354	.724
		Notdrinking	3	20,7619	7,60818		
The habit of brushing teeth before bedtime	Experimental	Yes	7	20,6327	4,72859	*	*
		No	0	.	.		
	Control	Yes	3	21,6667	1,52753	.000	1.000
		No	4	20,3214	6,88227		
Endotracheal Intubation Tube	Experimental	Yes	3	20,4762	1,29625	-1.061	.289
		No	4	20,7500	6,59971		
	Control	Yes	4	22,5000	2,08167	-.707	.480
		No	3	18,7619	7,51371		
Tracheostomy Tube	Experimental	Yes	3	23,7619	3,30224	-2.121**	.034
		No	4	18,2857	4,50699		
	Control	Yes	2	19,6429	10,40457	.000	1.000
		No	5	21,4000	3,04959		
Enteral Nutrition	Experimental	Yes	6	20,9048	5,11952	-1.000	.317
		No	1	19,0000	.		
	Control	Yes	6	22,3333	3,55903	-1.500	.134
		No	1	12,2857	.		
Sedation Protocol	Experimental	Yes	2	20,3571	1,91929	-.387	.699
		No	5	20,7429	5,70660		
	Control	Yes	2	22,5000	3,53553	-.387	.699
		No	5	20,2571	5,70481		

Not.

* Mann-Whitney Test was not performed because the number of cases in the second group was 0.

** Significant at 0.05 level.

Discussion

The study was conducted experimentally to examine the effect of oral care given by two different methods on the frequency of care in patients on mechanical ventilator support.The change in the frequency of oral care of the sick individuals was observed by using a chlorhexdine-flux toothbrush in the case group and a chlorhexidine-oral care stick and ICOCFAS in the control group.

This study was carried out as an experimental study to investigate the effects of two different oral care methods on the frequency of care of patients under ventilator support. The experimental group underwent chlorhexidine and suction toothbrush cleaning and the control group underwent chlorhexidine and oral care swab cleaning, and changes in the frequency of oral care were monitored by the ICOCFAS.

In the literature, some studies have investigated the effects of different oral care solutions on the frequency and time of oral care and VAP development.[3,11,20,21]However, few experimental studies haveevaluated the effect of using suction toothbrushes and oral care swabs for oral care.

In this study, no difference was seen between the before and after average total ICOCFASscores for the experiment and control groups. However, a significant difference was present in the measurements that were obtained on the seventh and final day of the study.

There are differences in oral care solutions and equipment choicesacrossICUs. However, in general, it is important to use oral care swabs and toothbrushes to prevent oral plaque. Similar to our study, the study by Marino et al. (2016) investigating the effects of using oral care swabs and toothbrushes on plaques found no significant difference between the two groups.[22] Camargo et al. (2019) stated in a literature review that it decreased the incidence of VAP and the length of stay in the ICU, though no statistically significant differences were present.[21]Contrary to this study, some studies have reported that toothbrushes are more effective in preventing plaque, and suction toothbrushes are particularly important for patients under mechanical ventilator support.[5,23,24] In this study, the application and monitoring period was seven days, keeping in mind that the development of plaque takes 48 hours. However, the results of the study suggest that the seven-day period was not long enough.

Similar to our study, Liu et al. and De Lacerda et al., who compared the effects of using chlorhexidine swabs and a negative-pressure toothbrush with a 0.12% chlorhexidine solution,found that using a toothbrush was effective in shortening the duration of mechanical ventilation,decreasing the incidence of VAP and, although statistically non-significant, decreasing the length of stay in the ICU.[12,25] Similarly, Anggraeni et al. (2020), who comparedtoothbrush and oral care swab methods, stated that the oral evaluation scale score decreased after oral care application; however,the mucosal structure of the intubated patientsdeteriorated and extra moisturizers were needed. Anggraeni et al. stated that the study in which they used swabs with sterilized gauze patches in addition to soft paediatric toothbrushes was planned as a pre-experimental study and the results would change with larger samples.[5]Another study revealed that VAP development was less common in patients who received oral care with a soft paediatric toothbrush compared to patients in the control group.[23] In a meta-analysis of studies on electrical and manual toothbrushing, it was found that toothbrushing did not decrease VAP development in patients under mechanical ventilation support and did not have an effect on the length of stay in theICUor mortality rates,though the need for further research was highlighted.[26]The differing results of these studies may be related to a number of factors, such as sample size and variability in diagnosis and treatment criteria.

When investigating average ICOCFAS scores and participant characteristics, it was found that patients in the experiment group who had tracheostomy tubes had significantly higher average ICOCFAS scores than patients who did not have tracheostomy tubes (Table 3). Tracheostomy negatively affected the ICOCFAS score and is one of the ventilatory support treatments that increase the risk of VAP. Therefore, oral care should be administered more frequently to patients with tracheostomy. Contrary to our study, one study comparing a gauze patch with 0.12% chlorhexidine and a manual toothbrush with 0.12% chlorhexidine reported that tracheostomy did not cause a difference between groups.[3,27]

Conclusion

The use of ICOCFAS, which is a reliable and valid measurement tool, can be recommended in determining the frequency of oral care in intensive care units. ICOCFAS, a reliable and valid measurement tool, can be used to identify the oral care frequency for patients in the ICU. Moreover, for all patients, including intensive care patients, toothbrushing cannot be replaced by other oral care applications. The use of oral care materials that provide both brushing and suctioning of oral secretions is critical to effectively sterilise the oral cavity and prevent aspiration of oral fluids into the lungs. Further experimental studies assessing different oral care materials with the ICOCFAS on larger samples in the ICU are needed.

Conflict of interest: The authors report no actual or potential conflicts of interest.

Ethical approval: Ethical approval of this study was obtained from Sakarya University Faculty of Medicine (permission number: 71522473/050.01.04/126-27.07.2018). Written informed consent was obtained from the patients or patients' relatives.

Authors' contribution: Concept and design: ÖD; Data collection and compilation: ÖD, BT; Data analysis: ÖD; Manuscript writing, revision and finalizing:ÖD, BT.

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