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The Effect of Oral Care on Bacterial Colonization in the Oral Mucosa of Non-Mechanically Ventilated Patients with Stroke

Wpływ pielęgnacji jamy ustnej na kolonizację bakteryjną błony śluzowej jamy ustnej u pacjentów z udarem mózgu niewentylowanych mechanicznie

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Abstract

Introduction. Stroke impairs the patient's activities of daily living, including oral care, with the deficits (motor, perceptual, and cognitive) it causes. These limitations adversely affect oral health by limiting the patient's ability to perform self-care tasks such as oral cleaning and tooth brushing.
Aim. It was aimed to examine the effect of oral care on bacterial colonization in the oral mucosa of non-mechanically ventilated patients with stroke.
Material and Methods. The study was conducted with 42 non-mechanically ventilated patients (21 experimental, 21 control) hospitalized in a neurology intensive care unit in Istanbul. The standardized oral care protocol was applied three times a day to the patients randomized to the experimental group. Oral care was applied to the control group according to the routine practice of the clinic. Sociodemographic and clinical characteristics of the patients were recorded at admission, and the oral mucosa was evaluated for oral health and bacterial colonization at baseline and at the end of the fifth day. Our paper adheres to the CONSORT guidelines.
Results. The experimental and control groups were found to be similar in terms of sociodemographic, clinical, and oral health characteristics before the intervention. At the end of the intervention, bacterial count, microorganism diversity, and the mean scores of the Oral Assessment Scale were lower in the experimental group compared to the control group. When each group was compared within itself before and after the intervention, there was no change in the control group. However, a significant improvement was detected in the bacterial count, microorganism diversity, and the mean scores of the Oral Assessment Scale in the experimental group.
Conclusions. These results support that applying the standardized oral care protocol is effective on bacterial colonization in the oral mucosa. **(JNNN 2025;14(2):51–60)**
Key Words: bacteria, colonization, oral care, oral mucosa, stroke

Streszczenie

Wstęp. Udar mózgu wpływa na codzienne czynności pacjenta, w tym higienę jamy ustnej, powodując deficyty (motoryczne, percepcyjne i poznawcze). Sytuacja ta negatywnie wpływa na zdrowie jamy ustnej, ograniczając pacjentowi możliwość samodzielnego dbania o higienę jamy ustnej, w tym szczotkowanie zębów i czyszczenie jamy ustnej.
Cel. Celem badania była ocena wpływu pielęgnacji jamy ustnej na kolonizację bakteryjną błony śluzowej jamy ustnej u pacjentów z udarem mózgu, niewentylowanych mechanicznie.

Materiał i metody. Badanie przeprowadzono wśród 42 pacjentów niewentylowanych mechanicznie (21 w grupie eksperymentalnej i 21 w grupie kontrolnej), hospitalizowanych na oddziale intensywnej terapii neurologicznej w Stambule. U pacjentów przydzielonych losowo do grupy eksperymentalnej stosowano standardowy protokół pielęgnacji jamy ustnej trzy razy dziennie. W grupie kontrolnej pielęgnację jamy ustnej stosowano zgodnie z rutynową praktyką kliniki. Charakterystykę socjodemograficzną i kliniczną pacjentów odnotowywano przy przyjęciu, a błonę śluzową jamy ustnej oceniano pod kątem stanu zdrowia jamy ustnej i kolonizacji bakteryjnej na początku badania i na koniec piątego dnia. Niniejsza praca jest zgodna z wytycznymi CONSORT.
Wyniki. Przed interwencją stwierdzono, że grupy eksperymentalna i kontrolna były podobne pod względem cech socjodemograficznych, klinicznych i stanu zdrowia jamy ustnej. Pod koniec interwencji liczba bakterii, różnorodność mikroorganizmów oraz średnie wyniki w Skali Oceny Jamy Ustnej były niższe w grupie eksperymentalnej w porównaniu z grupą kontrolną. Porównując wyniki każdej z grup przed i po interwencji, nie zaobserwowano zmian w grupie kontrolnej. Jednakże, w grupie eksperymentalnej zaobserwowano istotną poprawę w zakresie liczby bakterii, różnorodności mikroorganizmów oraz średnich wyników w Skali Oceny Jamy Ustnej.
Wnioski. Wyniki te potwierdzają, że stosowanie standardowego protokołu pielęgnacji jamy ustnej jest skuteczne w ograniczaniu kolonizacji bakteryjnej błony śluzowej jamy ustnej. **(PNN 2025;14(2):51–60)**
Słowa kluczowe: bakterie, kolonizacja, pielęgnacja jamy ustnej, błona śluzowa jamy ustnej, udar

Introduction

Stroke, a neurological deficit caused by interrupted cerebral blood flow, damages brain tissue [1]. Physiological stress responses emerge within 48 hours, affecting temperature, blood pressure, heart rhythm, sugar levels, and oxygenation. Since this clinical picture increases brain damage, intensive care follow-up in stroke patients for the first 48 hours is extremely important to administer thrombolytic agents, which are a specific treatment [2]. Hospitalized in intensive care unit, patients face increased oral infections due to invasive procedures and suppressed immunity [3,4].

Stroke affects the patient's activities of daily living, including oral care, with the deficits (motor, perceptual, and cognitive) it causes. These limitations adversely affect oral health by limiting the patient's ability to perform individual self-care, including oral cleaning and tooth brushing. Moreover, orofacial dysfunction and dysphagia developing in stroke patients affect the cleaning of food residues from the oral cavity [5,6]. Decreased oral hygiene in individuals with dysphagia leads to the formation of an appropriate environment for the development of opportunistic bacteria associated with pneumonia [7,8].

When poor oral hygiene is combined with intensive care interventions, patients may experience xerostomia, halitosis, mouth ulcers, gum problems, and bleeding [8,9]. The replacement of Gram-positive bacteria with Gram-negative bacteria can lead to changes in oral flora and dental plaque [10]. The mixing of plaque components into the bloodstream can cause bacteremia and other diseases [4]. This situation prolongs the duration of hospitalization and increases costs, morbidity, and mortality. Standardized oral care in accordance with care protocols is necessary to prevent these problems [11,12]. In addition, oral care is known to be an important nursing intervention in preventing hospital-acquired infections [13,14].

Although there is consensus on the necessity of oral care in stroke patients, the materials and products to be used and how often care should be performed are still controversial. Suction toothbrushes and sponge sticks are commonly used. Suction toothbrushes prevent the formation of plaque, mucus and infection. Solutions such as hydrogen peroxide, physiological serum, sodium bicarbonate and chlorhexidine are used, and the literature shows that chlorhexidine reduces bacterial colonization in the oropharynx [15,16].

Daily assessment of the oral mucosa is crucial in determining the frequency of oral care [17]. A study suggests that oral care should be performed at least twice a day [18]. The literature reports that oral care in non-mechanically ventilated patients is generally performed two or three times a day [3,19]. It has been highlighted that oral care practices performed by nurses in non-mechanically ventilated patients are primarily aimed at hygiene rather than preventing infection risk, and the importance of oral care for this patient group is not adequately recognized [4,13]. There is a paucity of research on oral care in non-mechanically ventilated patients [4].

The aim of this study is to evaluate the effect of oral care on bacterial colonization of the oral mucosa in non-mechanically ventilated patients who have suffered a stroke.

Material and Methods

Sample and Setting

The study was conducted on stroke patients hospitalized in the neurology intensive care unit of a tertiary hospital in Istanbul between January and June 2020. Stroke patients over 18 years of age, spontaneously

breathing or receiving oxygen support with a mask or nasal cannula, and having at least 3 teeth were included in the study. Patients who could meet their oral care needs by themselves and were connected to a mechanical ventilator were excluded from the study. The sample size was calculated as 21 individuals in each of the experimental and control groups with a 0.80 power value, 0.05 margin of error, and 0.88 effect size by power analysis. During the research, some patients in the sample were decided to be intubated due to developing disease-related complications, and other patients were discharged to neurology wards by the physician. These patients were excluded from the study. Of the 89 patients hospitalized in the unit between the study dates, 42 constituted the study sample.

Study Design

This randomized controlled trial used a pretest-posttest control group design. Twenty-one patients were assigned to each group. The study adhered to CONSORT guidelines (Figure 1).

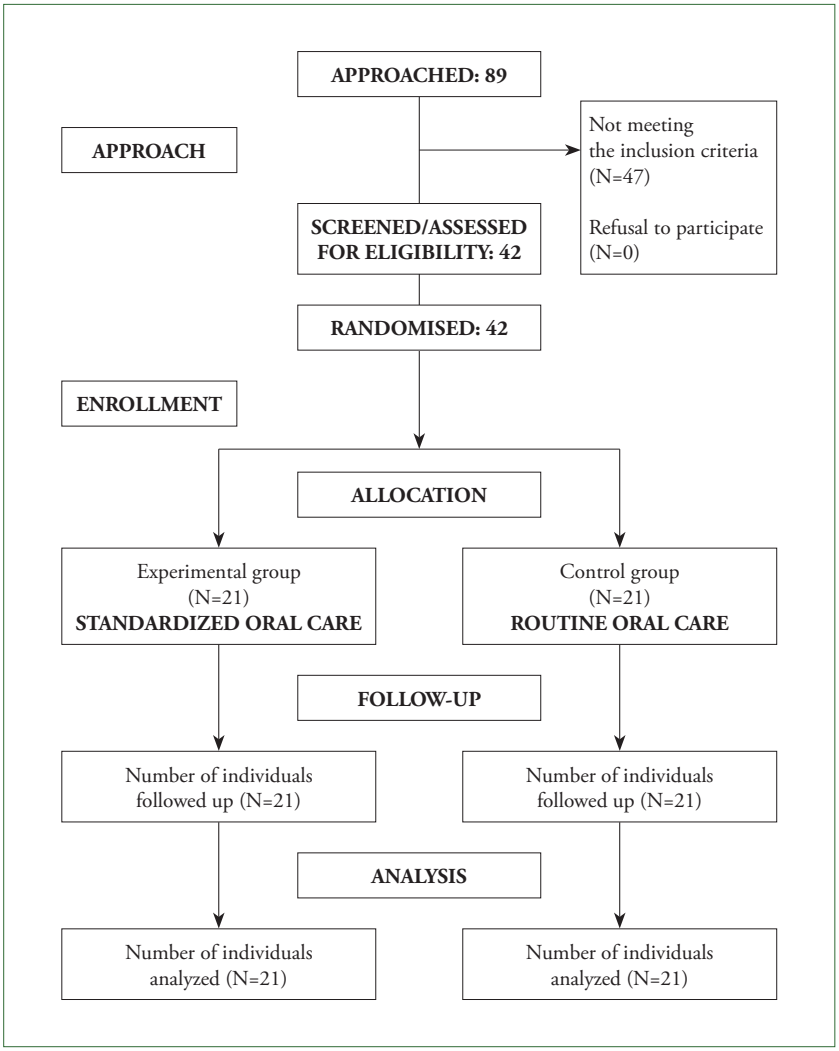

Figure 1. CONSORT (2018) Flow Diagram

Intervention (Standardized Oral Care Protocol)

In the unit where the study was conducted, routine oral care was performed using an oral care set (solution containing chlorhexidine, suction toothbrush, oral care sticks, lip moisturizer) once in night and day shifts, twice a day in total. However, since there are no directives, protocols, etc. related to the practice, the care performed may differ according to the knowledge and skill of the nurse on duty at that time. In our study, the standardized oral care protocol was created by the researcher in line with the literature was applied to the patients in the experimental group. Before initiating the study, the purpose of the study was explained to all nurses, and information about the protocol was provided. Prior to commencing work, an informative meeting was organized for all nurses in regards to the purpose, scope, and expectations of the employment.

A sheet related to the standardized oral care protocol was placed in patient files of the experimental group and applied by the nurses working in the unit. Oral care was applied to the patients three times a day (06:00, 14:00, 22:00) for a total of five days using the oral care set used routinely by the hospital. Each quarter of the mouth (inside the mouth, teeth, gums, top of the tongue, underside of the tongue, cheek interiors, and hard-soft palate areas) was cleaned for a total of two minutes using the recommended oral care solution and oral care kit for 30 seconds [13]. Teeth (with horizontal, vertical, and circular movements) were brushed softly with the suction toothbrush without applying pressure. The gums, top of the tongue, underside of the tongue, cheek interiors, and hard-soft palate areas were cleaned with sponge sticks, and intraoral aspiration was applied. Then, a thin layer of lip moisturizer was applied with the help of gauze. The patients were monitored for five days during their stay in the intensive care unit.

Data Collection

Patients who were hospitalized in the unit were evaluated at the end of 24–48 hours, and patients who continued to be hospitalized in the intensive care unit were evaluated in terms of the oral cavity status and

bacterial colonization. On the first day of the evaluation, patients were evaluated with a form including sociodemographic, clinical and oral health characteristics (the presence of decayed and prosthetic teeth, frequency of daily routine oral care, tools used in oral care, etc.). A follow-up form was created to evaluate patients' oral status and clinical status on a daily basis. The number of bacteria growing and the type and number of microorganisms were noted in the follow-up form on days 1 and 5. Microbiological samples were taken from the vestibular fornix, which was close to the third molar tooth area on the left cheek side of the patients, under sterile conditions with the help of a swab. The sample was placed in tubes with 1 millimeter of 0.9% sodium chloride and sent to the microbiology laboratory as soon as possible. In the study, the Oral Assessment Scale was also used. The Oral Assessment Scale is a form that assesses the condition of lips, gums, tongue, teeth, and saliva. Each section is rated on a scale of 1–4, and the total score for the oral assessment scale ranges from 4–20. A high score on the Oral Assessment Scale indicates an increase in problems in the oral cavity [20].

Ethical Considerations

This study fulfilled all ethical requirements, as detailed in the Declaration of Helsinki. Ethics committee approval (Date: 03.12.2019, Protocol no: 386) and institutional permission were obtained. The participants' consent was obtained directly from the patients in cases when the patients were conscious and from the patients' first-degree relatives in cases when the patients were lethargic. Moreover trial registration details: A Systematic Oral Care Protocol in Non-Mechanically Ventilated Stroke Patients — NCT05521659.

Data Analysis

The analysis was carried out using the SPSS Statistics Version 21.0 (IBM Inc., Armonk, NY). The patients' characteristics were presented as mean and standard deviation. Categorical data were compared by the chi-square test or Fisher's exact test. In the comparison of continuous variables between the experimental and control groups, the Mann–Whitney U test was used since the data did not show a normal distribution. A p-value of <0.05 was considered statistically significant.

Results

A total of 42 people were included in this study. The patients were divided into experimental and control groups, each including 21 individuals. As seen in Table 1, the experimental and control groups are similar in terms of sociodemographic characteristics (p>0.05). The mean age was 63.90±17.32 (median 64) years in the experimental group and 65.33±13.33 (median 66) years in the control group (p=0.990).

When the experimental and control groups were evaluated in terms of clinical problems, the groups were found to be similar (Table 2). The only parameter in which a difference (approaching significance, although not statistically significant) was found between the groups was the presence of nasogastric/orogastric catheter. The rate of patients using nasogastric catheters was higher in the experimental group compared to the control group (90.5% vs 40.6%; p=0.067). PEG use was found to be higher in the control group (19.0%) compared to the experimental group (0%) (p=0.107). It was revealed that the mean Glasgow Coma Scale score was approximately 11.5, most of the patients (more than 80%) had Foley and intravenous catheters, most of them received oxygen therapy, had dysphagia and were fed enterally.

No difference was observed between the groups in terms of oral health habits In both groups, decayed tooth problems were detected by 66% Upon comparing the experimental and control groups in terms of oral symptoms, no difference was found between the groups before the intervention. After the intervention, intraoral bleeding was determined to be less in the experimental group compared to the control group (0% vs 23.8%; p<0.05).

When each of the experimental and control groups was compared in terms of post-intervention (day 5) and pre-intervention (day 0), there was no significant difference in terms of the presence of secretion, intraoral ulceration, xerostomia, and halitosis (p>0.05). In the experimental group, a decrease was found in the number of patients with post-intervention (day 5) intraoral bleeding compared to the pre-intervention period (p<0.05).When the experimental and control groups were compared in terms of the mean score of the Oral Assessment Scale, bacterial count, and the diversity of microorganisms, there was no difference between the groups before the intervention. After the intervention, the mean score of the Oral Assessment Scale was observed to be lower in the experimental group compared to the control group (6.66±1.11 vs 8.42±1.98; p=0.002). After the intervention, the experimental group was also found to be better in terms of bacterial count (p<0.001) and diversity (p<0.001) in the oral cavity. When bacterial count and diversity were compared between pre-intervention (day 0) and post-intervention (day 5) in each group, there was no change over time in the control group, whereas there was a significant difference in all three parameters in the experimental group. At the end

Table 1. Sociodemographic characteristics of experimental and control groups (N=21)

Variable	Experimental	Control	χ^2/Z	p
	N (%)	N (%)		
Gender				
Women	10 (47.6)	7 (33.3)	0.889*	0.346
Men	11 (52.4)	14 (66.6)		
Marital status				
Single/divorced	6 (28.6)	6 (28.6)	0.000*	1.000
Married	15 (71.4)	15 (71.4)		
Education				
≤Secondary school	15 (71.4)	19 (90.5)	5.797**	0.326
≥High school	6 (28.6)	2 (9.5)		
Working status				
Working	7 (33.3)	5 (23.8)	0.492*	0.782
Not working/retired	14 (66.6)	16 (76.2)		
Smoking status				
Smoker	5 (23.8)	7 (33.3)	0.467*	0.495
Non-smoker	16 (76.2)	14 (66.6)		
Alcohol use				
Yes	0 (0.0)	0 (0.0)	–	–
No	21 (100.0)	21 (100.0)		
Chronic disease				
Yes	16 (76.2)	13 (61.9)	2.369*	0.668
No	5 (23.8)	8 (38.1)		
Age (Mean±SD)	63.90±17.32	65.33±13.33	–0.013***	0.990

*Chi-square test, **Fisher's Exact Test, ***Mann–Whitney U Test, N — number of observations; % — percent; χ^2 — chi-square test; Z — Mann–Whitney U test; p — test probability; SD — standard deviation

Table 2. Clinical characteristics and problems of experimental and control groups

Variable	Experimental	Control	χ^2/Z	p
	N (%)	N (%)		
1	2	3	4	5
Stroke type: Ischaemic	21 (100)	21 (100)	–	–
Aphasia				
Yes	12 (57.1)	10 (47.6)	0.382*	0.537
No	9 (42.9)	11 (52.4)		
Dysarthria				
Yes	7 (33.3)	9 (42.9)	0.404*	0.525
No	14 (66.7)	12 (57.1)		
Dysphagia				
Yes	20 (95.2)	17 (81.0)	2.043**	0.343
No	1 (4.8)	4 (19.0)		
Glasgow Coma Scale (Mean±SD)	11.95±1.50	11.19 ±2.38	–1.238***	0.216
Foley catheter				
Yes	20 (95.2)	21 (100)	1.024**	1.000
No	1 (4.8)	0 (0.0)		

Table 2. Continued

1	2	3	4	5
Nutrition type				
Oral	2 (9.5)	4 (19.0)	1.846**	0.410
Enteral	19 (90.5)	17 (81.0)		
Naso/orogastric tube				
Yes	19 (90.5)	13 (40.6)	4.725**	0.067
No	2 (9.5)	8 (38.1)		
Percutaneous endoscopic gastrostomy				
Yes	0 (0.0)	4 (19.0)	4.421**	0.107
No	21 (100)	17 (81.0)		
Foley catheter				
Yes	20 (95.2)	21 (100)	1.024**	1.000
No	1 (4.8)	0 (0.0)		
Peripheral IV catheter				
Yes	18 (85.7)	17 (81.0)	0.171**	1.000
No	3 (14.3)	4 (19.0)		
Central venous catheter				
Yes	3 (14.3)	4 (19.0)	0.171**	1.000
No	18 (85.7)	17 (81.0)		
Arterial catheter				
Yes	14 (66.7)	12 (57.1)	0.404*	0.525
No	7 (33.3)	9 (42.9)		
Oxygen therapy				
Yes	18 (85.7)	20 (95.2)	1.105**	0.606
No	3 (14.3)	1 (4.8)		

*Chi-square test; **Fisher's Exact Test; ***Mann–Whitney U Test; N — number of observations; % — percent; χ^2 — chi-square test; Z — Mann–Whitney U test; p — test probability; SD — standard deviation

Table 3. Comparison of Oral Symptoms, Oral Assessment Scale scores, Number and Diversity of Microorganisms of the Experimental and Control Groups Before and After the Intervention

Variable	Experimental		Control		Test value	p
	Yes	No	Yes	No		
1	2	3	4	5	6	7
Secretion						
T_0	21 (100)	0 (0.0)	20 (95.2)	1 (4.8)	1.024*	1.000
T_1	20 (95.2)	1 (4.8)	19 (90.5)	2 (9.5)	0.359*	1.000
χ^2;p	0; p=1.000**		0; p=1.000**			
Ulceration						
T_0	7 (33.3)	14 (66.7)	7 (33.3)	14 (66.7)	0.000***	1.000
T_1	2 (9.5)	19 (90.5)	6 (28.6)	15 (71.4)	2.471*	0.238
χ^2;p	3.2; p=0.063**		0; p=1.000**			
Intraoral bleeding						
T_0	7 (33.3)	14 (66.7)	5 (23.8)	16 (76.2)	0.467*	0.495
T_1	0 (0.0)	21 (100)	5 (23.8)	16 (76.2)	5.676*	0.048
χ^2;p	5.1; p=0.016**		0; p=1.000**			

Table 3. Continued

1	2	3	4	5	6	7
Xerostomia						
T0	8 (38.1)	13 (61.9)	3 (14.3)	18 (85.7)	3.079*	0.159
T1	4 (19.0)	17 (81.0)	5 (23.8)	16 (76.2)	0.141*	1.000
χ^2;p	2.3; p=0.125**		0; p=1.000**			
Halitosis						
T0	16 (76.2)	5 (23.8)	20 (95.2)	1 (4.8)	3.111*	0.184
T1	12 (57.1)	9 (42.9)	15 (71.4)	6 (28.6)	0.933*	0.334
χ^2;p	2.3; p=0.125**		3.2; p=0.063**			
	Mean±SD		Mean±SD		Test value	p
Oral Assessment Scale						
T0	9.57±1.39		8.71±1.64		–1.527	0.127
T1	6.66±1.11		8.42±1.98		–3.149	0.002
Z;p	–5.073; p<0.001****		–0.533; p=0.594****			
Number of bacteria						
T0	1.51×106±1.42×106		1.15×106±1.02×106		–0.591	0.554
T1	0.35×106±0.36×106		1.19×106±0.94×106		–4.154	<0.001
Z;p	–3.725; p<0.001****		–0.440; p=0.660****			
Diversity of microorganisms						
T0	2.57±0.87		2.47±0.98		–0.411	0.681
T1	1.38±1.02		2.66±0.73		–3.989	<0.001
Z;p	–3.594; p<0.001****		–0.740; p=0.459****			

T0: Before the intervention; T1: After the intervention; *Fisher's Exact Test; **McNemar test; ***Chi-square test; ****Mann–Whitney U test; p — test probability; χ^2 — chi-square test; Z — Mann–Whitney U test; SD — standard deviation

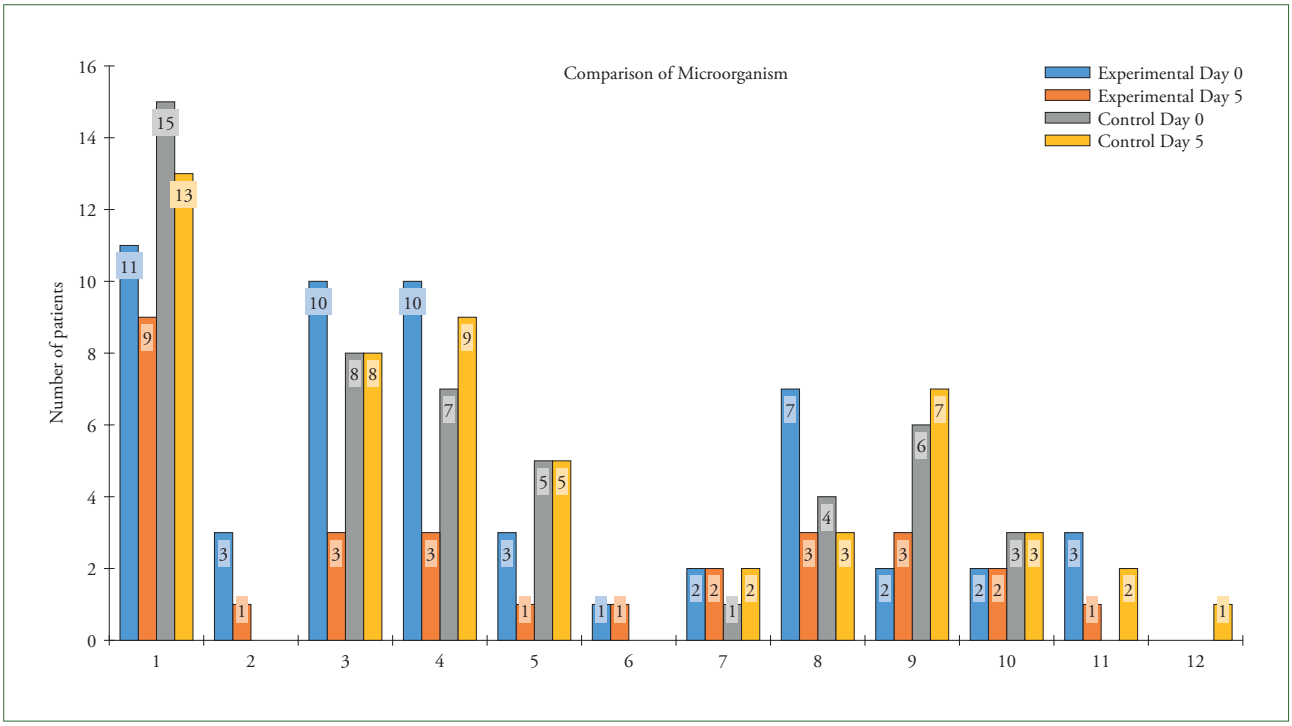

Figure 2. Comparison of Microbial Growth in Experimental and Control Groups Before and After the Intervention

1 — Gram-positive bacilli; 2 — Non-hemolytic streptococci; 3 — Alpha-hemolytic streptococci; 4 — Coagulase-negative staphylococci; 5 — Neisseria spp; 6 — Micrococcus spp; 7 — Enterococcus spp; 8 — Candida spp; 9 — Pseudomonas spp; 10 — Klebsiella spp; 11 — Staphylococcus Aureus; 12 — Bacillus spp

of the intervention, a decrease was seen in the mean score of the Oral Assessment Scale ($p<0.001$), bacterial count ($p<0.001$) and diversity ($p<0.001$) in the oral cavity in the experimental group compared to the pre-intervention period (Table 3).

In this study, different types of microorganisms were identified in the cultures obtained. While the number of patients with bacterial growth mostly decreased or remained constant in the experimental group after the intervention, this number did not change or even increased in the control group. Gramme-positive bacilli, nonhemolytic streptococci, alpha-hemolytic streptococci, coagulase-negative staphylococci, and Neisseria sp. were detected in the oral cavity of the patients. In addition, potentially pathogenic microorganisms such as Micrococcus spp, Enterococcus spp, Candida spp, Pseudomonas spp, Klebsiella spp, Staphylococcus aureus, and Bacillus spp were identified (Figure 2).

Discussion

Stroke patients monitored in intensive care units are at risk for oral cavity infections due to poor oral hygiene, prolonged hospitalization, and inability to feed orally [21,22]. Studies report that various protocols are effective on oral health and intraoral bacterial colonization in intensive care patients. However, no standard guidelines are used for oral care in intensive care units, and the used solutions, tools, and techniques vary [13,23,24]. In the literature, the number of studies on non-ventilated patients is limited [4]. In this study, in which oral care was applied to non-mechanically ventilated stroke patients every 8 hours within the framework of the standardized oral care protocol using chlorhexidine solution, suction toothbrushes and oral care sticks, the effect of standardized oral care on bacterial colonization in the oral mucosa was investigated.

In our study, most patients were male, with secondary school education or lower, and had chronic diseases. Their mean ages were 63.90±17.32 years in the experimental group and 65.33±13.33 years in the control group. Our sample represents the stroke population in sociodemographic terms [25,26]. Over half received oxygen therapy and had Foley and intravenous catheters. Glasgow Coma Scale mean scores were 11.95±1.50 in the experimental group and 11.19±2.38 in the control group. Patients with GCS≤8 typically require mechanical ventilator support [27].

Most patients (>80%) had dysphagia and could not be fed orally. Those with permanent nasogastric tubes due to dysphagia often suffer oral health issues like reduced salivation, dry mouth, and tooth decay [28]. In our study, intraoral problems included ulceration, bleeding, halitosis, and xerostomia.

Studies on oral health in intensive care patients show colonization by Staphylococcus aureus, Gram-negative bacteria, Micrococcus, Klebsiella, Enterococcus, Candida albicans, Pseudomonas, and Acinetobacter species [23,29]. Consistent with the literature, our study's microbiology results revealed similar bacterial species in the oral mucosa.

Inadequate oral hygiene, decayed teeth, periodontal disease, and high oral bacterial count increase the risk of infections, especially aspiration-related ones. Dysphagia exacerbates this issue by limiting oral intake. Stroke patients, prone to oral health issues, benefit from regular oral care. Such practices control bacterial count, alleviate bad breath, enhance mouth comfort, appetite [30], and lower aspiration pneumonia risk [28,31,32].

In our study, oral care was administered every 8 hours using a chlorhexidine solution within the framework of a standardized oral protocol, utilizing suction toothbrushes and oral care swabs. The AHA/ASA stroke guidelines emphasize that chlorhexidine may prevent aspiration pneumonia [2]. Additionally, chlorhexidine inhibits the proliferation of bacteria implicated in periodontal diseases [33]. The use of suction toothbrushes has been shown to maintain oral health in mechanically ventilated patients [17] and reduce the incidence of pneumonia and bacterial colonization [34]. While oral care four times daily is recommended for mechanically ventilated patients, actual practice often reduces this frequency to 2–3 times daily in non-mechanically ventilated patients [4].

In the clinic where the study was carried out, oral care is applied twice a day at irregular intervals. Therefore, the researcher observed that the oral care of non-mechanically ventilated patients was insufficient, and an oral care protocol was developed upon reviewing the literature. After the intervention, a decrease was identified in the bacterial colonization of the oral mucosa of the patients in the experimental group compared to the control group. Tali et al. demonstrated reduced bacterial colonization with regular oral care in mechanically ventilated patients [23]. Fields observed a zero VAP rate within a week of implementing an 8-hourly tooth brushing protocol in neurology ICU patients [35]. Chipps et al. found a near-doubling of bacterial colonization in stroke clinic controls, contrasting with reduced colonization in the intervention group [36]. These findings align with our study, affirming efficiacy of standardized oral care' in decreasing intraoral bacterial colonization [23,35,36].

Furthermore, oral health improved in the experimental group (decreased Oral Assessment Scale score). Applying an oral care protocol three times daily for a week at a stroke rehabilitation center led to reported oral health enhancement, regardless of dysphagia presence [37]. Haghighi et al. observed a significant decrease in Beck

Oral Assessment Scale scores on the fifth day compared to the first day after systematic oral care in the ICU [34]. Another study noted improved oral health in extubated patients over time with a standardized oral care protocol, particularly in the intervention group [13]. Similar findings were reported in prior research [13,34,37].

Limitations of the Study

When interpreting the study results, its limitations should be taken into consideration. The present study was conducted in a single center; therefore, the external validity of our findings may be limited. The small sample and short follow-up due to the transfers to the ward or initiation of MV were the limitations of the study. The absence of an independent evaluator in the study (the researcher who evaluated outcomes also applied oral care) may have influenced the results. Nonetheless, the fact that all assessments were made by a single person may have increased the standardization of the results.

Since the quantification of cultured microorganisms by species was not performed, the changes in the numbers of normal flora and pathogenic microorganisms could not be assessed.

Conclusions

A standardized oral care protocol was applied to the patients in the experimental group, unlike the routine oral care protocol in the intensive care unit where the study was conducted. As a result, a decrease in oral problems assessed with the Oral Assessment Scale and a decrease in bacterial count and diversity in the oral cavity were observed. More research is required on non-mechanically ventilated patients. Since studies show that awareness of the importance of oral care can improve the oral care practices of nurses, in-service training on this subject can be recommended.

Implications for Nursing Practice

The results of this study emphasize the importance of standardizing oral hygiene practices by nurses in intensive care units for stroke patients. A standardized oral care protocol effectively reduces bacterial colonization in the oral mucosa and improves oral health outcomes. Furthermore, regular and frequent oral care can decrease the risk of infections such as aspiration pneumonia and positively impact the overall health status of patients. It is recommended to organize in-service training programs on oral care protocols for stroke patients to enhance nurses' awareness and knowledge on this subject.

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