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Investigation of Pneumonia Rates in Enteral Fed Patients with Two Different Oral Care Methods: Pilot Study in Patients with Acute Stroke

Enteral Beslenen Hastalarda İki Farklı Ağız Bakım Yöntemine Göre Pnömoni Oranlarının Karşılaştırılması: Akut İnmeli Hastalarda Pilot Çalışma

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ABSTRACT

Objective: This study compared the impact of two different oral care methods on the incidence of stroke-associated pneumonia in patients who were fed via nasogastric tube and had no oral intake after a stroke.

Methods: This randomized controlled trial was conducted at the Neurology Intensive Care Unit of Ege University Hospital between August 2020 and April 2021. Different oral care protocols were administered to both groups for seven days. Data were collected using the Patient Information Form, the National Institutes of Health Stroke Scale, the Glasgow Coma Scale, the Bedside Oral Exam and Patient Follow-up Form. Oral care was applied to both the intervention and control groups for seven days, with oral health and saliva pH measured and recorded. The diagnosis of pneumonia was made by the Infectious Diseases unit based on physical examination, blood tests, and chest X-rays.

Results: The difference in the seven-day oral health assessment scores between the intervention and control groups was found to be significant ($P<.05$). While no patients in the intervention group developed pneumonia, 25% of patients in the control group did, with the difference between the groups found to be insignificant ($P<.05$). The difference in oral health assessment scores between patients who developed pneumonia and those who did not was found to be significant ($P<.05$).

Conclusion: It was determined that comprehensive oral care had a significant effect on oral health but did not affect saliva pH or pneumonia rates.

Keywords: Enteral nutrition, oral hygiene, pneumonia, stroke

ÖZ

Amaç: Bu çalışma, inme sonrası nazogastrik tüp ile beslenen ve ağızdan gıda alımı olmayan hastalarda iki farklı ağız bakım yönteminin inme ile ilişkili pnömoni insidansı üzerindeki etkisini karşılaştırmıştır.

Yöntemler: Randomize kontrollü olarak planlanan bu çalışma Ağustos 2020 ile Nisan 2021 arasında Ege Üniversitesi Hastanesi Nöroloji Yoğun Bakım Ünitesinde yürütüldü. Her iki gruba yedi gün boyunca farklı ağız bakım protokolleri uygulandı. Verilerin toplanmasında, Hasta Bilgi Formu, Ulusal Sağlık Enstitüleri İnme Ölçeği, Glasgow Koma Ölçeği, Yatak Başı Ağız Değerlendirme İzlem Formu ve Hasta Takip Formu kullanıldı. Uygulama ve kontrol gruplarına yedi gün boyunca ağız bakımı uygulandı, ağız sağlıkları ve tükürük pH'ı ölçülüp kaydedildi. Pnömoni tanısı fizik muayene, kan testleri ve göğüs röntgenine dayanarak enfeksiyon hastalıkları birimi tarafından konuldu.

Bulgular: Hastaların 7 günlük ağız sağlığı değerlendirme puanlarına göre uygulama ve kontrol grubu arasındaki farkın anlamlı olduğu tespit edildi ($P<,05$). Uygulama grubunda hiçbir hastada pnömoni gelişmezken kontrol grubundaki hastaların %25'inde pnömoni gelişti, gruplar arasındaki fark anlamız bulundu ($P<,05$). Pnömoni gelişen ve gelişmeyen hastaların ağız sağlık değerlendirme puanları arasındaki farkın anlamlı olduğu belirlendi ($P<,05$).

Sonuç: Kapsamlı ağız bakım uygulamasının ağız sağlığı üzerinde anlamlı etkisi olduğu ancak tükürük pH'ını ve pnömoni oranlarını etkilenmediği belirlenmiştir.

Anahtar Kelimeler: Enteral beslenme, oral hijyeni, pnömoni, inme

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INTRODUCTION

A total of 13.7 million people around the globe suffer strokes every year, and 5.5 million people die from the condition, being the second leading cause of death worldwide.[1] In our country, stroke is the second leading cause of death after cardiovascular disease, and the leading cause of permanent disability.[2, 3]

An important cause of death after a stroke is infection, and stroke-associated pneumonia is one of the most common and serious post-stroke infections, leading to mortality after stroke, as well as the need for long-term rehabilitation.[4] The incidence of stroke-associated pneumonia is reported in the range of 1.4–57% in different studies.[5,6]

Stroke can lead to dysfunction of the oropharyngeal region, gastric region and lower esophageal sphincter. For the clinical nutrition of neurology patients, clinical guidelines state that enteral feeding may be given for the first 72 hours after a stroke, and longer than 7 days in the presence of severe dysphagia.[7,8] Studies have reported that 10–44% of patients require nasogastric tube (NGT) feeding after a stroke.[9-12] Although the practice reduces the risk of feeding-related aspiration, the incidence of pneumonia has been found to be much higher in those receiving NGT than in those not receiving NGT.[13-16] This has been attributed to the prolonged presence of NGT being associated with the pathological bacterial colonization of the oropharynx.[17,18]

There have been many recent randomized controlled studies of pneumonia and oral care.[17,19-24] A search for the terms "pneumonia" and "oral care" in the Pubmed database produced 2,681 results for the last decade, although few were identified discussing the prevention of stroke-associated pneumonia in patients receiving NGT feeding and with no oral intake after stroke.[17,19,22,25] The incidence of stroke-associated pneumonia, however, has been reported to be high in patients receiving NGT feeding after stroke.[9,26] There is a need for studies assessing the efficacy of thorough oral care in the prevention of stroke-associated pneumonia. We believe that the contributions of our study to literature include its involvement of patients with no oral intake after stroke, and its examination of the incidence of non-ventilator-associated pneumonia within the first seven days of a stroke.

AIM

Our study aims to establish the difference in the incidence of stroke-associated pneumonia between two different oral care practices among patients receiving NGT feeding after a stroke.

Research questions/hypothesis

- Is there a statistically significant difference in the incidence of stroke-associated pneumonia between two different oral care practices in patients receiving NGT feeding following a stroke?
- Which oral care practice is more effective in reducing the incidence of stroke-associated pneumonia within the first seven days after stroke in patients with NGT feeding.
- What are the other risk factors (e.g., age, sex, stroke severity) that influence the development of pneumonia in patients without oral intake who are receiving NGT feeding?

METHODS

Design and Sample

The study data for this interventional, randomized, controlled, single-blind study were collected from records of the Neurology Intensive Care Unit of Ege University Hospital between August 2020 and April 2021. The effect of two different oral care methods on the oral health assessment scores was used to determine the sample size. Consequently, the study sample comprised 24 patients admitted to the Ege University Faculty of Medicine Hospital Neurology Intensive Care Unit with a diagnosis of acute stroke between August 2020 and 30 April 2021. The power of the sample size was determined statistically by Power Analysis at an 80% confidence interval and 0.5% error (α=0.05, 1-β=0.80). The study inclusion criteria were as follows: age ≥18 years, acute stroke diagnosis, no oral intake, NGT feeding, and the presence of at least one natural or prosthetic tooth. The exclusion criteria, on the other hand, were previous head and neck surgery, pre-stroke dysphagia, lung infection and chronic respiratory disease, being on mechanical ventilation, presence of pulmonary embolism, pulmonary edema, and COVID-19 diagnosis or contact with someone with COVID-19. The patients denoted Group A received the Thorough Oral Care Protocol and Group B received the Wiping Oral Care Protocol. Randomization was stratified by age to ensure homogeneity between the study groups. The researcher divided the patients into four strata according to age (18–29, 30–49, 50–69 and ≥70), and were assigned to groups through a simple randomization approach using a computer-based randomization program (https://www.random.org/). According to the randomization table, patients were assigned to groups starting with Group A. The homogeneity between the groups was maintained through assignments based on age groups. The first patient was assigned to the intervention

group. The randomization sequence was taken into account when assigning patients of a similar age group to the study groups. This study presented detailed information regarding participant inclusion and exclusion in the CONSORT 2010 Flow Diagram (Figure 1). One of the reasons for the decrease in the sample size is the absence of objective and measurable methods for assessing dysphagia after acute stroke in the neurology intensive care unit where the study was conducted. Physician examination was the sole criterion for diagnosing dysphagia. Consequently, in the majority of included patients, swallowing dysfunction improved in the early period following treatment, leading to the discontinuation of enteral nutrition therapy. As a result, 24 patients (66%) were excluded from the study.

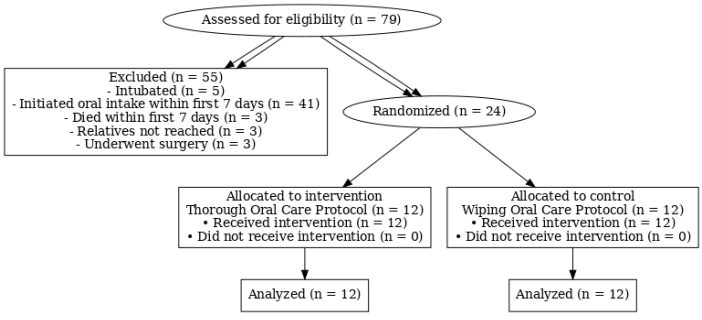

Figure 1. CONSORT Flow Diagram

Measurements

The patient data on age, sex, smoking, and clinical and stroke characteristics were collected using a questionnaire. The state of consciousness and the severity of stroke were determined by a physician based on the Glasgow Coma Scale (GCS) and the National Institutes of Health Stroke Scale (NIHSS) scores, respectively. The oral assessment of the patients was performed by the researcher using the BOE scale. The dysphagia assessment of the patients was performed by the clinic physician through a clinical examination, although no method was used to determine the severity of the dysphagia. Patients with symptoms of pneumonia were reported to the Infectious Diseases unit by the clinic physician. The infectious diseases physician established a diagnosis of pneumonia based on a clinical examination (body temperature, breath sounds) of the patient, blood tests (leukocyte count-WBC, C-reactive protein-CRP) and chest X-ray. The groups of patients were concealed from the infectious diseases physicians, thus blinding the diagnosis of pneumonia.

Glasgow Coma Score (GCS): The Glasgow Coma Score (GCS) is a neurological scale that is commonly used to assess the level of consciousness and neurological functioning in patients, especially those with brain injuries. It provides a standardized and objective way to evaluate the severity of a brain injury and to monitor the patient's condition over time. The GCS assesses three primary areas: eye opening, verbal response, and motor response. Each area is scored, and the scores are then combined to give an overall GCS score. The scores from each category are added together to give a total GCS score, which can range from 3 (indicating the deepest coma) to 15 (indicating full consciousness). The validity and reliability coefficient of the GCS was found to be *P*=0.89 and *P*=.84 in our study.

National Institutes of Health Stroke Scale (NIHSS): The National Institutes of Health Stroke Scale (NIHSS) is a widely used tool for assessing and quantifying the severity of stroke symptoms. The NIHSS consists of a series of 15 neurological assessment items, each of which evaluates a specific aspect of neurological function. These items are designed to assess a wide range of stroke-related impairments, including motor function, level of consciousness, language skills, visual field defects, and sensory deficits. The scoring for each item on the NIHSS is typically based on a scale from 0 to 4 or 0 to 3, depending on the item. A score of 0 indicates no impairment or normal function, while higher scores indicate increasing severity of impairment. Some items may have additional options to capture specific findings. The scores from each item are then summed to give the total NIHSS score, which can range from 0 to 42. The validity and reliability coefficient of the NIHSS was found to be *P*=.69 and *P*=.84 in our study.

Bedside Oral Exam Scale (BOE): The scale developed by Eilers (1988) was revised by Prendergast et al. (2013)[27] to assess the oral health of neurology intensive care patients. The validity and reliability coefficient of the BOE was found to be *P*=.76 and p=81 in our study. The scale consists of eight subheadings related to oral health: swallowing, lips, tongue, saliva, mucous membranes, gums, teeth or dentures, and odor. Each subheading is evaluated visually and numerically, with a score of 1 representing normal (healthy) condition, a score of 2 indicating mild functional impairment, and a score of 3 indicating severe functional impairment. The total score on the BOE scale ranges from 8 to 24, with low scores indicating excellent oral health and high scores indicating poor oral health. The scale is designed as a suitable tool for use by healthcare professionals who are not dentists.

Data Collection

The oral assessment of the patients in both groups was made daily by the researcher using the BOE scale prior to the administration of the oral care protocol. In Group A, the patients were administered oral care by the researcher at least three times a day (at 09.00, 14.00 and 18.00) using the Thorough Oral Care Protocol. In Group B, the patients were

administered oral care by the clinic nurses at least twice a day (at 09.00 and 21.00) using the Wiping Oral Care Protocol. In the Group A patients, oral suction was applied and the entire mouth was wiped using a 0.9% isotonic sodium chloride solution and a sponge swab. The teeth were then brushed using a toothbrush and 0.12% chlorhexidine. After brushing, oral suctioning was performed to clear any residue from the mouth, and moisturizing gel was applied to the lips. In the Group B patients, oral suction was applied, a 0.9% isotonic sodium chloride solution and 0.12% chlorhexidine solution were mixed, and wiping oral care was applied using an langue depressor and gauze. After wiping, oral suction was applied to clear any residue from the mouth, and moisturizing gel was applied to the lips. The oral care protocol took an average of 10 minutes in the Group A and an average of 3 minutes in the Group B patients. Both groups received oral care for seven days and the data were recorded. Blood culture samples were collected from patients with a body temperature above 38 degrees Celsius by resident physicians, while blood samples were obtained by clinical nurses. Blood test results and radiological findings were conveyed by the clinical physician to the infectious disease specialist. Following evaluation and clinical examination, the infectious disease specialist diagnosed pneumonia.

Data Analysis

The statistical analyses of the data were performed using IBM SPSS Statistics (Version 22 Armonk, NY: IBM Corp.). Categorical variables were presented as numbers and percentage distribution. The homogeneity of the control and treatment groups in terms of certain demographic and disease characteristics was presented in cross tables. Furthermore, NIHSS, GCS and BOE scale data and any differences or associations between the groups were analyzed with a Chi-Square Test, a Mann-Whitney U test, a Kruskal-Wallis test, a Wilcoxon Signed-Rank Test and a Spearman's Rank Order Correlation test, which are non-parametric tests, due to the sample size of <30. The power analysis was performed using the G*Power. The results were evaluated at an 80% confidence interval and a significance level of *P*<.05.

Ethical Approval

The study was approved by the Medical Research Ethics Committee of Ege University Faculty of Medicine (Date: 24.06.2020 and Decision No: 20-6.1T/45). In addition, the necessary permissions were obtained from the author of the Bedside Oral Exam (BOE) scale. The purpose of the study was explained to the conscious patients and to the relatives of those who were unconscious, and verbal and written consents were obtained. This study was performed in compliance with the Declaration of Helsinki.

RESULTS

Patient Characteristics

The mean age of the patients was 63.58±12.80 (min-max: 42–85) years. Of the 24 patients, 13 were female and 11 were male. Of the 36 patients initially assigned to Group A, two were excluded due to intubation before completing the 7-day study protocol, 20 patients due to the initiation of oral intake, one patient due to death and one patient due to surgery. Group A was completed with 12 patients. Of the 43 patients initially assigned to Group B, three were excluded due to intubation during the procedure, 24 due to the initiation of oral intake, two due to death and two due to surgery. Thus, Group B was also completed with 12 patients. The distribution by age, gender, chronic disease, type of stroke, type of teeth and oxygen therapy was homogeneous among the patients in the control and treatment groups. The two groups of patients did not differ in terms of mean age, GCS score, NIHSS score or BOE score on Day 1, and the distribution was homogeneous (Table 1).

Oral Health Scores

The BOE score on Day 1 was 12.33±1.43 in the treatment group and 12.25±1.14 in the control group, and there was no statistically significant difference between the groups (*P*<.05) (Table 1).

Table 1. Comparison of Treatment and Control Group Patients According to Some Variables

Variables	Treatment group X̄±SD	min-max	Control group X̄±SD	min-max	Test Statistics* P-value
Mean age	63.00±12.43	43-85	64.08±13.72	43-85	.433
GCS	10.42±2.53	7-15	12.00±1.75	8-14	.665 1.666
NIHSS	11.67±3.25	7-17	9.17±3.61	4-14	.096 1.655
Mean BOE at Day 1	12.33±1.43	10-16	12.25±1.14	10-14	.098 -.271 .786

*Mann-Whitney U Test; NIHSS, National Institutes of Health Stroke Scale; GCS, Glasgow Coma Scale; BOE, Bedside Oral Exam Scale; X̄, Mean; SD, Standard Deviation

The BOE score on Day 7 was 10.42±0.79 in the treatment group and 15.17±2.44 in the control group, with a statistically significant difference between the groups *P*<.05 (Table 2).

In the treatment group, the BOE score decreased after seven days of oral care administration, and the difference in the BOE score between Day 1 and Day 7 was statistically significant (*P*<.05) (Table 3). In the control group, the BOE score increased after seven days of oral care administration, and the difference in the BOE score between Day 1 and Day 7 was statistically significant (*P*<.05) (Table 3).

Table 2. Comparison of Seven-Day BOE Scale Scores of Patients in the Treatment and Control Groups

Groups	X̄±SD	Z	Test Statistics* *P*-value
BOE at Day 1			
Treatment Group	12.33±1.43	8.4	-0.271
Control Group	12.25±1.14	14.1	.786
BOE at Day 2			
Treatment Group	11.58±1.68	8.9	-2.542
Control Group	13.08±1.44	16.1	**.011**
BOE at Day 3			
Treatment Group	11.0±1.28	7.2	-3.753
Control Group	14.42±1.56	17.8	**<.001**
BOE at Day 4			
Treatment Group	10.83±1.34	7	- 3.910
Control Group	15.08±1.68	18	**<.001**
BOE at Day 5			
Treatment Group	10.67±1.3	6.7	- 4.070
Control Group	15.58±1.9	18.3	**<.001**
BOE at Day 6			
Treatment Group	10.50±1.00	6.7	- 4.059
Control Group	15.50±2.40	18.3	**<.001**
BOE at Day 7			
Treatment Group	10.42±0.79	6.6	-4.125
Control Group	15.17±2.44	18.4	**<.001**

*Z, Mann-Whitney U Test; BOE, Bedside Oral Exam Scale; X̄, Mean; SD, Standard Deviation.

Table 3. Comparison of BOE Scores of Treatment and Control Group Patients between Day 1 and Day 7

Groups	BOE at Day 1		BOE at Day 7		Test Statistics*
	Z	X̄±SD	Z	X̄±SD	*P*-value
Treatment Group	.00	12.33±1.43	6.00	10.42±0.79	-2.965 **.003**
Control Group	6.00	12.25±1.14	0.00	15.17±2.44	-2.944 **.003**

*Wilcoxon Signed-Rank Test; BOE, Bedside Oral Exam Scale; X̄, Mean; SD, Standard Deviation

In addition, the BOE scores on Days 2, 3, 4, 4, 6 and 7 were higher in the control group than in the treatment group, and the difference was statistically significant (*P*<.05) (Table 2). There was no statistically significant difference in the pH saliva of the patients in the groups across the 7 days (*P*<.05) (Table 4).

Clinical Outcomes

There was no statistically significant difference in the incidence of pneumonia between the treatment and control groups (*P*>.05), and the pneumonia incidence did not differ by age groups, gender, chronic disease, smoking or stroke type (*P*>.05). The BOE score, however, was higher and statistically significantly different in those who developed pneumonia than in those who did not develop pneumonia (*P*<.05) (Table 5).

In addition to statistical analyses, effect size values were also calculated to determine clinical significance in the study. In this context, effect size was calculated based on the scores obtained from oral health assessments. As a result of this calculation, Cohen's d was found to be 2.62. A value of 0.8 or higher indicates a high effect size. In other words, there is a difference between the effects of the two different oral care interventions on oral health scores. This difference is clinically significant because the detailed oral care intervention applied in the experimental group led to a significantly greater reduction in oral health assessment scores compared to the oral care intervention in the control group. This finding suggests that the implemented protocol positively influenced oral health. Additionally, the fact that pneumonia did not develop in patients with better oral health in the experimental group, whereas pneumonia occurred in patients with poorer oral health in the control group, is an important finding for clinical significance.

Table 4. Comparison of the 7-Day Salivary pH Values between Treatment and Control Group Patients

Groups	n	X̄±SD	Z	Test Statistics* *P*-value
pH at Day 1				
Treatment Group	12	6.33±0.51	6.33	-0.471
Control Group	12	6.20±0.44	5.60	.637
pH at Day 2				
Treatment Group	12	6.20±0.44	4.80	-0.775
Control Group	12	6.00±0.0	4.00	.439
pH at Day 3				
Treatment Group	12	6.00±0.0	2.5	- 0.816
Control Group	12	6.33±0.57	3.33	.414
pH at Day 4				
Treatment Group	12	6.25±0.50	6.38	- 0.423
Control Group	12	6.14±0.37	5.79	.673
pH at Day 5				
Treatment Group	12	6.00±0.00	4.00	- 1.00
Control Group	12	6.25±0.50	5.00	.317
pH at Day 6				
Treatment Group	12	6.00±0.00	2.50	0.00
Control Group	12	6.00±0.00	2.50	1.00
pH at Day 7				
Treatment Group	12	6.25±0.46	5.75	- 0.750
Control Group	12	6.00±0.00	4.50	.453

*Z, Mann-Whitney U Test; X̄, Mean; SD, Standard Deviation

Table 5. Analysis of the BOE Scores at Day 7 according to Pneumonia Diagnosis among Patients

Pneumonia diagnosis	Treatment group		Control group		Total	
	n	Z	n	Z	n	Z
Yes	0	-	3	11	3	23
No	12	6.50	9	5	21	11
BOE at Day 7 (X̄±SD)	10.42±0.79		15.17±2.44			
Test Statistic*	-		-2.541		2.787	
***P*-value**			**.011**		**.005**	

*Mann-Whitney U Test; Z, mean rank; X̄, Mean; SD, Standard Deviation

To further determine clinical significance, the effect size value was also calculated based on oral pH scores. As a result of this calculation, Cohen's d was found to be .75. A value between 0.5 and 0.8 indicates a moderate effect size. In other words, there is a difference between the effects of the two different oral care interventions on oral pH scores. However, the effect size of this difference is moderate. This difference is clinically significant because the detailed oral care intervention applied in the experimental group resulted in a significant increase in oral pH scores compared to the oral care intervention in the control group. This finding suggests that the oral care protocol applied to the experimental group positively influenced oral pH levels.

DISCUSSION

Oral health in acute stroke patients fed NGT

The oral intake of stroke patients is mostly restricted due to the changes in consciousness and dysphagia that develop in the early post-stroke period, when the nutritional and hydration needs of the patients can be provided via NGT. NGT feeding is the most common practice for the prevention of aspiration pneumonia in patients with dysphagia.[7,8] Previous studies have reported that 10–44% of patients receive NGT feeding after stroke.[1,9,10,12] Although its use has been identified as a risk factor for respiratory tract infections. Prolonged NGT has been said to increase the risk of bacterial colonization of the oropharynx, and to increase the risk of oral pathogens by reducing the ratio of stimulated salivary flow to basal levels.[18] In this regard, oral care is important in this patient group, although a review of literature suggests that the significance of oral care of patients with no oral intake who receive NGT feeding after stroke has been largely ignored.

The findings of our study indicate that the oral health of patients in the intervention group was better compared to the control group. Furthermore, the effect size values suggest that the findings are clinically significant. This supports that the protocol implemented in our study positively impacted oral health and provided clinical benefits. Studies supporting our research findings have been identified in the literature. A multicenter randomized clinical trial demonstrated that two different oral health promotion programs (traditional methods and intensive methods) were effective in reducing dental plaque in hospitalized stroke patients.[19] One of the factors contributing to this positive effect is the use of chlorhexidine. Studies conducted with stroke patients indicate that the combined application of chlorhexidine and toothbrushing is one of the most common practices. Chlorhexidine has been shown to be effective in reducing cariogenic organisms and pathogens that cause periodontal diseases, preventing gingival bleeding, and controlling dental plaque.[20,21] An expert panel emphasized that oral hygiene protocols for patients with dysphagia after a stroke should include brushing the teeth and oral mucosa, moisturizing the mouth, and protecting the oral tissues (lips and mucosa). In cases of severe dysphagia, it is recommended that the oral cavity be cleaned twice daily with an antiseptic solution containing 0.12% chlorhexidine.[20] The findings of our study also support the importance of chlorhexidine use in maintaining oral hygiene after a stroke. Another crucial factor contributing to the effectiveness of the oral care protocol in our study is toothbrushing. Toothbrushing positively impacts oral health by reducing plaque and gingival bleeding indices.[22,23] Guidelines recommend brushing the teeth and oral mucosa in individuals with reduced salivary flow and those who do not consume food orally.[24,25] One of the reasons for the clinical significance of our study results may be the frequency of oral care. The literature states that stroke patients, particularly those with swallowing difficulties or those fed via tube, should receive oral care at least twice daily. It is also emphasized that this frequency should be increased based on the patient's needs.[19,26] General oral health guidelines for the population recommend brushing teeth twice a day and using mouthwash.[27] However, findings indicate that individuals with swallowing difficulties and those who do not consume food orally have poorer oral health compared to healthy individuals.[26,28] This particular patient group, who often requires assistance with daily oral care, should receive more comprehensive and intensive oral interventions.[29] In a multicenter randomized clinical trial, Malik et al.[16] demonstrated that two different oral health promotion programs (traditional methods and intensive methods) were effective in reducing dental plaque in hospitalized stroke patients. Another study highlighted that, in individuals with brain injury, performing oral care twice daily alongside the free water protocol was an effective intervention for preventing aspiration pneumonia.[26] Moreover, studies have reported improvements in swallowing-related outcomes following intensive oral health interventions.[29,30] Another study found a positive correlation between improvements in oral health status and enhancements in daily living activities and swallowing function during the rehabilitation process.[31] Stroke patients are at high risk for inadequate oral hygiene, which can negatively affect overall health, communication, nutrition, and quality of life.[32] Maintaining oral hygiene in post-stroke patients with swallowing difficulties helps prevent complications, enhances oral

comfort, reduces bad breath, prevents difficulties in eating, pain, and discomfort, and decreases dental plaque formation and gingival bleeding. Additionally, good oral hygiene can stimulate appetite, contribute to adequate nutritional intake, and shorten the duration of nasogastric tube use.[29] However, evidence on oral care programs specifically designed for stroke patients remains limited.

Oral Ph value in patients without oral intake

Salivary pH is not only an important parameter for oral health but also a significant factor in the development of periodontal diseases.[33] Most oral bacteria thrive best at a neutral pH (pH 7). Generally, the pH of the oral cavity remains between 6.75 and 7.25 due to the buffering activity of saliva. In individuals without oral intake, the salivary flow rate decreases, leading to a reduction in salivary pH. This condition diminishes the bacteriostatic and bactericidal effects of saliva on bacteria. Aspiration pneumonia is a major complication of oropharyngeal dysphagia, resulting from the aspiration of oropharyngeal secretions and leading to an infectious process.[22] Poor oral hygiene increases bacterial colonization in saliva, thereby elevating the risk of bacterial pneumonia following aspiration. Although saliva contains antimicrobial components that help maintain microbiome balance, reduced salivary clearance in oropharyngeal dysphagia can lead to the proliferation of oral pathogens and deterioration of oral health.[23] While previous studies have reported that oral care with chlorhexidine increases salivary pH, our study found no statistically significant difference in salivary pH following the oral care intervention protocol. However, when the clinical effect size was calculated, it was determined that the intervention had a moderate effect compared to the control group and increased pH levels. One of the reasons why the desired effect was not achieved after the oral care protocol may be related to the patients' lack of oral intake. Additionally, in our study, the oral care intervention was applied for only seven days, which may be considered a short-term period and insufficient to achieve the desired effect. In this regard, further studies with control groups and longer intervention durations are needed.

The incidence of stroke-associated pneumonia and oral care

Many studies have reported that NGT following a stroke can increase the risk of aspiration pneumonia. The incidence of pneumonia in patients receiving NGT feeding after a stroke have been reported as 39.2% by Langdon et al.[34], 44% by Dziewas et al.[10], 38% by Brogan et al.[9], 14.4% Kalra et al.[14] and 38% by Brogan et al.[13] There have also been studies reporting NGT feeding to be beneficial in patients with acute stroke, but the effect to be decreased by prolonged use.[35] Wagner et al.[36], Murray and Scholten[37] and Lam et al.[22] all report systematic oral care to positively affect the prevention of pneumonia development in stroke patients. In the present study, no pneumonia developed in the patient group who received thorough oral care, whereas pneumonia developed in the patient group who received wiping oral care, although the difference was statistically insignificant. The studies by Maeda and Akagi[17], and Sorensen et al.[16], which are quite similar to the present study, reported no pneumonia development in the treatment group, and attributed this positive effect to the reduction in the rate of stroke-associated pneumonia due to thorough oral care with chlorhexidine.[22,35-38,] The effectiveness of oral care interventions in preventing aspiration pneumonia has been supported by numerous studies. One of the reasons for this positive effect is the prevention of pathogen growth in the oral flora, as many studies have indicated that pneumonia-causing pathogens are of oral origin. Another reason for this positive effect is the significant association between the use of chlorhexidine in oral care and the reduction in pneumonia incidence.[24-26] Another contributing factor is the comprehensiveness of the oral care intervention. It has been reported that implementing a comprehensive oral care program for stroke patients reduces hospital-acquired pneumonia rates.[27] Furthermore, intensified oral hygiene practices have been found to significantly reduce the incidence of aspiration pneumonia in elderly individuals.[28] Moreover, maintaining optimal oral health care has been shown to reduce the risk of aspiration pneumonia in stroke patients, and a systematic review has determined that oral care interventions slow the progression of respiratory diseases among high-risk elderly individuals residing in nursing homes.[29] These findings confirm the relationship between aspiration pneumonia, respiratory diseases, and good oral health and hygiene.[20] In our study, when comparing oral health status between groups that developed pneumonia and those that did not, our results were found to be consistent with the literature. In other words, pneumonia incidence was higher in patients with poor oral health compared to those with better oral health, and this finding was clinically significant. However, in our study, the effect of oral care intervention on reducing pneumonia incidence was not found to be statistically significant. We believe that one of the reasons for this may be the sample size. It is suggested that oral hygiene interventions play a crucial role in preventing pneumonia, not only by maintaining oral health and hygiene but also due to their effects on swallowing function. Several cross-sectional studies have reported a relationship between poor oral health and reduced swallowing function.[24]

Additionally, a single-center cohort study emphasized that poor oral health is a limiting factor in the improvement of swallowing function in elderly stroke patients.[30] Some studies have reported that comprehensive oral care interventions have positive effects on swallowing-related outcomes.[20] Moreover, an improvement in swallowing function has been found to have a positive correlation with patient comfort and daily living activities. A reduction in salivary flow can lead to dry mouth, which negatively affects swallowing function. Through intensive oral care interventions, oral moisture can be maintained, and salivary flow can be stimulated, thereby potentially exerting a positive effect on swallowing function. However, although the relationship between poor oral health and swallowing function in elderly patients has been reported, the generalizability of existing studies is limited due to their cross-sectional or single-center nature.[31] In our study, no improvement in patients' swallowing function was reported. Some studies examining the impact of oral care interventions on preventing aspiration pneumonia have also highlighted the importance of the intervention duration. Some of these studies have emphasized that oral care interventions conducted for up to three weeks are insufficient for preventing pneumonia, as this period is considered too short.[32] In contrast, other studies have reported no association between an increased duration of oral care interventions and aspiration pneumonia incidence.[32] In our study, the oral care intervention was applied for seven days in both groups. The primary reason for this duration was that the first seven days after a stroke pose a high risk for stroke-related pneumonia. However, high-quality studies are needed to determine the effect of oral care intervention duration on aspiration pneumonia. Based on this finding, we can conclude that poor oral health is a risk factor for pneumonia development in post-stroke patients who do not have oral intake and are fed via NGT.

Limitations

This study has a number of limitations. First, dysphagia in the patients was determined only by the physician through clinical examination, and so it is not known whether there was any difference in the severity of dysphagia between patient groups. The oral health of the patients in both the treatment and control groups was assessed by the researcher using the BOE scale, which is open to bias. In addition, the odor subscale of the BOE scale used to assess oral health and hygiene could not be evaluated due to the COVID-19 social distancing rules, and so all patients were assigned 2 points in the odor subscale, indicating moderate dysfunction. Due to having at least one tooth as a study inclusion criterion, many older adults could not be included in the study, and this affected the mean age. Due to the multifactorial nature of pneumonia, it was difficult to identify the cause of pneumonia during diagnosis. Another limitation of the study relates to the potential differences in the wiping approaches of different nurses in the control group.

This study examining the difference in the efficacy between two different oral care protocols in patients with no oral intake who received NGT feeding after stroke revealed thorough oral care using a standard protocol and a toothbrush to be a more effective approach than a wiping protocol. This approach was also determined to be clinically significant based on the effect size calculation. That said, incidence of pneumonia did not differ between the two oral care protocols. As another important finding of our study, oral health was found to be poorer in patients who developed pneumonia than in those who did not develop pneumonia. This finding was also found to be clinically significant. In other words, it can be concluded that poor oral hygiene and poor oral health are risk factors for pneumonia development in patients receiving NGT feeding with no oral intake after stroke.

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Bilgilendirilmiş Onam: Araştırmaya dahil edilen hasta ve yakınları çalışma hakında bilgilendirildikten sonra sözlü ve yazılı onamları alınmıştır.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir- AYI; Tasarım- AYI, İE; Denetleme- AYI, İE, HŞ, AG; Kaynaklar- AYI; Veri Toplanması ve/veya İşlemesi- AYI; Analiz ve/ veya Yorum- AYI, İE, HŞ, AG; Literatür Taraması- AYI, İE; Yazıyı Yazan- AYI, İE; Eleştirel İnceleme- AYI, İE, HŞ, AG
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Informed Consent: The patients included in the study and their relatives were informed about the study, and both verbal and written informed consent were obtained
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