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Effectiveness of Specialized Oral Care for Post-acute Stroke Patients

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ORIGINAL ARTICLE

Effectiveness of Specialized Oral Care for Post-acute Stroke Patients

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Abstract

Background: **Poor oral health is a common problem in stroke patients. In Taiwan, there are professional oral care processes for patients with special needs such as stroke patients, which are guided by dental hygienists. This study sought to investigate the effectiveness of specialized oral care for hospitalized stroke patients.**

Methods: **This prospective study was conducted in the Rehabilitation ward at the Taipei City Hospital. Sixty-six patients were randomly divided into two groups. The specialized oral care group (n = 34) was guided by dental hygienists. The control group (n = 32) received only routine oral care. The oral health outcome measure was the Oral Health Assessment Tool (OHAT) score, on admission (T0), one-week (T1), two-week (T2), three-week (T3), and four-week follow-up (T4).**

Results: **Both groups showed significant improvements in OHAT after the intervention over time. In the specialized oral care group, the improvement was greater than that in the control group.**

Conclusions: **The specialized oral care provided by dental hygienists is more effective than the usual oral care for the oral health of stroke patients. Incorporating dental hygienists into the care team enhances the comprehensiveness of stroke-integrated care.**

Keywords: Stroke, Oral health, Specialized oral care, Dental hygienist, Integrated care

1. Introduction

Globally, stroke ranks as the third highest cause of disability.[1] The Global Burden of Disease Study (GBD) reveals that stroke's prevalence in 2019 was 1240 per 100,000 people, with approximately 410,000 stroke cases reported in Taiwan.[2] Stroke patients may encounter various symptoms, including paralysis, poor balance, difficulty in swallowing, cognitive, and sensory impairment. These difficulties can lead to reduced oral care abilities and make seeking medical care more challenging.[3] As a result,

stroke patients commonly face oral health-related issues, such as missing teeth, periodontal disease, and dental caries. Research reveals that stroke patients exhibit significantly worse oral health behaviors and status compared to healthy controls.[4,5]

In cases of stroke, approximately 51−55% of stroke patients experience dysphagia.[6] Poor oral hygiene and dysphagia affect each other reciprocally. When combined with dysphagia, the capacity to clear food residues from the mouth is compromised, leading to an increase in the number of pathogenic bacteria in the oral cavity and

consequently poorer oral hygiene. Poor oral health can lead to dental caries, periodontal disease, stomatitis, tooth loss, and pain, further worsening swallowing function. Additionally, poor oral hygiene and dysphagia can lead to dehydration, malnutrition, and other serious systemic health issues, thereby increasing the risk of pneumonia and mortality.[7] Growing evidence supports the link between periodontal disease and chronic conditions such as diabetes, heart disease, and stroke.[8−10] Maintaining proper oral hygiene is integral to one's overall health and well-being.

Good oral health reduces the incidence of pneumonia, contributes to the overall health of stroke patients, and improves the prognosis of stroke.[11−13] Previous studies have shown that oral care programs are effective in improving oral health and preventing complications in stroke patients, as well as helping stroke patients with dysphagia to maintain their oral intake.[14−16]

While it is widely recognized that oral care is crucial for stroke patients, it often goes unaddressed due to a lack of awareness and concern about oral health among healthcare professionals. The process of providing oral care to stroke patients is both costly and time-consuming, and many team members are hesitant to do so due to their uncertainty and lack of necessary skills to properly care for this unique population's oral health.[17]

In summary, due to physiological, cognitive, and psychological changes in the population affected by stroke, conventional methods of oral hygiene are no longer suitable. A comprehensive understanding of oral anatomy, physiology, and pathology is necessary to provide appropriate oral care. In some cases, uncommon oral care tools may be required, such as mouth-opening devices or moisturizing mouthwash, to achieve optimal oral health maintenance.

In Taiwan, there are educational and training programs for oral care for people with special needs. There are dental hygienists who have received professional training in oral anatomy, physiology, pathology, health psychology, and oral care for people with special needs. They specialize in providing tailored oral care for individuals with special needs, which includes selecting and adjusting oral care tools, employing appropriate oral care methods, and administering extraoral and intraoral relaxation massages, as well as desensitization techniques. The duties of a dental hygienist primarily involve oral health education, patient oral care, and assistance in dental procedures. In terms of oral health education and patient oral care, dental hygienists can provide appropriate counseling and guidance on care techniques to special populations, including oral cancer patients, diabetes patients, dementia patients, stroke patients, pregnant women, developmentally delayed children, and patients in palliative care wards.

Much of the literature has examined the oral hygiene of stroke patients and discussed the problems encountered in the clinical practice of oral care. At the same time, most of the literature focuses on the nursing staff as the primary implementers of oral care. However, the nursing staff usually work in stressful environments, and other clinical care tasks are even more urgent and burdensome, which often results in a lack of provision of oral care.[18]

Currently, there is a lack of standardized oral care programs tailored to meet the unique needs of hospitalized stroke patients. While education and training are important, addressing the shortage of personnel and fostering teamwork is equally crucial. Some Japanese studies have shown that when dental hygienists provide oral health care to patients in rehabilitation wards, it leads to improved oral hygiene, swallowing function, nutritional status, activities of daily living, and even home discharge and mortality rates. Therefore, having a dedicated dental hygienist on staff in the rehabilitation unit could potentially enhance the rehabilitation outcomes of patients.[19,20] National Clinical Guideline for Stroke, 2023 edition suggests that oral care should be provided by an interdisciplinary team and that education and training should be increased; however, there is a lack of published information about the effectiveness of care programs that address the special needs of stroke patients.

We consider that interprofessional oral health collaboration between the medical and dental professions is essential. If dental hygienists can join the interprofessional teamwork in stroke care, oral health training courses for team members, patients, and

caregivers can be conducted by dental hygienists to solve the implementation barriers such as the lack of knowledge of care for special populations and excessive clinical burden. The research hypothesis of this study is that stroke patients who receive specialized oral care from dental hygienists will have better oral health outcomes than those who receive routine oral care.

2. Materials and methods

2.1. Design

This prospective, randomized, controlled single-blind trial examined the effect of specialized oral care on stroke survivor's oral health and was conducted between October 2022 and May 2023, in Taipei City Hospital rehabilitation units in Taiwan. Individuals who had experienced a stroke and were admitted for rehabilitation within six months of its onset were invited to this study. Additionally, participants needed to be able to communicate in Chinese (Mandarin or Taiwanese) and express a willingness to take part in the research. The exclusion criteria were age less than 20 years old; known ongoing acute infections, e.g., pneumonia, wound inflammation, bedsores, etc.; unstable conditions, e.g., cardiac/renal failure, gastrointestinal bleeding, acute coronary embolism, pulmonary embolism, deep vein thrombosis, acute mental illness, etc.; patients and caregivers are unable to cooperate in the performance of oral care. Sixty-six patients were randomly divided into two groups. The specialized oral care group (n = 34) was guided by the dental hygienist. The control group (n = 32) received only routine oral care. The oral health outcome measure was the Oral Health Assessment Tool (OHAT) scale. The OHAT evaluates eight categories, including the condition of the lips, tongue, gums, and mucous membranes, as well as the assessment of saliva, residual teeth, dentures, and the presence of dental pain and oral cleanliness. Each category in the OHAT is scored on a scale of 0−2 points, leading to a total score ranging from 0 to 16 points. Change is 1 point; abnormality is 2 points. Higher scores indicate a deterioration in oral health.[21] Fig. 1 shows the flow diagram for the assessment of the OHAT conducted on admission (T0), 1-week follow-up (T1), 2-week follow-up (T2), 3-week follow-up (T3), and 4-week follow-up (T4).

Approval for this trial was obtained from the Taipei City Hospital Research Ethics Committee (IRB no: TCHIRB-11107007-E-F).

2.2. Intervention

Oral care was performed by patients and caregivers. Control group patients were guided and assisted by the nurse. Specialized oral care group patients were guided and assisted by the dental hygienist.

Patients in the control group received the usual oral care and were educated by a trained nurse. The education session took place in the rehabilitation ward under the guidance of a supervising nurse. The instruction covered various aspects of oral hygiene, including tool selection for cleaning, proper tooth brushing techniques, caring for soft tissues in the mouth, and the correct methods for wearing and cleaning dentures.[22] When it comes to oral hygiene, it's crucial to select the appropriate tools for different areas. For cleaning teeth, a toothbrush is indispensable, while softer tissues require the use of cotton swabs or gauze. It's important to educate individuals on the proper technique for brushing teeth, such as the Bass method, and emphasize the importance of using dental floss daily. Cleaning teeth at least once in the morning and once in the evening is essential for maintaining oral health. If bleeding occurs during cleaning, it's crucial to persist with thorough cleaning to alleviate inflammation. In severe cases, referral to a dentist may be necessary. Additionally, encouraging frequent small sips of water intake and applying Vaseline or lip balm to keep the mouth and lips moist can help maintain oral comfort. Proper denture wearing and cleaning techniques should also be taught to ensure oral hygiene is maintained effectively.

The usual oral care described above was administered to both the control group and the specialized oral care group equally. The specialized oral care group, however, received additional attention as follows:

Oral care instruction is conducted by a dental hygienist. Prior to commencement, it is essential to inform the patient and their
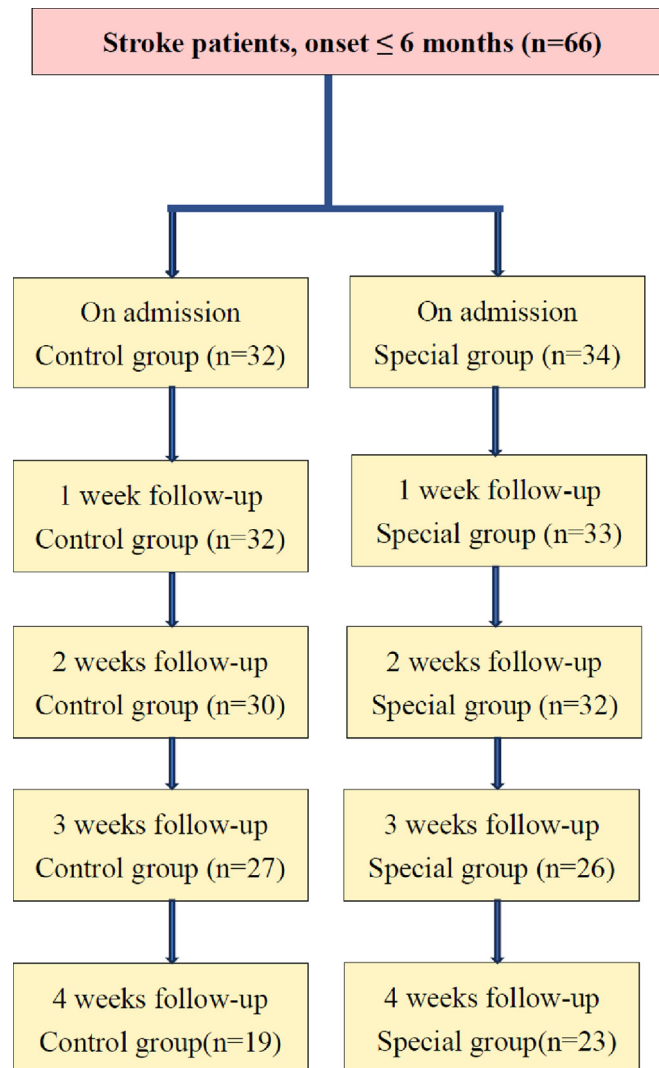
Fig. 1. The flow diagram for this study.

family about the oral care procedure and to provide updates before each step, allowing the patient to mentally prepare. Oral massage and desensitization cleaning techniques, both externally and internally, are employed to reduce stress and facilitate smoother oral care, particularly for patients who may not be able to cooperate fully or are overly sensitive. Addressing limb and swallowing difficulties resulting from strokes, appropriate oral care aids are selected and customized, such as toothbrushes with broader handles for better grip, notched cups to prevent excessive tilting of the head, and mouth-opening devices to increase access for cleaning. Moreover, positioning adjustments, such as elevating the bedhead by 30−45° for bedridden patients and turning the head towards the healthier side, are made to enhance the convenience and safety of oral care. Encouragement is provided appropriately through gestures, movements, and positive reinforcement to both reassure the patient and boost the confidence of caregivers.

2.3. Statistical analysis

Statistical analyses were conducted using SPSS Version 24.0. The baseline data for the specialized oral care group and the control group were compared using the chi-square test for categorical variables and the t-test for differences between groups. Paired sample t-test was used to confirm the within-group changes in the oral health

status of the two groups after the intervention. We employed generalized estimating equations (GEE) for inferential analysis of repeated measures to examine the effectiveness of the interventions in improving oral health status compared to the control group.

3. Results

Demographic, clinical, and stroke characteristics of the participants on admission included in this analysis are listed in Table 1, and four-week follow-up data are listed in Table 2. During this study, we lost some patients' follow-ups due to discharge or COVID-19 infection during admission. There was no significant difference in basic characteristics between the two groups on admission and four-week follow-up (Even if we lost some patients during this study, the comparability between the two groups was not affected).

A total of 66 hospitalized stroke patients were recruited, 59% were male, the average age was 65.88 years old, 55% were ≥65 years old, 58% were ischemic stroke, and 42% were hemorrhagic stroke. The average post-stroke time of the cases on admission day was 55.82 days, and 50% of the cases had post-stroke time ≤30 days. 42% of the patients had dentures, 30% had nasogastric tubes, 47% had swallowing disorders, and 48% of stroke patients required caregivers to assist or perform oral care. All recruited cases had OHAT scores ≥1 at the initial assessment (all had changes or abnormalities in oral health assessment categories). The mean value of the initial OHAT was 4.64.

If all patients were further divided into two groups, those with dysphagia (n = 31) and those without dysphagia (n = 35), it was found that patients with dysphagia had a significantly higher OHAT score (p < 0.001), which indicated that patients with dysphagia had a worse oral health status, as shown in Table 3.

Fig. 2 shows the change in OHAT scores for the two groups from the initial evaluation to the 4-week follow-up. At T0, T1, T2,

Table 1. Baseline characteristics of the specialized oral care and control groups on admission.

Variable	Total n = 66 (%)	Control group n = 32 (%)	Special group n = 34 (%)>	p-value
Sex				0.585
Male	39 (59%)	20 (62%)	19 (56%)	
Female	27 (41%)	12 (38%)	15 (44%)	
Age				0.852
Average	65.88	65.56	66.18	
≥65	36 (55%)	18 (56%)	18 (53%)	
<65	30 (45%)	14 (44%)	16 (47%)	
Stroke type				0.774
Ischemic	38 (58%)	19 (59%)	19 (56%)	
Hemorrhagic	28 (42%)	13 (41%)	15 (44%)	
Stroke location				0.431
Left	28 (42%)	14 (44%)	14 (41%)	
Right	28 (42%)	15 (47%)	13 (38%)	
Bilateral	10 (15%)	3 (9%)	7 (21%)	
Time post-stroke				0.153
Average (day)	55.82	64.84	47.32	
≤30 days	33 (50%)	15 (47%)	18 (53%)	
Dentures				0.716
Removable	18 (27%)	8 (25%)	10 (29%)	
Fixed	10 (15%)	4 (13%)	6 (18%)	
No	38 (58%)	20 (62%)	18 (53%)	
Oral care				0.455
Self care	34 (52%)	18 (56%)	16 (47%)	
Caregiver	32 (48%)	14 (44%)	18 (53%)	
Nasogastric tube				0.363
Yes	20 (30%)	8 (25%)	12 (35%)	
No	46 (70%)	24 (75%)	22 (65%)	
Dysphagia				0.135
Yes	31 (47%)	12 (38%)	19 (56%)	
No	35 (53%)	20 (62%)	15 (44%)	

Table 2. Baseline characteristics of the specialized oral care and control groups on four-week follow-up.

Variable	Total n = 42 (%)	Control group n = 19 (%)	Special group n = 23 (%)	p-value
Sex				0.480
Male	23 (55%)	12 (63%)	11 (48%)	
Female	19 (45%)	7 (37%)	12 (52%)	
Age				0.101
Average	66.48	62.89	69.43	
≥65	23 (55%)	9 (47%)	14 (61%)	
<65	19 (45%)	10 (53%)	9 (39%)	
Stroke type				0.711
Ischemic	23 (55%)	11 (58%)	12 (52%)	
Hemorrhagic	19 (45%)	8 (42%)	11 (48%)	
Stroke location				0.429
Left	17 (40%)	9 (47%)	8 (35%)	
Right	20 (48%)	9 (47%)	11 (48%)	
Bilateral	5 (12%)	1 (6%)	4 (17%)	
Time post-stroke				0.079
Average (day)	57.36	73.05	44.39	
≤30 days	17 (40%)	6 (32%)	11 (48%)	
Dentures				0.507
Removable	10 (24%)	4 (21%)	6 (26%)	
Fixed	7 (17%)	2 (11%)	5 (22%)	
No	25 (59%)	13 (68%)	12 (52%)	
Oral care				0.073
Self care	18 (43%)	11 (58%)	7 (30%)	
Caregiver	24 (57%)	8 (42%)	16 (70%)	
Nasogastric tube				0.696
Yes	8 (19%)	3 (16%)	5 (22%)	
No	34 (81%)	16 (84%)	18 (78%)	
Dysphagia				0.073
Yes	24 (57%)	8 (42%)	16 (70%)	
No	18 (43%)	11 (58%)	7 (30%)	

Table 3. OHAT scores on admission (T0) for patients with or without dysphagia.

	Initial OHAT Mean (SD)	p-value
Without dysphagia (n = 35)	3.57 (2.417)	<0.001
With dysphagia (n = 31)	5.84 (2.131)	

T3, and T4, the mean OHAT values in the specialized oral care group were 5.06 (SD = 2.77), 2.97 (SD = 2.22), 2.69 (SD = 1.99), 2.50 (SD = 2.14), and 2.48 (SD = 1.99), respectively. At the same time points, the average scores in the control group were 4.19 (SD = 2.22), 3.44 (SD = 2.06), 3.43 (SD = 2.06), 3.11 (SD = 2.21), and 2.74 (SD = 1.94), respectively. In the specialized oral care group, the mean OHAT decreased from T0 to T4 by 2.58 points compared to a decrease of 1.45 points in the control group. Paired sample t-test analysis showed significant improvement in the OHAT scores in both groups at T1, T2, T3, and T4 (Table 4).

GEE analysis showed no significant difference between the specialized oral care group and the control group at T0 of OHAT (P = 0.151). In the control group, OHAT scores significantly decreased at T1 (p < 0.001), T2 (p = 0.002), T3 (p < 0.001), and T4 (p < 0.001) compared with T0. The interaction effect reached significance at T1 (95% CI = −1.958~-0.833, p < 0.001), T2 (95% CI = −2.517~-1.172, p < 0.001), T3 (95% CI = −2.535~-0.966, p < 0.001), T4 (95% CI = −2.604~-0.971, p < 0.001), which indicated that the improvement in OHAT over time in the specialized oral care group was greater than that in the control group (Table 5).

4. Discussion

This study examined the efficacy of incorporating dental hygienists into the post-acute stroke interdisciplinary care team in improving oral health in Taiwanese stroke patients.

According to the results, significant improvements in oral health status were
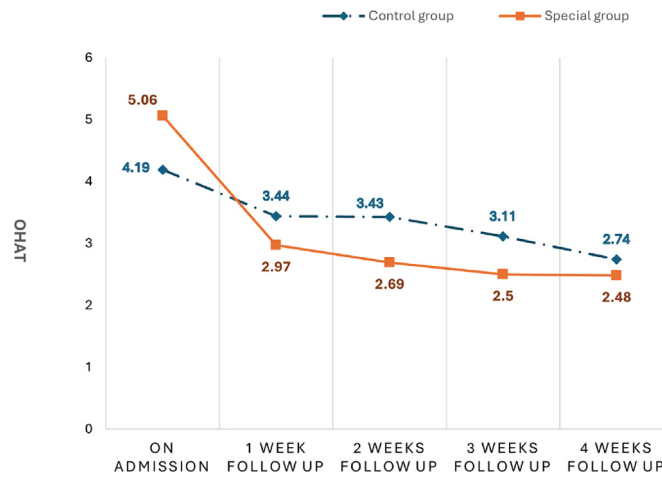
Fig. 2. The change in OHAT scores for the two groups from T0 to T4.

Table 4. OHAT scores within-group differences from T0 to T4.

	Control group OHAT Mean (SD)	p-value	Special group OHAT Mean (SD)	p-value
T0	4.19 (2.22)		5.06 (2.77)	
T1	3.44 (2.06)	<0.001	2.97 (2.22)	<0.001
T2	3.43 (2.06)	0.004	2.69 (1.99)	<0.001
T3	3.11 (2.21)	<0.001	2.50 (2.14)	<0.001
T4	2.74 (1.94)	<0.001	2.48 (1.99)	<0.001

Table 5. Generalized Estimating Equation analysis on the effectiveness of the specialized oral care.

	Regression coefficient	Standard error	95% confidence interval		Wald χ^2	p-value
			Lower limit	Upper limit		
OHAT	4.188	0.3864	3.430	4.945	117.455	<0.001
Group (Special)[a]	0.871	0.6074	−0.319	2.062	2.058	0.151
Time (T4)[b]	−1.142	0.1970	−1.529	−0.756	33.633	<0.001
Time (T3)[b]	−1.002	0.1982	−1.391	−0.614	25.569	<0.001
Time (T2)[b]	−0.661	0.2140	−1.080	−0.241	9.526	0.002
Time (T1)[b]	−0.750	0.1712	−1.085	−0.415	19.200	<0.001
Group (Special) × Time (T4)[c]	−1.788	0.4165	−2.604	−0.971	18.421	<0.001
Group (Special) × Time (T3)[c]	−1.750	0.4002	−2.535	−0.966	19.118	<0.001
Group (Special) × Time (T2)[c]	−1.844	0.3430	−2.517	−1.172	28.910	<0.001
Group (Special) × Time (T1)[c]	−1.395	0.2871	−1.958	−0.833	23.621	<0.001

T0: on admission; T1: 1 week; T2: 2 weeks; T3: 3 weeks; T4: 4 weeks.
[a] Reference group = control group.
[b] Reference group = T0.
[c] Reference group = control group × T0.

achieved and maintained over a four-week hospitalization period, regardless of whether the patients received usual or specialized oral care. In addition, the improvement in the special group was significantly greater than that in the control group, which means that the specialized oral care is more effective than the usual oral care for the oral health of stroke patients.

This result is similar to the study conducted by Chen et al. in Taiwan in 2019, which had a recruited population of stroke patients with swallowing disorders (n = 66). The control group received routine oral care twice daily. In contrast, the oral care group received routine oral care and additional oral health care, administered 30 min prior to swallowing training, three times a week over a duration of three weeks. Within the oral care group, the lead author guided the caregiver through the oral health procedure, offering instructions until the caregiver

gained the confidence to carry out the tasks independently. The caregiver was responsible for gathering essential oral health tools and suction equipment, as well as assisting the patient in an upright position. The patient's teeth were then brushed following the Bass method, utilizing fluoride toothpaste to coat all teeth. The findings revealed that there was no notable enhancement in OHAT scores among participants in the control group during the follow-up assessments conducted in the second and third weeks. The oral care group showed a significantly greater improvement in OHAT scores than that in the control group.[15]

Compared with Chen's study, the control group in this study also demonstrated statistically significant improvement, which is presumed to be attributed to the oral care training program for the team members, conducted by the dental hygienist, which was administered before the commencement of the study. Team members can therefore provide specialized oral care education that is different from the routine oral care for stroke patients. Similar results were found in a 2014 study by Chipps et al. in the U.S., where the control group received routine oral care (brushing with a regular toothbrush twice daily + mouthwash and rinsing once a day + lip balm) by nursing staff assigned to ward assistants, and the intervention group received brushing with an electric toothbrush, flossing, tongue cleansing, plus lip balm twice a day and mouthwash and rinsing once a day, all performed by nursing personnel who had received oral health training program (from dental hygienists and dentists). The oral health status was measured by Revised-THROAT, which included lips, teeth, gums, tongue, odor, and saliva. After ten days, both groups showed improvement in oral health status, with the intervention group having more improvement, but neither group reached a statistically significant difference in oral health status. This may be because the design of the Chipps's study focused on the differences in cleaning tools (electric V.S. manual), whereas the differences in oral care content between the two groups were relatively small. The sample size (n = 42 V.S. n = 66) is smaller than this study and follow-up period is shorter than this study (10 days

V.S. 4 weeks) resulted in no significant difference in effectiveness.[23]

Previous studies have found that wearing dentures improves the formation and transportation of bolus during swallowing.[24] Dental professional intervention can maintain and improve oral health, and early detection and appropriate treatment of oral problems not only improves oral condition but also contributes to swallowing function.[25] Oral health is highly related to swallowing function. Good oral health can reduce the incidence of pneumonia and improve the prognosis of stroke patients.[8,9,26] Swallowing function and oral health are important for stroke patients to recover oral ingestion.[27]

In our study, we found that 47% of post-acute stroke patients (onset ≤6 months) had dysphagia, and patients with dysphagia had worse oral health status, 30% had nasogastric tubes, and 48% were unable to perform oral care independently. Stroke patients are unique due to their functional impairments. And their special needs cannot be met by conventional care. For the oral health of stroke patients, it is important to increase the knowledge and skills of medical professionals in oral health management and to establish a collaborative approach between medical and dental professionals. This will ensure that a customized model of care is developed to cater to the specific needs of this special population.

Based on the findings of this study, the necessity and effectiveness of specialized oral care for stroke patients were verified. Adding a dental hygienist to the integrated stroke care team can bring valuable oral health knowledge and skills to the team, while also reducing the caregiving stress on nurses. This approach can help provide more comprehensive interdisciplinary care to patients with special needs, thereby reducing barriers to oral health care. By doing so, we can improve patients' quality of life, enhance the quality of care, prevent health problems caused by poor oral hygiene, and reduce the risk of subsequent complications.

Currently, national health insurance does not cover the assignment of dental hygienists to integrated stroke care teams in Taiwan. We hope that specialized oral care

can be included in the stroke care model and health insurance coverage in the future.

This study has some limitations. During the period of this study, due to COVID-19, the number of hospitalized patients was reduced, and some patients need to discharge early or be isolated, resulting in a smaller sample size and not possible to track all the cases for four weeks. There was no significant difference in basic characteristics between the two groups on admission and four-week follow-up. Even if we lost some patients during this study, the comparability between the two groups were not affected.

This study was conducted in a single hospital, which limits the representativeness of the results, and the recruitment was limited to inpatients and may not be extrapolated to outpatients and home care patients. Besides, the requirement to obtain informed consent has resulted in the exclusion of patients with severe cognitive impairment who may be the most in need of specialized oral care.

5. Conclusions

Poor oral health is a common problem in post-acute stroke patients. Stroke patients have special need in oral health care due to their functional impairments. The specialized oral care which provides by dental hygienists is more effective than the usual oral care for the oral health of stroke patients.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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