Association between the Number of Natural Teeth and Posterior Occluding Pairs with the Stroke Severity prior discharged

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Abstract

Stroke, a neurological deficit, is a major cause of chronic disability and death in Thailand. Stroke severity relates to the level of disability. In medical studies, there are many factors that associate with stroke severity. However, there was a lack of data about the association between oral health status and stroke severity. Identifying factors that relate to stroke severity. It may be useful for preventing and raising awareness of the occurrence of high stroke severity. This study aimed to determine the association between oral health status by focusing on the number of natural teeth and posterior occluding pairs with stroke severity. This study included 85 stroke patients in King Chulalongkorn Memorial Hospital. Patients consisted of interviewed for sociodemographic data and orally examined by counting number of natural teeth and posterior occluding pairs. Stroke severity was assessed by using the National Institute of Health Stroke Scale (NIHSS). The data collected from July 2022 to January 2023 and analyzed using descriptive statistic, Pearson correlation and Independent T-test by using SPSS version 22. The results showed the mean age of 85 stroke patients was 66 years. The number of natural teeth and posterior occluding pairs were found to be statistically significant associated with the NIHSS score prior to discharged, with a *p*-value < 0.01. An inverse correlation was observed between the number of natural teeth (r=-0.398, p-value=0.000) and posterior occluding pair (r=-0.372, p-value=0.000) with NIHSS. Moreover, the results showed that there were statistically significant differences in NIHSS scores between two groups of number of natural teeth (≥20 teeth and <20 teeth) and between two groups of number of posterior occluding pairs (≥4 pairs and < 4 pairs). We concluded that the greater number of natural teeth and posterior occluding pairs, it could be one of the contributing factors that relates to the lower stroke severity.

Keywords: *Natural teeth, Posterior occluding pairs, Stroke, NIHSS*

1. Introduction

Stroke is a neurological deficit attributed to an acute injury of the central nervous system (CNS) by a vascular cause including cerebral infarction, intracerebral hemorrhage and subarachnoid hemorrhage. Stroke is a common cause of chronic disability and death in Thailand and globally (Ralph L. Sacco et al., 2013). The incidence of stroke has been continuously increasing every year, especially among the elderly (Majavong, 2019). In Thailand, stroke is the third most common cause of death, following cancer and pneumonia. Stroke is more prevalent in men than in women. There are more than 250,000 new stroke cases in each year and more than 50,000 deaths from stroke annually (Suwanwela, 2014). There are two main types of strokes. First, Ischemic stroke is the most common type of stroke in Thailand. It accounts for about 85% of all stroke cases. It happens when a clot blocks blood flow in blood vessels within some area of brain due to various factors. The common causes of ischemic stroke are smoking, high blood pressure, diabetes, high cholesterol, and age over 60 years. Second, Hemorrhagic stroke accounts for about 15% of all stroke cases (Aunali S. Khaku & Tadi., 2021). It occurs when a weakened blood vessel ruptures. High blood pressure and aneurysms are examples of conditions that can cause a hemorrhagic stroke. The most common cause of hemorrhagic stroke is uncontrolled high blood pressure. These are cerebral deficits lasting more than 24 hours. Clinical finding in stroke patients such as weakness, ataxia, dysphagia, slurred speech, loss of vision and loss of consciousness (Gopal, 2008). Symptoms depend on the area of brain damaged. Nowadays, the medical managements rather advance cause of reduced mortality rate but at the same time it impacted to increase the number of disability stroke patients. Stroke survivors may have defects resulting in dependent status, bedridden patient, and poor quality of life (Alawieh, Zhao, & Feng, 2018).

Stroke has varying degrees of severity which can affect mobility and independence in activities of daily living (ADL) which is associated with health-related quality of life (Hartley, Burger, & Inglis-Jassiem, 2022). If the stroke patients have more severity, they also take a long time for post stroke recovery. It could take months to years with many individuals. These affect the quality of life in stroke patients and their caregivers. Stroke severity is the main factor that affects level of disability. It can be assessed and measured by clinical examination. There are many factors that associate and influence with stroke severity such as stroke etiology, age, fasting serum triglyceride levels, active smoking, pre-stroke medication (Khuda et al., 2020) and hypertension. Stroke severity was found to be higher with advancing age. The stroke etiology or stroke type was one of the main factors related to stroke severity. In medical, there are many scoring systems which assess and measure stroke severity for proper treatment. National Institute of Health Stroke Scale (NIHSS) is one of these. NIHSS is reliable, valid and widely used scaling system for assessing the level of stroke severity (Nilanont et al., 2010). It measures 15 neurological items including level of consciousness, eye movement, vision, facial expression, arm and leg strength, limb ataxia, sensation, language ability, speech difficulty, sensory and visual inattention. In dental, identifying factors that relate to the stroke severity. It may be useful for preventing and making aware of the occurrence of high stroke severity in stroke risk patients.

In previous studies, they were only found about the relationship between periodontal disease and tooth loss with incidence of stroke. Joshipura et al. (2003) reported their finding that periodontal disease and fewer teeth may be associated with increased risk of ischemic stroke. Siriporn (2019) found that the stroke patients had higher missing teeth and clinical attachment loss than other hospitalized patients. Her results support an association between periodontitis and stroke. However, there was a lack of data about the association between oral health status and stroke severity. Therefore, in this study, we designed to observe the association between oral health status by focusing on the number of natural teeth and posterior occluding pairs with stroke severity as measured by NIHSS among stroke patients.

2. Objectives

1) To determine association between number of natural teeth with stroke severity.
2) To determine association between number of posterior occluding pairs with stroke severity.

3. Materials and Methods

This study was designed as cross-sectional survey. The study was carried out in the department of Neurology at King Chulalongkorn Memorial Hospital between July 2022 to January 2023.

3.1 Study criteria

Inclusion criteria for stroke sufferers were 40 years old and above who admitted in the neurology service unit with the diagnosis of ischemic and hemorrhagic stroke, conscious and able to be written informed consent for oral examination. Patients with neurological illnesses other than stroke (such as brain tumors and cerebral injuries) and psychiatric disorders were excluded from this study.

3.2 Data collection

- Sociodemographic data

The enrolled patients were interviewed by using a questionnaire about sociodemographic information (sex, age, main caregiver, education level, income).

- General medical information

Data on individuals' general health status and condition were interviewed with patients such as systemic disease, side of lesion and dysphagia. Type of stroke and NIHSS level before patients discharged were taken from medical charts record which scanned in Hospital Information System (HIS).

The National Institutes of Health Stroke Scale (NIHSS) is a reliable and valid form for assessing the level of stroke severity, neurological deficit, and degree of discovery in stroke sufferers. This scale is adjusted to Thai version by department of Neurology, Siriraj Hospital, Bangkok, Thailand. NIHSS measures 15 neurological items consisting of level of consciousness, eye movements, visual fields, facial expression, arm strength, leg strength, limb ataxia, sensory, aphasia, dysarthria, extinction, and inattention. Each item uses a

0-2 or 0-3 or 0-4 scale level. Total score is 0-42 with higher score level indicating that high severity and deficits. The score assessed by neurologist medicine.

- Oral examination

The oral examination was performed in a separated room from other patients in a neurological service unit by using dental explorer, mouth mirror, dental tray, and flashlight. The enrolled patients were interviewed about removable denture wearing history and were assessed removable denture. We counted the number of functional natural teeth consisting of pathology free-teeth, teeth with pathology that were restorable and restored tooth. Then, we counted the number of posterior occluding pairs. If any of the patients were wearing removable dentures, we asked patients for removed the denture before we counted.

3.3 Statistical Analysis

Data analysis was carried out by using the software program SPSS version 22, and the data was presented in descriptive statistics with means, percentages, standard deviations, frequencies, and minimum-maximum range. Pearson's coefficients were used to assess for correlations between the number of natural teeth and posterior occluding pairs with NIHSS ($p<0.01$). Independent T-test was used to identify statically significant differences of NIHSS compare between two groups of the number of natural teeth and two groups of posterior occluding pairs ($p<0.01$). Statistical tests were performed under the assumptions of normally distributed measurements using equal variances between groups using Levene's test ($p\geq0.05$).

3.4 Ethical approval

All procedures performed in this study were in the accordance with the ethical standards of the institutional review board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand, has approved the following study which is to be carried out in compliance with the international guidelines for human research protection as Declaration of Helsinki, the Belmont Report, CIOMS Guidelines and International Conference on Harmonization in Good Clinical Practice (ICH-GCP). Informed consent after explanation about the study design was obtained from all individual patients prior to their participation in the study. All patients in this study participated voluntarily.

4. Results and Discussion

4.1 Results

Baseline characteristics of patients: Total 85 stroke patients were selected after applying the inclusion and exclusion criteria. The mean age of patients was 66.07 years (S.D. = 12.86). The ages ranged from 40 to 96 years. There were 54 (63.5%) males and 31 (36.5%) females. The spouses were the main caregivers for most patients. The average mean household income is 59,000 Baht. The education level found 50(58.8%) patients graduated secondary school or lower. Demographic data of patients were shown in Table 1.

Health status and Oral health status of patients: Of the total 85 stroke patients, 84(98.8%) patients had ischemic stroke. There were 38(44.7%) patients' weakness on right side and 30(35.3%) patients' weakness on left side of body after suffer from stroke. The mean NIHSS before discharged was 3.32 (S.D. = 3.97) (Table 2). NIHSS ranged from 0 to 24. The data showed that 31(36.5%) patients had a medical history of diabetes, divided into 2 groups: 25(29.4%) with controlled diabetes and 6(7.1%) with uncontrolled diabetes. It was found that 14(16.5%) patients were likely to have dysphagia. In addition, the minimum and maximum numbers of natural teeth found in patients were 0 and 32 teeth, respectively. The average number of natural teeth was 19.28±9.48 teeth. Fifty-three patients had at least 20 teeth and 32 patients had less than 20 teeth. Moreover, the minimum and maximum numbers of posterior occluding pair in our patients were 0 and 10 pairs, respectively. The average number of posterior occluding pair was 3.86±3.11 pairs. Forty-six patients had at least 4 posterior occluding pairs, and 39 patients had less than 4 posterior occluding pairs. Twenty-seven patients wore removable dentures.

Table 1 Demographic data of stroke patients (n = 85).

Item	n	Percent
Age		
Mean	66.07	
Gender		
Male	54	63.5
Female	31	36.5
Education		
Secondary school or lower	50	58.8
Higher secondary school	35	41.2
Caregiver		
Spouse	37	43.5
Offspring	32	37.6
Relative	11	12.9
Employee	2	2.4
None	3	3.5
Type of stroke		
Ischemic	84	98.8
Hemorrhagic	1	1.2
Weakness side		
Left	30	35.3
Right	38	44.7
None	17	20.0
Diabetes		
No	54	63.5
Controlled	25	29.4
Uncontrolled	6	7.1
Dysphagia		
No	71	83.5
Yes	14	16.5
Removable denture wearing		
No	58	68.2
Yes	27	31.8
Number of natural teeth		
≥20	53	62.6
<20	32	37.4
Number of posterior occluding pairs		
≥4	46	54.1
<4	39	45.9
The average mean household income(baht)		
Mean	59,000	

By means of Pearson's coefficients, it was observed that the number of natural teeth and posterior occluding pairs were statistically significantly correlated with NIHSS prior patients discharged at a *p*-value < 0.01. A reversed correlation was observed between the number of natural teeth (r=-0.398, *p*-value=0.000) and posterior occluding pairs (r=-0.372, *p*-value=0.000) with NIHSS. However, the age wasn't statistically significant correlated with NIHSS (Table 2). Our results showed that there were statistically significant differences in NIHSS between two groups of number of natural teeth (≥20 teeth and <20 teeth) at p=0.004 and two groups of number of posterior occluding pair (≥4 pairs and < 4 pairs) at p=0.006 (Table 3).

Table 2 The association between age, the number of natural teeth, number of posterior occluding pairs and NIHSS.

	Mean(SD)	r	p-value
NIHSS	3.32(3.97)		
Age	66.07(12.86)		0.100
Number of natural teeth	19.28(9.48)	-0.398	0.000*
Number of posterior occluding pairs	3.86(3.11)	-0.372	0.000*

*p<0.01; Pearson correlation

Table 3. Comparison NIHSS between subgroups (n = 85).

	NIHSS Mean(SD)	p-value
Number of natural teeth		0.004*
≥20 (n=53)	2.19(2.54)	
<20 (n=32)	5.19(5.12)	
Number of posterior occluding pairs		0.006*
≥4 (n=46)	2.24(3.00)	
<4 (n=39)	4.59(4.60)	

*p<0.01; Independent t-test

4.2 Discussion

Our results found the mean age of stroke patients is 66 years. Resemble to the Thai Stroke Registry, the mean age of stroke patients at the onset of ischemic stroke in Thailand is approximately 65 years (Nilanont et al., 2014)**.** Majavong (2019) explained that there was a high prevalence of stroke in elderly. Because in elderly had more systemic disease such as hypertension, hyperlipidemia, high cholesterol and diabetes which are stroke risk factors. Our results found that stroke is more prevalent in males than females. It's similar to the recent Thai Epidemiological Stroke Study. They found the prevalence of stroke in populations, men had a higher prevalence of stroke than women in all age groups according to controlling blood pressure, smoking and drinking alcohol (Suwanwela, 2014).

In our study, we had only one hemorrhagic stroke patients and eighty-four ischemic stroke patients because of ischemic stroke is the most common type and less symptoms. So, they could cooperate in this study. Our stroke participants had conscious and could write informed consent for oral examination. We found dysphagia in our stroke participants about 16.5% followed the study of Wattanapan P Mail et al. (2016). They explained that dysphagia is common symptom following stroke, affecting 39-55% of acute stroke sufferers. The severity of dysphagia associated with age, stroke types and site of brain lesion. Early diagnosis and treatment can prevent complication such as aspiration pneumonia and malnutrition.

We designed the study to include patients of various ages for analyzing the association between advancing age and stroke severity. According to our results, we found the age wasn't associated with stroke severity. It was different from the studies of Khuda et al. (2020) who found that stroke severity was higher with advancing age. This is maybe due to the limit number of our participants.

Oral health status for our stroke participants, only 31.8% wore removable dentures. From interviews and oral examinations, we found patients who had lost their teeth and didn't wear dentures. They said that their friends complained about pain from wearing dentures and they couldn't chew. So, they decided to deny wearing dentures. Some patients who wore removable dentures had denture problems such as uncleaned denture, ill-fitting denture, poor occlusion, extracted more natural teeth and broken denture, but they were still worn. Because it had difficulty making a new one from their health status reasons. So, we educated and provided suggestions to our stroke participants and their caregivers based on standard evidence, such as how to clean dentures, teeth, and oral cavity, modifying oral hygiene products to make them easier for stroke patients to use, and the frequency of dental care routines. Patients should be encouraged to wear dentures following stroke and that improvement in the fit of denture will assist with chewing and swallowing. After examining their oral health, the participants received instructions about individual oral health care plans.

When comparing the number of natural teeth and the number of posterior occluding pairs in our study with the Key Performance Indicators of Bureau of Dental health and the goals of the World Health Organization. We found the percentage of patients who had at least 20 teeth and the percentage of patients who had at least 4 posterior occluding pairs in our study were 62.6% and 54.1% respectively. Our findings exceeded the Key Performance Indicators of the Bureau of Dental Health, which aimed for at least 44% (Health, 2016), and the goals of the World Health Organization, which targeted at least 50% (Organization, 2006). Somsak and Kaewplung (2016) conducted a study on the impact of the number of natural teeth and posterior occluding pairs on the oral health-related quality of life in elderly dental patients. They concluded that Thai elderly dental patients who had at least 20 teeth and at least 4 posterior occluding pairs. They had greater oral health-related quality of life than patients who had less than 20 teeth and less than 4 posterior occluding pairs. Furthermore, our study found stroke patients who had at least 20 teeth or 4 posterior

occluding pairs, their stroke severity would be less and differences from other stroke patients who had less than 20 teeth or less than 4 posterior occluding pairs.

There are many studies which explained that stroke shares several etiology factors with periodontal disease and tooth loss. The association between periodontal disease and cerebrovascular disease (stroke) has several possible pathophysiologic links (Wu et al., 2000). Periodontitis is associated with elevated markers of inflammation that are indicators of stroke risk. Several risk factors are common to oral condition and stroke. According to the 8th National Oral Health Surveys, 63.3% of Thai older adults were found to have periodontal disease (Health, 2018). Tooth loss is mainly caused by periodontal disease in older adult patients. From the recent studied of Joshipura et al. (2003) concluded that periodontal disease and fewer numbers of teeth may be associated with increased risk of ischemic stroke. Although the pathophysiologic link between stroke severity with number of natural teeth and posterior occluding pairs is still unclear, our study results found that stroke patients with fewer natural teeth and posterior occluding pairs had a tendency for higher stroke severity. Tooth loss can affect general health in several ways (Emami et al., 2013). The number of teeth below 20 teeth is associated with impaired masticatory efficiency and ability. So, it's difficulty chewing a hard food. It's the cause of lower intake of fruits, vegetables, fiber, carotene and increased intake high carbohydrate, high cholesterol and high saturated fats. These can increase the risk of cardiovascular diseases, hyperlipidemia and hypertension. Soliman et al. (2018) found that stroke severity was significantly higher in hypertensive patients. This evidence is contributing factors to support an indirect link between stroke severity and number of natural teeth.

5. Conclusion

We concluded that a greater number of natural teeth and posterior occluding pairs could be one of the contributing factors that relates to the lower stroke severity (assessed by NIHSS) prior to patients being discharged. We found that stroke patients who had at least 20 teeth or at least 4 posterior occluding pairs, their stroke severity would be less and significant differences from other stroke patients who had less than 20 teeth or less than 4 posterior occluding pairs. However, the definitive pathophysiologic link between stroke severity with number of natural teeth and posterior occluding pairs is still unclear. Further studies may be needed to confirm our findings.

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